Vegetable

PRODUCTION HANDBOOK *of* FLORIDA

2016-2017

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Farm Journal MEDIA

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Welcome to the twentieth edition of the Vegetable Production Handbook for Florida. This handbook is designed to provide Florida growers with the latest information on crop cultivars, cultural practices and pest management.

The information is a result of a cooperative effort among State and County Extension and Research faculty to share expertise and advice that can help growers maximize production, sustainability and profits.

The handbook is available as individual chapters and in its entirety at the University of Florida Institute of Food and Agricultural Sciences EDIS website (edis.ifas.ufl.edu/topic_vph). Over time, chapters have been removed but are still available through the EDIS website; these chapters are listed in Chapter 1 on pages 1 and 2 along with QR codes for quicker access on your mobile device. In addition, insecticide tables were recently reformatted by pest and mode of action to make it easier to identify labelled insecticides and encourage proper insecticide rotations. Free hard copies of the handbook are available at UF/IFAS research and education centers and county extension offices.

The authors wish to thank Florida vegetable growers for their continued support of UF/IFAS research and extension. The authors also thank *The Grower's Citrus + Vegetable Magazine*, Farm Journal Media, and Dow Agrosciences for their continued support of this publication.

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Florida Pesticide Emergency Phone List

Call 911 for pesticide emergencies or the appropriate contact below:

- National Pesticide Information Center (NPIC), 800-858-7378, 8AM-12PM Pacific Time, Monday through Friday.
- The Poison Center Emergency Telephone Service, 800-222-1222
- The manufacturer of the pesticide in question. Their phone number is listed on the pesticide label.

The information above was provided by the University of Florida's Institute of Food and Agricultural Sciences Pesticide Information Office 352-392-4721.

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Chapter 1. Commercial Vegetable Production in Florida

Josh H. Freeman, Peter J. Dittmar, and Gary E. Vallad

Vegetable production remains a tremendous industry for Florida in terms of acreage and value. Including vegetables, melons, potatoes, and strawberry, production occurred on approximately 173,500 acres and generated more than $1.1 billion in gross sales in 2015, which ranks second among all the states. Growing seasons are well defined by the peninsula geography, allowing Florida to serve as the main vegetable supplier during late fall, winter, and early spring months to the U.S. Although more than 40 vegetable crops are commercially-planted in the state, Florida ranks in the top two on production value of tomato, bell pepper, snap bean, squash, sweet corn, watermelon, cabbage, cucumber, and strawberry (Table 1.1).

Table 1.1. Vegetable production acreage and value in Florida.

Crop	Planted acres	Value (million US$)	U.S. rank
Tomato	33,000	453.1	1
Strawberry	11,000	290.6	2
Bell pepper	12,400	220.5	2
Sweet corn	41,500	155.0	2
Potato	29.300	117.0	11
Snap bean	29,500	76.2	1
Watermelon	21,500	88.2	1
Squash	6,000	27.5	2
Cabbage	8,900	33.8	2
Cucumber	11,000	47.8	1

Source: Vegetables-2015 summary, NASS, USDA.

The objective of this publication is to provide updated information on crop cultivars, pesticide labels, and certain practices for vegetable production in Florida. Suggested practices are guidelines for growers to plan farm activities and are always subjected to review using the latest scientific data available.

Web Links to Additional Information on Vegetable Production Topics

University of Florida IFAS Extension provides information through the Electronic Data Information Source (EDIS) found at edis.ifas.ufl.edu. Below is a partial list of EDIS pertaining to vegetable production for further information beyond the Vegetable Production Handbook of Florida. The boxes on the left are QR codes that can be scanned with a mobile device and a QR scanning app will direct you to the listed website.

Complete Vegetable Production Handbook
http://edis.ifas.ufl.edu/pdffiles/cv/cv29200.pdf

Soil and Fertilizer Management for Vegetable Production in Florida
http://edis.ifas.ufl.edu/cv101

Principles and Practices of Irrigation Management for Vegetables
http://edis.ifas.ufl.edu/cv107

Drip Irrigation in the BMP Era
http://edis.ifas.ufl.edu/hs172

Commercial Vegetable Fertilization Principles
http://edis.ifas.ufl.edu/cv009

Introduction to Organic Crop Production
http://edis.ifas.ufl.edu/cv118

Florida Nematode Management Guide
http://edis.ifas.ufl.edu/features/handbooks/nematode.html

Weed Management
http://edis.ifas.ufl.edu/cv113

Maximizing the Efficacy of Soil Fumigant Applications for Raised-Bed Plasticulture Systems in Florida
http://edis.ifas.ufl.edu/hs1169

Plastic Mulches
http://edis.ifas.ufl.edu/cv105

Variety Selection
http://edis.ifas.ufl.edu/cv102

Seed Quality and Seeding Technology
http://edis.ifas.ufl.edu/cv103

Transplant Production
http://edis.ifas.ufl.edu/cv104

Row Covers for Growth Enhancement
http://edis.ifas.ufl.edu/cv201

Pesticide Safety
http://edis.ifas.ufl.edu/cv108

Interpreting PPE Statements on Pesticide Labels
http://edis.ifas.ufl.edu/pi137

Vegetable IPM. Integrated Disease Management for Vegetable Crops
http://edis.ifas.ufl.edu/pp111

Food Safety on the Farm – An Overview of Good Agricultural Practices
http://edis.ifas.ufl.edu/fs135

Value Added Agriculture: Is It Right for Me?
http://edis.ifas.ufl.edu/fe638

Pesticide Provisions of the Florida Agricultural Worker Safety Act (FAWSA)
http://edis.ifas.ufl.edu/pi078

Food Safety on the Farm: An Overview of Good Agricultural Practices
https://edis.ifas.ufl.edu/fs135

The Food Safety Modernization Act and the FDA Facility Registration Program
http://edis.ifas.ufl.edu/fs231

Controlled-Release and Slow Release Fertilizers as Nutrient Management Tools
edis.ifas.ufl.edu/hs1255

Cover Crops
https://edis.ifas.ufl.edu/aa217

Farm to School
edis.ifas.ufl.edu/topic_farm_to_school

Insects in Vegetables
edis.ifas.ufl.edu/topic_vegetable_pest_insects

Honeybees and Pesticides
edis.ifas.ufl.edu/in1027

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Chapter 2. Fertilizer Management for Vegetable Production in Florida

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Best Management Practices

With the passage of the Federal Clean Water Act (FCWA) in 1972, states were required to assess the impacts of agricultural fertilizer use on surface and ground waters. The FCWA also requires states to identify impaired water bodies and establish the amount of fertilizer nutrient that can enter water bodies consistent with its intended use (swimming, fishing, or potable uses) called total maximum daily loads (TMDLs). Water quality TMDLs involving vegetable production are concentrations of nitrate, phosphate, and total dissolved solids. Best Management Practices (BMPs) are specific cultural practices aimed at reducing the load of specific fertilizer compounds entering ground and surface water, while maintaining or increasing economical yields. BMPs are intended to be economically sound, environmentally effective, and based on science. It is important to recognize that BMPs do not aim at becoming an obstacle to vegetable production. Instead, they should be viewed as a means to balance economical vegetable production with environmental responsibility.

The BMPs that will apply to vegetable production in Florida are described in the 'Agronomic and Vegetable Crop Water Quality/Water Quantity BMP Manual for Florida' produced by the Florida Department of Agriculture and Consumer Services (FDACS). This manual was developed through a cooperative effort between state agencies, water management districts and commodity groups, and under the scientific leadership of the University of Florida's Institute of Food and Agricultural Sciences (UF/IFAS). The manual was adopted by reference in 2006 and by rule in Florida Statutes (5M-8 Florida Administrative Code) and was revised in 2015 (http://www.floridaagwaterpolicy.com/ PDFs/BMPs/vegetable&agronomicCrops.pdf). Vegetable growers may get one-on-one information on 1) the benefits for joining the BMP program, 2) how to join it, 3) how to select the BMPs that apply to their operation and 4) record keeping requirements by getting in contact with their county extension agent.

The vegetable BMPs have adopted all current UF/IFAS recommendations; including those for fertilizer and irrigation management (see the new BMP manual on "Optimum Fertilizer Management"). At the field level, adequate fertilizer rates should be used together with proper irrigation scheduling techniques and crop nutritional status monitoring tools (leaf analysis, petiole sap testing). In the BMP manual, adequate fertilizer rates may be achieved by combinations of UF/IFAS recommended base rates and supplemental fertilizer applications added after leaching rainfall, when tissue analyses suggest a need for more fertilizer, or when the harvesting season is prolonged.

Soils

Vegetables are grown on more than 300,000 acres in various soil types throughout the state. These soil types include sandy soils, sandy loam soils, Histosols (organic muck), and calcareous marl soils. Sandy soils make up the dominant soil type for vegetable production in Florida. Vegetables are produced on sandy soils throughout the Florida peninsula and on sandy soils and sandy loams in the panhandle. Sandy soils have both advantages: ease of tillage; production of the earliest vegetable crops; timely production operations and disadvantages: leaching mobile nutrients such as nitrogen, potassium and even phosphorus by heavy rain or over irrigation. Therefore, sands must be managed carefully with regard to fertility programs and irrigation scheduling. Histosols, calcareous rock, and marl are also important for Florida's vegetable production. For more information, please see "Soil and Fertilizer Management for Vegetable Production in Florida" at <http://edis.ifas.ufl.edu/cv101>.

SOIL PREPARATION

A well-prepared planting bed is important for uniform stand establishment of vegetable crops. Old crop residues should be plowed down well in advance of crop establishment. A 6- to 8-week period between plowing down of green cover crops and crop establishment is recommended to allow the decay of the refuse. Freshly incorporated plant material promotes high levels of damping-off organisms such as *Pythium* spp. and *Rhizoctonia* spp. Turning under plant refuse well in advance of cropping reduces damping-off disease organisms. Land should be kept disked if necessary to keep new weed cover from developing prior to cropping.

Chisel plowing is beneficial in penetrating and breaking tillage pan layers in fields. If plastic mulch culture is practiced, debris and large undecayed roots will create problems in preparing good beds over which mulch will be applied. For information about soil preparation for commercial vegetable production see "Soil preparation and Liming for Vegetable Gardens" at <http://edis.ifas.ufl.edu/vh024>.

LIMING

Current UF/IFAS recommendations call for maintaining soil pH between 6.0 and 6.5 (Table 1); further discussion is in "Soil pH Range for Optimum Commercial Vegetable Production" at <http://edis.ifas.ufl.edu/hs1207>. If soil pH is too low, liming is needed. A common problem in Florida has been over-liming, resulting in high soil pH tying up micronutrients and phosphorus causing a restriction of their uptake by plants. Over-liming can also reduce the accuracy with which a soil test can predict the fertilizer component of the CNR. For more information about liming see "Liming of Agronomic Crops" at <https://edis.ifas.ufl.edu/aa128>. Liming can not only adjust soil pH but also provide calcium.

Irrigation water from wells in limestone aquifers is an additional source of liming material. The combination of liming and use of alkaline irrigation water has resulted in soil pH greater than 7.0 for many sandy soils in south Florida. To measure the liming effect of irrigation, have a water sample analyzed for total bicarbonates and carbonates annually, and the results converted to pounds of calcium carbonate per acre. Liming (Table 2),

fertilization (Table 3), and irrigation programs are closely related to each other. To maximize overall production efficiency, soil and water testing in a critical BMP and must be made a part of any fertilizer management program. Additionally, using ammoniacal fertilizers can neutralize alkalinity (Table 3) but nitrate fertilizers can increase pH in rootzone due to selective uptake of different ions by plants. Fertigation with ammonium-N (such as ammonium sulfate) is effective for decreasing soil pH.

BEDDING

Fields, where seepage irrigation is used or fields prone to flooding, should be cropped using raised beds. Beds generally range from 3 to 8 inches in height, with high beds of 6 to 8 inches preferred where risk of flooding is greatest. Raised beds dry faster than non-bedded soils. Raised beds promote early season soil warming resulting in somewhat earlier crops during cool seasons. Mulching requires a smooth, well-pressed bed for efficient heat transfer from black mulch to the soil. Adequate soil moisture is essential in forming a good bed for mulching using a bed press.

Fertilization

Nitrogen fertilization is needed for vegetable production in Florida. A new and innovative approach to BMPs for fertilizer known as **4R** nutrient stewardship defined as follows: the **RIGHT** fertilizer **SOURCE** is applied at the **RIGHT RATE** in the **RIGHT PLACE** and at the **RIGHT TIME** to a particular crop. More information about the 4Rs is available in "The Four Rs of Fertilizer Management" at <http://edis.ifas.ufl.edu/ss624>.

Right Rate

SOIL TESTING

Soil testing is a key BMP for nutrient management. There are 17 elements essential for plant growth (Table 4). Nickel is the 17th element (see "Nickel Nutrition in Plants" http://edis.ifas.ufl.edu/hs1191). The crop nutrient requirement (CNR) for a particular element is defined as the total amount in lb/A of that element needed by the crop to produce economic optimum yield. The CNR can be satisfied from many sources, including soil, water, air, organic matter, or fertilizer.

The CNR for a crop has been determined from field experiments that test the yield response to selected levels of added fertilizer. The CNR is equivalent to the fertilizer rate above which no significant increases in yield is expected. The CNR values derived from such experiments take into account factors such as fertilizer efficiencies of the soils and cultural practices. Using the CNR concept will ensure optimum, economic yields and minimize both pollution from over-fertilization and loss of yield due to under-fertilization.

It is important to remember that nutrients are supplied to the crop from both the soil and fertilizer. The amounts are applied as fertilizers only when a properly calibrated soil test indicates very small extractable amounts of macronutrients (N, P, K, Mg, and Ca) and micronutrients present in the soil. Decisions should be based on two common extractants used by commercial laboratories (Mehlich1 or Mehlich 3), however, Mechlich 3 provides better results for soils with a pH of 7 or greater. Based on such tests, the amount of fertilizer that is needed to supplement the nutrition component of the native soil can be calculated. The BMP program for vegetables requires the importance of calibrated soil test. More information about soil testing can be found in "Developing a Soil Test Extractant: The Correlation and Calibration Processes" at <http://edis.ifas.ufl.edu/ss622> and "Soil Testing for Plant-Available Nutrients—What Is It and Why Do We Use It?" at <http://edis.ifas.ufl.edu/ss621>.

PLANT TISSUE ANALYSIS

Analysis of plant tissues (e.g. leaves or petioles) for nutrient concentration provides a good tool to monitor nutrient management programs. There are basically two approaches to plant tissue testing: standard laboratory analysis and the plant sap testing procedures. Standard laboratory analysis involves analyzing the most-recently-matured leaf of the plant for an array of nutrients. The resulting analyses are compared against published adequate ranges for that particular crop. Laboratory results that fall outside the adequate range for that nutrient may indicate either a deficiency or possibly toxicity (especially in the case of micronutrients). The most-recently- matured leaf serves well for routine crop monitoring and diagnostic procedures for most nutrients. However, for the immobile nutrients such as Ca, B, and certain other micronutrients, younger leaves are generally preferred.

The second approach is use of plant sap quick test kits that have been calibrated for N and K for several vegetables in Florida. These testing kits analyze fresh plant sap for N and K. Quick tests can be a valuable tool for on-the-spot monitoring of plant nutrient status. Diagnostic information for leaf and petiole sap testing can be found in "Plant Tissue Analysis and Interpretation for Vegetable Crops in Florida," at <http://edis.ifas.ufl.edu/ep081> and "Petiole Sap Testing for Vegetable Crops" <http://edis.ifas.ufl.edu/cv004>.

Right Source

N, P, K, NUTRIENT RATES AND SOURCES

Nitrogen often is the most limiting nutrient in Florida's sandy soils. The amount of nitrogen required by vegetable plants must be applied each growing season because it leaches rapidly. Therefore crop nitrogen requirements vary among crops and are not dependent on soil test results (Table 5). Fertilizer rates of other nutrients must be applied based on soil test results (see soil test above) to follow BMPs. The interpretations of Mehlich 1 (very low, low, medium, high, and very high) and Mehlich 3 (low, medium, and high) are shown in Table 6. The soil test extractant used in UF/IFAS recommendations recently has changed to Mehlich 3. UF recommendations based on Mehlich 3 test include P_2O_5 and K_2O (Table 7) and nutrient management using fertigation (Table 8). More information on the change to Mehlich-3 can be found in "Extraction of Soil Nutrients Using Mehlich-3 Reagent for Acid-Mineral Soils of Florida" at <http://edis.ifas.ufl.edu/ss620>. Some private companies may use Mehlich 1 and recommendations include P_2O_5 and K_2O (Table 9) and micronutrients (Table 10).

The recommendations found in Tables 7 through 10 were determined in field rate studies considering a wide range of nutrient applications and various soil pH levels. Crop plant development, crop yield and vegetable quality were considered in determining the optimum nutrient levels for UF/IFAS recommendations.

Nitrogen (N) can be supplied in both nitrate and ammoniacal forms. Nitrate-nitrogen is generally the preferred form for plant uptake in most situations, but ammoniacal N can be absorbed directly or after conversion to nitrate-N by soil microbes. Since this rate of conversion is reduced in cold, fumigated, or strongly acidic soils, it is recommended that under such conditions 25% to 50% of the N be supplied from nitrate sources. This ratio is not critical for unfumigated or warm soils.

Phosphorus (P) can be supplied from several sources, including single and triple superphosphate, diammonium phosphate (DAP) and monoammonium phosphate (MAP), and monopotassium phosphate. All sources can be effective for plant nutrition. However, on soils that test very low in native micronutrient levels, DAP in mixtures containing micronutrients reduces yields when banded in large amounts. Initial soil reaction pH with DAP is about 8.5 which favors ammonia production and volatilization.

This produced ammonia causes seedling injury and inhibits root growth. Adequate separation of seed and DAP is needed to eliminate any seedling damage. DAP should not be used on calcareous or high pH soils. MAP's reaction pH is 3.5 and doesn't have the above problems.

Potassium (K) can also be supplied from several sources, including potassium chloride, potassium sulfate, potassium nitrate, and potassium-magnesium sulfate. If soil-test-predicted amounts of K fertilizer are adhered to, there should be no concern about the K source or its relative salt index.

CA, MG, S NUTRIENT RATES AND SOURCES

The secondary nutrients calcium (Ca), magnesium (Mg), and sulfur (S), and have not been a common problem in Florida. Calcium usually occurs in adequate supply for most vegetables when the soil is limed. Since we don't have an interpretation for Mehlich-3 soil Ca yet we still have Mehlich-1 soil Ca interpretation. If the Mehlich-1 soil Ca index is above 300 ppm, it is unlikely that there will be a response to added Ca. Maintaining correct moisture levels in the soil by irrigation will aid in Ca supply to the roots. Calcium is not mobile in the plant; therefore, foliar sprays of Ca are not likely to correct deficiencies. It is difficult to place enough foliar-applied Ca at the growing point of the plant on a timely basis.

Magnesium deficiency may be a problem for vegetable production; however, when the Mehlich-3 soil-test index for Mg is below 23 ppm, 30–40 lb Mg/A will satisfy the Mg CNR. If lime is also needed, Mg can be added by using dolomite as the liming material. If no lime is needed, then the Mg requirement can be satisfied through use of magnesium sulfate or potassium-magnesium sulfate. Blending of the Mg source with other fertilizer(s) to be applied to the soil is an excellent way of ensuring uniform application of Mg to the soil.

Sulfur deficiencies have seldom been documented for Florida vegetables. Sulfur deficiency would most likely occur on deep, sandy soils low in organic matter after leaching rains. If S deficiency has been diagnosed, it can be corrected by using S-containing fertilizers such as magnesium sulfate, ammonium sulfate, potassium sulfate, normal superphosphate, or potassium-magnesium sulfate. Using one of these materials in the fertilizer blends at levels sufficient to supply 30 to 40 lb S/A should prevent S deficiencies.

MICRONUTRIENT SOURCES

It has been common in Florida vegetable production to routinely apply a micronutrient package. This practice has been justified on the basis that these nutrients were inexpensive and their application appeared to be insurance for high yields. In addition, there was little research data and a lack of soil-test calibrations to guide judicious application of micronutrient fertilizers. Compounding the problem has been the vegetable industry's use of micronutrient-containing pesticides for disease control.

Copper (Cu), manganese (Mn), and zinc (Zn) from pesticides have tended to accumulate in the soil. This situation has forced some vegetable producers to over-lime in an effort to reduce availability and avoid micronutrient toxicities. Data have now been accumulated which permit a more accurate assessment of micronutrient requirements (Table 10). Growers are encouraged to have a calibrated micronutrient soil test conducted and to refrain from shotgun micronutrient fertilizer applications. It is unlikely that micronutrient fertilizers will be needed on old vegetable land, especially where micronutrients are being applied regularly via recommended pesticides. A micronutrient soil test every 2 to 3 years will provide recommendations for micronutrient levels for crop production.

MANURES AND COMPOSTS

Waste organic products, including animal manures and composted organic matter, contain nutrients for enhancing plant growth. These materials applied to the soil decompose releasing nutrients for vegetable crops to utilize. The key to proper use of organic materials as fertilizers comes in the knowledge of the nutrient content and the decomposition rate of the material. Growers contemplating using organic materials as fertilizers should have an analysis of the material before determining the rate of application. In the case of materials such as sludges, it is important to have knowledge about the type of sludge to be used. Certain classes of sludge are not appropriate for vegetable production, and in fact may not be permitted for land application. Decomposition rates of organic materials are rapid in warm sandy soils in Florida. Therefore, there will be relatively small amounts of residual nutrients remaining for succeeding crops. Usually application rates of organic wastes are determined largely by the N content. Organic waste materials can contribute to groundwater or surface water pollution if applied in rates in excess of the CNR for a particular crop. Therefore, it is important to understand the nutrient content and the decomposition rate of the organic waste material, and the P-holding capacity of the soil. For more information about using manure for vegetable production see "Using Composted Poultry Manure (Litter) in Mulched Vegetable Production" at <https://edis.ifas.ufl.edu/ss506> and "Introduction to Organic Crop Production" at <http://edis.ifas.ufl.edu/cv118>.

As a soil amendment, compost improves soil physical, chemical, and biological properties making soil more productive. To eliminate or minimize human and plant pathogens, nematodes, and weed seeds composting temperature must be kept in a range from 131 and 170°F for 3 days in an in-vessel or static aerated pile. N in compost is basically organic. Thus, compost N is not as readily bioavailable as synthetic N fertilizers before being mineralized. Compost N mineralization rate varies with feedstock, soil characteristics, and composting conditions. Generally speaking, compost N fertilizer releases only 5% to 30% bioavailable N to crops in the first year. On the contrary, compost P and K are as bioavailable as as chemical fertilizers. Composting converts raw organic materials to humus-stable forms and hence minimizes possibly adverse impacts on the environment.

Right Place

FERTILIZER PLACEMENT

Fertilizer rate and placement must be considered together. Banding low amounts of fertilizer too close to plants can result in the same amount of damage as broadcasting excessive amounts of fertilizer in the bed. Because P movement in most soils is minimal, it should be placed in the root zone. Banding is generally considered to provide more efficient utilization of P by plants than broadcasting. This is especially true on the high P-immobilizing calcareous soils. Where only small amounts of fertilizer P are to be used, it is best to band. If broadcasting P, a small additional amount of starter P near the seed or transplant may improve early growth, especially in cool soils. The modified broadcast method where fertilizer is broadcast only in the bed area provides more efficient use of fertilizer than complete broadcasting.

Micronutrients can be broadcast with the P and incorporated in the bed area. On the calcareous soils, micronutrients, such as Fe, Mn, and B, should be banded or applied foliarly. Since N and, to a lesser extent, K are mobile in sandy soils, they must be managed properly to maximize crop uptake. Plastic mulch helps retain these nutrients in the soil. Under non-mulched systems, split applications of these nutrients must be used to reduce losses to leaching. Here, up to one-half of the N and K may be applied to the soil at planting or shortly after that time. The remaining fertilizer is applied in one or two applications during the early part of the growing season. Split-applications also will help reduce the potential for fertilizer burn defined as leaf scorch resulting from over-fertilization.

When using plastic mulch, fertilizer placement depends on the type of irrigation system (seepage or drip) and on whether drip tubing or the liquid fertilizer injection wheels are to be used. With seepage irrigation, all P and micronutrients should be incorporated in the bed. Apply 10% to 20% (but not more) of the N and K with the P. The remaining N and K should be placed in narrow bands on the bed shoulders, the number of which depends on the crop and number of rows per bed. These bands should be placed in shallow (2- to 2 1/2-inch deep) grooves. This placement requires that adequate bed moisture be maintained so that capillarity is not broken. Otherwise, fertilizer will not move to the root zone. Excess moisture can result in fertilizer leaching. Fertilizer and water management programs are linked. Maximum fertilizer efficiency is achieved only with close attention to water management.

In cases where supplemental sidedressing of mulched crops is needed, applications of liquid fertilizer can be made through the mulch with a liquid fertilizer injection wheel. This implement is mounted on a tool bar and, using 30 to 40 psi pressure, injects fertilizer through a hole pierced in the mulch.

Right Time

SUPPLEMENTAL FERTILIZER APPLICATIONS AND BMPS

In practice, supplemental fertilizer applications when growing conditions require doing so, allow vegetable growers to stay within BMP guidelines while numerically apply fertilizer rates higher than the standard UF/IFAS recommended rates. The two main growing conditions that may require supplemental fertilizer applications are leaching rains and extended harvest periods. Applying additional fertilizer under the following three circumstances is part of the current UF/IFAS fertilizer recommendations and thus BMPs. Supplemental N and K fertilizer applications may be made if 1) grown on bare ground with seepage irrigation, a 30 lbs/A of N and / or 20 lbs/A of K_2O supplemental application is allowed after a leaching rain. A leaching rain occurs when it rains at least 3 inches in 3 days, or 4 inches in 7 days; 2) nutrient levels in the leaf or in the petiole fall below the sufficiency ranges. For bare ground production, the supplemental amount allowed is 30 lbs/A of N and/or 20 lbs/A of K_2O. For drip irrigated crops, the supplemental amount allowed is 1.5 to 2.0 lbs /A/day for N and/or K_2O for one week; or 3) for economic reasons, the harvest period has to be longer than the typical harvest period. When the results of tissue analysis and/ or petiole testing are below the sufficiency ranges, a supplemental 30 lbs /A N and/or 20 lbs /A of K_2O may be made for each additional harvest for bare ground production. For drip-irrigated crops, the supplemental fertilizer application is 1.5 to 2.0 lbs/A/day for N and/or K_2O until the next harvest.

FERTIGATION

Common irrigation systems used for fertigation include drip, sprinkler, and pivot systems. Advantages of fertigation over conventional fertilizing methods are: 1) more efficient delivery of nutrients, 2) more precise localized application, 3) more flexible control of application rate and timing, and 4) lower application cost. Liquid and water soluble fertilizers are more commonly used for fertigation than dry fertilizers. The most common liquid N fertilizers for fertigation are ammounium nitrate (20-0-0), calcium ammonium nitrate (17-0-0), and urea ammonium nitrate (32-0-0). Complete fertilizers (e.g. 8-8-8 and 4-10-10) are also commonly used. To develop a more precise fertilizer application strategy, growers can request a custom blend at a local fertilizer dealer based on soil test results and crop nutrient requirements. For more information, consult "Fertigation Nutrient Sources and Application Considerations for Citrus" at <http://edis.ifas.ufl.edu/ch185>.

The basic components for a fertigation system include a fertilizer tank, an injector, a filter, a pressure regulator, a pressure gauge, and a backflow prevention device. All of the components must be resistant to corrosion. In most situations, N and K are the nutrients injected through the irrigation tube. Split applications of N and K through irrigation systems offers a means to capture management potential and reduce leaching losses. Other nutrients, such as P, are usually applied to the soil rather than by injection. This is because chemical precipitation can occur with these nutrients and the high calcium carbonate content of our irrigation water in Florida.

Nutrient management through irrigation tubes involves precise scheduling of N and K applications. Application rates are determined by crop growth and resulting nutrient demand. Demand early in the season is small and thus rates of application are small, usually on the order of ½ to ¾ lb of N or K_2O per acre per day. As the crop grows, nutrient demand increases rapidly so that for some vegetable crops such as tomato the demand might be as high as 2 lb of N or K_2O per day. Schedules of N and K application have been developed for most vegetables produced with drip irrigation in Florida (Table 7).

FOLIAR FERTILIZATION

Foliar fertilization should be thought of as a last resort for correcting a nutrient deficiency (Table 11). The plant leaf is structured in such a way that it naturally resists easy infiltration by fertilizer salts. Foliar fertilization most appropriately applies to micronutrients and not to macronutrients such as N, P, and K. In certain situations, temporary deficiencies of Mn, Fe, Cu, or Zn can be corrected by foliar application. Examples include vegetable production in winter months when soils are cool and roots cannot extract adequate amounts of micronutrients and in cases where high pH (marl and Rockdale soils) immobilizes broadcast micronutrients. There is a fine line between adequate and toxic amounts of these nutrients. Indiscriminate application of micronutrients may reduce plant growth and restrict yields because of toxicity. Compounding the problem is the fact that the micro-nutrients can accumulate in the soil to levels which may threaten crop production on that soil.

Table 2.1. A general guideline to crop tolerance of mineral soil acidity.[1]

Slightly tolerant (pH 6.8–6.0)		Moderately tolerant (pH 6.8—-5.5)		Very tolerant (pH 6.8–5.0)
Beet	Leek	Bean, snap	Mustard	Endive
Broccoli	Lettuce	Bean, lima	Pea	Potato
Cabbage	Muskmelon	Brussels sprouts	Pepper	Shallot
Cauliflower	Okra	Carrot	Pumpkin	Sweet potato
Celery	Onion	Collard	Radish	Watermelon
Chard	Spinach	Corn	Squash	
		Cucumber	Strawberry	
		Eggplant	Tomato	
		Kale	Turnip	

[1] From Donald N. Maynard and George J. Hochmuth, Knott's Handbook For Vegetable Growers, 4th edition (1997). Reprinted by permission of John Wiley & Sons, Inc.

Table 2.2. Liming materials.

Material	Formula	Amount of material to be used to equal 1 ton of calcium carbonate[1]	Neutralizing value2(%)
Calcium carbonate, calcite, hi-cal lime	$CaCO_3$	2,000 lb	100
Calcium-magnesium carbonate, dolomite	$CaCO_3$, $MgCO_3$	1,850 lb	109
Calcium oxide, burnt lime	CaO	1,100 lb	179
Calcium hydroxide, hydrated lime	$Ca(OH)_2$	1,500 lb	136
Calcium silicate, slag	$CaSiO_3$	2,350 lb	86
Magnesium carbonate	$MgCO_3$	1,680 lb	119

[1] Calcutated as (2000 x 100) / neutralizing value (%).

[2] The higher the neutralizing value, the greater the amount of acidity that is neutralized per unit weight of material.

Table 2.3. Effect of some fertilizer materials on soil pH.

Fertilizer material	Approximate calcium carbonate equivalent (lb)[1]	Fertilizer material	Approximate calcium carbonate equivalent (lb)[1]
Ammonium nitrate	-1200	Normal (ordinary) superphosphate	0
Ammonium sulfate	-2200	Potassium nitrate	+520
Anhydrous ammonia	-3000	Potassium sulfate	0
Diammonium phosphate	-1250 to -1550	Potassium-magnesium sulfate	0
Potassium chloride	0	Triple (concentrated) superphosphate	0
Sodium-potassium nitrate	+550	Urea	-1700
Nitrogen solutions	-759 to -1800		

[1] A minus sign indicates the number of pounds of calcium carbonate needed to neutralize the acid formed when one ton of fertilizer is added to the soil.

Table 2.4. Nutrient elements required by plants.

	N/utrient	Deficiency symptoms	Occurrence
Macronutrients	Nitrogen (N)	Stems thin, erect, hard. Leaves small, yellow; on some crops (tomatoes) undersides are reddish. Lower leaves affected first.	On sandy soils especially after heavy rain or after over irrigation. Also on organic soils during cool growing seasons.
	Phosphorus (P)	Stems thin and shortened. Leaves develop purple color. Older leaves affected first. Plants stunted and maturity delayed.	On acidic soils or very basic soils. Also when soils are cool and wet.
	Potassium (K)	Older leaves develop gray or tan areas on leaf margins. Eventually a scorch appears on the entire margin.	On sandy soils following leaching rains or over irrigation.
Secondary nutrients	Calcium (Ca)	Growing-point growth restricted on shoots and roots. Specific deficiencies include blossom-end rot of tomato, pepper and watermelon, brown heart of escarole, celery blackheart, and cauliflower or cabbage tip burn.	On strongly acidic soils, or during severe droughts.
	Magnesium (Mg)	Initially older leaves show yellowing between veins, followed by yellowing of young leaves. Older leaves soon fall.	On strongly acidic soils, or on leached sandy soils.
	Sulfur (S)	General yellowing of younger leaves and growth.	On very sandy soils, low in organic matter, reduced especially following continued use of sulfur-free fertilizers and especially in areas that receive little atmospheric sulfur.
Micronutrients	Boron (B)	Growing tips die and leaves are distorted. Specific diseases caused by boron deficiency include brown curd and hollow stem of cauliflower, cracked stem of celery, blackheart of beet, and internal browning of turnip.	On soils with pH above 6.8 or on sandy, leached soils, or on crops with very high demand such as cole crops.
	Copper (Cu)	Yellowing of young leaves, stunting of plants. Onion bulbs are soft with thin, pale scales.	On organic soils or occasionally new mineral soils.
	Chlorine (Cl)	Deficiencies very rare.	Usually only under laboratory conditions.
	Iron (Fe)	Distinct yellow or white areas between veins on youngest leaves.	On soils with pH above 6.8.
	Manganese (Mn)	Yellow mottled areas between veins on youngest leaves, not as intense as iron deficiency.	On soils with pH above 6.4.
	Molybdenum (Mo)	Pale, distorted, narrow leaves with some interveinal yellowing of older leaves, e.g. whiptail disease of cauliflower. Rare.	On very acidic soils.
	Nickel (Ni)	Deficiencies very rare.	Usually only under laboratory conditions.
	Zinc (Zn)	Small reddish spots on cotyledon leaves of beans; light areas (white bud) of corn leaves.	On wet, cold soils in early spring or where excessive phosphorus is present.

Table 2.5. Target pH and Nitrogen (N) fertilization recommendations for selected vegetable crops in mineral soils of Florida.

Crops	Target pH	N (lb/acre)
Tomato, pepper, potato, celery, sweet corn, crisphead lettuce, endive, escarole, romaine lettuce and eggplant	6.0 (potato) and 6.5	200
Snapbean, lima bean and pole bean	6.5	100
Broccoli, cauliflower, Brussels sprouts, cabbage, collards, Chinese cabbage and carrots	6.5	175
Radish and spinach	6.5	90
Cucumber, squash, pumpkin, muskmelon, leaf lettuce, sweet bulb onion, watermelon and strawberry	6.0 (watermelon) and 6.5	150
Southernpea, snowpea, English pea and sweet potato	6.5	60
Kale, turnip, mustard, parsley, okra, bunching onion, leek and beet	6.5	120

Table 2.6. Mehlich-1 (double-acid) and Mehlich-3 interpretations for vegetable crops in Florida.

	Mehlich-1 (double-acid) interpretations					Mehlich-3 interpretations		
	Very low	Low	Medium	High	Very high	Low	Medium	High
Nutrient	(parts per million soil)					(parts per million soil)		
P	<10	10–15	16–30	31–60	>60	≤25	26–45	>45
K	<20	20–35	36–60	61–125	>125	≤35	36–60	>60
Mg[1]	<10	10–20	21–40	41–60	>60	≤20	21–40	>40
Ca[2]	<100	100–200	201–300	301–400	>400			

[1] Up to 40 lbs/A may be needed when soil test results are medium or lower.

[2] Ca levels are typically adequate when > 300 ppm.

Table 2.7. Phosphorus (P, expressed as P_2O_5) and potassium (K, expressed as K_2O) fertigation recommendations for selected vegetable crops in mineral soils for Florida based on low, medium, and high soil test index using **MEHLICH 3 SOIL EXTRACATANT METHOD.**

P_2O_5			K_2O		
Low	Medium	High	Low	Medium	High
(lb/A/crop season)			(lb/A/crop season)		
Celery					
150-200	100	0	150-250	100	0
Eggplant					
130-160	100	0	130-160	100	0
Broccoli, cauliflower, Brussels sprouts, cabbage, collards, Chinese cabbage, carrots, kale, turnip, mustard, parsley, okra, muskmelon, leaf lettuce, sweet bulb onion, watermelon, pepper, sweet corn, crisphead lettuce, endive, escarole, strawberry and romaine lettuce					
120-150	100	0	120-150	100	0
Tomato					
120-150	100	0	125-150	100	0
Cucumber, squash, pumpkin, snapbean, lima bean, pole bean, beet, radish, spinach and sweet potato					
100-120	80	0	100-120	80	0
Bunching onion and leek					
100-120	100	0	100-120	100	0
Potato					
120	100	0	150	--	--
Southern pea, snowpea and English pea					
80	80	0	80	60	0

Table 2.8. Fertigation[1] and supplemental fertilizer[1] recommendations on mineral soils testing low in potassium (K_2O) based on the **MEHLICH 3 SOIL EXTRACTION METHOD.**

	Preplant[2] (lb/A)	Injected[3] (lb/A/day)					Low plant content[4,5]	Extended season[4,6] (lb/A/day)
Eggplant								
Wk after transplanting[7]		1-2	3-4	5-10	11-13			
N	0-70	1.5	2.0	2.5	2.0		1.5-2.0	1.5-2.0
K_2O	0-55	1.0	1.5	2.5	1.5		1.5-2.0	1.5-2.0
Okra								
Wk after transplanting		1-2	3-4	5-12	13			
N	0-40	1.0	1.5	2.0	1.5		1.5-2.0	1.5-2.0
K_2O	0-50	1.0	1.5	2.0	1.5		1.5-2.0	1.5-2.0
Pepper								
Wk after transplanting		1-2	3-4	5-11	12	13		
N	0-70	1.5	2.0	2.5	2.0	1.5	1.5-2.0	1.5-2.0
K_2O	0-70	1.5	2.0	2.5	2.0	1.5	1.5-2.0	1.5-2.0
Strawberry								
Wk after transplanting		1-2	Sept.-Jan.	Feb.-Mar.	Apr.			
N	0-40	0.3	0.6	0.75	0.6		0.6-0.75	0.6-0.75
K_2O	0-40	0.3	0.5	0.75	0.6		0.6-0.75	0.6-0.75
Tomato[8]								
Wk after transplanting		1-2	3-4	5-11	12	13		
N	0-70	1.5	2.0	2.5	2.0	1.5	1.5-2.0	1.5-2.0
K_2O	0-70	1.5	2.0	2.5	2.0	1.5	1.5-2.0	1.5-2.0

[1] A=7,260 linear feet per acre (6-ft. bed spacing); for soils testing "low in Mehlich 3 potassium (K_2O), seeds and transplants may benefit from applications of a starter solution at a rate no greater than 10 to 15 lb/A for N and P_2O_5 and applied through the plant hole or near the seeds.

[2] Applied using the modified broadcast method (fertilizer is broadcast where the beds will be formed only, and not over the entire field). Preplant fertilizer cannot be applied to double/triple crops because of the plastic mulch; hence, in these cases, all the fertilizer has to be injected.

[3] This fertigation schedule is applicable when no N and K_20 are applied preplant. Reduce schedule proportionally to the amount of N and K_20 applied preplant. Fertilizer injections may be done daily or weekly. Inject fertilizer at the end of the irrigation event and allow enough time for proper flushing afterwards.

[4] Plant nutritional status may be determined with tissue analysis or fresh petiole-sap testing, or any other calibrated method. The "low' diagnosis needs to be based on UF/IFAS interpretative thresholds.

[5] Plant nutritional status must be diagnosed every week to repeat supplemental fertilizer application.

[6] Supplemental fertilizer applications are allowed when irrigation is scheduled following a recommended method (see "Evapotranspiration-based Irrigation Scheduling for Agriculture at <http://edis.ifas.ufl.edu/ae457>). Supplemental fertilizations is to be applied in addition to base fertilization when appropriate. Supplemental fertilization is not to be applied 'in advance' with the preplant fertilizer.

[7] For standard 13 week-long, transplanted tomato crop.

[8] Some of the fertilizer may be applied with a fertilizer wheel through the plastic mulch during the tomato crop when only part of the recommended base rate is applied preplant. Rate may be reduced when a controlled-release fertilizer source is used.

Table 2.9. Phosphorus (P; expressed as P_2O_5) and potassium (K; expressed as K_2O) fertilization recommendations for selected vegetable crops in mineral soils of Florida, using **MEHLICH 1 SOIL EXTRACTANT METHOD.** VL, L, M, H, and VH = very low, low, medium, high, and very high, respectively.

P_2O_5					K_2O				
VL	L	M	H	VH	VL	L	M	H	VH
(lb/A/crop season)					(lb/A/crop season)				
Celery									
200	150	100	0	0	250	150	100	0	0
Eggplant									
160	130	100	0	0	160	130	100	0	0
Broccoli, cauliflower, Brussels sprouts, cabbage, collards, Chinese cabbage, carrots, kale, turnip, mustard, parsley, okra, muskmelon, leaf lettuce, sweet bulb onion, watermelon, pepper, sweet corn, crisphead lettuce, endive, escarole, strawberry and romaine lettuce									
150	120	100	0	0	150	120	100	0	0
Tomato									
150	120	100	0	0	225	150	100	0	0
Cucumber, squash, pumpkin, snapbean, lima bean, pole bean, beet, radish, spinach and sweet potato									
120	100	80	0	0	120	100	80	0	0
Bunching onion and leek									
120	100	100	0	0	120	100	100	0	0
Potato									
120	120	60	0	0	150	--	--	--	--
Southern pea, snowpea and English pea									
80	80	60	0	0	80	80	60	0	0

Table 2.10. Interpretations of **Mehlich-1** soil tests for micronutrients.

	Soil pH (mineral soils only)		
	5.5–5.9	**6.0–6.4**	**6.5–7.0**
	(parts per million)		
Test level below which there may be a crop response to applied copper.	0.1–0.3	0.3–0.5	0.5
Test level above which copper toxicity may occur.	2.0–3.0	3.0–5.0	5.0
Test level below which there may be a crop response to applied manganese.	3.0–5.0	5.0–7.0	7.0–9.0
Test level below which there may be a crop response to applied zinc.	0.5	0.5–1.0	1.0–3.0
When soil tests are low or known deficiencies exists, apply per acre 5 lbs Mn, 2 lbs Zn, 4 lbs Fe, 3 lb Cu and 1.5 lbs B (higher rate needed for cole crops).			

Table 2.11. Some nutrients and fertilizer management for vegetable production in Florida.

Nutrient	Source	Foliar application (lb product/A)
Boron	Borax[1]	2 to 5
	Solubor	1 to 1.5
Copper	Copper sulfate	2 to 5
Iron	Ferrous sulfate	2 to 3
	Chelated iron	0.75 to 1
Manganese	Manganous sulfate	2 to 4
Molybdenum	Sodium molybdate	0.25 to 0.50
Zinc	Zinc sulfate	2 to 4
	Chelated zinc	0.75 to 1
Calcium	Calcium chloride	5 to 10
	Calcium nitrate	5 to 10
Magnesium	Magnesium sulfate	10 to 15

[1] Mention of a trade name does not imply a recommendation over similar materials.

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Chapter 3. Principles and Practices of Irrigation Management for Vegetables

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This section contains basic information on vegetable water use and irrigation management, along with some references on irrigation systems. Proper water management planning must consider all uses of water, from the source of irrigation water to plant water use. Therefore, it is very important to differentiate between crop water requirements and irrigation or production system water requirements. Crop water requirements refer to the actual water needs for evapotranspiration (ET) and plant growth, and primarily depend on crop development and climatic factors which are closely related to climatic demands. Irrigation requirements are primarily determined by crop water requirements, but also depend on the characteristics of the irrigation system, management practices and the soil characteristics in the irrigated area.

Best Management Practices (BMP) For Irrigation

BMPs have historically been focused on nutrient management and fertilizer rates. However, as rainfall or irrigation water is the vector of off-site nutrient movement of nitrate in solution and phosphate in sediments as well as other soluble chemicals, proper irrigation management directly affects the efficacy of a BMP plan. The irrigation BMPs in the "Water Quality/ Quantity Best Management Practices for Florida Vegetable and Agronomic Crops" (accessible at www.floridaagwaterpolicy.com) manual cover all major aspects of irrigation such as irrigation system design, system maintenance, erosion control, and irrigation scheduling.

Uses of Irrigation Water

Irrigation systems have several uses in addition to water delivery for crop ET. Water is required for a preseason operational test of the irrigation system to check for leaks and to ensure proper performance of the pump and power plant. Irrigation water is also required for field preparation, crop establishment, crop growth and development, within-season system maintenance, delivery of chemicals, frost protection, and other uses such as dust control.

FIELD PREPARATION

Field preparation water is used to provide moisture to the field soil for tillage and bed formation. The water used for field preparation depends on specific field cultural practices, initial soil moisture conditions, the depth to the natural water table, and the type of irrigation system. Drip-irrigated fields on sandy soils often require an additional irrigation system for field preparation because drip tubes are not installed until after the beds have been formed. Thus, many drip irrigated vegetable fields may also require an overhead or subirrigation system for field preparation. For example, many strawberry production fields have sprinkler irrigation systems already installed for frost protection. These systems are also used for field preparation and may apply one or more inches of water for this purpose. Subirrigated (seepage) fields use the same system for field preparation as well as for crop establishment, plant growth needs and frost protection. Subirrigation water management requirements depend on the soil characteristics within the irrigated field and surrounding areas. Sufficient water must be provided to raise the water table level as high as 18 to 24 in below the soil surface. Water is required to fill the pores of the soil and also satisfies evaporation and subsurface runoff requirements. As a rough guide, 1.0 to 2.5 in of water are required for each foot of water table rise. For example, a field with a pre-irrigation water table 30 in deep may need about 2 in of water to raise the water table to 18 in, while a pre-irrigation water table at 48 in may require 5 in of water for the same result.

CROP ESTABLISHMENT

Vegetables that are set as transplants, rather than direct seeded require irrigation for crop establishment in excess of crop ET. Establishment irrigations are used to either keep plant foliage wet by overhead sprinkler irrigation (to avoid desiccation of leaves) or to maintain high soil moisture levels until the root systems increase in size and plants start to actively grow and develop. Establishment irrigation practices vary among crops and irrigation systems. Strawberry plants set as bare-root transplants may require 10 to 14 days of frequent intermittent overhead irrigation for establishment prior to irrigation with the drip system. The amount of water required for crop establishment can range widely depending on crop, irrigation system, and climate demand. Adequate soil moisture is also needed for the uniform establishment of direct-seeded vegetable crops.

CROP GROWTH AND DEVELOPMENT

Irrigation requirements to meet the ET needs of a crop depend on the type of crop, field soil characteristics, irrigation system type and capacity, and crop growth stage. Crops vary in growth characteristics that result in different relative water use rates. Soils differ in texture and hydraulic characteristics such as available water-holding capacity (AWHC) and capillary movement. Because sands generally have very low AWHC values (3% to 6% is common), a 1% change in AWHC affects irrigation practices.

Table 3.1. Application efficiency for water delivery systems used in Florida.

Irrigation system	Application efficiency (Ea)
Overhead	60-80%
Seepage[1]	20-70%
Drip[2]	80-95%

[1] Ea greater than 50% are not expected unless tailwater recovery is used
[2] With or without plastic mulch

WATER APPLICATION (IRRIGATION REQUIREMENT)

Irrigation systems are generally rated with respect to application efficiency (Ea), which is the fraction of the water that has been applied by the irrigation system and that is available to the plant for use (Table 1). Applied water that is not available to the plant may have been lost from the crop root zone through evaporation or wind drifts of spray droplets, leaks in the pipe system, surface runoff, subsurface runoff, or deep percolation within the irrigated area. Irrigation requirements (IR) are determined by dividing the desired amount of water to provide to the plant (ETc), by the Ea as a decimal fraction (Eq.[1]). For example, if it is desired to apply 0.5 in to the crop with a 75% efficient system, then 0.5/0.75 = 0.67 in would need to be pumped. Hence, when seasonal water needs are assessed, the amount of water needed should be based on the irrigation requirement and all the needs for water, and not only on the crop water requirement. For more information, consult "Field Evaluation of Microirrigation Water Application Uniformity" at <http://edis.ifas.ufl.edu/AE094>. Catch cans can be used in the field to measure the actual amount of water applied.

Eq. [1] Irrigation requirement = Crop water requirement / Application efficiency

IR = ETc/Ea

FERTIGATION/CHEMIGATION

Irrigation systems are often used for delivery of chemicals such as fertilizers, soil fumigants, or insecticides. The crop may require nutrients when irrigation is not required, e.g. after heavy rainfall. Fertilizer injection schedules based on soil tests results are provided in Chapter 2 of this production guide. Fertigation should not begin until the system is pressurized. It is recommended to always end a fertigation/chemigation event with a short flushing cycle with clear water to avoid the accumulation of fertilizer or chemical deposits in the irrigation system, and/or rinse crop foliage. The length of the flushing cycle should be 10 min longer than the travel time of the fertilizer from the irrigation point to the farthest point of the system.

SYSTEM MAINTENANCE

Irrigation systems require periodic maintenance throughout the growing season. These activities may require system operation during rainy periods to ensure that the system is ready when needed. In addition, drip irrigation systems may require periodic maintenance to prevent clogging and system failure. Typically, cleaning agents are injected weekly, but in some instances more frequent injections are needed.

FROST PROTECTION

For some crops, irrigation is used for frost protection during winter growing seasons. For strawberry production, sprinkler irrigation is primarily used with application rates of about 0.25 in per hour during freeze events. Water freezes at 32ºF, while most plant tissues freeze at lower temperatures. Overhead freeze protection is efficient for air temperature as low as 26-28ºF, but seldom below. For vegetable fields with subirrigation systems, the relatively higher temperature of groundwater can be used for cold protection. Growers may also irrigate to raise the water table throughout the field. Frost protection water requirements vary and depend on the severity and duration of freeze events, the depth to the existing water table level, and field hydraulic characteristics. For more information, consult IFAS bulletin HS931 "Microsprinkler Irrigation for Cold Protection of Florida Citrus" at <http://edis.ifas.ufl.edu/ch182> and "Citrus Cold Weather Protection and Irrigation Scheduling Tools Using Florida Automated Weather Network (FAWN) Data" at <http://edis.ifas.ufl.edu/ss509>.

OTHER USES

Other irrigation uses vary according to the type of crop, system characteristics, and field location. Some examples include: periodic overhead irrigation for dust control; wetting of dry row middles to settle dust and prevent sand from blowing during windy conditions; and, wetting of roadways and drive aisles to provide traction of farm vehicles.

Irrigation Scheduling

Irrigation scheduling consists simply of applying water to crops at the "right" time and in the "right" amount and it is considered an important BMP. The characteristics of the irrigation system, crop needs, soil properties, and atmospheric conditions must all be considered to properly schedule irrigations. Poor timing or insufficient water application can result in crop stress and reduced yields from inappropriate amounts of available water and/or nutrients. In sandy soils, excessive water applications may reduce yield and quality, and increase the risk of nutrient leaching.

A wide range of irrigation scheduling methods is used in Florida, with corresponding levels of water management (Table 2). The recommended method (level 5) for scheduling irrigation (drip or overhead) for vegetable crops is to use together: the crop water requirement method that takes into account plant stage of growth associated with measurements of soil water status, and guidelines for splitting irrigation (see below). A typical irrigation schedule contains (1) a target crop water requirement adjusted to growth stage and actual evaporative demand, (2) adjustment of irrigation application based on soil moisture, (3) a rule for splitting irrigation, (4) a method to account for rainfall, and (5) record keeping (Table 3). For seepage irrigation, the water table should be maintained near the 18-inch depth (measured from the top of the bed) at planting and near the 24-inch depth when plants are fully grown. Water tables should be maintained at the proper level to ensure optimum moisture in the bed without leading to oversaturation of the root zone and potential losses of nutrients. Water tables can be monitored with a section of PVC pipe sunk in the soil with a calibrated float inside the PVC pipe. The calibrated float can be used to determine the exact level of the water table. For more information on observation well construction consult 'Water Table Measurements and Monitoring for Flatwood Citrus' at <http://edis.ifas.ufl.edu/ch151>.

Table 3.2. Levels of water management and corresponding irrigation scheduling method.

Water Mgt. Level	Irrigation scheduling method
0	Guessing (irrigate whenever), not recommended
1	Using the "feel and see" method, see ftp://ftp-fc.sc.egov.usda.gov/MT/www/technical/soilmoist.pdf
2	Using systematic irrigation (Example: ¾ in. every 4th day; or 2 hr every day)
3	Using a soil water tension measuring tool or soil moisture sensor to start irrigation
4	Schedule irrigation and apply amounts based on a budgeting procedure and checking actual soil water status
5[1]	Adjusting irrigation to plant water use (ETo), and using a dynamic water balance based on a budgeting procedure and plant stage of growth, together with using a soil water tension measuring tool or soil moisture sensor

[1] Recommended method

Table 3.3. Summary of irrigation scheduling guidelines for vegetable crops grown in Florida.

	Irrigation system[1]	
Irrigation scheduling component	**Seepage[2]**	**Drip[3]**
1- Target water application rate	Keep water table between 18 and 24 inch depth	Historical weather data or crop evapotranspiration (ETc) calculated from reference ET or Class A pan evaporation
2- Fine tune application with soil moisture measurement	Monitor water table depth with observation wells	Maintain soil moisture level in the root zone between 8 and 15 cbar (or 8% and 12% available soil moisture
3- Determine the contribution of rainfall	Typically, 1 inch rainfall raises the water table by 1 foot	Poor lateral water movement on sandy and rocky soils limits the contribution of rainfall to crop water needs to (1) foliar absorption and cooling of foliage and (2) water funneled by the canopy through the plan hole.
4- Rule for splitting irrigation	Not applicable. However, a water budget can be developed	Irrigations greater than 12 and 50 gal/100ft (or 30 min and 2 hrs for drip tapes with medium flow-rate) when plants are small and fully grown, respectively are likely to push the water front being below the root zone
5-Record keeping	Irrigation amount applied and total rainfall received [4] Days of system operation	Irrigation amount applied and total rainfall received [4] Daily irrigation schedule

[1] Efficient irrigation scheduling also requires a properly designed and maintained irrigation system
[2] Practical only when a spodic layer is present in the field
[3] On deep sandy soils
[4] Required by the BMPs

SOIL WATER STATUS, SOIL WATER TENSION AND SOIL VOLUMETRIC WATER CONTENT

Generally, two types of sensors may be used for measurements of soil water status, those that measure soil water potential (also called tension or suction) and those that measure volumetric water content directly. Soil water tension (SWT) represents the magnitude of the suction (water potential, negative pressure) the plant roots have to create to free soil water from the attraction of the soil, and move it into the root cells. The dryer the soil, the higher the suction needed, hence, the higher SWT. SWT is commonly expressed in centibars (cb) or kilopascals (kPa; 1cb = 1kPa; 7kPa = 1psi). For most vegetable crops grown on the sandy soils of Florida, SWT in the rooting zone should be maintained between 6 (slightly above field capacity) and 15 cb. Because of the low AWHC of Florida soils, most full-grown vegetable crops will need to be irrigated daily. During early growth, irrigation may be needed only two to three times weekly. SWT can be measured in the field with moisture sensors or tensiometers. For more information on SWT measuring devices, consult IFAS circular ABE326 'Using Tensiometers for Vegetable Irrigation Scheduling in Miami-Dade County' at <http://edis.ifas.ufl.edu/tr015>.

Within the category of volumetric sensors, capacitance based sensors have become common in recent years due to a decrease in cost of electronic components and increased reliability of these types of sensors. However, sensors available on the market have substantially different accuracies, response to salts, and cost. Soil moisture sensors are detailed in the publication, "Field Devices for Monitoring Soil Water Content" (http://edis.ifas.ufl.edu/AE266). All methods under this definition estimate the volume of water in a sample volume of undisturbed soil [ft3/ft3 or percentage]. This quantity is useful for determining how saturated the soil is (or, what fraction of total soil volume is filled with the soil aqueous solution). When it is expressed in terms of depth (volume of water in soil down to a given depth over a unit surface area (inches of water)), it can be compared with other hydrologic variables like precipitation, evaporation, transpiration, and deep drainage.

PRACTICAL DETERMINATION OF SOIL FIELD CAPACITY USING VOLUMETRIC SOIL MOISTURE SENSORS

It is very important that the irrigation manager understands the concept of "field capacity" to establish an irrigation control strategy goals of providing optimum soil moisture for plant growth, productivity, and reduction of fertilizer nutrient leaching. Figure 1 represents volumetric soil water content (VWC) at depth of 0-6 in measured by a capacitance sensor during a period of 4 days. For the soil field capacity point determination, it is necessary to apply an irrigation depth that resulted in saturation of the soil layer, in this particular case 0-6 in. The depth of irrigation applied was 4,645 gal/ac (equivalent to 0.17 in for overhead or seepage irrigation, or 34 gal/100ft for drip irrigation with 6 ft bed centers in plasticulture) in a single irrigation event. Right after the irrigation events, there was a noticeable increase in soil moisture content. The degree to which the VWC increases, however, is dependent upon volume of irrigation, which is normally set by the duration of irrigation event. For plastic mulched drip irrigation in sandy soils, long irrigation events result in a relatively large increase in soil moisture in the area below the drip emitter. The spike in soil moisture appears to only be temporary, as the irrigation water rapidly drains down beyond the 6-inch zone (observed by the decrease in VWC). This rapid spike in soil water content indicates that the VWC rapidly reaches a point above the soil water holding capacity and the water percolated down to deeper soil layers. Between end of day 1 and day 3, the VWC declined at a constant rate due to some soil water extraction by drainage, but most extraction due to evapotranspiration during the day. For sandy soils, the change in the slope of drainage and extraction lines, in other words, changing from "rapid" to "slower" decrease in soil water content can be assumed as the "field capacity point". At this time, the water has moved out from the large soil pores (macropores), and its place has been taken by air. The remaining pore spaces (micropores) are still filled with water and will supply the plants with needed moisture.

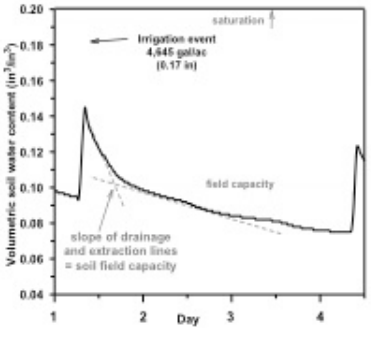

Figure 1. Example of practical determination of soil field capacity at 0-6 inches soil depth after irrigation event using soil moisture sensors.

EXAMPLES OF IRRIGATION SCHEDULING USING VOLUMETRIC SOIL MOISTURE SENSOR DEVICES

In this section, two examples of irrigation management of vegetable crops in sandy soils using soil moisture sensor readings stored in a data logger are provided: one example with excessive ("over") irrigation (Fig. 2) and one with adequate irrigation (Fig.4) using plasticulture. In Figure 2, the irrigation events consisted of the application of a single daily irrigation event of 4,718 gal/ac (equivalent to 0.18 in for overhead or seepage irrigation, or 36 gal/100ft for drip irrigation with 6-ft bed centers in plasticulture. After each irrigation event, there was an increase in the soil water content followed by rapid drainage. Large rainfall events may lead to substantial increases in soil moisture content. On day 2, right after the irrigation, a large rainfall of 0.44 in occurred, which resulted in a second spike of soil water content in the same day. The following irrigation (day 3) started when the volumetric soil water content was above the soil field capacity. In this case, the irrigation event of the day 3 could have been safely skipped. Between day 3 and 6, no irrigation was applied to the crop. The volumetric water content decreased from 0.14 to 0.08 in^3/in^3. Due to the very low water holding capacity of the sandy soils, skipping irrigation for several days could lead to unneeded crop water stress especially during very hot days or very windy days (when high evapotranspiration rates may occur), or during flowering stage. Between day 6 and 10, large daily irrigation events were repeated, exceeding the "safe irrigation zone", and leading to more water drainage and nutrient leaching.

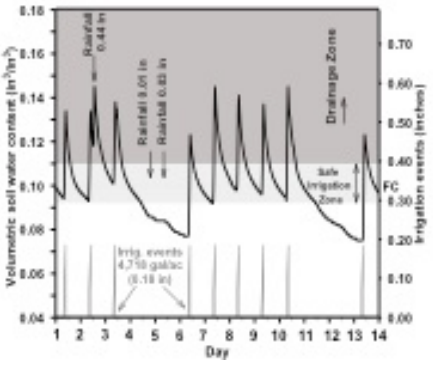

Figure 2. Example of excessive ("over") irrigation of the upper soil layer (0 to 6 inch depth) moisture content for drip irrigation under plastic mulched condition for sandy soils. Black line indicates volumetric soil water content using soil moisture sensors. Grey line indicates Irrigation event, single daily irrigation event with volume application of 65 gal/100ft (0.18 in). Dotted line indicates soil field capacity line. Arrows indicate rainfall events.

Conversely, Figure 3 shows "adequate" irrigation applications for a 10 day period. In this case, the irrigation event will start exclusively when the volumetric soil water content reaches an arbitrary threshold. For this particular situation, the soil field capacity is known, the irrigation events started when the volumetric soil moisture content reached values below the soil field capacity (or 0.09 in^3/in^3). However, to maintain the soil volumetric water content in the "safe irrigation zone", a previous determination of the length of the irrigation is necessary, to avoid over irrigation (additional information about irrigation depths can be obtained in "Microirrigation in Mulched Bed Production Systems: Irrigation Depths" at <http://edis.ifas.ufl.edu/AE049>.

The example in Figure 3 received irrigation depth of 943 gal/ac (equivalent to 0.03 in for overhead or seepage irrigation, or 6 gal/100ft for drip irrigation with 6-ft bed centers in plasticulture, this irrigation depth was sufficient to increase the volumetric water content to a given moisture without exceeding the "safe irrigation zone". On average, the volumetric soil water content is maintained close to the field capacity, keeping water and nutrients in the root zone. For this particular example, there was no deep water percolation. In addition, with the information of the soil water status, the irrigation manager might decide to not irrigate if the soil moisture content is at a satisfactory level. For example, in day 8, due to a rainfall event of 0.04 in, there was no need of irrigation because the soil moisture was above the field capacity and the arbitrary threshold, therefore the irrigation event of day 8 was skipped. On the other hand, this "precise" irrigation management requires very close attention by the irrigation manager. For a given reason (such as pump issue), the irrigation was ceased in day 5 and it was resumed late in day 6. As a result, soil water storage decreased to a certain level, and if the water shortage is prolonged, the plants would be water stressed.

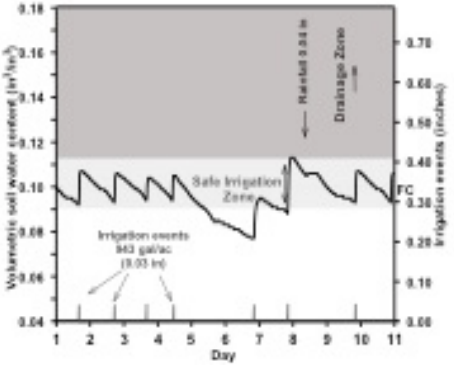

Figure 3. Example of adequate irrigation management using soil moisture sensors for monitoring the volumetric soil moisture content the upper soil layer (0 to 6 inch depth), on drip irrigation under plastic mulched condition for sandy soils. Black line indicates volumetric soil water content using soil moisture sensors. Grey line indicates Irrigation event, single daily irrigation event with volume application of 943 gal/ac (0.03 in). Dotted line indicates soil field capacity line. Arrows indicate rainfall events.

INSTALLATION AND PLACING OF SOIL MOISTURE SENSOR DEVICES

The use of soil moisture monitoring devices (volumetric or soil water tension) has potential of save irrigation water application in a given vegetable area by reducing the number of unnecessary irrigation events. However, the effectiveness of the use of these sensors depends on a proper installation in representative locations within vegetable fields. These sensors may be used to monitor water table levels in seepage irrigation.

Sensors should be buried in the root zone of the plants to be irrigated. Most of the vegetable crops have 80% to 90% of the root zone in the upper 12 in, which generally is the soil layer with higher water depletion by evapotranspiration. For vegetable crops cultivated in rows and irrigated by drip tapes, the sensors should be installed 2-3 in away from the plant row. For single row crops (such as tomato, eggplant, or watermelon), the sensor should be placed in the opposite side of the drip tape, for double row crops (pepper, squash), the sensors should be placed in between the drip tape and plant rows.

Sensors need to be in good contact with the soil after burial; there should be no air gaps surrounding the sensor. Soil should be packed firmly

but not excessively around the sensor. In plasticulture, after the installation, the area above the sensor should be recovered back with plastic and sealed with tape.

CROP WATER REQUIREMENT (ET)

Crop water requirements depend on crop type, stage of growth, and evaporative demand. Evaporative demand is termed evapotranspiration (ET) and may be estimated using historical or current weather data. Generally, reference evapotranspiration (ETo) is determined for use as a base level. By definition, ETo represents the water use from a uniform green cover surface, actively growing, and well watered (such as turf or grass covered area).

Historical daily averages of Penman-method ETo values are available for six Florida regions expressed in units of acre-inches and gallons per acre (Table 4). While these values are provided as guidelines for management purposes, actual values may vary above and below these values, requiring individual site adjustments. Actual daily values may be as much as 25% higher on days that are hotter and drier than normal or as much as 25% lower on days that are cooler or more overcast than normal. Real time ETo estimates can be found at the Florida Automated Weather Network (FAWN) internet site (http://fawn.ifas.ufl.edu). For precise management, SWT or soil moisture should be monitored daily in the field.

Crop water use (ETc) is related to ETo by a crop coefficient (Kc) which is the ratio of ETc to the reference value ETo (Eq. [2]). Because different methods exist for estimating ETo, it is very important to use Kc coefficients which were derived using the same ETo estimation method as will be used to determine the crop water requirements. Also, Kc values for the appropriate stage of growth (Table 5 and 6; Fig. 3-3) and production system (Tables 7 and 8) must be used.

With drip irrigation where the wetted area is limited and plastic mulch is often used, Kc values are lower to reflect changes in row spacing and mulch use. Plastic mulches substantially reduce evaporation of water from the soil surface. Associated with the reduction of evaporation is a general increase in transpiration. Even though the transpiration rates under mulch may increase by an average of 10-30% over the season as compared to no-mulched system, overall water use values decrease by an average of 10-30% due the reduction in soil evaporation. ETo may be estimated from atmometers (also called modified Bellani plates) by using an adjustment factor. During days without rainfall, ETo may be estimated from evaporation from an ET gauge (Ea) as ETo = Ea/0.89. On rainy days (>0.2 in) ETo = Ea/0.84.

Eq. [2] Crop water requirement =
Crop coefficient x Reference evapotranspiration

$$ETc = Kc \times ETo$$

Table 3.4. Historical Penman method reference evapotranspiration (ETo) for six Florida regions expressed in (A) inches per day and (B) gallons per acre per day[1].

Month	Northwest	Northeast	Central	Central West	Southwest	Southeast
Inches per day (A)						
JAN	0.06	0.07	0.07	0.07	0.08	0.08
FEB	0.07	0.08	0.10	0.10	0.11	0.11
MAR	0.10	0.10	0.12	0.13	0.13	0.13
APR	0.13	0.14	0.16	0.16	0.17	0.17
MAY	0.16	0.16	0.18	0.18	0.18	0.18
JUN	0.17	0.16	0.18	0.18	0.18	0.17
JUL	0.17	0.16	0.17	0.17	0.18	0.18
AUG	0.15	0.15	0.17	0.16	0.17	0.16
SEP	0.13	0.13	0.14	0.14	0.15	0.14
OCT	0.09	0.10	0.11	0.11	0.12	0.12
NOV	0.07	0.07	0.08	0.08	0.09	0.09
DEC	0.05	0.06	0.06	0.07	0.07	0.07
Gallons per acre per day[2] (B)						
JAN	1629	1901	1901	1901	2172	2172
FEB	1901	2172	2715	2715	2987	2987
MAR	2715	2715	3258	3530	3530	3530
APR	3530	3801	4344	4344	4616	4616
MAY	4344	4344	4887	4887	4887	4887
JUN	4616	4344	4887	4887	4887	4616
JUL	4616	4344	4616	4616	4887	4887
AUG	4073	4073	4616	4344	4616	4344
SEP	3530	3530	3801	3801	4073	3801
OCT	2444	2715	2987	2987	3258	3258
NOV	1901	1901	2172	2172	2444	2444
DEC	1358	1629	1629	1629	1901	1901

[1] Assuming water application over the entire area, i.e., sprinkler or seepage irrigation with 100% efficiency, See Table 1 for conversion for taking into account irrigation system efficiency.

[2] Calculation: for overhead or seepage irrigation, (B) = (A) x 27,150. To convert values for drip irrigation (C) use (C) = (B) x bed spacing / 435.6. For example for 6-ft bed spacing and single drip line, C in Southwest Florida in January is C = 2,172 x 6/ 435.6 = 30 gal/100ft/day.

Soil Water Holding Capacity and the Need to Split Irrigations

Appropriate irrigation scheduling and matching irrigation amounts with the water holding capacity of the effective root zone may help minimize the incidence of excess leaching associated with over-irrigation. In Florida sandy soils, the amount of water that can be stored in the root zone and be available to the plants is limited. Usually, it is assumed that approximately 0.75 in of water can be stored in every foot of the root zone. Only half of that should be used before next irrigation to avoid plant stress and yield reduction (this will help maintain SWT below 15 cb). Any additional water will be lost by deep percolation below the root zone.

Table 8 gives approximate amount of water that can be applied at each event in Florida sandy soil under different production systems. When the calculated volume of water to be applied in one day exceeds the values in Table 7, then it is necessary to split applications. The number of split irrigations can be determined by dividing the irrigation requirement (Eq. [1]) by the numbers in Table 8, and rounding up the result to the nearest whole number. Splitting irrigation reduces both risks of water loss through deep percolation and nutrient leaching. Sandy soil with the available water holding capacity of 0.75 in/ft was assumed in these calculations. If a soil contains more clay or organic matter the amount of water applied during one irrigation event and stored in the root zone can be increased. It is recommended to check the depth of wetting after irrigation to assure that the water is not lost from the roots by digging out a perpendicular profile to the drip line and observing the wetted pattern.

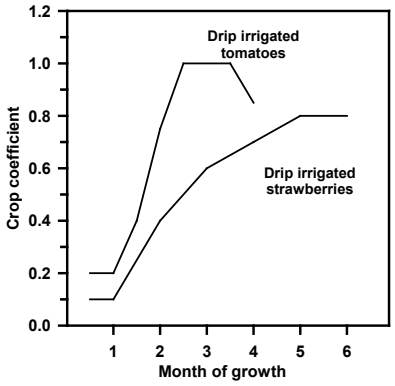

Figure 4. Crop coefficient of drip irrigated tomato and strawberry.

Example

As an example, consider drip irrigated tomatoes on 6-ft center beds, grown under plastic mulch production system in the Central West area (sandy soils). For plants in growth Stage 5 the crop coefficient is 0.85 (Table 7). If this period of growth occurred in May, the corresponding ETo value is 4,887 gal/ac/day (Table 4). Daily crop water use would be estimated as:

ETcrop = (0.85) x (4,887 gal/ac/day) = 4,153 gal/ac/day

If the drip irrigation system can apply water to the root zone of the crop with an application efficiency of 80%, the irrigation requirement would be

Irrigation Requirement = (4,153 gal/ac/day) / (0.80)
= 5,192 gal/ac/day

If the maximum water application in one irrigation event for this type of soil is 1,700 gal/ac/irrigation, then the irrigation will have to be split:

Number of events = (5,292 gal/ac/day) /
(1,700 gal/acre/day/irrigation event) = 3.1,
rounded up to 4 irrigation events each of
5,292 / 4 = 1,323 gal/acre

Therefore, in this example, four irrigations of 1,323 gal/ac each will be needed to replace ETc, not exceed the soil water holding capacity. This amount of water would be a good estimate for scheduling purposes under average growth and average May climatic conditions. However, field moisture plant status should be also monitored to determine if irrigation levels need to be increased or reduced. While deficit irrigation will reduce fruit size and plant growth, excessive irrigation may leach nutrients from the active root system. This may also reduce plant growth and yield.

Table 3.5. Description of growth stages (plant appearance and estimated number of weeks) for most vegetable crops grown in the Spring in Florida[1].

Crop	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Expected growing season (weeks)
Bean	Small plants	Growing plants	Pod enlargement 2-3	Pod maturation		9-10
	2-3	3-4		2-3		
Cabbage, cauliflower, chinese cabbage	Small plants	Growing plants	Head development			10-12
	2-3	5-6	3-4			
Cantaloupe (muskmelon)	6-in vine	12-in vine	First flower	Main fruit production	Late fruit production	11-12
	1-2	3-4	3-4	2-3	2-3	
Carrot	Small plants	Growing plants	Root development	Final growth		10-13
	1-2	3-4	5-7	1-2		
Cucumber	6-in vine	12-in vine	Fruit production	Late season		10-12
	1-2	2-3	6-7	1-2		
Eggplant	Small plants	Growing plants	Fruit production	Late season		12-13
	2-3	2-3	6-7	2-3		
Potato	Small plants (after hilling)	Large plants (vegetative growth)	First flower (tube initiation and bulking)	Maturation (top dies)		12-14
	2-4	4-6	3-5	2-4		
Okra	Small plants	Growing plants	Pod production	Late season		12-13
	2-3	2-3	7-8	1-2		
Onion	Small plants	Growing plants	Bulb development	Maturation (top falls)		13-16
	2-4	4-5	6-8	1-2		
Pepper	Small plants	Growing plants	Pod production	Last bloom	Last harvest	13-15
	2-3	2-3	7-8	1-2	1	
Pumpkin (bush)	Small plants	First flower	Fruit enlargement	Harvest		9-11
	2-3	2-3	5-6	1-2		
Pumpkin (vining)	6-in vines	12-in vines	Small fruit	Large fruit	Harvest 1-2	13-15
	2-3	2-3	3-4	2-3		
Radish	Small plants	Rapid growth				3-5
	1-2	2-4				
Strawberry	Young plants	Growing plants	Early harvest	Main harvest period	Late harvest	23-30
	October	November	December-January	February-March	April	
Summer squash (crookneck, straightneck, zucchini)	Small plants	Growing plants	Fruit production	Late fruit production		7-9
	1-2	2-3	3-4	1		
Sweet corn	Small plants	Large plants	Ear development			10-15
	3-4	5-8	2-3			
Sweetpotato	Early vine growth	Expanding vines	Storage root enlargement		Late season	13-17
	2-3	5-6	6-10			
Tomato	Small plants	1st bloom	2nd-3rd bloom	Harvest	Late harvest	12-14
	2-3	2-3	6-7	1-2	1-2	
Watermelon	6-in vines	12-in vines	Small fruit	Large fruit	Harvest 1-2	13-15
	2-3	2-3	3-4	2-3		

[1] Same growth stages used for irrigation and fertilizer schedules; for South Florida, each stage may be 30% longer because of winter planting during short days.

Table 3.6. Crop coefficient estimates for use with the ETo values in Table 4 and growth stages in Table 5 for unmulched crops. (Actual values will vary with time of planting, soil conditions, cultural conditions, length of growing season and other site-specific factors)

Crop	Growth Stage	Crop Coefficient[1]
All field-grown vegetables	1	0.20[2] to 0.40[3]
	2	Stage 1[4] value to Stage 3 value (See Figure 4)
Legumes: sandbean, lima bean and southernpea	3	0.95[5]
	4	0.85[5]
Beet	3	1.00
	4	0.90
Cole crops:		
Broccoli, brussels sprouts, cabbage, cauliflower	3	0.95
Collards, kale, mustard, turnip	4	0.80[5]
	3	0.90[5]
	4	1.00[5]
Carrot	3	1.00
	4	0.70
Celery	3	1.00
	4	0.90
Cucurbits: cucumber, cantaloupe, pumpkin, squash, watermelon	3	0.90
	4	0.70
Lettuce, endive, escarole	3	0.95
	4	0.90
Okra	3	1.00[5]
	4	0.90[5]
Onion (dry)	3	0.95
	4	0.75
Onion (green)	3 and 4	0.95
Parsley	3	1.00[5]
Potato	3	1.10
	4	0.70
Radish	3	0.80
	4	0.75
Spinach	3	0.95
	4	0.90
Sweet corn	3	1.10
	4	1.00
Sweetpotato	3	1.10[5]
	4	0.70[5]

[1] adapted from Doorenbos, J., and Pruitt, W. O. 1977. Crop water requirements. Irrigation and Drainage Paper No. 24, (rev.) FAO, Rome and Allen, R.G., L.S.Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration: Guidelines for computing crop water requirements Food and Agriculture Organization of the United Nations, Rome.

[2] low plant population; wide row spacing

[3] high plant population; close row spacing

[4] 0.30 or Kc value from Stage 1

[5] values estimated from similar crops

Table 3.7. Crop coefficient estimates (Kc) for use with ETo values in Table 4 and growth stages in Table 5 for selected crops grown in a plasticulture system.[1]

Crop	Growth Stage	Crop Coefficient (Kc)	Crop	Growth Stage	Crop Coefficient (Kc)
Cantaloupe[1]	1	0.35	Strawberry (4-ft bed centers)[2]	1	0.4
	2	0.6		2	0.5
	3	0.85		3	0.6
	4	0.85		4	0.8
	5	0.85		5	0.8
Cucumber[1]	1	0.25	Tomato (6-ft bed centers)[3]	1	0.4
	2	0.5		2	0.75
	3	0.9		3	1.0
	4	0.75		4	1.0
				5	0.85
Summer squash[1]	1	0.3	Watermelon (8-ft bed center)[1]	1	0.3
	2	0.55		2	0.5
	3	0.9		3	0.7
	4	0.8		4	0.9
				5	0.8

[1] Adapted from Tables 12 and 25 in Allen, R.G., L.S.Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration: guidelines for computing crop water requirements Food and Agriculture Organization of the United Nations, Rome.

2 Adapted from Clark et al.(1993) Water Requirements and Crop Coeffcients for Tomato Production in Southwest Florida. Southwest Florida Water Management District, Brandon, FL.

3 Adapted from Clark et al. 1996. Water requirements and crop coefficients of drip-irrigated strawberry plants. Transactions of the ASAE 39:905-913.

Table 3.8. Maximum water application (in gallons per acre and in gallons/100lbf) in one irrigation event for various production systems on sandy soil (available water holding capacity 0.75 in/ft and 50% soil water depletion). Split irrigations may be required during peak water requirement.

Wetting Width (ft)	Gal/100lbf to wet depth of			Bed spacing (ft)	Vegetable crop	Bed length (100 lbf/a)	Gal/acre to wet depth of		
	1 ft	1.5 ft	2 ft				1 ft	1.5 ft	2 ft
1.0	24	36	48	4	Lettuce, strawberry	109	2,600	3,800	5,100
				5	Muskmelon	87	2,100	3,100	4,100
				6	Broccoli, cabbage, cauliflower, eggplant, okra, pepper, pumpkin (bush), summer squash, tomato	73	1,700	2,600	3,500
				8	Watermelon, pumpkin (vining)	55	1,300	1,900	2,600
1.5	36	54	72	4	Lettuce, strawberry	109	3,800	5,800	7,600
				5	Muskmelon	87	3,100	4,700	6,200
				6	Broccoli, cabbage, cauliflower, eggplant, okra, pepper, pumpkin (bush), summer squash, tomato	73	2,600	3,900	5,200
				8	Pumpkin (vining), watermelon,	55	1,900	3,000	3,900

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Chapter 4. Integrated Pest Management

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Disease Management

The health of vegetable crops is best maintained through management practices that integrate different techniques. When making management decisions it is important to consider the economics of the crop, cost of the management practice, history of the production area, weather and climatic conditions, and potential risk for a disease to develop. Integrated management strategies are more likely to successfully control diseases than non-integrated because they reduce disease risk through multiple techniques and often before infection begins. Non-integrated strategies can also adequately manage a disease, however producers must limit expectations about the probability that they will see significant economic return from a crop. Ultimately, integrated management strategies provide a means for producers to reduce the risk that they will have significant economic losses from a disease.

ECONOMICS.

Often the top priority of any producer is the economic benefit they will see from the application of a specific management strategy. These benefits will depend upon the market price of the crop as well as the cost of the specific management strategy. Typical costs include the price of a cultivar, labor, machinery, fuel and various materials (e.g. fungicides) used in an integrated disease management strategy. All of these costs are variable and it is up to a producer to assess the inputs required for managing specific diseases so they can calculate the economic returns from their decisions, if any.

DISEASE IDENTIFICATION.

Proper management of any plant disease starts with an accurate identification of the pathogen or pest causing the problem. There are many different types of pathogens (i.e. fungi, bacteria, viruses and nematodes) involved in diseases of vegetable crops, which can require very different management strategies. In order to assess which management strategy is most appropriate, there needs to be information about the pathogen present in a field. This information can be gained by either assessing the crop yourself and/or with the aid of a professional. There are many guides and applications available for disease identification; however, proper identification often requires the use of microscope to identify key structures or through a more complex test (e.g. DNA/RNA-based and serological). There are many printed and electronic (e.g. EDIS; University of Florida) resources available for disease identification, but if a producer is unsure about how to identify a disease they should contact their local extension office or nearest University of Florida Plant Disease Clinic for help.

DISEASE RISK.

Once a pathogen has been identified, monitoring of the disease is critical to collecting the information needed to make a beneficial management decision. The distribution of a disease within a field can inform a producer about where and when the disease may be a problem. Monitoring is also critical to determining the risk a producer's crop has to experiencing significant economic impacts from a disease. For example, if a disease is affecting only 5% of a production area, it is likely that the combination of multiple low cost strategies may effectively manage a disease. However, if a disease is causing a problem in 50% or more of field then it is likely different management strategies will be needed to adequately reduce its impact.

There are many integrated management methods available for disease control, and many of these methods are often chosen even before the crop is planted. Three important pre-plant tools are site determination and preparation, crop rotation, and cultivar selection. Site determination and crop rotation are 2 excellent methods for reducing a pathogen population within a specific site. For example, fields with a history of a disease are more likely to have that disease again, especially if it has been continually planted with susceptible host plants. Removal of debris through tillage or the planting of a non-host plant can limit the pathogens present and thus reduce a diseases overall impact. Cultivar selection is also critical to determining how likely a disease is to continue developing and spread within a field. Resistant cultivars will most likely require less inputs than susceptible cultivars after disease establishment.

Multiple post-plant management options are also available to producers. These include, but are not limited to, weed control, irrigation management, nutrient management, soil amendments, sanitation practices, and canopy regulations (e.g. staked tomatoes). These management options are aimed at reducing plant stresses and limiting mechanical movement of the pathogen within a field site. For instance, weeds can serve as alternate hosts for a pathogen and can stress plants by competing for essential nutrients such as calcium. Stressed plants are more prone to pathogen infections and alternate weed hosts create local inoculum sources that can cause problems under the right environmental conditions. All of these management strategies provide better results when used as prevention methods, and are even more useful when combined with pre-plant methods.

Inoculum is the pathogen propagule that can cause infection in vegetable crops. The amount of inoculum present is critical to the development and spread of disease. Monitoring provides producers with an initial assessment of the pathogens inoculum, however, the production of further inoculum is highly dependent on the environment. Environmental conditions that are conducive for pathogen development varies, but with proper identification it is possible to assess the risk of continued inoculum production. There are many disease models and decision support systems (e.g. strawberry) available to evaluate disease risk based on environmental conditions. When determining the risk of further disease development it is important to consider the environment and the likelihood that disease will continue to develop.

Three key factors for successful integrated management.	
1.	**Economics:** successful programs are not only effective but cost effective too.
2.	**Diagnosis:** proper disease identification is a critical first step to determining proper management
3.	**Disease risk:** management strategies will be more

Biological and chemical products are an important component of many disease management programs. These products provide post infection management options, however, they should be integrated with all other techniques mentioned in this chapter. The efficacy of these products will vary depending on timing of the application and the physical mode of action of the product. Often these products will be more efficacious when applied early in a disease epidemic, before the pathogen has produced significant amounts of inoculum. All of these products should be used following recommended rates and application frequencies, and within all labeled requirements. It is important to consider the cost of these products and what average yield savings will equal with a product application. In general, the most costly product application is when there is no disease present or a product does not affect the disease afflicting the crop. However, preventive applications can be beneficial particularly when the disease risk is high, thus proper disease assessment is critical for any management strategy.

SUMMARY.

Successful disease management starts with assessing the economics of the cropping system combined with an understanding of the disease risk. Diagnosis of the disease is the first step in any management plan as it can affect the techniques that can be used in the current growing season as well as the future. There are many pre and post-planting management technique available to producers that can be used to reduce disease risk. Ultimately, integrate plant disease management strategies provide producers with the tools to obtain acceptable yields with adequate economic returns that are more sustainable than a single management method.

Detailed Source: http://edis.ifas.ufl.edu/pp111

Insect Management

The management and control of insects and mites can be challenging, even under optimum conditions. Integrated pest management (IPM) is a useful approach for producing vegetables. It involves integration of cultural, physical, biological, and chemical methods to maximize productivity in a way that is ecologically sound and safe. Often, but not always, it means limiting the use of broad-spectrum insecticides and miticides. IPM implies management of all crop pests, including insects, mites, diseases, nematodes, and weeds; however, only insects and mites will be considered here. Where possible, the effects of measures to control diseases and weeds should enhance or, at least, not interfere with the management of insects and mites.

Many of the general IPM principles and tactics that apply to the control of plant diseases apply to the management of insects and mites. These include regular scouting or monitoring for problems, identifying pests and their life stages, keeping good records of pest management practices, using exclusion techniques, practicing good sanitation, testing soil or plants for nutrients, using biological controls when possible, and using selective pesticides, properly timed and applied.

CROP SCOUTING AND MONITORING

In order to detect pests and the damage they cause before a problem becomes serious, growers must visually inspect plants once or twice a week. As a first step, growers should observe the overall plant, looking for speckling or bronzing on leaves, holes and other damage caused by chewing insects, distorted growth, and fruit damage. The next step is to carefully inspect all plant parts from ground or stem level up to the growing tip. Some insects will feed on roots, others on stems, leaves, flower blossoms, and fruit. The grower must become proficient at quickly examining these plant parts and recognizing the presence of pests and the damage they cause. Workers engaged in cultural practices should be trained to recognize insects and the damage they cause.

Both the upper and lower leaf surfaces must be thoroughly inspected. Many insects, as well as some diseases, begin their infestation or infection from the lower side of the leaf. Many insects and mites only feed on the underside of the leaf and may never move to the upper leaf surface or other plant parts until populations become so great that overcrowding forces movement. Attention should be given to the midrib area under the leaf and along large, lateral, lower leaf veins. The leaf axils, growing tips, and terminal buds should be carefully inspected. Often weeds serve as hosts for insects, mites, and diseases that can move to vegetable crops and should be removed (see section on sanitation).

Some insects, particularly thrips, will be found within the blossoms, so these should be included in the inspection. Tap the blossoms over a white pan or card to see these tiny insects. The area under the calyx or stem end of tomatoes and cucumbers can also be an attractive hiding place for insects. Generally speaking, insects inhabit secluded areas of the plant that provide protection.

Yellow sticky traps are useful for monitoring the adult (flying) stages of many insects. Blue is more attractive to thrips, but yellow works well also. Traps are usually placed vertically at or just above the plant canopy. Some insects, such as thrips and leafminers, can be caught just above the surface of the growing medium. One recommendation is to use one to three cards per 1000 sq ft. Traps should be inspected weekly and replaced regularly. A system of numbered traps can facilitate sampling and simplify record keeping. Yellow sticky tape can be used on a larger scale to reduce insect populations by trapping. Yellow sticky traps and tape are available from many online distributors.

Many of the arthropod pests that infest vegetable crops are very small. Mites are 1/50–1/60 of an inch long. Thrips, aphids, whitefly crawlers, and the eggs of other harmful insects are not much larger. Growers should have at least a 10x hand lens (jewelers' hand lens), but a 16x–20x is preferred. With a hand lens, a grower can quickly identify many of the arthropod pests that are otherwise difficult to see. If at all possible, growers should buy and learn to use a common dissecting microscope. These microscopes can be purchased either as a monocular (one barrel) or binocular (two barrel) type. They have approximately 10x–200x magnification. With a microscope, a grower can see small mites, such as broad mites, and disease lesions clearly. This tool can be very helpful in detecting and diagnosing problems early.

IDENTIFICATION OF INSECTS AND MITES

Proper identification of insects and mites and the damage they cause is absolutely critical. If the grower knows exactly which pests are present, proper chemical or biological controls can be selected and steps taken to exclude or limit further introductions. In Florida, Cooperative Extension Service offices in each county are able to help with pest identification (to find an office near you, visit http://solutionsforyourlife.ufl.edu/map/). Workshops may be offered on pest scouting and identification, and there are many publications and online resources available (see http://ipm.ifas.ufl.edu).

RECORD KEEPING

Good records can help growers see trends in pest infestations, keep track of the success or failure of control efforts, and determine how the environment affected the crop. Of course, pesticide application records are essential and should include the time and date of application, product name, EPA registration number, active ingredient, amount used, the target pest, and effectiveness. Some things that general records should include are daily minimum and maximum temperatures, measurements of plant growth and development, the pH of the growing medium, soluble salts,

general root health, and other specific crop observations. Insect counts from monitored plants and sticky cards are also useful for identifying trends over time and for determining the effectiveness of control efforts. Over several seasons, it may be possible to see that certain problems occur at the same time each year. Details of releases of beneficial insects and mites should be recorded.

Managment Strategies and Tactics

EXCLUSION

Growers need to make every effort from the beginning of a crop until the final harvest to prevent the introduction of insect and mite pests into the vegetable crop. Highly reflective or metalized plastic mulches have been used in agriculture for many purposes, but the primary use has been to repel certain insects. Metalized mulches are effectively used in field production by covering the narrow raised beds in a full-bed polyethylene mulch production system.

SANITATION

Sanitation is closely related to exclusion and should be practiced to manage insects and mites as well as diseases. The following practices are strongly recommended:

- Burning, burying, or hauling away all leftover roots and other plant parts so that there is no chance that insects in the egg, larval, nymphal, pupal, or adult stages could remain in the greenhouse. Crop residues must be removed immediately after the final harvest.
- Sanitation must be practiced not only during preplant times but also throughout the growing period. Workers should immediately dispose of plant parts generated by pruning, such as leaves and stems. Culls (undesirable) or overripe fruit should be removed from the greenhouse and surrounding areas. Insects are often attracted to and can live for long periods on these plant materials.
- Weeds should not be allowed to grow around or within the greenhouse. A 10–30-ft vegetation-free zone around the greenhouse can be created with a heavy-duty geotextile weed barrier material typically used in the container nursery industry as a groundcover.
- A clean transplant program will aid in keeping pests out. Plants coming from other locations should be carefully inspected for insects, mites, and diseases and temporarily quarantined until it is clear that the plants are free of pests. Workers should avoid wearing yellow clothing because it is highly attractive to insects, which may hitch rides into the greenhouse or from one greenhouse to another.

BIOLOGICAL CONTROL

Biological control in the greenhouse environment means providing or releasing insect or mite predators, parasitoids (specialized parasites that ultimately kill their hosts), nematodes, or disease-causing organisms (fungi, bacteria, and viruses) that attack insect pests. Some biological controls cannot be used with most insecticides. Reducing or eliminating chemical pesticides leads to a safer working environment, can reduce production costs, and, in the case of organic production, can result in premium prices for the crop. Biological control, however, is much more management intensive than using conventional insecticides and miticides and requires a greater knowledge of pest biology and pest numbers. Many factors contribute to success or failure of biological control: type and quality of the natural enemy selected, release rates, timing, placement, temperature and humidity, and the previous use of insecticides and miticides.

Suppliers can provide technical advice on the optimum use of their products. Some have detailed websites. In general, releases must be made when or before the pest population is first detected. High pest populations will be difficult to control biologically. Some predators and parasitoids are better adapted to particular temperature and humidity conditions than others, and some do better on some crops than others. The life span of the parasitoid or predator will determine how often it has to be reintroduced. It is important to note that if all the pests are eliminated, the natural enemies will also be eliminated. Providing nectar sources (flowering plants) may prolong the life of parasitoid wasps. Yellow sticky cards may have to be temporarily removed to avoid trapping predators and parasitoids.

INSECTICIDES AND MITICIDES

Even when a good biological control program has been established, there may be times when a conventional insecticide or miticide is needed. Biorational insecticides, such as insecticidal soaps, oils, neem products, and *Bacillus thuringiensis* (Bt) can be much less harmful to beneficial insects, although active against pest species. Systemic insecticides, insect growth regulators, and pheromones used for mating disruption also fall into this category. Some products are harmful to some stages of some beneficial insects and not others. Oils, for example, are toxic to lacewing eggs and adult parasitoid wasps, but have relatively little effect on adult lady beetles and lacewings. Soaps are toxic to young lady beetle larvae. Neem and Bt products are generally safe for use with natural enemies. Other advantages of biorational insecticides are shorter reentry intervals and safety for workers.

Conventional insecticides and miticides also have a place in IPM, if it is not feasible to use biological controls and if biorational insecticides do not offer sufficient control. These options are limited, however, to only a few registered pesticides. The development of resistance to insecticides is more likely if a product is used repeatedly. Therefore, pesticides with different modes of action should be used in a sequence that will help prevent resistance.

The following steps are suggested when using any pesticide:

Step 1: Choose the right insecticide or miticide.

Only after the grower has properly identified the pest can the best insecticide or miticide be selected. Insecticides and miticides are sometimes effective against one pest but useless against other closely related pests. Also, one pesticide may be effective against a specific developmental stage, while others may be effective against a different stage, or even against all developmental stages. Properly identifying the pest and understanding its biology and life cycle allow the grower to make wiser decisions when choosing an insecticide or miticide. Growers should consult their Cooperative Extension Service, pesticide companies and dealers, published literature, and, ultimately, the pesticide label, for helpful information.

Step 2: Use the correct amount of pesticide.

After choosing the pesticide, the grower must carefully read the label to determine the correct amount to use. Sometimes this decision will be based on the size or stage of the pest and whether the population is high or low. For example, small caterpillars may require the lowest recommended label rate, while large ones may require the highest.

It is critical that the quantity of pesticide be accurate; growers should buy a set of graduated cylinders that are marked in ounces (oz) and milliliters (cc or mL), as well as a set of good-quality measuring cups. Plastic syringes (minus the needles) are very useful for measuring thick liquids, such as suspension concentrate (SC) formulations. These are available in several sizes from suppliers of animal feed. A scale is essential for weighing dry flowables, wettable granules, and other dry formulations.

Measuring devices, such as graduated cylinders, should have pouring lips and graduated markings that enable accurate measurements. Plastic is generally safer than glass. Accurate measurement is essential for efficacy against the target pest, a safe range of pesticide residues on the crop, efficient use of chemicals and money, and the reduction or elimination of phytotoxicity (burning).

Proper measuring devices also play an important role in the overall safety and handling of pesticides. They aid in preventing spills of concentrated materials. Pesticide concentrates are usually handled when the sprayer is loaded and diluted sprays are being prepared. Special handling precautions are necessary at this time. The applicator must be particularly careful in handling finished sprays but even more so in dealing with the more dangerous concentrated material. Workers must be mindful, cautious, and use all pesticides according to the label.

If applicators use too much pesticide, the following problems can result:

- The crop can have more residue than the law allows, which can pose health hazards to consumers and could prevent the crop from entering the market until it has undergone special cleaning.
- The crop can be confiscated by authorities for excessive residues and destroyed without any compensation to the grower. Resulting negative publicity can harm the future markets for that commodity.
- Reentry by workers into overdosed areas could be dangerous and lead to illnesses, medical costs, and liability to the grower.
- Production costs could increase without the benefit of added profits.
- Phytotoxicity is more likely to occur.

It is important not to exceed the label rates. If the maximum labeled rate is not achieving the desired results, look for other reasons for failure, such as poor coverage or resistance to the insecticide in the target insect population.

Step 3: Apply pesticides at the right time.

The chosen pesticide should be applied at the correct time. This is one of the most difficult tasks any grower faces. Determining the best time to apply chemical control is a very dynamic undertaking. Failure to treat at or near the correct time is one of the major reasons for unsuccessful pest management.

- Growers should regularly and thoroughly inspect the crop so that they are aware of the presence of insects and mites as well as any increase in numbers.
- Growers should know the pest, its behavior, and its ability to damage the crop.
- Growers should be aware of the number of insects or mites that constitute an economic or action threshold. Thresholds for each pest where information is available are discussed later in this document.
- Growers should know the biology of the pest so that insecticide or miticide application can be aimed at the weakest, most vulnerable stage or size. Some stages of insects and mites, such as the egg stage, can seldom be controlled. Young larval or nymphal stages are more easily controlled and require less insecticide or miticide than older stages. Pesticides generally do not affect pupae (large larvae nearing this stage are also difficult to control).

It is generally best to apply pesticides in the late afternoon or evening hours when temperatures start to decrease. This also allows for maximum exposure before "airing" out the sprayed area for employees. Also, many insects are most active at night. The risk of phytotoxicity is greater when applications are made during the middle of the day when temperatures are high. However, it has been reported that better mite control can be achieved by spraying early in the morning hours. As a rule, insecticide or miticide applications should be made while temperatures are low. Pesticides should not be applied when plants are water stressed.

Step 4: Apply pesticides correctly.

Proper application, like proper timing, is one of the most important steps in pest control efforts. It does little good to complete the first three steps properly and then fail to deliver the material to the target area. There are many factors and components of spray methods that add up to proper application of pesticides.

Spray equipment must be properly calibrated. A calibration mistake can result in applying too little pesticide and not achieving control, or applying too much, which is wasteful and illegal.

Growers should purchase the proper type of equipment to meet the needs of the operation and use equipment designed for the target pest. Each pest differs in habits and behavior, and a single piece of equipment may not meet all needs.

High-volume sprayers are popular and have been used for years. They can accommodate a wide range of pesticide types and offer flexibility in their operation. However, high-volume sprayers require a great deal of labor, are time consuming to use, and are considered to be low in application efficiency. It has been estimated that less than 10% of the active ingredient reaches the actual target when using high-volume systems. However, most insecticides and miticides are labeled for high-volume application.

For best results, knowledge about the pest and its biology should be coupled with the capabilities of the equipment. To reach the bottom sides of the leaves in thick canopy crops, a driving, directed spray may be required. If the crop canopy is thin, a rolling fog, atomizer, or electrostatic applicator may be very effective. Many insecticides can produce vapors that aid in controlling insects even when the coverage is less than desired. However, proper coverage can further enhance their fumigating properties.

Another consideration when correctly applying insecticides and miticides is the proper maintenance of spray equipment. Many spray operations are hampered and their effectiveness drastically reduced because the spray cannot be delivered at the proper pressure, droplet size, or pattern due to excessive wear, improper adjustment, or broken or improperly working parts. Growers should regularly check nozzles and discs for wear and tear and replace them when they do not meet specifications. Discs and nozzles wear fast when flowables, suspensions, and wettable powder formulations are used. Workers should be aware of spray pressure and have accurate gauges. Inaccurate pressure—even small errors—can result in improper droplet size and failure to deliver the desired coverage. Equipment upkeep also factors heavily in the overall success of spray operations. Most insecticides are highly corrosive and will react with hoses, lines, nozzles, tanks, and other components. The resulting corrosion affects the spray patterns and also leads to the formation of foreign particles that clog the equipment. Applicators should use the spray as soon as it is mixed and thoroughly clean and rinse the equipment as soon as they are finished spraying.

Workers must mix only the spray that is needed for the job. Leftover spray allowed to sit in the sprayer can quickly destroy it and other sprayer parts, lines, and components. Leftover spray also must be carefully and legally disposed of by application to a labeled site. Disposal of pesticides is a growing concern, with liability becoming more of a problem. Therefore, growers need to plan carefully for the amount of pesticide they need, use what is mixed, and clean up properly afterward.

Spray equipment must be properly stored after cleaning to keep it free of dust, dirt, and other foreign materials. Rust particles, pieces of rubber lines, and other unwanted particles can quickly stop up a system or cause poor spray patterns, particularly when pressure is applied.

Clean water should be used for spraying. Water is the most commonly used diluent (carrier) for pesticide sprays. Water frequently contains dirt, sand, or corrosion from the pipes or lines that may enter the spray tank. Loading hoses or pipes can be dirty. These contaminants can cause severe operational problems. Growers should filter water as many times as possible to ensure freedom from contamination. Filters should be used between the source of water, the spray tank, and where the water enters the tank. Filters are also needed between the tank and the final nozzle. This allows the spray to flow and be delivered in the pattern needed to meet the capabilities of the equipment.

Pesticides should be used as soon as they are mixed. Once mixed with water, the pesticide begins to change. The effective life of certain pesticides can be only hours once they are mixed with water. Water with a pH over 7.0, which is neutral, can be particularly detrimental to many pesticides. Generally speaking, the higher the pH, the faster the pesticide is broken down and rendered useless. Under Florida conditions, where the underground water is frequently high in calcium carbonate with resulting water pH of 8.0 to 8.5, it is even more important not to allow finished spray to sit any longer than necessary.

Weed Management

Weeds compete with vegetable crops for light, water, and nutrients. This competition decreases plant vigor, yield and crop quality. They also interfere with hand harvest and can complicate or prevent machine harvest. Weeds also serve as alternative hosts for diseases, viruses, and nematodes. EDIS documents with lists of weed hosts for virus and nematodes include “Common Weed Hosts of Insect-Transmitted Viruses of Florida Vegetable Crops” (ENY-863) and “Weed Hosts of Root-Knot Nematodes Common to Florida” (ENY-060). There are also a range of books and EDIS documents that can help you identify weeds in Florida such as Weeds of the South and Weeds of the Northeast.

The first step in weed management is frequent and proper scouting. Fields should be scouted frequently early in the production year when the crop is more susceptible to competition. Keep in mind that weed populations tend to be patchy, are greater along the edges of fields, and will vary within and between fields due to small changes in site characteristics such as increased soil moisture or changes in soil type Scouting should be completed in a zig zag pattern that covers the entire field area. Be sure to include areas with known differences that might lead to increased weed incidence such as low lying areas and areas with a history of weeds. All observations should be recorded in a field manual for future reference.

Proper identification and an understanding of the life cycle is important for selecting the correct method and timing of weed control. Weeds may be annuals, biennials, or perennials. Annual weeds emerge from seed, grow, and flower within a single year. Summer annuals emerge in the spring and grow through the heat of the summer months. Summer annuals include pigweed, morningglory, crabgrass, pusley, and goosegrass. Winter annuals emerge during the fall and grow during the winter months. Biennial weeds emerge from seed and typically form rosettes but do not flower and produce seeds until after a dormancy period. Biennial weeds include wild carrot, cutleaf evening primrose, and common mullen. Perennial weeds can grow and produce flowers for multiple years. Perennial weeds produce vegetative structures that generate new plants such as stolons, rhizomes, tubers, or large roots. Perennial weeds include nutsedge, Bermuda grass, Brazil pusley, and creeping beggerweed.

Weed management practices can be separated into five categories: prevention, cultural, mechanical, biological, and chemical. The most successful weed management programs will incorporate more than one type of weed control.

PREVENTATIVE CONTROL

The first step is site selection. Select a field with low weed populations and treat problem areas such as poor drainage prior to crop establishment. Control or mow the weeds at the edges of fields or irrigation furrows to prevent seed formation. Seeds can move on equipment, wind, animals, and in water and may spread throughout the field. Weed seed can also move between fields on tractors, blades of cultivators, heads of harvest equipment and other methods. All equipment should be cleaned after completing a task in a field with a high weed population. In addition, when possible limit travel in the field to periods when weed seeds are not mature and when possible work your cleanest fields first and move towards the ones with the greatest weed populations. Purchase crop and cover crop seed from reputable sources to limit the amount of weed seed contamination. Prevention of weed seed production when possible will help reduce weed seedbanks over time and reduce future problems. Keep in mind that seeds can mature on a weed in some situations after it has been hand pulled.

CULTURAL CONTROL

A healthy crop is a better competitor with weeds. Use healthy transplants or seeds with excellent germination to insure quick canopy closure when possible. Plants stressed by improper watering (too wet or two dry) or diseases /nematodes are less competitive. Proper nutrition is important and minimize fertilizer in the row middles where crops won’t benefit but weeds will. Select the proper row spacing that will allow for quicker canopy closure.

Crop and variety selection has an impact on weed growth. Crops that are tall or have large leaves shade the soil surface and prevent weed seed germination. Crops such as cabbage, bean, and corn are very competitive crops. Whereas onions and carrots allow more light to the soil surface and are less competitive. The same principal of light penetration to the soil surface can be applied to crop varieties, a variety that is compact or smaller in growth are less competitive compared to other varieties.

Multiple vegetable crops are grown with polyethylene mulch as part of the cultural practices. The horticultural benefits of plasticulture are reduced water loss, improved nutrient management, and increased fumigant retention. Plastic mulches also prevents light penetration to the soil surface and inhibits weed seed germination. Weeds can germinate under clear or white plastic which allows light to reach the soil surface. If white mulch is desired select one that has a black underside to prevent light penetration. When plastic mulches are used, grass and broadleaf weed emergence is limited to the crop hole and row middle. Minimizing the size of the planting hole can reduce the number of weeds that emerge. Yellow and purple nutsedge are the only species that pierce the plastic mulch and can rapidly spread within a mulched bed.

Crop rotation is an effective weed management tool. Growing the same crop repeatedly with the same weed management practices can select for difficult to control weed species as well as other pests and diseases. Properly designed rotations typically include a range of: (1) crop types preferably with a mix of row and agronomic crops, (2) planting dates, (3) agrochemical inputs, and (4) weed management tools. Choose a rotation based on crop competitiveness, use of mulch or cultivation, and different herbicide mode of actions. The inclusion of cover crops can be an effective weed management tool. Care must be taken to observe plant back restrictions of herbicide or injury may occur in subsequent crops.

Cover crops should be included in any crop rotation. Cover crops shade the soil surface and prevent weed germination. Some cover crops such as rye have allelopathetic compounds, which are plant chemicals that prevent seed germination. Additional information can be found in the EDIS "Annual Cover Crops in Florida Vegetable Systems Part 1. Objectives: Why grow cover crops?' (HS387).

MECHANICAL CONTROL

Mechanical weed control includes plows, cultivators, mowers, hoes, and hand-weeding. Chisel and moldboard plows are used at the beginning of the season and cultivate deep into the soil profile. This process buries weed seeds below the germination zone. Light cultivation with a field cultivator controls small weeds by cutting the weeds and is shallow to prevent weed seeds from being brought to the soil surface. A single cultivation provides excellent control of annual weeds; however, cultivation may break apart pieces of perennial weeds and cause the weed to spread. Repeat cultivation is important for perennial weed control as it encourages repeated growth and can reduce the carbohydrates in the storage structure of the weed which can reduce the population over time.

Basket, tine, or finger cultivators lightly disturb the soil surface and control small weeds by breaking roots or foliage. Basket cultivars will provide control in the row middles, however, weed control in the crop row will be minimal (Figure 4). Tine or finger cultivators may provide better weed control in the crop row.

Use mechanical weed control only when it will be most effective because mechanical weed control degrades soil structure, dries the soil surface, and prunes crop roots.

BIOLOGICAL CONTROL

Biological control relies on biological agent to damage a weed species. This method uses insects, plant pathogens, or animals. Several control agents are host specific controlling certain weed species (i.e. tropical soda apple leaf beetle and tropical soda apple, Pakistani hydrilla tuber weevil and hydrilla). Because of the narrow feeding habits this method is typically used in natural and aquatic areas for a single invasive species. Biological control is not used in vegetable production due to the multiple weed species in the field, however, research is being conducted and new techniques may emerge in the future.

CHEMICAL CONTROL

Proper herbicide selection can be an effective weed control tool. Herbicides are classified by their mode of action, which is how they affect plant growth. Herbicides are separated by application placement, selectivity, and translocation.

Application placement includes foliar-applied or soil applied herbicides. Foliar-applied herbicides control the weeds after emergence above the soil surface (post emergence). Proper coverage of the foliage is important for foliar applied herbicides and a surfactant is often required for proper absorption of the herbicide. Soil-applied herbicides control the weeds before emergence above the soil surface (preemergence). Soil-applied herbicides are applied to the soil surface or require incorporation into the soil surface. Incorporation reduces vaporization of certain herbicides or places the herbicide closer to the weed seed. Incorporation includes irrigation, rainfall, or light cultivation. Poor incorporation will result in reduced efficacy.

Herbicide selectivity results in control of a specific type of weed such as broadleaf or grass weeds only. Auxin herbicides (2,4-D, clopyralid) control broadleaf weeds only and are common in grass crops or turfgrass. Carfentrazone and certain sulfonylureas have excellent control of broadleaf weeds and low to no injury to grass crops. Grass only herbicides (clethodim, sethoxydim, fluaziflop) control only grass weeds and can be applied over the top of broadleaf weeds.

Herbicides can be grouped as translocating or contact herbicides. Translocating herbicides (glyphosate, halosulfuron) move from the contact point to another part of the plant. This is important when controlling perennial weeds, which require root death for complete control. Contact herbicides (carfentrazone, paraquat) kill the area around the contact point; complete coverage is important for these herbicides.

Herbicide resistant weed species have become more problematic. Paraquat resistant American black nightshade, paraquat resistant goosegrass, and glyphosate resistant Palmer amaranth have been documented or observed in Florida vegetable crops. To prevent resistance, growers should incorporate nonchemical methods, rotate modes of action, use products with multiple modes of action, use correct rates, and constant monitoring.

Other EDIS that provide information about herbicides in vegetables and fruits include "Calibration of Chemical Applicators Used in Vegetables" (HS1220) and "Factors Affecting Herbicide Use in Fruits and Vegetables" (HS1219).

Fumigation

Soil fumigation is a preplant chemical treatment of soil, using a pesticide product (typically a liquid) that converts to form a volatile gas once released into soil. The gas is able to diffuse through open pore space throughout the soil to provide pest and disease control. All of the fumigants are phytotoxic to plants and the fumigant gases must dissipate from soil, usually from a few days to well over a month depending on environmental conditions, before seeding or transplanting can occur without risk of crop injury. They are used globally on a wide range of annual and perennial crops, and can be used alone or in combination to expand control of a wide range of soil inhabiting pest species including: insects, nematodes, fungi, and weeds. Because of their wide range of pesticidal activity, they are often called 'multi-purpose' or 'broad-spectrum' fumigants.

In Florida, soil fumigants are most commonly used in high value cropping systems to protect investment in crops where pest pressure is so high that it would be economically unfeasible to grow a crop without the use of fumigant. As such, preplant soil fumigants have had a profound influence on production agriculture in Florida, and have catalyzed the development of many high-value, raised bed and plasticulture cropping systems. Fumigants are also used in a variety of other lower value fruit, vegetable and agronomic crops such as potatoes, sweet corn, Brassicae, melon and curcurbit crops to manage nematodes and other soilborne pests and diseases. In some cases, fumigants have been adopted almost to the exclusion of all other soil pest management strategies because of their superior broad-spectrum pest control efficacy and consistent enhancement of crop growth, uniform development, fruit quality and yield.

METHODS OF APPLICATION

Fumigants are formulated and applied to soil in a number of different ways. Liquid fumigants can be either applied by directly injecting them into the soil using shanks or chisels, or via direct injection into the irrigation system (drip fumigation). The portion of the field that is fumigated can also vary. For example, in the production of some crops, the entire field is treated, and this represents an overall or broadcast treatment. In other situations, fumigants are only applied in the plant row or raised plant bed. In this situation, only a portion of the field is treated and this is termed a strip, band, or in-row treatment. Most liquid fumigants with high vapor pressure are shanked or knifed into the soil. As liquids with relatively high vapor pressure, they are usually stored and applied as liquids (under

pressure) and begin to vaporize shortly after injection in the soil. Narrow knifelike shanks are tractor-drawn through the soil at the required depth to inject the fumigant into soil. Metal delivery tubes attached to the trailing edges of the shanks provide the conduit for injection to soil. Delivery tubes release the fumigant in the bottom of the furrow made when pulling the shank thorough the soil. Fumigant flow rate to the soil shanks is regulated using various combinations of pressure, metering valves, nozzle orifices, shank spacing, and speed of travel. Errors in field application are typically attributed to mistakes in calculation of treated acreage, metering, and calibrated flow rates through properly sized delivery lines.

For many of the fumigants, a special EC (emulsified concentrate) formulation is required for drip application. Metam sodium, metam potassium, allyl isothiocyanate and emulsified concentrate formulations of 1,3-Dichloropropene, chloropicrin, and dimethyl disulfide can be metered and applied through a low volume trickle or drip irrigation system. Drip fumigation (chemigation) is the most common method of application for some fumigants like metam sodium, metam potassium, or allyl isothiocyanate. Once these fumigants are applied to soil in the presence of water, they decompose to form MITC or AITC. Because of the slow and limited diffusion of MITC or AITC gases and high affinity for the water phase, continuous delivery in irrigation water following premixing has generally resulted in more uniform soil distribution with enhanced nematode control and crop yield for these products when compared with conventional chisel injection methods. MITC distribution in soil initially follows the water distribution patterns, but unlike other fumigants, the distribution patterns do not change over time. Moreover, MITC and AITC disappears from the soil gaseous phase at faster rates than most of other fumigants.

The proximity of the plant to the drip tube has also been demonstrated to be very important in terms of defining pest control efficacy and plant growth response with a drip chemigated fumigant. Given the sandy nature of most Florida soils, narrower bed widths, drip tubes with closer drip emitter spacing (mostly in the range of 8-12 inches), and planting practices that place plants closer to the drip tube are needed to more effectively utilize the drip tape for chemigational purposes.

Soils and grower production practices differ markedly, and these differences in soil type, compaction, and depth to restrictive layers can all affect water movement and the final distribution of chemicals within beds and soil profile. The presence of a shallow compacted traffic layer severely restricts downward penetration of drip water and fumigants contained within it. In general, the average depth, width, and cross sectional area wetted by drip irrigation water increases with total water volume applied. For a given water volume, the use of two tapes per bed increases spatial distribution of irrigation water simply because of the spacing between drip tubes and the increased number of emission points along the bed. Drip fumigant users are encouraged to consult with county agricultural extension personnel regarding specific drip fumigation recommendations regarding delivery system, application rates, product concentrations in irrigation water, water volumes and optimal injection periods to maximize movement and proportions of treated bed volumes for their farm locations.

Other formulations, like those marketed for shank applications of chloropicrin, dimethyl disulfide, and 1,3-dichloropropene, are premixed and sold in compressed gas cylinders. In most cases, these fumigants are shank-injected into the soil 8 to 15 inches deep using a positive pressure-closed system in which the fumigant cylinders are pressurized with nitrogen. Nitrogen is an inert gas used to propel liquid flow from the cylinder through the metering systems and through armored lines to the rear shanks or chisels, exiting through a steel delivery tube welded to the back side of the shank or chisel. Deep placement is not only a requirement of the fumigant label but is essential for prolonged fumigant retention in soil. In general, the closer to the soil surface a fumigant is applied, the faster the out-gassing or escape from soil, and in general the poorer the pest control response. A plastic, polyethylene tarp may be laid down over the soil immediately behind the injection equipment to provide a diffusion barrier for containment of the fumigant.

Recent studies have demonstrated the barrier properties of a traffic pan to shank applied fumigants. The traffic pan is a layer of compacted soil occurring just below the level of deepest tillage implement used in the field. Fumigant gases applied above the traffic pan do not provide control of nematodes occurring below the traffic pan. Recent studies have determined that high population densities of plant parasitic nematodes can be broadly distributed to depths 3 feet below the plant bed surface. Subsequent studies have demonstrated the importance of deep shank fumigant applications which destroy the traffic pan and place fumigants within deeper soil horizons where upwardly mobile nematodes reside. The physical and practical challenge that remains to be resolved is how to achieve fumigant movement in lethal concentration to the soil depths to which nematodes reside.

THE IMPORTANCE OF FUMIGANT PLACEMENT

Proper fumigant placement is another critical element that must be considered when using any of the different soil fumigant compounds because of the large difference in vapor pressure (Table 1). In some instances, application depth and placement varies with the formulation of the fumigant product, giving the grower the opportunity to choose between a drip or shank application. For the 3-Way system approach that utilizes 1,3-D, chloropicrin, and metam, there are essentially three different locations to consider for fumigant placement. Placement of prebed applications of Telone® II are made on the flat to a soil depth that places the fumigant 12–15 inches from the top of the bed or nearest soil interface. If fumigants are placed at this depth and used in conjunction with a seepage irrigation system, growers should ensure that the soil is not wet at this depth. Otherwise, poor nematode control and longer aeration times and crop plantback intervals may be observed. Chloropicrin, applied over the top of the Telone treatment, is then applied 8 to 10 inches deep into soil as the beds are being formed and compressed. Metam sodium (Vapam®) or metam potassium (K-PAM™) should be applied 4 inches from the top of the bed and 4 inches apart using multiple coulters or shanks. After application, the bed must be recompressed and mulched immediately to prevent rapid escape of volatilizing gases. The primary objective for such shallow placement is to achieve maximum control of weeds. Most other fumigants should be placed 8–12 inches deep with shanks no further than 9–12 in. apart.

While methyl bromide will rapidly diffuse as a gas across a bed, many of the currently proposed alternatives lack the vapor pressure or chemical properties to move as fast and effectively throughout the bed. Their movement in the bed is clearly limited and must be accounted for in fumigant placement. For example, if the shanks are not close enough together for some fumigants, an overlap in the area between shanks may not occur, leaving streaks of pests down the length of the bed. Many products are formulated for shank or drip applications. To maximize efficacy via drip application, proper placement of the fumigant generally mandates two drip tapes per bed to improve bed coverage.

The vertical and horizontal distribution of diseases, weeds, and nematodes in correlation with spatial movement of soil fumigants from their points of injection, are now being considered as some of the primary causes of fumigant treatment inconsistency and origins of bed recolonizing populations of pests. For example, current field research is demonstrating that additional streams of fumigant placed under the tuck areas of the plastic mulch at the bed shoulders results in a significant reduction of Fusarium wilt incidence and severity within the tomato planted row compared with the standard in-the-row grower application practice. Additional

streams of fumigants deeply shanked below the mulch covered plant bed and traffic pan are also demonstrating significant reductions in plant damage by nematodes and improvements to crop yield.

In most field surveys, a compacted zone (traffic pan) occurs just below the base of the raised bed. The presence of subsurface traffic pans (a dense, highly compacted soil layer), was shown to unavoidably cause changes in the downward percolation of water, permeability and diffusion to fumigant gases, and root penetration into soil. In practical terms, the compaction zone occurs just below the depth of the deepest tillage operation or implement used in the field. Other fumigant placement studies are showing the benefits to crop production of fumigants placed under the traffic pan, allowing fumigant gases to make contact with deep dwelling nematodes within the field. Since the traffic pan almost completely restricts downward diffusion in soil of a fumigant when it is applied above the restrictive layer, application below the layer reducing damaging populations of nematodes which would have otherwise survived the fumigant bed treatment.

PHYSICAL AND CHEMICAL PROPERTIES

After application the fumigants penetrate the soil and quickly become partitioned in liquid, gas, and adsorbed soil phases. Immediately after soil injection, fumigant movement in soil is driven by density and pressure gradients from a narrow, linear band of concentrate product deposited directly below the chisel path. As the fumigant's partial pressure falls, soil movement via mass flow becomes less important than simple gas diffusion processes. Fumigant persistence, volatility, and degradation are influenced by many factors, including chemical properties, soil properties, and environmental conditions. A partial listing of some of the physical and chemical properties of the primary soil fumigants available in Florida is provided below in Table 1.

Volatilization continues as long as the fumigant remains in soil and upward movement of the fumigant occurs as long as a concentration difference exists between the soil surface and soil atmosphere. Vapor pressure is a measure of the tendency of a fumigant compound to change into the gaseous or vapor state. The temperature at which the vapor pressure at the surface of a liquid becomes equal to the pressure exerted by the surroundings is called the boiling point of the liquid. The lower the boiling point, the more volatile the fumigant compound. Note the differences between methyl bromide and all the other fumigants listed. Hot and dry soil conditions favor more rapid escape of fumigants like methyl bromide and chloropicrin, particularly within surface soil horizons. Fumigant products with high solubility and low vapor pressures are typically better suited for drip application rather than shank, which is why metam sodium, potassium and allyl isothiocyanate are described as being better suited for drip fumigation.

MODE OF ACTION AND LETHAL DOSE

Fumigant mode of action refers to the lethal action of a chemical on vital life processes of an organism. For example, a broad-spectrum fumigant can penetrate the body wall of a nematode directly and does not have to be eaten to be effective. Once inside the body cavity of the nematode, different internal organs are affected since they are bathed by body fluids containing the fumigant compound. Metam sodium and potassium are very soluble compounds which become activated in water. The fumigants and their products interfere with many different vital processes, including enzymatic, nervous, and respiratory systems. Death of the nematode is rapid under these conditions, and development of tolerant or resistant populations of nematodes to the chemical are unlikely because so many integral bodily functions are simultaneously affected. This is not to say that all organisms are equally affected, since in fields with a history of repeated applications, metam sodium can disappear rapidly and fail to provide a lethal dose following application, indicating the key role of microorganisms in accelerated degradation of the product. In general however, fumigant concentration in internal body fluid of nematodes frequently reach equilibrium with soil concentrations within about 30 minutes to 4 hours. In some cases fumigant concentration may accumulate too much greater levels within the nematode than in soil.

In general, the lethal effect of a fumigant is determined by two components. The first is concentration (C) of the fumigant in soil air or soil solution, usually expressed as parts per million (PPM). The second is the length of time (T) the pest organism is exposed, expressed in minutes, hours or days. The level of pest control is then related to dosage, the amount of fumigant pesticide placed in the environment of the soilborne pest for a known length of exposure time (concentration X time). Total exposure is the sum of CT products. Computed in this way, the cumulative dosage or concentration-time index (CT), is often used as a criterion with which to evaluate the effectiveness of soil fumigation. For most organisms, there is a concentration level below which kill is not obtained regardless of the length of exposure. For most nematodes, long exposures to low concentrations of fumigant nematicides above the minimum concentration appears to be more effective than short exposures to higher concentration.

Fumigants move through soil air, dissolve in the soil water and kill in the soil water. Fumigants are volatile substances and change into gases upon injection into the soil as liquids. The vapors can only move through continuous soil air space. Pest and disease organisms normally exist within surface films of water surrounding soil particle grains. Even as fumigants move through open air passages, fumigant molecules dissolve in into these surface water films and establish a dynamic equilibrium, moving back and forth from the air to the water phase as the fumigant diffuses through the soil mass. The portion of the fumigant dissolved in the soil water establishes the concentrations responsible for the kill of most soil-borne organisms.

In practice, fumigants are commonly injected through a series of uniformly spaced shanks into soil. As the liquid volatilizes, gases begin moving in mass flow, diffusing outward in all directions from the point of injection. Because diffusion is greater in air above the soil surface, upward

Table 4.1. Physical and chemical properties of various soil fumigants.

Fumigant Compound & Physical State	Boiling Point (°C)	Vapor Pressure (mm/Hg)	Soil Degradation Half-life (d)	Solubility (mg L^{-1})
1,3–Dichloropropene	120	28	3-5	2250
Chloropicrin	112.4	18	1-2	2270
Methyl Bromide	3.6	1420	12-20	13400
Dimethyl Disulfide (DMDS)	110	28.7		3000
Metam Sodium	112	0.4	4-5	578290
Metam Potassium	114	24	4-5	complete
Allyl Isothiocyanate (AITC)	112	20		89400

mass flow and diffusion is usually greater than downward movement, and much of the gas may escape the soil and enter the atmosphere. As the fumigant front moves through soil, gaseous molecules are adsorbed to soil particle surfaces, redissolve into soil solution, and fill empty air spaces between soil particles. Maximum fumigant concentration decreases as do the sums of CT products with distance from the point of injection. Eventually, with time and distance, concentrations fall below an immediate killing level. The number of pests or disease propagules killed by fumigant treatment within these areas depend on the number of CT units which develop within the fumigant treated zone. The relationship between fumigant application rate and pest control efficacy is therefore not only a measure of fumigant toxicity but chemical dispersion as well. If dispersal is good, increases in fumigant application rates will result in higher CT values and provide control to a greater soil volume. If dispersal is poor, increases in application rates will not provide control to a larger soil volume. Reducing volatilization losses from soil is an effective way in which to increase CT values and improve fumigant pest control efficacy. It is for this reason that water seals and impermeable plastic mulches (VIF, TIF) are used to increase fumigant diffusion resistance near the soil surface. This serves to promote both downward diffusion of the fumigant and to enhance residence time and gas phase persistence in soil.

PEST CONTROL EFFICACY

Since their introduction to Florida agriculture, many different soil fumigants have been evaluated in field research trials to characterize pest control efficacy and crop yield response. The results from many of these research trials, particularly those to evaluate methyl bromide alternatives, have provided the basis for overall generalization of pesticidal activity for the various fumigant chemicals (see Table 2). In general, this research has repeatedly demonstrated methyl bromide to be very effective against a wide range of soilborne pests including nematodes, diseases, and weeds. Chloropicrin has proved very effective against diseases but seldom nematodes or weeds. Although with some suppression, bacterial pathogens have not been satisfactorily controlled by any of the soil fumigants. Historically, most of the research conducted to evaluate 1,3-dichloropropene (Telone™; DowAgroSciences) has repeatedly demonstrated consistently effective nematode control with little or no control provided for soilborne disease or weeds. Metam sodium, metam potassium, and Dazomet are all non-selective pre-plant soil fumigants which provide measures of fungicidal, herbicidal, insecticidal, and nematicidal activity. Pest control efficacy of metam sodium and metam potassium have proved inconsistent, performing good to excellent in some trials, while poor in others. Field research continues to evaluate modification of rate, placement, and improved application technology to resolve problems of fumigant inconsistency with these compounds. Metam sodium and metam potassium can provide good control of weeds when placed properly in the bed, however research to evaluate modification of rate, placement, and improved application technology have not resolved all problems of inconsistent pest control. Dimethyl disulfide (DMDS), has demonstrated good to excellent control of nematodes, disease, and weeds when coapplied with chloropicrin. Due to issues of off-site odors, DMDS must now only be used in conjunction with a TIF plastic mulch. AITC, the newest entry to registered fumigants in Florida has shown promise in preliminary trials but is still under field assessment in a variety of crops and plant pathogens.

Because of their target pest specificity, many of the soil fumigants are formulated together or co-applied to increase their overall level and spectrum of pest control. For example, chloropicrin is used both as a stand-alone soil fumigant, as a chemical warning agent in formulation with methyl bromide, and in formulation with 1,3-D to increase its disease control effectiveness. Examples of co-formulated or sequential application include 1,3-Dichloropropene plus chloropicrin formulated together as Telone C17 or Telone C35, or sequentially applications involving a broadcast or prebed application of 1,3-Dichloropropene, followed later by chloropicrin and or metam sodium in separate soil applications. Given the general lack of herbicidal activity associated with many of the fumigants, separate application of one or more herbicides may be required to achieve effective weed control.

Much of the current field research in Florida continues to focus on evaluations of chloropicrin co-applied with additional fumigants. In this co-application approach, chloropicrin has clearly been shown to be an integral, foundation component of any alternative chemical approach to provide broad spectrum pest control activity. Of the chloropicrin combinations, including Pic-Clor 60, Telone C-35, a combination of 1,3-dichloropropene and 35% chloropicrin, has been the most extensively evaluated in Florida field trials since 1994. DMDS in combination with chloropicrin (21%) has also been extensively studied in west central and south Florida field trials and has proved to be very effective for soil pest control. All DMDS formulations and applications now mandatorily requires that Totally Impermeable Film (TIF) must be used for field application and odor abatement.

Research conducted in Florida and areas of the southeast appear to support the general conclusion that reasonably consistent soilborne pest

Table 4.2. Generalized Summary of maximum use rate and relative effectiveness of various soil fumigant alternatives to methyl bromide for nematode, soilborne disease, and weed control in Florida.

		Relative pesticidal activity		
Fumigant chemical[1]	**Maximum use rate**	**Nematode**	**Disease**	**Weed**
1) Methyl bromide 50/50	350 lb	Good to excellent	Excellent	Fair to excellent
2) Chloropicrin	300 lb	None to poor	Excellent	Poor
3) Metam Sodium (Vapam)	75 gal	Erratic	Erratic	Erratic
4) Telone II	18 gal	Good to excellent	None to poor	Poor
5) Telone C17	26 gal	Good to excellent	Good	Poor
6) Telone C35	35 gal	Good to excellent	Good to excellent	Poor to fair
7) Pic-Clor 60	300 lb	Good to excellent	Good to excellent	Fair to good
8) Potassium N methyldithiocarbamate (Kpam)	60 gal.	Poor to good	Poor to good	Poor to good
9) Dimethyl disulfide (Paladin)	60 gal.	Good to excellent	Good to excellent	Poor to excellent
10) Allyl isothiocyanate (Dominus)	40 gal.	Still in assessment	Still in assessment	Still in assessment

[1] All currently within EPA Fumigant Reregistration review with potential for new restrictions and applicator requirements.

[2] Broad spectrum pest control achieved when co-applied with chloropicrin (21% wt./wt.). Provides excellent control of nutsedge but poor to fair control of annual grasses and requires the use of a herbicide for adequate control. Now mandatorily requires Totally Impermeable Film (TIF) for field application and odor abatement.

and disease control can be obtained with in-row or prebed applications of Telone C35 (35 gal/A) or Telone II, applied at 12 gallons per treated acre followed by chloropicrin applied in the bed at 150 pounds per treated acre. In combination with Telone II, Telone C35 or Chloropicrin, use of a high barrier or virtually impermeable mulch film (VIF) or totally impermeable mulch film will generally improve fumigant performance and reduce soil gas emissions. Currently EPA only recognizes use of specific high barrier VIF or TIF mulch films where film permeability's (mass transfer coefficients) to the different fumigant gases have been measured and meet EPA approved emission reductions to qualify for buffer zone reducing credits. With use of the more impermeable plastic TIF or VIF mulches, fumigant rates can be reduced 25 to 40% from maximum labeled application rates. Due to use restrictions for all Telone products in Dade County, either metam sodium or metam potassium at 75 and 60 gallons per acre respectively, in combination with shank injections of chloropicrin (150 pounds per treated acre) and appropriate herbicide(s) are currently defined as the best alternatives to methyl bromide. Use of dimethyl disulfide (Paladin), in combination with chloropicrin and metam sodium or potassium can also be utilized as an effective coapplied fumigant approach for soilborne pest and disease control. However, recent studies are demonstrating that even though the addition of chloropicrin may synergize the efficacy of the coformulation with DMDS, but it can also destroy microbial populations in soil that digest DMDS, thereby contributing to longer persistence in soil and potential delays in plant back into the bed.

Given the general lack of herbicidal activity associated with the alternative fumigants, weed control is usually assigned the highest pest management priority for most methyl bromide alternative chemical systems. Regardless of crop, separate application of one or more herbicides is a requirement for effective weed control with any of the different fumigants. In general, weed control with these different fumigants (including Vapam or KPam) plus herbicides is reported as good as or better than that of what methyl bromide formerly provided. There are however numerous examples of less than ideal herbicide performance in which various grasses and broadleaf weeds were not effectively controlled. The problems incurred usually demonstrate the importance of soil conditions, incorporation method, and improper rate calibration for good weed control, as well as for inducing significant phytotoxic effects and cause for resultant yield losses.

HERBICIDE PARTNERS

In addition to Telone II plus chloropicrin, Telone C35, or PicClor 60, additional applications of appropriate herbicides will be necessary to provide weed control for any CUE crop (Table 3). For tomato, follow the fumigant prebed application of Telone C35 or Telone II and Chloropicrin with a tank mix of napropamide (2 pounds) and *s*-metolachlor (0.95 pounds) per treated acre applied to the top of the raised bed at plastic laying for weed control. An additional application of halosulfuron (0.024 pounds) as a post-emergent, directed spray for nutsedge control may be necessary. For strawberry, the fumigant application of Telone C35 is supplemented by a herbicide tank mix of oxyfluorfen (0.5 pounds) plus napropamide (4 pounds) per treated acre, to the raised bed surface at plastic laying. (Note: A minimum 30-day interval is required before transplanting when using oxyfluorfen.) In pepper, a herbicide tank mix of napropamide (2 pound) and *s*-metolachlor (0.71 pounds, 3rd party label obtained through FFVA) per treated acre is applied after the Telone II Pre-Bed and Chloropicrin injection to the raised bed at plastic laying for weed control. Recent research on soil application technologies in Florida and Georgia have demonstrated improved nutsedge control with metam sodium or potassium applied through a series of minicoulters to the established plant bed just before installation of the plastic mulch.

AVOIDING PLANT PHYTOTOXICITY

All of the fumigants, including the gas and water phases of these fumigants, are toxic to plants. Soil dissipation and the persistence of toxic residues is strongly influenced by environmental conditions. Any change in soil condition which promotes a cooling and or a wetter soil condition will typically delay dissipation of a fumigant compound from soil. As a result, soil applications must always be made well in advance of a seeding or planting date to ensure sufficient time for dissipation of fumigant residues from soil. The problem is usually most severe with fumigants of low vapor pressure, where longer term planning horizons must be adopted to avoid problems of phytotoxicity or to avoid long unscheduled delays in planting after the plants have arrived from the nursery. Growers who use fumigants, typically adopt planning horizons which consider beginning field preparation and soil application two to three weeks earlier than normal to avoid problems of potential phytotoxicity that may result from use of impermeable mulches, or unexpected cold fronts or storm(s) producing abundant rainfall. Recent studies have also demonstrated the addition of chloropicrin in the fumigant mix can destroy microbial populations in soil that digest fumigants like DMDS, and thereby contribute to longer persistence in soil and potential delays in plant back into the bed than would have occurred with DMDS alone.

High Barrier / Gas Impermeable Plastic Mulch Films (VIF,TIF)

FUMIGANT CONTAINMENT

Historically, most of the field research conducted to evaluate the use of soil fumigation has repeatedly demonstrated effective soilborne pest and disease control when applications were made under optimal soil conditions, uniformly applied at the appropriate dosage and depth, and using containment systems that prevented rapid escape of gases from soil. Any system designed to provide containment of fumigant gases must first insure immediate closure and seal of chisel traces as they are produced behind the tractor moving across the field. Left undisturbed, the chisel traces act as chimney vents for volatilizing fumigant gases. This can be accomplished with press wheels behind the chisel or chisel injections immediately in front of bed forming equipment. The treated field area may also be rolled to compact surface soil, so as to increase soil density and reduce air passage size and volume. Irrigation is also often applied over the top of the treated area and or rolled surface to form a surface water seal to further inhibit fumigant out-gassing from soil. In some instances, repeated irrigations may be necessary to manage fumigant containment and offsite movement of fumigant gases.

After a fumigant is applied, the treated soil may also be tarped with a plastic polyethylene mulch to provide an additional measure of fumigant containment to soil. The plastic mulches, often a prerequisite for fumigant use, are not only a barrier in themselves but act as a condensation surface for the formation of water droplets that redeposit to soil as a water layer, adding another barrier to soil volatilization loss. There are a range of different mulches which can be used to reduce fumigant emissions from soil. Low density polyethylene (LDPE) or high density polyethylene (HDPE) tarps have been extensively used in combination with soil fumigation as a soil covering to reduce fumigant emissions from soil. Unfortunately, the barrier properties of LDPE and HDPE to fumigant gases is quite poor, and depending on the fumigant much of it may quickly escape the soil. In general, the permeability of a plastic mulch to a fumigant gas is directly related to its thickness, density, and chemical composition. Significant resistance to fumigant outgassing has been achieved with use a virtually impermeable mulch films (VIF) and totally impermeable mulch films (TIF).

VIF mulches are typically manufactured as multi-layer films composed of barrier polymers such as ethylene vinyl alcohol (EVOH) or polyamide (nylon) sandwiched between other polymer layers (typically LDPE) or have metalized coatings to reduce the amount of fumigant that can move through the film and into the atmosphere. A VIF film thus typically defined as a 5 layer film where the outer two layers are LDPE. The innermost layer is nylon and it is surrounded by a bridging layer on each side. The TIF films are generally manufactured the same as VIF except the center layer which produces the barrier is made of EVOH instead of nylon.

Compared to LDPE, certain VIF and TIF films are over 20,000 times less permeable to fumigant compounds, and as a result, significantly increase the residence time of fumigants in soil. Because of their excellent barrier properties, fumigant application rates can often be reduced as much as 30 to 50% without loss of pest control activity or crop yield. These mulch, although not completely impervious to fumigant gases, reduces the dissipation rate of gases into the air that increases the overall efficacy of the treatment by subjecting soil pests to greater cumulative dosages levels of the fumigant. With such efficient and near complete retention of gases

Table 4.3. Recommended fumigant and herbicide treatment regimens for Florida[1] tomato, pepper, eggplant, and strawberry crops. All rates are expressed per treated acre. To achieve maximum weed control an application of Metam Sodium (Vapam) at 75 gal/A or Metam Potassium (KPam) at 60 gal/A should be included to all recommended products using a mini coulter applicator or through a drip application using double drip tapes.

CROP	Treatment	Application Procedure	Herbicide Rate
Tomato	Telone C35 35 gal/A	In-Row or Pre-Bed[2], under LDPE, High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	Napropamide (2 lb) S-metolachlor (0.95 lb.) Postemergent Halosulfuron (0.05 lb)
	Telone II 12 gal/A Chloropicrin 150 lb/A	Telone Pre-Bed[2], Chloropicrin In-bed under High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
	Pic-Clor 60 250-300 lb/A	Pic-Clor 60 In-Row or Pre-Bed[2] under High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
	[4]DMDS (79%)+ PIC(21%) 45 gal/A	In-Row or Pre-Bed[2], under High Barrier TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
Pepper	Telone C35 35 gal/A	In-Row or Pre-Bed[2], under LDPE, High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	Napropamide (2 lb) S-metolachlor (0.95 lb, 3rd party label obtained through FFVA) Posttransplant Imazosulfuron (0.3 lb)
	Telone II 12 gal/A Chloropicrin 150 lb/A	Telone Pre-Bed[2], Chloropicrin In-bed under High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
	Pic-Clor 60 250-300 lb/A	Pic-Clor 60 InRow orPre-Bed[2] under High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
	[4]DMDS(79%) + PIC(21%) 45 gal/A	In-Row or Pre-Bed[2], under High Barrier TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
Eggplant	Telone C35 35 gal/A	In-Row or Pre-Bed[2], under LDPE, High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	Napropamide (2 lb) S-metolachlor (0.95 lb.)
	Telone II 12 gal/A Chloropicrin 150 lb/A	Telone Pre-Bed[2], Chloropicrin In-bed under High Barrier VIF or TIF Mulch Film[3]; 3-5 weeks before transplanting	
	Pic-Clor 60 250-300 lb/A	Pic-Clor 60 In-Row or Pre-Bed[2] under High Barrier VIF or TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
	[4]DMDS (79%)+ PIC(21%) 45 gal/A	In-Row or Pre-Bed[2], under High Barrier TIF Mulch Film[3]; applied 3-5 weeks before transplanting	
Strawberry	Telone C35 35 gal/A	In-Row or Pre-Bed[2], under LDPE, High Barrier TIF or VIF Mulch Film[3]; 4-5 weeks before transplanting	Napropamide (4 lb) Oxyfluorfen (0.5 lb) Flumioxazin (0.1 lb)

[1] Crop recommendations for Pic-Clor 60, Telone II or Telone C35 do not apply to the Homestead, Dade County production region of south Florida where soil types and water tables currently prohibit product use.

[2] Inject Telone II, Telone C35, or Pic-Clor 60 to flat soil prior to any soil mounding or bed operation (PreBed) to a depth of at least 12 inches below the final bed top.

[3] In combination with fumigant, use of an EPA approved high barrier or virtually impermeable (VIF) or totally impermeable (TIF) mulch film. With use of the mulch, fumigant rates can be reduced 25 to 40% from maximum pesticide labeled application rate.

[4] DMDS (Dimethyl Disulfide) (79%) coformulated with 21% Chloropicrin. It has proved very effective against nematode and disease, and for many weeds. Provides excellent control of nutsedge but only poor to fair control of annual grasses and requires the use of a separately applied herbicide for adequate control. TIF mulch film is now a mandatory requirement for use of all DMDS products.

to soil, these same mulch films are renown for resulting in plant back issues, often requiring extended periods to allow for soil water and air concentrations to fall below levels phytotoxic to seedlings and transplants. To use the high barrier mulch technology, plantings may have to be delayed to insure soil residues have dissipated and plant injury will not occur. A monitoring program using colormetric detector tubes (GasTek, Kitagawa, Sensidyne) or MiniRae type VOC meters to assess residual fumigant gases in soil should be considered before a commitment to planting is made.

Due to increased environmental and regulatory scrutiny, use of VIF or TIF high barrier plastic mulch films are now mandated for use with some fumigants to receive buffer zone reducing credits (20-60%) to allow fumigant applications within certain proximities of human occupied structures. They are also extensively used to allow for reduced rate applications of the different fumigants without compromising concentration and time dosages without compromising pest control efficacy. More recently, as an odor abatement strategy, the use of dimethyl disulfide (DMDS) in Florida now mandatorily requires use of a TIF mulches installed immediately after its application. Today, over a hundred different manufacturers or product lines can be identified with high barrier, VIF or TIF status with EPA currently approved for buffer zone credit. Additional information regarding EPA approved tarps can be found at http://www.epa.gov/soil-fumigants/tarps .

Reduced Rate Application Technologies

Currently, soil injection equipment for many of the different fumigant compounds is designed to dispense as much as 20 to 40 gallons of a liquid fumigant compound through armored lines from the gas cylinder, to the flow meter and rear manifold and then through each of three chisel per bed. The system is designed and calibrated to do this while moving at 3½ to 5 mph, uniformly dispensing multiple liquid streams of fumigant within 7260 to 10, 890 linear feet of row per acre. With such high rates, the flow lines are full, with liquids moving as continuous streams without in-line voids or bubbles. At 30 to 50% reduced rates of application, such as those demanded for use with high barrier TIF or VIF film, the situation may be vastly different, particularly if metered flow rates are low and do exceed the total capacity of the delivery tubing and manifold system. With reduced flow and presence of bubbles or even voids in flow within lines, a significant loss of back pressure occurs at the chisel orifices. The dramatic fall in back-pressure with reduced rate prevents accurate and uniform flow of the fumigant between chisels. This occurs at the point where total internal volume (flow capacity) of 9 chisel tubes, typically ¼ inch in diameter, exceeds the flow capacity of a ¾ armored delivery hose from the flow meter. When the outflow potential is greater than inflow then you have a significant loss of pressure, and without back pressure the system becomes one of gravity flow. With the existing on-farm systems, accuracy cannot be achieved at such low volumes, and without significant back pressure. To resolve the back pressure problem, it is extremely important to reduce total line volume and/or diameter of the delivery tubes from the manifold to the chisels so as to guarantee adequate back pressure at the point of fumigant release. With a high barrier mulch, reducing the field application rate of a fumigant results in a greatly reduce rate of liquid flow. Some chisels are so reduced in flow that accuracy and uniformity of application along and between the rows was compromised along with pest control efficacy.

In all practicality, use of these more gas retentive mulches will require changes in field application and soil injection equipment to insure accurate and uniform dispensing of such low fumigant application rates (10 to 15 gallons per acre). These required changes include smaller delivery tubing size (1/8 to 1/16 inch diameter), installation of sight gauges to monitor flow uniformity among chisel streams, and installation of a low pressure gauge upstream of the flow divider to monitor overall back pressure (at least 15 psi) at the flow divider (Table 4). For additional, more comprehensive information, readers are advised to review “Application Considerations for Successful Use of VIF and Metalized Mulches with Reduced Fumigant Rates in Tomato”. Appendix; or http://edis.ifas.ufl.edu/HS270).

Table 4.4. Summary of recommended fumigant injection equipment modifications required for use of high barrier TIF and VIF mulches and reduced rate applications of soil fumigants.

1.	Replace tubing from manifold to chisels with smaller diameter poly tubing to compensate for the new reduced flow capacity requirement and to increase line back pressure needed to insure accurate, uniform flow among all chisel streams.
2.	To the manifold - flow divider, install individual sight gauges to observe uniformity of fumigant liquid flow to each chisel outlet.
3.	Install a low pressure gauge (0-30 psi) immediately upstream of the manifold or flow divider to insure at least 15 psi of backpressure.
4.	Insure that the flow meter registers a minimum of 10% flow.

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Chapter 5. Cole Crop Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Broccoli - *Brassica oleraceae* Italica group, Brassicaceae (Cruciferae).

Cabbage - Brassica oleraceae Capitata group.

Cauliflower - *Brassica oleraceae* Botrytis group.

Chinese broccoli – gailan or gai lan / kalian or kai lan / flowering kale – *Brassica oleracea* var. alboglabra

Chinese cabbage – napa (tight headed), chi-hili (semi-loose headed) – *Brassica rapa* var. pekinsis

Chinese mustard – bok choi, shanghai choi / baby bok choi / yuchoi / yuchoy / u-choi / choy sum – *Brassica rapa* subsp. Chinensis

Kohlrabi – *Brassica oleracea* var. gongylodes

Oriental radish – Daikon (Japanese) / lobok or lo bok (Chinese) – *Raphanus sativus* var. longipinnatus

Collards - *Brassica oleraceae* Acephala group.

Kale - *Brassica oleraceae* Acephala group.

Mustard - *Brassica juncea.*

Turnip - *Brassica rapa* Rapifera group.

Table 5.1. Planting information for cole crops.

Planting dates	Broccoli	Brussels sprouts	Cabbage[1]	Cauliflower[1]
North Florida	Aug - Feb	Aug - Feb	Aug - Feb	Aug - Feb
Central Florida	Sept - Feb	Sept - Feb	Sept - Feb	Sept - Feb
South Florida	Oct - Jan	Oct - Jan	Sept - Jan	Sept - Jan
Planting information				
Distance between rows (in)	24 - 40	24 - 40	24 - 40	24 - 40
Distance between plants (in)	10 - 15	18 - 24	9 - 16	12 - 18
Seeding depth (in)	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Seeding per acre for field (lb)	1 - 2	1 - 2	1 - 2	1 - 2
Seeding per acre for transplant (lb)	1.25 - 1.5	1.25 - 1.5	1	1.25 - 1.5
Days to maturity from seed	75 - 90	90 - 120	85 - 110	75 - 90
Days to maturity from transplant	50 - 70	70 - 90	70 - 90	50 - 70
Plant populations (acre)	10,400-26,000	Up to 15,500	Up to 29,400	Up to 29,000

Planting dates	Collards	Kale	Mustard	Turnip
North Florida	Aug - Feb	Aug - Feb	Aug - Feb	Aug - Feb
Central Florida	Sept - Feb	Sept - Feb	Sept - Feb	Sept - Feb
South Florida	Sept - Jan	Sept - Jan	Sept - Jan	Sept - Jan
Planting information				
Distance between rows (in)	24 - 36	18 - 24	12 - 36	12 - 36
Distance between plants (in)	12 - 24	8 - 12	5 - 10	2 - 6
Seeding depth (in)	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5	0.25 - 0.5
Seeding per acre for field (lb)	2 - 4	2 - 4	3 - 5	2 - 3
Seeding per acre for transplant (lb)	1.25 - 1.5	N/A[2]	N/A[2]	N/A[2]
Days to maturity from seed	70 - 90	50 - 70	40 - 50	40 - 60
Days to maturity from transplant	50 - 70	—	—	—
Plant populations (acre)	Up to 21,800	Up to 43,500	Up to 116,200	Up to 261,400

[1] It could be planted in double rows (15-24 in between rows; 10-12 in within rows; 40-60 in bed centers).

[2] Direct seeded.

Cultivars

Table 5.2. Cabbage cultivars.

Green		Red	Savoy
Bravo (H)	Expat (H)	Cairo	Clarissa (H)
Bronco (H)	Gran Vantage (H)	Garnet (H)	Melissa (H)
Cheers (H)	Ramada (H)	Red Dynasty (H)	Savoy Ace (H)
	Superstar (H)	Red Hawk (H)	Savoy King (H)
	Capture (H)	Red Jewel (H)	
		Rio Grande (H)	

Table 5.3. Broccoli, cauliflower, collard, kale, mustard, and turnip cultivars.

Broccoli	Cauliflower	Collards	Kale	Mustard	Turnip	Turnip Greens
DuraPak 19 (H)*	Albacete	Bull Dog (H)	Blue Ridge (H)	Florida Broad Leaf	Just Right (H)	Top Star (H)
Emerald Crown (H)	Flamenco	Flash (H)	Darkibor (H)	Green Wave	Purple Top	Topper (H)
Emperial	Majestic (H)	Georgia	Reflex (H)	Red Giant	Royal Crown (H)	All Top (H)
Green Magic (H)	Whistler (H)	Hi Crop (H)	Starbor (H)	Southern Giant Curled	Southern Green	
Packman (H)	White Passion (H)	Top Bunch (H)	Vates	Tendergreen		
		Vates	Winterbor (H)			

H = hybrid, * = for northeast Florida

Asian Crucifers

The term "Asian vegetables" is a broad category which encompasses both the vegetables grown in the countries that comprise Asia and those eaten mainly by people of Asian extraction or who like Asian cuisine. Since many of the Asian vegetables which are described in this chapter are members of correspondent families that are covered in depth in other chapters in this volume, that information will not be duplicated.

This group of vegetables include crops with edible leaves like cabbage, broccoli, mustard but also kohlrabi, with an edible swollen stem and daikon which is an edible root. The crops can be grown on raised beds with or without mulch and with drip, overhead or subsurface irrigation. Fertilizer recommendations for these crops can be found in under broccoli, cabbage or Chinese cabbage section. For pest control products, these crops are included under this chapter, with the exception of daikon.

Table 5.4. Planting information for Asian crucifers.

Planting dates	Chinese broccoli	Chinese cabbage	Chinese mustard	Daikon
North Florida	Aug - Feb	Aug - Feb	Aug - Feb	Sept- Mar
Central and South Florida	Sept- Apr	Sept- Apr	Sept- Apr	Sept- Apr
Planting information				
Number of rows/44-inch wide beds (6-ft centers)	3-4	2-3	4	3 (fall/spring); 4 (winter)
Distance between rows (in)	11	14 or 24	14 - mustard 11 - others (below)	11
Distance between plants (in)	3-5	14-18	12-18 (mustard); 8-12 (Shanghai/choy sum); 6-10 (baby bok choy); 2-4 (u-choy)	6-9
Seeding depth (in)	0.25 – 0.5	0.25 – 0.5	0.25 – 0.5	0.25
Plant populations (acre)	116,160	18,671	29,040 (mustard); 43,560 (Shanghai/choy sum); 58,080 (baby bok choy); 174,240 (u-choy)	58,080

Table 5.5. Asian crucifer cultivars.

Chinese Broccoli	Chinese Cabbage-napa (tight head)	Chinese Cabbage-chihili (semi-loose head)	Chinese Mustard	Kohlrabi	Oriental Radish
Dark Green Gailan	Blues Hybrid (H)	Green Rocket (H)	Crown Jewel	Green Beauty	April Cross
Green Lance (H)	China Express	Jade Pagoda	Canton Choice	Kolibri	Daikon (Japanese)
Green Jade	China Pride	Michihili	Ching-Chiang	Kolibri Hybrid (H)	Everest
Kaliburi	Minuet	Monument	Dwarf	Peking Purple	Green Meat
Kichi	SF-65	Rubicon	Dynasty	Purple Vienna	Minowase
Suiho	WR-70 days (H)	Tainong Nanjing	Extra Dwarf	Winner	Mantanghong Hybrid (H)
Te You	Emiko		Fortune King		Mikura Cross
	Pacifiko		Lucky Choi		Mino Early
			Long White		Red Meat
			Mei Quing Choi		Relish Lobok / lo bok (Chinese)
			San Fran		Shunko
			Shanghai Green		

H = hybrid

Table 5.6. Herbicides approved for managing weeds in cole crops.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
		***	**PREEMERGENCE / PRETRANSPLANT**	***
Bensulide **5.0 - 6.0**	(Prefar) 4 E 5 - 6 qt.	8	Head & stem and leafy brassica	Annual broadleaf and grass weeds. Fair to poor control of lambsquarter, purslane, and some amaranth. Mechanically incorporate 1 to 2 in or irrigate 2 to 4 in deep within 36 hrs.
Carfentrazone **up to 0.031**	(Aim) 2 EC up to 2 fl.oz.	14	Head & stem and leafy brassica	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Clomazone **0.25** **0.25 - 0.38**	(Command) 3ME 0.67 pt. direct seeded 0.67 - 1.0 pt. transplanted	13	Cabbage	Annual broadleaf and grass weeds. On coarse soils, use lower rates. Only one application per season. PHI 45 days.
DCPA **4.5 - 10.5**	(Dacthal) 75 WP 6 - 14 lb.	3	Broccoli, brussel sprouts, cauliflower, cabbage, and Brassica leafy vegetables	Broadleaf and grass weeds. Can be preplant incorporated. If weeds have emerged they must be cultivated or weeded before application
Glyphosate	(various formulations) consult label	9	Head & stem and leafy brassica	Actively growing broadleaf and grass weeds. Use as a preplant burndown.
Napropamide **2**	(Devrinol DF-XT) 4 lb. (Devrinol 2-XT) 4 qt.	15	Broccoli, brussels sprouts, cabbage, cauliflower	Annual broadleaf and grass weeds. Apply in transplanted crops. Irrigate within 24-72 hr. to a soil depth of 4-8 in. Do not exceed 2 lb. a.i./A per season.
Oxyfluorfen **0.25 - 0.5**	(Galigan, Goal 2XL) 2 EC 1 - 2 pt. (Galigan, GoalTender) 4 E 0.5 - 1.0 pt.	14	Broccoli, cabbage, cauliflower	Certain annual broadleaf weeds. Transplants less than 5 weeks old or in containers less than 1 in. square may result in more crop injury. Injury will occur as leaf cupping or crinkling. DO NOT apply in fields where acentanilde herbicides (Dual Magnum, Lasso, or Ramrod) have been applied in the same growing season.
Pyraflufen ethyl **0.0008 - 0.003**	(ET Herbicide/Defoliant) 0.5 - 2.0 fl. oz.	14	Cole crops	Broadleaf and grass weeds. Burndown preplant application 1 day before planting. Include a NIS or COC in the spray solution. Allow 30 days between applications. Do not exceed 3 applications or 5.5 fl. oz./A per season.

Table 5.6. Herbicides approved for managing weeds in cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.				
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Crops**	**Weeds controlled / remarks**
Paraquat **0.5 - 1.0**	(Gramoxone) 2 SL 2.0 - 4.0 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.	22	Broccoli, cabbage, cauliflower, cavalo broccoli, Chinese cabbage, turnip	Emerged broadleaf and grass weeds. Use as a preplant burndown. Crop plants that have emerged will be injured.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Broccoli, cabbage, cauliflower, collards, kale, mustard/turnip greens	Emerged broadleaf and grass weeds. Use as a preplant burndown.
S-metolachlor **mineral** **0.64 - 1.91** **muck** **1.91**	(Dual Magnum) 7.62 EC mineral 0.80 - 4.0 pt. muck 4.0 pt.	15	Head & stem brassica	Annual broadleaf and grass control. Apply immediately after planting. Label is a third party registration by TPR, Inc. and grower must sign an indemnification agreement. Use a higher rate on fine textured soils or high in organic matter. Do not apply more than 1.91 lb. a.i./A of Dual Magnum per crop on sandy soils. Chinese varieties are more sensitive to Dual Magnum injury. PHI 60 days.
Trifluralin **0.5 - 0.75**	(Treflan HFP, Trifluralin, Trilin) 4 EC 1.0 - 1.5 pt. (Treflan) 4 L 1.0 - 1.5 pt.	3	Broccoli, brussels sprouts, cabbage, cauliflower	Annual broadleaf and grass weeds. Incorporate or irrigate 4 in. within 8 hrs. Results in Florida are erratic on soils with low organic matter and clay contents.
			***** POSTEMERGENCE / POSTTRANSPLANT *****	
Carfentrazone **up to 0.031**	(Aim) 2 EC up to 2 fl. oz. (Aim) 1.9 EC up to 2 fl. oz.	14	Head & steam and leafy brassica	Emerged broadleaf weeds. Apply with a hooded sprayer to row middles. Do no exceed 4.1 fl. oz./A in season as a row middle application. PHI 0 days.
Clethodim **0.09 - 0.13** **0.07 - .25**	(Select) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Head & stem and leafy brassica	Emerged grass weeds. Include crop oil concentrate at 1% v/v in finished spray volume. Head & stem brassica PHI 30 days. Leafy brassica PHI 14 days.
Clopyralid **0.09 - 0.19**	(Stinger) 3 EC 0.25 - 0.5 pt.	4	Cabbage, Chinese cabbage (bok choy, napa), Chinese mustard cabbage	Broadleaf weeds. Do not apply more than 0.5 pt./A per year. Check plant back dates. PHI 30 days.
DCPA **4.5 - 10.5**	(Dacthal) 75 WP 6 - 14 lb.	3	Broccoli, Brussels sprouts, cauliflower, cabbage, and Brassica leafy vegetables	Broadleaf and grass weeds. Spray over transplants without injury. If weeds have emerged they must be cultivated or weeded before application. Can be preplant incorporated.
Glyphosate	(various formulations) consult label	9	Head & steam and leafy brassica	Broadleaf and grass weeds. Use a hooded sprayer and direct to row middles only.
Paraquat **0.3 - 0.5**	(Gramoxone) 2 SL 1.2 - 1.9 pt.	22	Cabbage	Emerged broadleaf and grass weeds. Direct spray solution to row middles only. Do not allow spray to contact crop as injury or excessive residues may result. Outer leaves should be stripped at the time of harvest. Do not apply where paraquat products have been used as preplant application.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Broccoli, cabbage, cauliflower, collards, kale, mustard/turnip greens	Emerged broadleaf and grass weeds. Apply as hooded spray to row middles only. Include a residual herbicide to broaden spectrum of weed control.
Pendimethalin **0.48 - 0.71**	(Prowl H20) 3.8 1.0 - 1.5 pt.	3	Broccoli, brussel sprouts, cabbage, cauliflower	Broadleaf and grass weeds. Apply after crop emergence (2- to 4- leaf stage) or after transplanting (1 to 3 days) and prior to weed emergence. Direct the spray to the base of the plant to limit contact to the foliage. PHI 60 days. PHI 7 days for cabbage and head & stem brassica.
Sethoxydim **0.28**	(Poast) 1.5 EC 1.5 pt.	1	Broccoli (including Chinese and raab), Brussels sprouts, cabbage (bok choy, Chinese mustard, napa), cauliflower, collards, kale, kohlrabi, mustard/rape greens	Annual and perennial weeds. Include a crop oil concentrate or methylated seed oil in spray solution. Maximum rate of 3.0 pt./A per season. PHI 30 days.

Table 5.7. Insecticides approved for managing insect pests of cole crops.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Aphids	--	**BotaniGard 22 WP, ES** (Beauveria bassiana)	**WP:** 0.5-2 lb/100 gal; **ES:** 0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	4	0	Can be used in organic production. OMRI-listed[2]
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2 % V/V	12	0	OMRI-listed[2].
	--	**Saf-T-Side, others** (Oil, insecticidal)	1-2 gal/100 gal	4	up to day of harvest	Saf-T-Side is OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Trilogy** (extract of neem oil)	0.5-2% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	1B	***Dibrom 8 EC** (naled)	1 pt	48	1	Apply no more than 1 pt per acre in Florida. Do not apply more than 5 pt per acre per season. **Broccoli, cabbage, cauliflower, Brussels sprouts, kale and collards**.
	1B	**Dimethoate 4 EC** (dimethoate)	0.5-1 pt – broccoli, cauliflower; 0.5 pt – kale, mustard greens, turnip	48	7 – broccoli, cauliflower; 14 – kale, mustard greens, turnip	Highly toxic to bees**. For broccoli, cauliflower, kale, turnip greens and roots, and mustard greens only**.
	1B	***Lorsban Advanced** (chlorpyrifos) and other generic products	Preplant, at plant, post plant soil application: See label. **Foliar:** 1-2 pt	24, 72 for cauliflower	**Preplant:** 30 **Foliar:** 21	See label for crop-specific instructions; Pre or post-plant soil application for root aphids only. Foliar: Do not make more than 3 applications of products containing chlorpyrifos.
	1B	**Malathion 5EC, 8F** malathion)	**5EC:** 1-2 pt, 1.6 pt for collards, kale, mustard greens; **8F:** 1.25 pt, 1 for collards, kale, mustard greens	48, 12 for collards, kale, and mustard greens	2 for head and stem Brassica except cabbage, 7 for greens and cabbage	see label for limitations on number of applications per season--varies by crop.
	1B	***MSR Spray Concentrate** (oxydemeton-methyl)	1.5-2 pt	7 days	7	**Broccoli, broccoflower, broccolini, cabbage, cauliflower** - See label for restrictions.
	3A	***Ambush 25W3 (and generics)**	3.2-6.4 oz 3.2-12.8 oz – cabbage and Chinese cabbage only	12	1	Do not apply more than 51.2 oz/acre per season. **Head and stem *Brassica* crops only.**
	3A	***Brigade 2 EC**[3] (bifenthrin)	2.1-6.4 fl oz	12	7	Do not apply more than 0.4 lb ai/acre for leafy or 0.5 lb ai/acre for head and stem.
	3A	***Mustang3 (zeta-cyand generics)**	2.4-4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0 -head and stem 7 - leafy	Foliar application. Do not use if other 4A insecticide has been applied.
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	**soil:** 4.4-10.5 fl oz, **foliar:** 1.3 fl oz	12	**soil:** 21, **foliar:** 7	**Most effective as a soil application.** Do not apply more than 10.5 fl oz per acre per crop season as a soil application or 6.5 fl oz as foliar applications. Do not apply to both soil and foliage.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz—head and stem cole crops, 2.0-5.3 oz—leafy cole crops and turnip greens	12	7-head and stem, 3-leafy cole crops and turnip greens	Succeptibility may vary with aphid species. Do not apply more than 5 times per season for head and stem cole crops or 4 times per season for leafy cole crops, or apply more often than every 7 days. Turnip roots cannot be used for food/feed.

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	4A	**Belay Insecticide; 50 WDG** (clothianidin)	**Insecticide: soil:** 9-12 fl oz, **foliar:** 3-4 fl oz; **50 WDG: soil:** 4.8-6.4 oz, **foliar:** 1.6-2.1 oz	12	**Insecticide: soil:** apply at planting, **foliar:** 7; **50 WDG:** 7	**Insecticide: soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb ai/acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Platinum, Platinum 75SG** (thiamethoxam)	**Platinum:** 5.0-11 fl oz; **Platinum 75SG:** 1.66-3.67 oz	12	30	Soil application.
	4A	**Venom Insecticide Scorpian 35 SL insecticide** (dinotefuran)	**Soil and foliar rates different; Check label**	12	**foliar** - 1 **soil** - 21	Use one application method, not both (soil or foliar). **For head and stem Brassica only. Foliar:** Do not apply more than 0.268 lb ai per acre per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	1	Soil or foliar application. Maximum per crop season: 28 fl oz/acre. Maximum crop seasons per year: 3.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	Soil application. May be applied via one of several different applications methods. One application per season within 28 days of plant emergence or transplanting.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4-7 oz	12	head and stem – 3, leafy *Brassica* greens - 7	Foliar application. Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids first appear. Maximum of 2 applications per crop.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	23	**Movento** (spirotetramat)	4-5 fl oz	24	1	Limited to 10 oz/acre per season. Only use a spreading-penetrating adjuvant known to be safe for the target crop.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai/acre of cyazypyr or cyantraniliprole containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** cyazypyr)	5-13.5 fl oz	4	N/A: applied at planting	See label for diamondback moth resistance management.
Caterpillars (including Diamondback moth, cabbage looper, imported cabbageworm, corn earworm, cross-striped cabbageworm, cabbage webworm, armyworm, root maggot, symphylans)	--	**Checkmate DBM-F** pheromone)	3.1-6.2 fl oz	0	0	For mating disruption of diamondback moth. Does not affect larvae and eggs already on plants. Do not exceed 23 fl oz per acre per year.
	–	**Grandevo** Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	4	0	Can be used in organic production. OMRI-listed[2]
	un	**Aza-Direct** and other (productsazadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Prokil Cryolite** (cryolite)	8-16 lb	12	7	**For broccoli, Brussels sprouts, and cauliflower only**. Do not apply more than 96 lb per season or more often than every 7 days.
	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1 lb	48	Cabbage – 1, broccoli and cauliflower – 3, others –10	Do not make more than 10 applications per crop (8 for collards, kale, mustard and turnip greens). **For use on broccoli, cabbage, cauliflower, Chinese cabbage, fresh market collards, kale, mustard and turnip greens**.
	1A	***Larvin 3.2** (thiodicarb)	16-40 fl oz	48	7	Do not exceed more than 4.0 lb active ingredient per acre per season. (160 fl oz) **For broccoli, cabbage, and cauliflower only**.

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	1A	**Sevin 80S; XLR Plus, 4Fand other generic products** (carbaryl)	**80S:** 0.625-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	3 or 14, depending on specific crop	Apply no more than 7.5 lb/acre of 80S or 6 qt of 4F or XLR Plus per crop. **See label for specific crops**.
	1B	***Diazinon AG-500, *50 W** (diazinon)	**AG500 preplant:** 1-4 qt **50W:** 2-8 lb	96	preplant	**Root maggot, cutworms only. Broccoli, cabbage, cauliflower, collard, kale, mustard greens**. See label for depth to incorporate.
	1B	***Dibrom 8 EC** (naled)	1 pt	48	1	Apply no more than 1 pt per acre in Florida. Do not apply more than 5 pt per acre per season. **Broccoli, cabbage, cauliflower, Brussels sprouts, kale and collards**.
	1B	***Lorsban Advanced** (chlorpyrifos) and other generic products	Preplant, at plant, post plant soil application: See label. **Foliar:** 1-2 pt	24, 72 for cauliflower	**Preplant:** 30 **Foliar:** 21	**Preplant for root maggot, cutworms and symphylans only.** See label for crop-specific instructions; **Foliar:** Do not make more than 3 applications of products containing chlorpyrifos. Will not control organophosphate-resistant diamondback moth.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1-2 pt, 1.6 pt for collards, kale, mustard greens; **8F:** 1.25 pt, 1 for collards, kale, mustard greens	48, 12 for collards, kale, and mustard greens	2 for head and stem *Brassica* except cabbage, 7 for greens and cabbage	see label for limitations on number of applications per season--varies by crop.
	3A	***Ambush 25W3 (and generics)**	3.2-6.4 oz 3.2-12.8 oz – cabbage and Chinese cabbage only	12	1	Do not apply more than 51.2 oz/acre per season. **Head and stem *Brassica* crops only.**
	3A	***Asana XL (0.66 EC)**[3] (esfenvalerate)	2.9-9.6 fl oz – head and stem Brassicas, 5.8-9.6 oz –collards, 9.6 – mustard greens	12	3-head and stem; 7-collards, mustard greens	Do not apply more than 0.4 lb ai/acre per season for head and stem *Brassica* or 0.2 lb ai/acre per season for collards and mustard greens.
	3A	***Baythroid XL**[3] (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum per crop season: 12.8 fl oz/A.
	3A	***Brigade 2 EC**[3] (bifenthrin)	2.1-6.4 fl oz	12	7	Do not apply more than 0.4 lb ai/acre for leafy or 0.5 lb ai/acre for head and stem.
	3A	***Capture LFR**[3] (bifenthrin)	3.4-8.5 fl oz	12	at planting	For mixing directly with liquid fertilizer to control soil insect pests.
	3A	***Danitol**[3] (fenpropathrin)	10.67-16 fl oz	24	7	Do not apply more than 42.67 fl oz per acre per season. **Head and stem *Brassica* only**.
	3A	***Declare Insecticide**[3] (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	(1) First and second instars only. **Head and stem *Brassica* only.** Do not apply more than 12.3 fl oz per acre per season.
	3A	***Mustang3 (zeta-cyand generics)**	2.4-4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	3A	***Warrior II**[3] (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	Do not apply more than 0.24 lb ai/acre or 15.36 fl oz of produc/acre per season. (1)1st and 2nd instar only. **For head and stem Brassica only.**
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	May be applied via one of several different soil applications methods. One application per season within 28 days of plant emergence or transplanting.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4-7 oz	12	head and stem – 3, leafy *Brassica* greens - 7	Highly toxic to bees exposed to direct treatment or residues on blooming crops.

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Do not apply to seedlings grown for transplant. Do not make more than two consecutive applications of Group 5 insecticides.Recommended to reserve for thrips where they are a problem.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7 - head and stem; 14 - leafy	Do not make more than 2 sequential applications without rotating to another product with a different mode of action. Do not apply by aircraft. **Not for turnips grown for roots**.
	11A	**DiPel DF and other products** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. See label for rates for specific pests. Good coverage is essential. OMRI-listed[2]. Can be used in greenhouses.
	11A	**Xentari DF and other products** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem Brassica only**.
	18	**Intrepid 2F** (methoxyfenozide)	4-10 fl oz, depending on pest	4	1	Do not apply more than 64 oz per acre per season.
	22	**Avaunt** (indoxacarb)	2.5-3.5 oz	12	3	Do not apply more than 14 oz per acre per crop. Add a wetting agent to improve coverage. Do not use in greenhouse or in crops grown for transplant.
	28	**Belt SC** (flubendiamide)	2.0-2.4 fl oz	12	8	Do not apply more than 7.2 fl oz/acre per season.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	3	For best results, use an adjuvant when using as a foliar spray. Can be applied to soil at planting or by drip chemigation. See label for diamondback moth resistance management.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai/acre of cyazypyr or cyantraniliprole containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
Fire Ants	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	12	1	Apply when ants are actively foraging. Do not exceed 0.134 lb ai per acre per season
Flea beetles	--	***Declare Insecticide**[3] (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	(1) First and second instars only. **Head and stem *Brassica* only.** Do not apply more than 12.3 fl oz per acre per season.
	–	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	4	0	Can be used in organic production. OMRI-listed[2.] **Leaf beetle larvae:** newly hatched to second instar
	un	**Azatin XL** azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Prokil Cryolite** (cryolite)	8-16 lb	12	7	**For broccoli, Brussels sprouts, and cauliflower only**. Do not apply more than 96 lb per season or more often than every 7 days.
	1A	***Larvin 3.2** (thiodicarb)	16-40 fl oz	48	7	Do not exceed more than 4.0 lb active ingredient per acre per season. (160 fl oz) **For broccoli, cabbage, and cauliflower only**.

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	1A	**Sevin 80S; XLR Plus, 4F** (carbaryl)	**80S:** 0.625-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	3 or 14, depending on specific crop	Apply no more than 7.5 lb/acre of 80S or 6 qt of 4F or XLR Plus per crop. **See label for specific crops**.
	1B	***Lorsban Advanced** (chlorpyrifos)	Preplant, at plant, post plant soil application: See label. **Foliar:** 1-2 pt	24, 72 for cauliflower	**Preplant:** 30 **Foliar:** 21	See label for crop-specific instructions; **Foliar:** Do not make more than 3 applications of products containing chlorpyrifos.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1-2 pt, 1.6 pt for collards, kale, mustard greens; **8F:** 1.25 pt, 1 for collards, kale, mustard greens	48, 12 for collards, kale, and mustard greens	2 for head and stem Brassica except cabbage, 7 for greens and cabbage	see label for limitations on number of applications per season--varies by crop.
	3A	***Asana XL (0.66 EC)**[3] (esfenvalerate)	2.9-9.6 fl oz – head and stem Brassicas, 5.8-9.6 oz –collards, 9.6 – mustard greens	12	3-head and stem; 7-collards, mustard greens	Do not apply more than 0.4 lb ai/acre per season for head and stem *Brassica* or 0.2 lb ai/acre per season for collards and mustard greens.
	3A	***Baythroid XL**[3] (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum per crop season: 12.8 fl oz/A.
	3A	***Brigade 2 EC**[3] (bifenthrin)	2.1-6.4 fl oz	12	7	Do not apply more than 0.4 lb ai/acre for leafy or 0.5 lb ai/acre for head and stem.
	3A	***Mustang3 (zeta-cyand generics)**	2.4-4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	3A	***Warrior II**[3] and generics (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	Do not apply more than 0.24 lb ai/acre or 15.36 fl oz of produc/acre per season. (1)1st and 2nd instar only. **For head and stem Brassica only.**
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0 -head and stem 7 - leafy	Do not use if other 4A insecticide has been applied.
	4A	**Belay Insecticide; 50 WDG** (clothianidin)	**Insecticide: soil:** 9-12 fl oz, **foliar:** 3-4 fl oz; // **50 WDG: soil:** 4.8-6.4 oz, **foliar:** 1.6-2.1 oz	12	**Insecticide: soil:** apply at planting, **foliar:** 7; **50 WDG:** 7	**Insecticide: soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb ai/acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Platinum; Platinum 75SG** (thiamethoxam)	5.0-11 fl oz; **75G:** 1.66-3.67 oz	12	30	Soil application.
	4A	**Venom and Scorpion Insecticide** (dinotefuran)	**Soil and foliar rates different; Check label**	12	**foliar** - 1 **soil** - 21	Use one application method, not both (soil or foliar). **For head and stem Brassica only. Foliar:** Do not apply more than 0.268 lb ai per acre per season.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	May be applied via one of several different soil applications methods. One application per season within 28 days of plant emergence or transplanting.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4-7 oz	12	head and stem – 3, leafy *Brassica* greens - 7	Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem Brassica only**.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai/acre of cyazypyr or cyantraniliprole containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	28	**Verimark** (cyazypyr)	5-13.5 fl oz	4	N/A: applied at planting	See label for diamondback moth resistance management.
Grasshoppers	3A	***Asana XL (0.66 EC)**[3] (esfenvalerate)	2.9-9.6 fl oz – head and stem Brassicas, 5.8-9.6 oz –collards, 9.6 – mustard greens	12	3-head and stem; 7-collards, mustard greens	Do not apply more than 0.4 lb ai/acre per season for head and stem *Brassica* or 0.2 lb ai/acre per season for collards and mustard greens.
	3A	***Mustang3 (zeta-cyand generics)**	2.4-4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A, 28	***Voliam Xpress**[3] (lambda-cyhalothrin and chlorantraniliprole)	5-9 fl oz	24	3	Highly toxic to bees exposed to direct treatment or residues on blooming crops. **Head and stem *Brassica* only.**
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6 oz	12	**foliar** - 1 **soil** - 21	Use one application method, not both (soil or foliar). **For head and stem Brassica only. Foliar:** Do not apply more than 0.268 lb ai per acre per season.
	15	***Dimilin 2L** (diflubenzuron)	2-4 fl oz	12	7	Not effective against adult stage. No more than 4 applications per season. May be applied only to turnip varieties that do not produce a harvestable root.
Harlequin bug, stink bug, plant bugs	--	***Declare Insecticide**[3] (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	(1) First and second instars only. **Head and stem *Brassica* only.** Do not apply more than 12.3 fl oz per acre per season.
	1A	**Sevin 80S; XLR Plus, 4F** (carbaryl)	**80S:** 0.625-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	3 or 14, depending on specific crop	Apply no more than 7.5 lb/acre of 80S or 6 qt of 4F or XLR Plus per crop. **See label for specific crops**.
	3A	***Baythroid XL**[3] (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum per crop season: 12.8 fl oz/A.
	3A	***Brigade 2 EC**[3] (bifenthrin)	2.1-6.4 fl oz	12	7	Do not apply more than 0.4 lb ai/acre for leafy or 0.5 lb ai/acre for head and stem.
	3A	***Danitol**[3] (fenpropathrin)	10.67-16 fl oz	24	7	Do not apply more than 42.67 fl oz per acre per season. **Head and stem *Brassica* only**.
	3A	***Mustang3 (zeta-cyand generics)**	2.4-4.3 fl oz	12	1	Do not make applications less than 7 days apart. Diamondback moth populations in Florida have been found to be resistant to pyrethroids.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	12	0	Harmful to bees. Can be used in greenhouses. OMRI-listed.[2]
	3A	***Warrior II**[3] (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	Do not apply more than 0.24 lb ai/acre or 15.36 fl oz of produc/acre per season. (1)1st and 2nd instar only. **For head and stem Brassica only.**
	3A, 28	***Voliam Xpress**[3] (lambda-cyhalothrin and chlorantraniliprole)	5-9 fl oz	24	3	Highly toxic to bees exposed to direct treatment or residues on blooming crops. **Head and stem *Brassica* only.**
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz—head and stem cole crops, 2.0-5.3 oz—leafy cole crops and turnip greens	12	7-head and stem, 3-leafy cole crops and turnip greens	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season for head and stem cole crops or 4 times per season for leafy cole crops, or apply more often than every 7 days. Turnip roots cannot be used for food/feed.
	4A	**Belay Insecticide; 50 WDG** clothianidin)	**Insecticide: soil:** 9-12 fl oz, **foliar:** 3-4 fl oz; **50 WDG: soil:** 4.8-6.4 oz, **foliar:** 1.6-2.1 oz	12	**Insecticide: soil:** apply at planting, **foliar:** 7; **50 WDG:** 7	**Insecticide: soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb ai/acre regardless of application method (or a total of 12 fl oz of this formulation).

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar**: 2-7 fl oz, **soi**l: 9-10.5 fl oz	12	foliar, 1; soil, 21	**Head and stem *Brassica* only.** Do not use more than 10.5 fl oz when applying to foliage or 21 fl oz when applying to soil. Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6 oz	12	**foliar** - 1 **soil** - 21	Use one application method, not both (soil or foliar). **For head and stem Brassica only. Foliar:** Do not apply more than 0.268 lb ai per acre per season.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem Brassica only**.
Leafminers	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. Greenhouse and field. OMRI-listed[2].
	4A	**Belay Insecticide; 50 WDG** (clothianidin)	**Insecticide: soil:** 9-12 fl oz, **foliar:** 3-4 fl oz**; 50 WDG: soil:** 4.8-6.4 oz, **foliar:** 1.6-2.1 oz	12	**Insecticide: soil:** apply at planting, **foliar:** 7; **50 WDG:** 7	**Insecticide: soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb ai/acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar**: 2-7 fl oz, **soi**l: 9-10.5 fl oz	12	foliar, 1; soil, 21	**Head and stem *Brassica* only.** Do not use more than 10.5 fl oz when applying to foliage or 21 fl oz when applying to soil. Use only one application method.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6 oz	12	**foliar** - 1 **soil** - 21	Use one application method, not both (soil or foliar). **For head and stem Brassica only. Foliar:** Do not apply more than 0.268 lb ai per acre per season.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Do not apply to seedlings grown for transplant. Do not make more than two consecutive applications of Group 5 insecticides.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7 - head and stem; 14 - leafy	Do not make more than 2 sequential applications without rotating to another product with a different mode of action. Do not apply by aircraft. **Not for turnips grown for roots**.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem Brassica only**.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Limited to 6 applications. **Includes turnip greens, not grown for roots**.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai/acre of cyazypyr or cyantraniliprole containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** (cyazypyr)	5-13.5 fl oz	4	N/A: applied at planting	See label for diamondback moth resistance management.
Mites	--	**Saf-T-Side, others** (Oil, insecticidal)	1-2 gal/100 gal	4	up to day of harvest	Saf-T-Side is OMRI-listed[2].
Whitefly	--	**BotaniGard 22 WP, ES** (Beauveria bassiana)	**WP:** 0.5-2 lb/100 gal; **ES:** 0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	4	0	Can be used in organic production. OMRI-listed[2]. **Leaf beetle larvae:** newly hatched to second instar
	--	**M-Pede 49% EC** (soap, (insecticidal)	1-2 % V/V	12	0	OMRI-listed[2].

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	--	**Saf-T-Side, others** (Oil, insecticidal)	1-2 gal/100 gal	4	up to day of harvest	Saf-T-Side is OMRI-listed[2].
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. Greenhouse and field. OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2-4 qt	4	0	Apply before pests reach damaging levels.
	un	**Trilogy** (extract of neem oil)	0.5-2% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0 -head and stem 7 - leafy	Do not use if other 4A insecticide has been applied.
	4A	**Admire Pro** (imidacloprid) see appropriate labels for other brands)	4.4-10.5 fl oz for soil application, 1.3 fl oz for foliar	12	21-soil, 7-foliar	Do not apply more than 10.5 fl oz per acre per crop season as a soil application or 6.5 fl oz as foliar applications. Do not apply to both soil and foliage.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz—head and stem cole crops, 2.0-5.3 oz—leafy cole crops and turnip greens	12	7-head and stem, 3-leafy cole crops and turnip greens	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season for head and stem cole crops or 4 times per season for leafy cole crops, or apply more often than every 7 days. Turnip roots cannot be used for food/feed.
	4A	**Belay Insecticide; 50 WDG** (clothianidin)	**Insecticide: soil:** 9-12 fl oz, **foliar:** 3-4 fl oz**;** **50 WDG: soil:** 4.8-6.4 oz, **foliar:** 1.6-2.1 oz	12	**Insecticide: soil:** apply at planting, **foliar:** 7; **50 WDG:** 7	**Insecticide: soil:** Do not apply more than 6.4 oz per acre per season. See label for application instructions. **foliar:** Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **50 WDG:** Includes turnip greens. Do not apply more than 0.2 lb ai/acre regardless of application method (or a total of 12 fl oz of this formulation).
	4A	**Platinum; Platinum 75SG** (thiamethoxam)	5.0-11 fl oz; **75G:** 1.66-3.67 oz	12	30	Soil application.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar**: 2-7 fl oz, **soi**l: 9-10.5 fl oz	12	**foliar**, 1; **soil**, 21	**Head and stem *Brassica* only.** Do not use more than 10.5 fl oz when applying to foliage or 21 fl oz when applying to soil. Use only one application method.
	4A	**Venom Insecticide** dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6 oz	12	**foliar** - 1 **soil** - 21	Use one application method, not both (soil or foliar). **For head and stem Brassica only. Foliar:** Do not apply more than 0.268 lb ai per acre per season.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 fl oz	12	30	May be applied via one of several different soil applications methods. One application per season within 28 days of plant emergence or transplanting.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4-7 oz	12	head and stem – 3, leafy *Brassica* greens - 7	Highly toxic to bees exposed to direct treatment or residues on blooming crops.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	1	Maximum per crop season: 28 fl oz/acre. Maximum crop seasons per year: 3.
	7C	**Knack** (pyriproxyfen)	8-10 fl oz	12	7	Immatures only. Apply when nymphs first appear. Limited to 2 applications per season.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids and whiteflies first appear. Provides suppression of whiteflies. Maximum of 2 applications per crop.

Table 5.7. Insecticides approved for managing insect pests of cole crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	7	No more than 3 applications or 24 fl oz per acre per season. No more than 2 applications for thrips or whiteflies. **Head and stem Brassica only**.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	12	1	Immatures only. Do not make more than 2 applications per crop cycle or 4 applications per year**.**
	23	**Movento** (spirotetramat)	4-5 fl oz	24	1	Limited to 10 oz/acre per season. Only use a spreading-penetrating adjuvant known to be safe for the target crop.
	23	**Oberon 2 SC** (spiromesifen)	7.0-8.5 fl oz	12	7	Maximum amount per crop: 25.5 fl oz/acre. No more than 3 applications. **Not for turnip greens.**
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai/acre of cyazypyr or cyantraniliprole containing products per crop whether applications are made to foliage or soil. See label for diamondback moth resistance management.
	28	**Verimark** (cyazypyr)	5-13.5 fl oz	4	N/A: applied at planting	See label for diamondback moth resistance management.
Wireworms	1B	***Diazinon AG-500, *50 W** (diazinon)	**AG500 preplant:** 1-4 qt **50W:** 2-8 lb	96	preplant	**Broccoli, cabbage, cauliflower, collard, kale, mustard greens**. See label for depth to incorporate.
	1B	**Lorsban 75WG** (chlorpyrifos)	**Foliar:** 0.67-1.33 lb **Preplant soil**: 2.66 lb for cauliflower, 3.00 lb for all others **At plant or post planting:** 0.8-2.15 oz/1000 feet of row. Specific rate depends on the crop.	24, 72 for cauliflower	21; pre or at planting	Do not make more than 3 applications of products containing chlorpyrifos. Will not control organophosphate-resistant diamondback moth. **Preplant:** Incorporate preplant applications 2- 4 inches deep.
	3A	***Capture LFR**[3] bifenthrin)	3.4-8.5 fl oz	12	at planting	For mixing directly with liquid fertilizer to control soil insect pests.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

[3] Avoid pyrethroids if diamondback moth is a problem. Larvae have been shown to be resistant.

*** Restricted use insecticide.**

Table 5.8. Cole crop fungicides ordered by disease and FRAC group according to mode of action.

Pertinent Diseases or Pathogens	Fungicide Group[1]		Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
COLE CROPS							
Head and Stem Crops: Broccoli, Brussels Sprouts, Cauliflower, Chinese Broccoli and Chinese Cabbage;							
Leafy Crops: Collard, Kale, Mustard and Turnip; and Watercress							
Alternaria leaf spot (*Alternaria* spp.)	M1	(copper compounds) Many brands available.	SEE INDIVIDUAL LABELS		1	Varies by product from 4 hr to 2 days	Mancozeb enhances bactericidal effect of fix copper compounds. Some reddening on older Broccoli leaves at higher rates and flecking on wrapper leaves of Cabbage may occur.
	M5	(chlorothalonil) Many brands available:	SEE INDIVIDUAL LABELS		7	1 - 2	See individual labels for crop subgrouping.
	2	Iprodione 4L AG Rovral 4F Enclosure 4 Nevado 4F (iprodione)	1pt	4 pt	10	-	Only labeled for Chinese mustard. Limit is 4 appl for mustard.
	3	Monsoon Orius 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	3	Procure 480 SC (triflumizole)	8 fl oz	18 fl oz	1	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infectionand repeat sprays at a 14 day interval.
	4 & M5	Ridomil Gold Bravo Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	1.5 lb	See label	7	2	Not labeled for leafy cole crops or watercress. Limit is 4 applications per crop.
	7	Endura (boscalid)	9 oz	18 oz	0 (head and stem) 14 (leafy)	0.5	Not labeled for watercress; Limit is 2 appl/crop.
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development, and continue on a 7 – 10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 sequential appl. before rotating to a different mode of action for at least 2 appl; 30 day plant back for off label crops.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem) 3 (leafy)	4 hr	No more than 2 sequential appl/stem and head crop.
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Do not make more than 1 sequential application.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	92.3 fl oz	0	4 hr	No more than 2 sequential appl. Different seasonal application limits for head and stem, and leaf green brasscia subgroups.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential appl. Limit of 4 applications per season.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.

Table 5.8. Cole crop fungicides ordered by disease and FRAC group according to mode of action. (continued)

Pertinent Diseases or Pathogens	Fungicide Group[1]		Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
Alternaria blight (*Alternaria* spp.)	7	Endura (boscalid)	9 oz	18 oz	0 (head and stem) 14 (leafy)	0.5	Not labeled for watercress; Limit is 2 appl/crop.
	9 &12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential appl.
Anthracnose (*Colletotrichum* spp.)	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development, and continue on a 7 – 10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action. Do not exceed 80 fl oz per season.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem) 3 (leafy)	4 hr	No more than 2 sequential appl/stem and head crop.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential appl.
Black Leg (*Leptosphaeria maculans*)	2	Iprodione 4L AG Rovral 4F Enclosure 4 Nevado 4F (iprodione)	2 pt	4 pt	0	-	Only labeled for broccoli. Limit is 2 appl for broccoli.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem)	4 hr	No more than 2 sequential appl/stem and head crop.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.
Black Rot (Xanthomonas camprestris)	M1	(copper compounds) Many brands available:	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb enhances bactericidal effect of fix copper compounds.
	21	Actigard 50 WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Apply preventively; limit is 4 appl/crop on a 7-day schedule. Suppression only.
Cercospora Leaf Spot (*Cercospora brassicicola*)	3	Monsoon Orius 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development, and continue on a 7 – 10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	9 &12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants. Suppression only.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem) 3 (leafy)	4 hr	No more than 2 sequential appl/stem and head crop.

Table 5.8. Cole crop fungicides ordered by disease and FRAC group according to mode of action. (continued)

Pertinent Diseases or Pathogens	Fungicide Group[1]		Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
	11	Reason 500SC (fenamidone)	8.2 oz	24.6 oz	2	0.5	Limits are no more than 1 sequential appl. Suppression only.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	46 fl oz	0	4 hr	Labelled for leaf greens brassica. No more than 2 sequential appl.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential appl.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.
Club root (*Plasmodiophora brassicae*)	21	Ranman (cyazofamid)	**SEE LABEL**		-	0.5	Applied as a transplant soil drench.
	29	Omega 500F (fluazinam)	2.6 pt soil appl.; 6.45 fl oz/ 100 gal transplant drench	3.85 pt	20 (leafy); 50 (head and stem)	2	Not labeled for watercress. Treated turnip roots are not fit for human or livestock consumption.
Downy Mildew (*Perenospora parasitica*)	M1	(copper compounds) **Many brands available:**	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	Mancozeb enhances bactericidal effect of fix copper compounds.
	M3	(mancozeb) **Many brands available:**	**SEE INDIVIDUAL LABELS**		10	1	Not labeled for collards, mustard, turnip or watercress. See labels for restrictions and details.
	M5	(chlorothalonil) Many brands available:	**SEE INDIVIDUAL LABELS**		7	2	Not labeled for leafy cole crops or watercress.
	4	Ridomil Gold SL (mefenoxam)	0.25 pt foliar	1 pt (foliar)	7	2	Not labeled for watercress; Use only in a tank mix with another effective fungicide (non FRAC code 4).
	4 & M5	Ridomil Gold Bravo Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	1.5 lb	See label	7	2	Not labeled for leafy cole crops or watercress. Limit is 4 applications per crop.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem) 3 (leafy)	4 hr	No more than 2 sequential appl/stem and head crop.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	92.3	0	4 hr	Labelled for head and stem brassicas. No more than 2 sequential appl.
	11	Reason 500SC(fenamidone)	8.2 oz	24.6 oz	2	0.5	Limits are no more than 1 sequential appl.
	21	Ranman (Cyazofamid)	2.75 fl oz	39.5 fl oz	0	0.5	This product can be applied as a transplant soil drench. Do not make more than six appl.
	21	Actigard 50 WG (acibenzolar-S-methyl)	1 oz	4 oz	7	0.5	Apply preventively; limit is 4 appl/crop on a 7-day schedule. Suppression only.
	33	Aliette (aluminum tris)	5 lbs	--	3	--	Do not exceed 7 applications per season.
	40	Acrobat (dimethomorph)	6.4 oz	32 oz	0	0.5	Not labeled for head and stem cole crops. Only 5 appl. per season. See supplemental label for restrictions and details.
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	Not labeled for turnip or watercress. Only 5 appl. per season.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Not labeled for turnip or watercress. Limit is no more than 2 sequential appl. or 4 total appl.

Table 5.8. Cole crop fungicides ordered by disease and FRAC group according to mode of action. (continued)

Pertinent Diseases or Pathogens	Fungicide Group[1]		Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	2	0.5	Not labeled for watercress. Limit is no more than 2 sequential appl. or 4 total appl. per season.
	45 & 40	Zampro (ametoctradin + dimthomorph)	14 fl oz	42	0	0.5	Limit is no more than 2 sequential appl.
Fusarium soilborne diseases *Fusarium* spp.	12	Maxim 4FS (fludioxonil)	0.08 to 0.16 fl oz/ 100 lb. of seed	See label	-	0.5	Seed treatment only; Not labeled for turnip or watercress.
Gray mold (*Botrytis cinera*)	7	Endura (boscalid)	9 oz	18 oz	0 (head and stem) 14 (leafy)	0.5	Not labeled for watercress; Limit is 2 appl/crop.
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development. No more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
Powdery Mildew (*Erysiphe polygoni*)	M2	(sulfur) **Many brands available:**	**SEE INDIVIDUAL LABELS**		0	-	Products are available for most cole crops; See labels for restrictions and details.
	3	Monsoon Orius 3.6F TebuStar 3.6L Tebuzol 3.6F Toledo 3.6F (tebuconazole)	4 fl oz	16 fl oz	7	0.5	Not labeled for watercress or head and stem cole crops. Apply prior to infection when environmental conditions are favorable.
	3	Procure 480 SC (triflumizole)	8 fl oz	18 fl oz	0 (leafy)	0.5	Not labeled for watercress or head and stem brassica. See label for restrictions and details.
	7	Endura (boscalid)	9 oz	18 oz	0 (head and stem) 14 (leafy)	0.5	Limit is 2 appl/crop. Suppression Only.
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	No more than 2 sequential appl. before rotating to a different mode of action for at least 2 appl; 30 day plant back for off label crops.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Begin applications prior to disease development, and continue on a 7 – 10 day interval. Make no more than 2 sequential applications before rotating to another effective fungicide with a different mode of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem) 3 (leafy)	4 hr	No more than 2 sequential appl/stem and head crop.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	No more than 1 sequential appl.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.

Table 5.8. Cole crop fungicides ordered by disease and FRAC group according to mode of action. (continued)

Pertinent Diseases or Pathogens	Fungicide Group[1]		Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
Pythium & Phytophthora diseases (soil)	4	Ridomil Gold SL (mefenoxam)	2 pt (soil)	2 pt (soil)	7	2	Not labeled for watercress; Use only in a tank mix with another effective fungicide (non FRAC code 4).
	4	Apron XL (mefenoxam)	**SEE LABEL**		-	2	Seed treatment only; Not labeled for watercress. See label for details.
	4	Ultra Flourish (mefenoxam)	4 pt	4 pt	-	2	Soil applied as a preplant treatment or following transplanting.
Pythium Damping-off *Pythium* spp.	4	Allegiance-FL (Metalaxyl)	**SEE LABEL**		-	2	Seed treatment only. Primarly for commecerial seed treatment.
	4	MetaStar 2E AG (Metalaxyl)	**SEE LABEL**		-	2	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	2	-	Not labeled for watercress. Limit is no more than 2 sequential appl. or 4 total appl. per season.
	4 & 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/100 ft of row	1.0 lb a.i.	-	-	Only one application per season.
***Phytophthora* spp.**	4	MetaStar 2E AG (Metalaxyl)	**SEE LABEL**		-	2	Can be applied as a preplant and surface application. Do not use in greenhouse crops or field-grown vegetable bedding plants.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	2	-	Not labeled for watercress. Limit is no more than 2 sequential appl. or 4 total appl. per season.
Rhizoctonia rot and blight (*Rhizoctonia solani*)	7	Endura (boscalid)	9 oz	18 oz	0 (head and stem) 14 (leafy)	0.5	Limit is 2 appl/crop. Suppression Only.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	See Label	4 hr	No more than 2 sequential appl/ stem and head crop. Labeled only for suppression in leaf greens.
	11	Quadris Equation SC Satori (azoxystrobin)	0.40 to 0.80 fl oz/100 row feet	46 fl oz	0	4 hr	Labeled only for the soilborne control on leaf green brassicas. See label for details on soilborne applications. Dynasty seed treatment is also available, check label for more information.
	12	Maxim 4FS (fludioxonil)	0.08 to 0.16 fl oz/ 100 lb. of seed		-	0.5	Seed treatment only; Not labeled for turnip or watercress.
	14	Blocker 4F Terraclor 400 Terraclor 75WP Terraclor FL (PCNB)	**SEE LABEL**	30 lb a.i.	-	0.5	Not labeled for leafy cole crops or watercress.
	4 & 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/ 100 ft of row	1.0 lb a.i.	-	-	Only one application per season.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.
Ring Spot (*Mycosphaerella brassicicola*)	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	4 hr	Not labeled for collards, kale, mustard or watercress; No more than 2 sequential appl/stem and head crop.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.

Table 5.8. Cole crop fungicides ordered by disease and FRAC group according to mode of action. (continued)

Pertinent Diseases or Pathogens	Fungicide Group[1]		Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
Sclerotinia rot (*Sclerotinia* spp.)	7	Endura (boscalid)	9 oz	18 oz	0 (head and stem) 14 (leafy)	0.5	Not labeled for watercress; Limit is 2 appl/crop.
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications.
White rust (*Albugo candida*)	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0 (head and stem) 3 (leafy)	4 hr	No more than 2 sequential appl.
	11	Quadris Equation SC Satori (azoxystrobin)	15.5 fl oz	46 fl oz	0	4 hr	Not labeled for watercress; No more than 1 sequential appl.
	11	Reason 500SC (fenamidone)	8.2 oz	24.6 oz	2	0.5	Limits are no more than 1 sequential appl.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.
White leaf spot (*Psuedocercosporella capsellae*)	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	4 hr	Not labeled for collards, kale, mustard or watercress; No more than 2 sequential appl/stem and head crop.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8.2 fl oz	24.6 fl oz	3	12 hr	No more than 2 sequential applications. No more the 3 applications in a season.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 6. Cucurbit Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Angled luffa (silk squash) – *Luffa acutangula*

Bittermelon – (Chinese and Indian types) – *Momordica charantia*

Butternut squash - *Cucurbita moschata.*

Chayote – *Sechium edule*

Chinese cucumber – *Trichosanthes kirilowii*

Cucumber - *Cucumis sativus*

Cantaloupe- *Cucumis melo.*

Fuzzy melon (immature fruit) and **Winter melon** – *Benincasa hispida*

Long gourd (oopoh) – *Lagenaria siceraria*

Pumpkin (jack-o-lantern is *C. pepo*; some processing pumpkins *are C. maxima* and *C. moschata*).

Smooth luffa – *Luffa aegyptica* (cylindrical)

Snake gourd – *Trichosanthes cucumerina*

Summer squash - *Cucurbita pepo.*

Tropical pumpkin (calabaza) - *Cucurbita moschata.*

Watermelon - *Citrullus lanatus.*

Winter squash - *Cucurbita maxima*

Table 6.1. Planting information for cucurbits.

Planting dates	Cucumber	Cantaloupe	Pumpkin	Squash		Watermelon
North Florida	Feb - Apr; July - Aug	Feb - Apr	Early July	Feb - Apr; Aug - Sept		Feb - Apr
Central Florida	Jan - Mar; Sept	Jan - Mar	Mid July	Jan - Apr; Aug - Sept		Jan - Mar
South Florida	Sept - Feb	Dec - Mar	Early August	Aug - Mar		Dec - Mar
Planting information				**Bush**	**Vining**	
Distance between rows (in)	48 - 60	60 - 72	60 - 108	36 - 48	60 - 108	60 - 108
Distance between plants (in)	6 - 12	20 - 36	36 - 60	12 - 24	36 - 60	24 - 48
Seeding depth (in)	0.5 - 0.75	0.5 - 1.0	1.5 - 2.0	1.0 - 1.5	1.5 - 2.0	1.5 - 2.0
Seed per acre (lb)	2 - 4	1 - 2	4 - 5	2 - 3	1 - 1.5	1 - 3
Days to maturity from seed	40 - 65	85 - 110	80 - 100	40 - 50	85 - 120	80 - 100
Days to maturity from transplant	Not recommended	70 - 90	70 - 90	Not recommended		60 - 90
Plant populations (acre)	21,780	4,356	2,904	7-14,520	2,904	1,815

Cultivars

Table 6.2. Cantaloupe cultivars.

Cantaloupe			
Eastern Shipper		**Harper Type**	**Calabaza (tropical pumpkin)**
Aphrodite (H)	Atlantis (H)	Caribbean Gold (H)	Agriset 9001 (vining type)
Ariel (H)	Avatar (H)	Timeless Gold (H)	La Estrella (compact plant)
Athena (H)			
H=hybrid			

Table 6.3. Cucumber cultivars.

Cucumber			
Pickling		**Slicing**	
Calypso (H) (GY)	Maxi Pack (H)	Bristol	Speedway (H) (GY)
Deli King	Maxi Pick (H)	Cobra (H) (GY)	SV3462CS* (H) (GY)
Deli Star	Powerpak (H) (GY)	Dominator (H) (GY))	SV4719CS* (H) (GY)
Excursion	Royal (H) (GY)	Impact (H) (GY)	Talledega (H) (GY)
Expedition (H)	Supremo (H)	Mongoose (H) (GY)	Thunder(H) (GY)
Eureka (H) (MO)	Transamerica (H)	Python (H)	
Excel (H) (GY)	Vlaspik (H)		
Fancipak (H) (GY)			
FMX 5020 (H)			
Jackson Classic (H) (GY)			

H=hybrid; flower habit: GY=gynoecious, MO=monoecious.

* Improved Downy Mildew resistance.

Table 6.4. Pumpkin cultivars.

Halloween pumpkin (North Florida only)				
Miniature:< 1 lb	**Small: 1-5 lb**	**Medium: 5-10 lb**	**Large: 10-20 lb**	**Giant: 25-80 lb**
Bumpkin (H)	Hybrid Pam (H)	Autumn Gold (H)	Apogee (H)	Dill's Atlantic Giant
Gold Dust (H)	Pick-A-Pie (H)	Goose Bumps II (H)	Magic Lantern (H)	Prizewinner (H)
Jill-Be-Little	Small Sugar	Jack of All Trades (H)	Connecticut Field	
Wee-Be-Little (PVP)		Knucklehead (H)	Gladiator (H)	
		Merlin (H)	Magician (H)	
		October (H)	Mustang (H)	
			Summit (H)	

PVP=Plant Variety Protection; H=hybrid

Table 6.5. Squash cultivars.

Squash				
Summer (yellow)		**Acorn**	**Butternut**	
Conqueror III (H) (SN)*	Lazor (H) (SN)	Mesa Queen (H)	Atlas (H)	Quantam (H)
Enterprise (H) (SN)	Lemondrop L (H) (SN)	Royal Ace (H)	Avalon (H)	Ultra (H)
Fortune (H) (SN)	Lioness (H) (SN)	Table Ace (H)	Canesi (H)	Waltham
Gentry (H) (CN)	Ocelot (H) (CN)	TayBelle PM (H)	Early Butternut (H)	Zenith (H)
Destiny III(H) (CN)*	Prelude II (H) (CN) *		Polaris (H)	
Goldprize (H) (SN)	XPT 1832 III (H) (SN)*			
Gold Star (H) (CN)	Sunglo (H) (CN)			
Summer (zucchini)			**Summer (yellow zucchini)**	**Summer (grey zucchini)**
Green Eclipse (H)	Pascola (H)	Senator (H)	Golden Delight (H) (SN)	Hurakan (H)
Green Machine	Paycheck (H)	Spineless Beauty (H)	Golden Glory (H) (SN)	Lolita (H)
Judgement III (H)*	Payload (H)	Spineless King (H)	Goldrush (H) (SN)	Luciana
Justice III (H)*	Payroll (H)	Spineless Perfection (H)		
	Respect (H)	SV6009YG (H)*		

H=hybrid; type: CN=crookneck, SN=straightneck.

* Biotech: Specific requirements and restrictions apply to these products.

Table 6.6. Watermelon cultivars.

Watermelon				
Diploid		**Triploid (seedless, large)**		
Estrella (H)	Summer Flavor 840 (H)	ACX 6177 (H)	Joy Ride (SV 8298) (H)	Tri X 313 (H)
Gold Strike (H) (orange flesh)	Summer Velvet 2800 (H)	Admiration (H)	Kingman (H)	Troubadour (H)
Jamboree (H)	Top Gun (H)	Affirmed (H)	Melody (H)	Unbridled (H)
Mardi Gras (H)	Vista (H)	Bold Ruler (H)	Razorback (H)	Warrior (nun 1009) (H)
Sangria (H)	8585	Captivation (H)	Road Trip (H)	Wrigley (H)
Sentinel (H)		Citation (H)	Secretariat(H)	4502 (H)
Starbrite (H)		Crisp N' Sweet (H)	Sugar Heart (H)	SS 7167 (H)
Stargazer (H)		Cronos (H)	Sugar Fresh (H)	SS 7177 (H)
Summer Flavor 790 (H)		Crunchy Red (H)	Sweet Gem (H)	SS 7197 (H)
Summer Flavor 800 (H)		Fascination (H)	Sweet Polly (H)	SV 0241 (H)
		Harmony (H)	Traveler (H)	
Triploid (seedless, mini)		**Non-Harvestable Pollenizer**		
Ana (H)	Promesa (H)	Ace	Patron	SP-6
Extazy (H)	Pixie (H)	Accomplice	Polimax	Wildcard
Leopard (H)	Sugar Bite (H)			
Ocelot	Sky View			
SKY STAR	Sky Line			
H=hybrid				

Asian Cucurbits

This group includes cucurbit fruits that can be eaten either immature or mature and several vegetables with edible tender stems and leaves. All can be grown on raised beds, with or without plastic mulch, and with drip, overhead or subsurface irrigation. Most of the crops are trellised, primarily to maximize space and sufficient sunlight, minimize bud drop and fruit rot caused by over shading and exposure to soil moisture and pathogens and to promote straight fruit. Winter melon is the exception since it is generally too heavy to trellis. Fertilizer recommendations for cucumbers are applicable for fuzzy melon, long gourd, both luffas, Chinese cucumber, bittermelon and snake gourd. There are two types of bittermelon: Indian and Chinese. The Indian type has smaller fruit with dark green color and rough skin, and the Chinese type has larger fruit with light green color and smooth skin. Chinese cucumber, though rarely commercially available, similar to European cucumber, has fruit more than 1 foot long with dark green color, very thin and rough skin and crisp texture. Recommendations for watermelon should be followed for winter melon and chayote. With the exception of chayote, where the entire fruit is planted, these crops are started from seed and grown as transplants prior to being set in the field.

Table 6.7. Planting information for Asian cucurbits.

Planting dates	**Bittermelon**	**Long gourd**	**Angled luffa**	**Smooth luffa**
North Florida	Feb – Apr; July – Aug	Feb – Apr; July – Aug	Feb – Apr; July – Aug	Feb – Apr; July – Aug
Central Florida	Jan – Mar; Sept	Jan – Mar; Sept	Jan – Mar; Sept	Jan – Mar; Sept
South Florida	Sept - Feb	Sept - Feb	Sept - Feb	Sept - Feb
Planting information				
Distance between rows (in)	60 – 72	60 – 72	60 – 72	60 – 72
Distance between plants (in)	36 – 60	36 – 60	36 – 60	36 – 60
Days to maturity from seed	80 – 100			
Plant populations (acre)	2904	2904	2904	2904
Planting dates	**Fuzzy melon**	**Snake gourd**	**Chayote**	**Winter melon**
North Florida	Feb-Apr; July-Aug	Feb-Apr; July-Aug	Not recommended	Feb – Apr
Central Florida	Jan – Mar; Sept	Jan – Mar; Sept	Not recommended	Jan – Mar
South Florida	Sept - Feb	Sept - Feb	Sept - Feb	Dec 15 – Mar 1
Planting information				
Distance between rows (in)	60 – 72	60 – 72	60 – 72	72 – 108
Distance between plants (in)	36 – 60	36 – 60	36 – 60	36 – 72
Seeding depth (in)	1.5 – 2.0	1.5 – 2.0	Whole fruit is used: It should be covered half way	1.5 – 2.0
Seed per acre			2904 – whole fruit	
Plant populations (acre)	2904	2904	2904	1452-2420

Cultivars

Table 6.8. Asian cucurbits cultivars.

Bittermelon (Chinese)*	Bittermelon (Indian)*	Winter Melon	Snake Gourd*	Angled Luffa*
Hong Kong Green	Hybrid India Star	Giant Wax	Buag Ngu	Bonanza
Hybrid Bangkok Large	India Green Queen	Hybrid Red Doll	Extra Long Dancer	Buam Liam Hybrid
Japan Green Sprindle	India Green Long	Hybrid Small Round	Long EX	Hybrid Green Glory
Taiwan Large	Palee	Hybrid Wonder Wax	Hybrid Snaky	Lucky Boy
		Round Tong Gwa	Polo	Summer Long
Smooth Luffa*	**Long Gourd***	**Fuzzy Melon***	**Chayote***	
Dok Hybrid	Bitter Gourd Long	Chiang Shin Joker	The seed is the viviparous fruit itself. There is some debate as to whether varieties remain true. Fruit purchased from grocery stores may not sprout.	
Hybrid Smooth Beauty	Hybrid Asia Short	Mokwa		
Smooth Boy	Hybrid India Long	Mokwa Long		
		Seven Star Long		

*** = Should be trellised**

Table 6.9. Herbicides approved for managing weeds in cucurbit crops.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
			*** PREEMERGENCE ***	
Bensulide 5.0 - 6.0	**(Prefar) 4 E 5 - 6 qt.**	8	All cucurbits	Annual broadleaf and grass control. Incorporate or irrigate 1 to 2 in. within 36 hr. of application. Nonlabeled crops should not be planted within 120 days of application.
Carfentrazone up to 0.031	**(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.**	14	All cucurbits	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Clomazone 0.15 - 0.38	**(Command) 3 ME 0.4 - 1 pt.**	13	Cucumber	Annual broadleaf and grass weeds. Use lower rates on coarse soils.
Clomazone 0.15 - 0.25	**(Command) 3 ME 0.4 - 0.67 pt.**	13	Muskmelon, watermelon	Annual broadleaf and grass control. Use lower rates in coarse soils.
Clomazone 0.25 - 0.5	**(Command) 3 ME 0.67 - 1.33 pt.**	13	Summer squash	Annual broadleaf and grass weeds. Broadcast for bareground production; row middles only if growing on plastic.
Clomazone 0.25 - 0.75	**(Command) 3 ME 0.67 - 2 pt.**	13	Winter squash	Annual broadleaf and grass weeds. Broadcast for bareground production; row middles only if growing on plastic. Read labels for cultivar restrictions.
Ethalfluralin + Clomazone 0.4 - 0.6 + 0.13 - 0.19	**(Strategy) 2 - 3 pt.**	3 + 13	Cucumbers, melons, summer & winter squash, pumpkin, watermelon	Annual broadleaf and grass control. Must be applied no later than 2 days after seeding. Overhead irrigation or rainfall of 0.5 in. within 5 days. Do not apply under row mulch or over top of plants.
Flumioxazin up to 0.125	**(Chateau) 51 WDG up to 4 oz.**	14	Cucumber, muskmelon, watermelon, pumpkins, summer & winter squash	Broadleaf control. Row middles only. Do not apply after crops are transplanted/ seeded. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
Glyphosate	**(various formulations) consult labels**	9	All cucurbits	Controls emerged broadleaf and grass weeds. Consult individual labels for restrictions.
Halosulfuron 0.024	**(Sandea) 75 DG 0.5 oz.**	2	Cantaloupe, cucumber, crenshaw, honeydew	Yellow and purple nutsedge and broadleaf control. Apply uniformly with ground equipment in a minimum of 15 gal. of water/A
Halosulfuron 0.024 - 0.036	**(Sandea) 75 DG 0.5 - 0.75 oz.**	2	Watermelon	Yellow and purple nutsedge and broadleaf control. May be applied preemergence to seeded watermelon on bareground or pre-seeding to mulch-cultured watermelon. Transplanting should be no sooner than 7 days after application. Use lighter rates on sandy soils with low organic matter.

Table 6.9. Herbicides approved for managing weeds in cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
Halosulfuron **0.024 - 0.036**	**(Sandea) 75 DG** **0.5 - 0.75 oz.**	2	Pumpkin, winter squash	Yellow and purple nutsedge and broadleaf control. Apply before soil cracking or pre-transplant. Transplanting should not be made sooner than 7 days after application. May be applied POST over-the-top when plants reach the 4 - 5 true leaf stage, but before first female flower appear.
Paraquat **0.63 - 0.94**	**(Gramoxone) 2 SL** **2 - 4 pt.** **(Firestorm) 3 SL** **1.3 - 2.7 pt.**	22	Cucumber, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Apply prior, during, or after planting, but before crop emergence. Use a non-ionic surfactant.
Pelargonic acid	**(Scythe) 4.2 EC** **3 - 10% v/v**	27	All cucurbits	Controls emerged weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar applied herbicide. There is no residual activity. May be tank mixed with soil residual herbicides.
Pendimethalin **1**	**(Prowl H20)** **2.1 pt.**	3	Cantaloupe, citron melon, muskmelon, watermelon	Annual broadleaf and grass weeds. Apply to the row middles only. May be applied as a sequential application with 2.1 pt./A before and 2.1 pt./A after transplanting or seeding with 21 days between applications. Do not exceed 4.2 pt./A per season.
S-metolachlor **0.95 - 1.26**	**(Brawl, Dual Magnum)** **1.0 - 1.33 pt.**	15	Pumpkin	Annual broadleaf and grass weeds and nutsedge control. Apply as inter-row or inter-hill application. Leave a 1 ft. untreated area over the seeded row (6 in. on either side of the row). Use lower rates on lighter soils. Apply before weeds emerge.
			***** POSTEMERGENCE *****	
Carfentrazone **up to 0.031**	**(Aim) 1.9 EW** **up to 2 fl. oz** **(Aim) 2.0 EC** **up to 2 fl. oz.**	14	All cucurbits	Emerged broadleaf control. Post-direct hooded application to row middles for burndown of emerged broadleaf weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Clethodim **0.94 - 0.13** **0.07 - 0.13**	**(Arrow, Intensity, Select) 2 EC** **6 - 8 oz.** **(Select Max) 1 EC** **9 - 16 fl. oz.**	1	Cucumber, squash, melons, and all commodies in crop group	Annual and perennial grass control. Use a crop oil concentrate at 1% v/v spray volume. Use nonionic surfactant in Select Max. PHI 14 days.
DCPA **4.5 - 10.5**	**(Dacthal) W 75** **6 - 14 lb.** **(Dacthal) 6 F** **6 - 14 pt.**	3	Muskmelon, cantaloupe, honeydew, watermelon	Annual grasses and certain broadleaf control. Apply only when plants have 4 - 5 true leaves, are well-established, and growing conditions are favorable for good plant growth. Cultivate prior to application to control emerged weeds.
Ethalfluralin + Clomazone	**(Strategy)** **2 - 3 pt.**	3 + 13	Cucumber, melon, summer & winter squash, pumpkin, watermelon	Annual broadleaf and grass control. After transplanting apply to row middles only. Does not control emerged weeds.
Glyphosate	**(various formulations)** **consult labels**	9	All cucurbits	Control emerged broadleaf and grass weeds. Apply to row middles only. Use a hooded sprayer to reduce drift. Consult individual labels for restrictions.
Halosulfuron **0.04 - 0.05**	**(Sandea) 75 DF** **0.5 - 1 oz.**	2	Cucumber, cantaloupe, honeydew, crenshaw melon	Apply after the 3-5 true leaf stage (no sooner than 14 days after transplanting) but before the first female flower. Spot spray a POST application if a PRE application was made. Cucumber PHI 30 days. Cantaloupe, honeydew, crenshaw 57 days.
Halosulfuron **0.02 - 0.05** **0.02 - 0.04**	**(Sandea) 75 DF** **0.5 - 1.0 oz.** **0.5 - 0.75 oz.**	2	Watermelon, summer sqaush Pumpkin, winter squash	Nutsedge and broadleaf weeds. Apply to the row middles only. Include a NIS in the spray solution. PHI 57 days in watermelon. PHI 30 days for summer/winter squash and pumpkin.
Imazosufuron **0..19 - 0.3**	**(League) 75 WG** **4 - 6.4 oz.**	2	Muskmelon, watermelon	Nutsedge and broadleaf weeds. No more than 6.4 oz/A/yr. One application per years. Surfactant is needed if weeds are emerged. Row middles only. PHI 45 days
Paraquat **0.47 - 0.93**	**(Gramoxone) 2 SL** **1.88 - 3.72**	22	Cucumber, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Row middles only. Limit of 3 applications per year. Gramoxone SL is a supplemental label consult labels for other paraquat formulations.
Pelargonic acid	**(Scythe) 4.2 EC** **3 - 10% v/v**	27	Cucumber, gourd, muskmelon, cantaloupe, pumpkin, squash, watermelon	Controls emerged weeds. Row middles only. Use a shielded sprayer directed to the row middles to reduce drift to the crop.

Table 6.9. Herbicides approved for managing weeds in cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.				
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Crops**	**Weeds controlled / remarks**
Pendimethalin **1**	**(Prowl H20)** **2.1 pt.**	3	Cantaloupe, citron melon, muskmelon, watermelon	Annual broadleaf and grass weeds. Apply to the row middles only. Apply 2.1 pt./A after transplanting or seeding and before vines are off the off the bed and in the spray area. If a preplant application was applied do not exceed 4.2 pt./A per season. PHI 35 days.
S-metolachlor **0.95 - 1.26**	**(Brawl, Dual Magnum) 7.62 EC** **1.0 - 1.33 pt.**	15	Pumpkin	Annual broadleaf and grass weeds and nutsedge. Apply as inter-row or inter-hill application. Leave a 1 ft. untreated area over the plant (6 in. on either side of the row). Use lower rates on lighter soils. Apply before weeds emerge. PHI 30 days.
Sethoxydim **0.19 - 0.28**	**(Poast) 1.5 EC** **1.0 - 1.5 pt.**	1	All cucurbits	Growing grass weeds. Include a crop oil concentrate. Efficacy is decreased if weeds are under stress. Use 1 pt. for seedling grasses and 1.5 pt. on perennial grasses. PHI 14 days.
Terbacil **0.1 - 0.2**	**(Sinbar) 80 WP** **2 - 4 oz.**	5	Watermelon	Annual broadleaf weeds. Apply to row middles only. Do not allow contact with plant foliage. Do not exceed 4 oz. per year. PHI 70 days.
Trifluralin	**(Treflan) 4 EC** **1.0 pt** **(Treflan) TR 10** **5 lb.**	3	All cucurbits	Annual broadleaf and grass control. Apply after crop is 3 to 4 true leaf stage. Row middles only. PHI 30 days except for watermelon 60 days.
			***** POSTHARVEST *****	
Diquat **0.25**	**(Reglone Dessicant)** **1.0 pt**	22	Cantaloupe	Minimum of 35 gal./A. Include a NIS. Thorough coverage is required.
Diquat **0.38**	**(Reglone Dessicant)** **1.5 pt**	22	Cucumber, watermelon, squash (except acorn)	Minimum of 35 gal./A. Include a NIS. Thorough coverage is required.
Diquat **0.5**	**(Reglone Dessicant)** **2.0 pt**	22	Squash (acorn)	Minimum of 35 gal./A. Include a NIS. Thorough coverage is required.

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops.

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.							
Insect or mite pest	**MOA Code[1]**	**Trade Name (Active Ingredient) *Restricted**	**Rate (Product/acre)**	**Max rate product per season**	**Days to Harvest**	**REI (hours)**	**Remarks[2]**
Aphids	1B	**Dimethoate 4 EC** (dimethoate)	**melons:** 1 pt **watermelons:** 0.5 – 1 pt	2 pt per year	3	48	Highly toxic to bees. **Not for squash or cucumber.**
	1B	**Malathion 5EC** **Malathion 8** (malathion)	**5EC:** cucumber: 1.5-2.8 pt; summer squash: 2.0-2.8 pt; winter squash: 1.6 pt **8:** 1.75 pt, 1.00 pt for winter squash	**5EC:** 5.6 pt for cucumber 8.4 pt for summer squash, 4.8 pt for winter squash **8:** 3.5 pt for cucumber, 5.25 for summer squash, 3.0 pt for winter squash	1	24	**5EC: Squash and cucumbers only.** Maximum of 2 **8: Squash and cucumbers only**
	3A	***Brigade 2 EC** (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	3	12	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	11.0 oz	0	12	Apply before pests reach damaging levels. Highly toxic to foraging bees.

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Max rate product per season	Days to Harvest	REI (hours)	Remarks[2]
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	7-10.5 oz **Planthouse:** 0.44 fl oz/10,000 plants	10.5 fl oz	21 (soil)	12	Will not control thrips in flowers. Do not use with other Group 4A insecticides. **Planthouse:** One application to transplants. See label for use on mature greenhouse cucumbers.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	26.5 oz	.	12	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	**Belay Insecticide** (clothianidin)	3.0-4.0 fl oz	12 fl oz	7	12	Do not apply when plants are blooming. See label for soil application instructions (21 days to harvest).
	4A	**Platinum Platinum 75SG** (thiamethoxam)	5-11 fl oz 1.66-3.67 oz	11 fl oz 3.67 oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar:** 2-7 fl oz **soil:** 9-10.5 fl oz	10.5 fl oz (foliar) or 21 fl oz (soil)	**foliar:** 1 **soil:** 21	12	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz**soil:** 5-6 oz	**foliar:** 6 oz **soil:**12 oz	**foliar:** 1 **soil:** 21	12	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.
	4D	**Sivanto 200 SL** (flupyradifurone)	**foliar:** 7-14 fl oz **soil:** 14-28 fl oz	**foliar:** 28 fl oz **soil:** 28 fl oz per crop season	**foliar:** 1 **soil:** 21	4	**foliar:** Minimum application interval: 7 days **soil:** For soil application methods, see label. Soil maximum : no more than 3 crop seasons per year.
	9B	**Fulfill** (pymetrozine)	2.75 oz	5.5 oz	0	12	Minimum of 7 days between applications.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	8.4 oz	0	12	Begin applications before pests reach damaging levels.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	36 fl oz	1	12	Do not apply more often than every 14 days. Do not use adjuvants.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	61.6 fl oz	1	12	Do not apply a total of more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	10.25 fl oz	0	4	Antifeedant, repellant, insect growth regulator. Rate depends on pest-see label.
	–	**M-Pede 49% EC, Des-X** (Soap, Insecticidal)	1-2%V/V		0	12	OMRI-listed[2]. Do not apply to stressed plants (high heat or drought conditions).
	--	**Oil, Insecticidal; SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil, Saf-T-Side, Others**	1-2 gal/100 gal **JMS:** 3-6 qt/100 gal (JMS)		0	4	Organic Stylet-Oil and Saf-T-Side are OMRI- listed[2].

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Max rate product per season	Days to Harvest	REI (hours)	Remarks[2]
Beetles (including cucumber beetle, flea beetle)	1A	**Sevin 80S, 4F, XLR** (carbaryl)	**80S:** 0.63-1.25 lb**4F, XLR:** 0.5-1.0 qt	**80S:** 7.5 lb **4F, XLR:** 6 qt	3	12	Do not apply when plants are wet. Use of carbaryl has been reported to flare (increase) mites. Do not apply to plants in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	11.2 fl oz	0	12	Can be used on all cucurbits in Crop Group 9. Highly toxic to foraging bees.
	3A	***Capture LFR** (bifenthrin)	3.4-8.5 fl oz, at planting	8.5 fl oz	N/A-applied at planting	12	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67-16 fl oz	42.67 fl oz	7	24	Highly toxic to foraging bees.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	76.8 oz, 51.2 for cantaloupe	0	12	Use high rate for aphids and squash bug. Highly toxic to foraging bees.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28-1.92 fl oz	11.5 fl oz	1	24	Do not apply to blooming crops.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	11.0 oz	0	12	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21	12	**Planthouse:** One application to transplants. See label for use on mature greenhouse cucumbers.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	26.5 oz	0	12	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	6.4 oz	Apply at planting	12	See label for application instructions. Maximum rate per season is for soil and foliar combined.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar:** 2-7 fl oz **soil:** 9-10.5 fl oz	10.5 fl oz (foliar) or 21 fl oz (soil)	**foliar:** 1 **soil:** 21	12	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz**soil:** 5-6 oz	6 oz 12 oz	**foliar:** 1 **soil:** 21	12	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	36 fl oz	1	12	Do not apply more often than every 14 days. Do not use adjuvants.
Caterpillars (including armyworms, cabbage looper, corn earworm, cutworm, melonworm, pickleworm)	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	6.4 lb	0	12	Do not apply more than 8 applications at the highest rate per season. Highly toxic to bees.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	48 fl oz	3	12	Do not apply more than 5 applications at high rate. For cucumber, melons, pumpkin, summer and winter squash. Highly toxic to foraging bees.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	11.2 fl oz	0	12	Can be used on all cucurbits in Crop Group 9. Highly toxic to foraging bees.
	3A	***Brigade 2 EC** (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	3	12	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Max rate product per season	Days to Harvest	REI (hours)	Remarks[2]
	3A	***Capture LFR** (bifenthrin)	3.4-8.5 fl oz, at planting	8.5 fl oz	N/A-applied at planting	12	At planting, banded over open furrow or in-furrow with seed or transplant.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67-16 fl oz	42.67 fl oz	7	24	Highly toxic to foraging bees.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	76.8 oz, 51.2 for cantaloupe	0	12	Use high rate for aphids and squash bug. Highly toxic to foraging bees.
	3A	***Warrior II** (lambda-cyhalothrin)	1.28-1.92 fl oz	11.5 fl oz	1	24	Do not apply to blooming crops.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	34 fl oz	3;1 for cucumbers	4	No more than 6 applications. Toxic to bees for up to 3 hours following application.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies aizawai)	0.5-2.0 lb		0	4	Apply when larvae are small for best control. OMRI-listed[2].
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed2.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies kurstaki)	0.5-2.0 lb		0	4	Use high rate for armyworms. Treat when larvae are young. Not for organic production.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb		0	4	Use higher rates for armyworms. OMRI-listed2.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies kurstaki)	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies kurstaki)	0.12-1.50 lb		0	4	Treat when larvae are young. Thorough coverage is essential. OMRI-listed2.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies aizawai)	0.5-2.0 lb		0	4	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	36 fl oz	1	12	Do not apply more often than every 14 days. Do not use adjuvants.
	18	**Intrepid 2F** (methoxyfenozide)	4-10 fl oz	64 fl oz	3	4	Do not make more than 4 applications per season.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	24 oz	3	12	Highly toxic to foraging bees.
	28	**Belt SC** (flubendiamide)	1.5 fl oz	4.5 fl oz	1	12	Rotate with products with a different mode of action. Do not use in enclosed structures.
	28	**Coragen** (chlorantraniliprole)	2.0-7.5 fl oz – drip, 3.5-7.5 – soil at planting, 2.0-7.0 – foliar	15.4 fl oz (10 fl oz for combined at plant and drip chemigation soil application)	1	4	May be applied through drip (chemigation), as well as to soil at planting, or as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	61.6 fl oz	1	12	Do not apply a total of more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per crop, either as foliar or soil applications.

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Max rate product per season	Days to Harvest	REI (hours)	Remarks[2]
Fire ants	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb		0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	2.0 lb	1	12	Apply when ants are actively foraging.
Leafminers	1B	**Dimethoate 4 EC** (dimethoate)	**melons:** 1 pt **watermelons:** 0.5 – 1 pt	2 pt per year	3	48	Highly toxic to bees. **Not for squash or cucumber.**
	5	**Radiant SC** (spinetoram)	5-10 fl oz	34 fl oz	3; 1 for cucumbers	4	No more than 6 applications. Toxic to bees for up to 3 hours following application.
	6	***Agri-Mek SC** (abamectin)	1.75-3.50 fl oz	10.25 fl oz	7	12	No more than 2 sequential applications. **Must** be mixed with an adjuvant-see label for types. Highly toxic to foraging bees.
	17	**Trigard (cyromazine)**	2.66 oz	15.96 oz	0	12	Do not make more than six applications.
	28	**Coragen** (chlorantraniliprole)	2.0-7.5 fl oz – drip, 3.5-7.5 – soil at planting, 2.0-7.0 – foliar	15.4 fl oz (10 fl oz for combined at plant and drip chemigation soil application)	1	4	May be applied through drip (chemigation), as well as to soil at planting, or as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	61.6 fl oz	1	12	Do not apply a total of more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per crop, either as foliar or soil applications.
Mites	6	***Agri-Mek SC** (abamectin)	1.75-3.50 fl oz	10.25 fl oz	7	12	No more than 2 sequential applications. **Must** be mixed with an adjuvant-see label for types. Highly toxic to foraging bees.
	10B	**Zeal** (etoxazole)	2.0-3.0 oz	3.0 oz, 6 oz for cucumber	7	12	Apply when populations are low. One application per season, except two for cucumbers (supplemental label).
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	62 fl oz	1	12	Do not apply more than twice per season. Do not apply by air. **Melons, watermeln, and cucumbers only.**
	21A	**Portal** (fenpyroximate)	2.0 pt	4.0 pt	3, 1 for cucumber	12	**All melons, watermelon, and cucumbers.** Two applications per season. Effective for broad mite control.
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	25.5 fl oz	7	12	No more than 3 applications. See label for plant-back intervals.
	--	**Acramite-50WS** (bifenazate)	0.75-1.0 lb	1.0 lb	3	12	One application per season.
Squash bug, leaf-footed bug	1A	**Sevin 80S, 4F, XLR** (carbaryl)	**80S:** 0.63-1.25 lb**4F, XLR:** 0.5-1.0 qt	**80S:** 7.5 lb**4F, XLR:** 6 qt	3	12	Do not apply when plants are wet. Use of carbaryl has been reported to flare (increase) mites. Do not apply to plants in bloom.
	3A	***Brigade 2 EC** (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	3	12	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	76.8 oz, 51.2 for cantaloupe	0	12	Use high rate for aphids and squash bug. Highly toxic to foraging bees.

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Max rate product per season	Days to Harvest	REI (hours)	Remarks[2]
	3A	***Warrior II** (lambda-cyhalothrin)	1.28-1.92 fl oz	11.5 fl oz	1	24	Do not apply to blooming crops.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	26.5 oz	0	12	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar:** 2-7 fl oz **soil:** 9-10.5 fl oz	10.5 fl oz (foliar) or 21 fl oz (soil)	**foliar:** 1 **soil**: 21	12	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz**soil:** 5-6 oz	6 oz 12 oz	**foliar:** 1 **soil:** 21	12	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.
	4D	**Sivanto 200 SL** (flupyradifurone)	**foliar:** 7-14 fl oz **soil:** 14-28 fl oz	**foliar:** 28 fl oz **soil:** 28 fl oz per crop season	**foliar:** 1 **soil:** 21	4	**foliar:** Minimum application interval: 7 days **soil:** For soil application methods, see label. Soil maximum : no more than 3 crop seasons per year.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	36 fl oz	1	12	Do not apply more often than every 14 days. Do not use adjuvants.
Thrips (check label for species controlled)	1B	**Dimethoate 4 EC** (dimethoate)	**melons:** 1 pt **watermelons:** 0.5 – 1 pt	2 pt per year	3	48	Highly toxic to bees. **Not for squash or cucumber.**
	5	**Radiant SC** (spinetoram)	6-10 fl oz	34 fl oz	3;1 for cucumbers	4	No more than 6 applications. Toxic to bees for up to 3 hours following application.
Whitefly	3A	***Brigade 2 EC** (bifenthrin)	2.6-6.4 fl oz	19.2 fl oz	3	12	Do not make more than 2 applications after bloom. Highly toxic to foraging bees.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	11.0 oz	0	12	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21	12	**Planthouse:** One application to transplants. See label for use on mature greenhouse cucumbers.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	26.5 oz	0	12	No more than 5 applications per season. Do not use with other group 4A insecticides. Toxic to foraging bees.
	4A	**Platinum Platinum 75SG** (thiamethoxam)	5-11 fl oz 1.66-3.67 oz	11 fl oz 3.67 oz	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. Highly toxic to foraging bees.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**foliar:** 2-7 fl oz **soil:** 9-10.5 fl oz	10.5 fl oz (foliar) or 21 fl oz (soil)	**foliar:** 1 **soil**: 21	12	Use only one application method (soil or foliar). Do not use with other Group 4A insecticides. Highly toxic to foraging bees for more than 38 hours after application. See label.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz**soil:** 5-6 oz	6 oz 12 oz	**foliar:** 1 **soil:** 21	12	Highly toxic to foraging bees. Use only one application method (soil or foliar). Note that pests controlled differ depending on application method.

Table 6.10. Insecticides approved for managing insect pests of cucurbit crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Max rate product per season	Days to Harvest	REI (hours)	Remarks[2]
	4D	**Sivanto 200 SL** (flupyradifurone)	**foliar:** 7-14 fl oz **soil:** 14-28 fl oz	**foliar:** 28 fl oz **soil:** 28 fl oz per crop season	**foliar:** 1 **soil:** 21	4	**foliar:** Minimum application interval: 7 days **soil:** For soil application methods, see label. Soil maximum : no more than 3 crop seasons per year.
	7C	**Knack IGR** (pyriproxyfen)	8-10 fl oz	20 fl oz	7	12	Immatures only. Apply when nymphs first appear. Do not apply more than twice per growing season.
	9B	**Fulfill** (pymetrozine)	2.75 oz	5.5 oz	0	12	Minimum of 7 days between applications.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	27.2 fl oz	7	12	Immatures only. Insect growth regulator. Do not make more than 2 applications per season per crop or 4 per year.
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	25.5 fl oz	7	12	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	61.6 fl oz	1	12	Do not apply a total of more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	28	**Verimark** (cyantraniliprole)	6.75-13.5 fl oz	at planting: 13.5 fl oz, drip chemigation: 20 fl oz (or 10 fl oz if at plant also used)	1	4	Both at plant and drip chemigation. Do not apply more than 2 drip chemigation applications (one of at plant application used).
	28,16	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	38 fl oz	1	12	Do not apply more than 3 times per crop season. Use 14- 17 fl oz for leafhoppers and whiteflies.
	–	**M-Pede 49% EC, Des-X** (Soap, Insecticidal)	1-2%V/V		0	12	OMRI-listed[2]. Do not apply to stressed plants (high heat or drought conditions).
Wireworm	1B	***Diazinon 50 W, *AG500** (diazinon)	**AG500:** 2-4 qt **50W:** 4-8 lb	4 qt8 lb	preplant	72	**Melons and watermelons only**. Not for squash or cucumbers. One application per year.
	3A	***Capture LFR** (bifenthrin)	3.4-8.5 fl oz, at planting	8.5 fl oz	N/A-applied at planting	12	At planting, banded over open furrow or in-furrow with seed or transplant.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Alternaria leaf spot	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion++, Copper-Count-N, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, NuCop HB	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	See label
	M1 & M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Labeled for all cucurbits. Some cantaloupe varieties are sensitive. See label.
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Flowable, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	SEE INDIVIDUAL LABELS		5	1	Labeled for all cucurbits.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	M5 & 27	Ariston (chlorothalonil + cymoxanil)	3.0 pt	17.5 pt	3	0.5	See label
	7	Fontelis (penthiopyrad)	16 fl oz	67 fl oz/ year	1	0.5	Maximum rate is for year. Do not make more than 2 app sequentially or any FRAC 7 containing fungicide
	7	Luna Privilege (fluopyram)	6.84 fl oz	13.7 fl oz	See label	0.5	Only labeled for watermelon. Do not make more than 2 app sequentially or any FRAC 7 containing fungicide
	7 & 3	Luna Experience (fluopryram + tebuconazole)	17 fl oz	34 fl oz	7	0.5	Only labeled for watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 3 fungicide
	7 & 11	Luna Sensation (fluopryram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	0	0.5	Only labeled on watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 11 fungicide
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl/A	7	0.5	Labeled for all cucurbits. Do not make more than two consecutive applications.
	9 & 12	Switch 62.5WG (cyprodinal + fludioxonil)	14 fl oz	See label	1	0.5	Labeled for all cucurbits. Do not apply more than 56 oz/A per plot of land per year. Do not make more than two consecutive applications before switching to fungicide with a different mode of action.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 oz	14	0.5	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits.
	11	Aframe, Azoxystar, Equation, Equation SC, Quadris, Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Labeled for all cucurbits. See label for tankmixing restrictions.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. Labeled for all cucurbits.
	19	PH-D (polyoxin D zinc salt)	6.2 oz	See label	0	4 h	See label
	22 & M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb	5	2	Limit is 8 appl/crop. Some cantaloupe varieties are sensitive, check label. Labeled for all cucurbits.
	25 & M5	Zing! (zoxamide + chlorothalonil)	36 fl.oz	See label	0	0.5	
	29	Omega 500 F (fluazinam)	1.5 pts	9 pts	30	0.5	Labeled on melon crop subgroup 9A crops only. See label
Angular leaf spot	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion++, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, Master Cop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop HB, Nu-Cop 50DF	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	See label
	M1 & M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Labeled for all cucurbits. Some cantaloupe varieties are sensitive. See label
	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventively prior disease development. Suppression of disease. Labeled for all cucurbits.
Anthracnose	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion++, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, Kop-Hydroxide 50W, MasterCop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	
	M1 & M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Labeled for all cucurbits. Some cantaloupe varieties are sensitive. See label.
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Flowable, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	SEE INDIVIDUAL LABELS		5	1	Labeled for all cucurbits.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	M5 & 27	Ariston (chlorothalonil + cymoxanil)	3.0 pints	17.5 pints	3	0.5	See label
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	Limit is 4 appl/crop. Labeled for all cucurbits.
	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Incognito 85 WDG, 3336 EG, 3336 F, 3336 WP, NuFarm T-Methyl 4.5F, NuFarm T-Methyl 70WSP, Topsin 4.5FL, Topsin M WSB, Thiophanate methyl 85WDG	SEE INDIVIDUAL LABELS		1	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	7 & 3	Luna Experience (fluopryram + tebuconazole)	17 fl oz	34 fl oz	7		Only labeled for watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7and non-FRAC 3 fungicide.
	7 & 11	Pristine 38WG (boscalid + pyraclostrobin)	18.5 oz	74 oz	0	0.5	Labeled for all cucurbits. Limit is 4 appl/crop & alternate chemistry.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	0	0.5	Only labeled on watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 11 fungicide
	7 & 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	0	0.5	Labeled for all cucurbits. Do not make more than one application before alternating to a non-FRAC 7 or non-FRAC 11 group fungicide.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl/A	7		Labeled for all cucurbits. Do not make more than two consecutive applications.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits
	11	Aframe, Azoxystar, Equation, Equation SC, Quadris, Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Labeled for all cucurbits. See label for tankmixing restrictions.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/cucumbers Subgroup 9B only.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. Labeled for all cucurbits.
	19	Oso 5% SC, PH-D (polyoxin D zinc salt)	See label	See label	See label	See label	See label

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	27 & 11	Tanos 50DF (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl/crop. Must tankmix with a contact fungicide. Labeled for all cucurbits.
	25 & M5	Zing! (Zoxamide + chlorothalonil)	36 fl.oz	See label	0	0.5	
Bacterial fruit blotch	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion++, Copper-Count-N, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide 50W, MasterCop, Nu-Cop 3L, Nu-Cop 50 DF, Nu-Cop HB	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	Suppression only
	M1 & M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Labeled on all cucurbits. Some cantaloupe varieties are sensitive. See label
	27 & 11	Tanos 50DF (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl/crop. Must tankmix with a contact fungicide. Labeled for all cucurbits. Bacterial fruit blotch disease suppression only
	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventively prior disease development. Suppression of disease. Labeled for all cucurbits.
Belly rot	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Incognito 85WDG, 3336 EG, 3336 F, 3336 WP, NuFarm T-Methyl 4.5F, NuFarm T-Methyl 70WSP, Topsin M 70WDG, Topsin M 70WP, Topsin 4.5FL, Topsin M WSB, Thiophanate methyl 85WDG	SEE INDIVIDUAL LABELS		1	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	7 & 3	Luna Experience (fluopryram + tebuconazole)	17 fl oz	34 fl oz	7		Only labeled for watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 3 fungicide.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/cucumbers Subgroup 9B only.
	11	Aframe, Azoxystar, Equation, Quadris, Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. First appl. should be made at the 1- to 3-leaf stage with 2nd appl. prior to fine tip or 10-14 days later. Labeled for all cucurbits.
	19	PH-D (polyoxin D zinc salt)	6.2 oz	See label	0	4 h	See label
Cercospora leaf spot	M1 & M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Labeled on all cucurbits. Some cantaloupe varieties are sensitive. See label.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Flowable, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	SEE INDIVIDUAL LABELS		5	1	Labeled for all cucurbits.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	0	2	Limit is 4 appl/crop. Labeled for all cucurbits.
	7 & 11	Pristine 38WG (boscalid + pyraclostrobin)	18.5 oz	74 oz	0	0.5	Labeled for all cucurbits. Limit is 4 appl/crop & alternate chemistry.
	7 & 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	0	0.5	Labeled for all cucurbits. Do not make more than one application before alternating to a non-FRAC 7 or non-FRAC 11 group fungicide.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl/A	7		Labeled for all cucurbits. Do not make more than two consecutive applications.
	11	Cabrio 20EG (pyraclostrobin)	16 fl oz	64 fl oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits.
	11	Aframe, Azoxystar, Equation, Quadris, Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1		Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/cucumbers Subgroup 9B only.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	22 & M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb	5	2	Limit is 8 appl/crop. Some cantaloupe varieties are sensitive, check label. Labeled for all cucurbits.
Downy Mildew	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion ++, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, MasterCop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	See label
	M1 & M3	ManKocide (copper hydroxide + mancozeb)	3 lb	24 lb	5	2	Labeled on all cucurbits. Some cantaloupe varieties are sensitive. See label.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Flowable, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	SEE INDIVIDUAL LABELS		5	1	Labeled for all cucurbits.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	4 & M1	Ridomil Gold/Copper 64.8 W (mefenoxam + copper hydroxide)	2 lb	8 lb	5	2	Limit is 4 appl/crop
	4 & M3	Ridomil Gold MZ WG (mancozeb + mefenoxam)	2.5 lb	10lb	5	2	Limit is 4 appl/crop. Rate for downy mildew is lower. Labeled for all cucurbits.
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt	See label	7	2	Limit is 4 appl/crop. Labeled for all cucurbits.
	3 & 33	Viathon (tebuconazole + Potassium Phosphite)	4 pt	12 pt	7	0.5	Disease suppression only. See label
	7 & 11	Pristine 38WG (boscalid + pyraclostrobin)	18.5 oz	74 oz	0	0.5	Labeled for all cucurbits. Limit is 4 appl/crop & alternate chemistry.
	7 & 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	0	0.5	(Downy mildew suppression only). Labeled for all cucurbits. Do not make more than one application before alternating to a non-FRAC 7 or non-FRAC 11 group fungicide.
	11	Cabrio 20EG (pyraclostrobin)	12 fl oz	64 fl oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/cucumbers Subgroup 9B only.
	11	Flint 50WP (trifloxystrobin)	4 oz	8 oz	0	0.5	(Disease supression) Limit is 4 appl/crop & alternate chemistry. Maximum rate is higher for downy mildew suppression. Labeled for all cucurbits.
	11	Aframe, Azoxystar, Equation, Quadris, Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 oz	14	0.5	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. Labeled for all cucurbits.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	21	Ranman 400 SC, Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Limit is 6 appl/crop.Follow resistance management guidelines on label. Labeled for all cucurbits.
	25 & M5	Zing! (zoxamide + chlorothalonil)	36 fl.oz	See label	0	0.5	
	22 & M3	Gavel 75DF (zoxamide & mancozeb)	2 lb	16 lb	5	2	Limit is 8 appl/crop. Some cantaloupe varieties are sensitive, check label. Labeled for all cucurbits.
	27	Curzate 60DF (cymoxanil)	5 oz	30 oz	3	0.5	Use only with a labeled rate of protectant fungicide.
	27 & 11	Tanos 50DF (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl/crop. Must tankmix with a contact fungicide. Labeled for all cucurbits.
	27 & M5	Ariston (chlorothalonil + cymoxanil)	3.0 pt	17.5 pt	3	0.5	See label
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.2 pt	6 pt	2	0.5	See label
	29	Omega 500 F (fluazinam)	1.5 pt	9 pt	30	0.5	Labeled on melon crop subgroup 9A crops only. See label
	33	Alude, Confine Extra, Fungi-Phite, ProPhyt, Phiticide, Phostrol, Rampart, Reveille Mono- and dibasic sodium, potassium and ammonium phosphates	See label	See label	See label	See label	See label for instructions
	33	Aliette 80WDG Linebacter WDG (fosetyl-Al)	5 lb	35 lb	12 hr	0.5	Limit is 7 appl/crop. Do not tank mix with copper fungicides. Labeled for all cucurbits. See label for specific brand.
	40	Forum (dimethomorph)	6 oz	30 oz	When spray is dried	0.5	Limit is 5 appl/ crop. Apply with another fungicide that has a different mode of action and alternate . Minimum gallons per acre required. Labeled for all cucurbits.
	40	Orondis Ultra B, Revus (mandipropamid)	8 fl oz	32 fl oz	0	4 h	See label. For suppression only
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	Tankmix with another fungicide product with a different mode of action. Labeled for all cucurbits.
	45 & 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	0.5	Limit is 3 appl/season. No more than 2 sequential appl. Addition of a spreading/ penetrating adjuvant is recommended. Labeled for all cucurbits.
	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventively prior disease development. Suppression of disease. Labeled for all cucurbits.
	U15	Orondis Ultra A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz/ year	0	4 h	Cucurbit vegetables, Crop group 9. See label for more information
Gummy stem blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion ++, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, MasterCop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	See label

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M1 & M3	ManKocide (copper hydroxide & mancozeb)	3 lb	24 lb	5	2	Labeled on all cucurbits. Some cantaloupe varieties are sensitive. See label.
	M3	(mancozeb) **Many brands available:** Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Flowable, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield	SEE INDIVIDUAL LABELS		5	1	Labeled for all cucurbits.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Incognito 85WDG, 3336 EG, 3336 F, 3336 WP, NuFarm T-Methyl 4.5 F, NuFarm T-Methyl 70WSB, Topsin M 70WP, Topsin 4.5FL, Topsin M WSB, Thiophanate methyl 85WDG, Topsin M 70WDG, T-methyl E-Ag 70WSB	SEE INDIVIDUAL LABELS		1	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	0.5	See label
	3	(tebuconazole) **Many brands available:** Folicur 3.6G, Incognito 4.5F, Monsoon, Onset 3.6L, Orius 3.6F, Tebu-Crop 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo	8 fl oz	24 fl oz	7	0.5	Maximum rate is lower for powdery mildew. Gummy stem blight suppression is only for watermelon, squash, pumpkin, and melons. See label for individual brands.
	3 & M5	Muscle ADV (tebulconazole + chlorothalonill)	1.6 pt	6.4 pt	See label	See label	See label
	3 & 33	Viathon (t ebuconazole + Potassium Phosphite)	4 pt	12 pt	7	0.5	See label
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	7	2	Limit is 4 appl/crop. Labeled for all cucurbits.
	7	Endura (boscalid)	6.5 oz	26 oz	0	0.5	Labeled for all cucurbits. Do not make more than one application of Endura before alternating to another labeled fungicide with a different mode of action for at least one application.
	7	Fontelis (penthiopyrad)	16 fl oz	67 fl oz/ year	1	0.5	Maximum rate is for year. Do not make more than 2 app sequentially
	7	Luna Privilege (fluopyram)	6.84 fl oz	13.7 fl oz	See label	0.5	Do not make more than 2 app sequentially or any FRAC 7 containing fungicide
	7 & 3	Luna Experience (fluopryram + tebuconazole)	17 fl oz	34 fl oz	7	0.5	Only labeled for watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 3 fungicide.
	7 & 11	Pristine 38WG (boscalid + pyraclostrobin)	18.5 oz	74 oz	0	0.5	Labeled for all cucurbits. Limit is 4 appl/ crop & alternate chemistry.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 & 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	0	0.5	Labeled for all cucurbits. Do not make more than one application before alternating to a non-FRAC 7 or non-FRAC 11 group fungicide. In areas where gummy stem blight reistance to FRAC 7 or 11 fungicides have been reported, tank mix with chlorothalonil at full rate
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Labeled for all cucurbits. Do not make more than two consecutive applications.
	9 & 12	Switch 62.5WG (cyprodinal + fludioxonil)	14 oz	See label	1	0.5	Labeled for all cucurbits. Do not apply more than 56 oz/A per plot of land per year. Do not make more than two consecutive applications before switching to fungicide with a different mode of action.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/ cucumbers Subgroup 9B only.
	11	Cabrio 20EG (pyraclostrobin)	16 fl oz	64 fl oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits.
	11	Aframe, Azoxystar, Equation, Quadris, Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	11	Sovran (kresoxim-methyl)	4.8 oz	19.2 oz	0	0.5	Follow resistance management guidelines on label. Labeled for all cucurbits.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. Labeled for all cucurbits.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	19	Oso 5% SC, PH-D (polyoxin D zinc salt)	See label	See label	0	4 h	See label
	27 & M5	Ariston (chlorothalonil + cymoxanil)	3.0 pt	17.5 pt	3	0.5	See label
	29	Omega 500 F (fluazinam)	1.5 pts	9 pts	30	0.5	Labeled on melon crop subgroup 9A crops only. See label
Phytophthora blight	21	Ranman 400 SC, Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Limit is 6 appl/crop.Follow resistance management guidelines on label. Labeled for all cucurbits.
	22 & M3	Gavel 75DF (zoxamide + mancozeb)	2 lb	16 lb	5	2	Limit is 8 appl/crop. Some cantaloupe varieties are sensitive, check label. Labeled for all cucurbits.
	27 & 11	Tanos 50DF (cymoxanil + famoxadone)	8 oz	See label	3	0.5	Limit is 4 appl/crop. Must tankmix with a contact fungicide. Labeled for all cucurbits. Phytophthora blight foliar and fruit phase only (disease suppression)
	33	Alude, Confine Extra, Fosphite, Fungi-Phite, ProPhyt, Phiticide, Phostrol, Rampart, Reveille (mono- and dibasic sodium, potassium and ammonium phosphates)	See label	See label	See label	Seel label	See label for instructions

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	33	Aliette 80WDG Linebacter WDG (fosetyl-Al)	5 lb	35 lb	12 hr	0.5	Limit is 7 appl/crop. Do not tank mix with copper fungicides. Labeled for all cucurbits. See label for specific brand. Phytophthora root and fruit rot
	40	Forum (dimethomorph)	6 oz	30 oz	When spray is dried	0.5	Limit is 5 appl/ crop. Apply with another fungicide that has a different mode of action and alternate . Minimum gallons per acre required. Labeled for all cucurbits. Phytophthora blight and crown rot
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	0	4 hr	An adjuvant is recommended for best control. Limit is 4 appl./crop. Phytophthora blight (supression).
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	Tankmix with another fungicide product with a different mode of action. Labeled for all cucurbits.
	45 & 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	0.5	Limit is 3 appl/season. No more than 2 sequential appl. Addition of a spreading/ penetrating adjuvant is recommended. Labeled for all cucurbits.
	U15	Orondis Gold 200, Orondis Opti A, Orondis Ultra A (oxathiapiprolin)	See label	See label	0	4 h	Cucurbit vegetables, Crop group 9. See label for more information
Plectosporium Blight	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7		Labeled for all cucurbits. Do not make more than two consecutive applications.
	11	Flint (trifloxystrobin)	2 oz	16 oz	0	0.5	Limit is 4 appl/ season. Apply or alternate with another fungicide that has a different mode of action. Labeled for all cucurbits.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/ cucumbers Subgroup 9B only.
	11	Cabrio 20EG (pyraclostrobin)	16 fl oz	64 fl oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits.
	11	Aframe, Azoxystar, Equation, Quadris 2.08FL Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. Labeled for all cucurbits.
Powdery Mildew	3	Topguard (Flutriafol)	14 fl oz	56 fl oz	0	0.5	See label
	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 FL, Champ WG, Champion ++, Copper-Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, MasterCop, Nordox, Nordox 75WG, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB	SEE INDIVIDUAL LABELS		1	Varies from 4 hr to 2 days	See label
	M1 & M3	ManKocide (copper hydroxide & mancozeb)	3 lb	24 lb	5	2	Labeled on all cucurbits. Some cantaloupe varieties are sensitive. See label.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M2	(sulfur) **Many brands available:** Cosavet DF, Cosavet DF Edge, Crusade DF, Golden Micronized Sufur, Kumulus DF, Micro Sulf, Microthiol Disperss, Suffa, Sulfur 90W, Thiolux	SEE INDIVIDUAL LABELS			1	See individual label. Do not use when temperatures are greater than 90 F or on sulfur-sensitive various. Labeled for all cucurbits.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Incognito 85 WDG, 3336 EG, 3336 F, 3336 WP, NuFarm T-Methyl 4.5F, NuFarm T-Methyl 70 WSB, Topsin M 70WP, Topsin 4.5FL, Topsin M WSB, Topsin M 70WDG, Thiophanate methyl 85WDG	SEE INDIVIDUAL LABELS		1	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	3	Rally 40WSP Sonoma 40WSP (myclobutanil)	5 oz	1.5 lb	0	1	Note that a 30 day plant back restriction exists. Follow resistance management guidelines on label. Labeled for all cucurbits.
	3	(tebuconazole) **Many brands available:** Folicur 3.6G, Monsoon, Onset 3.6L, Orius 3.6F, TebuCrop 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo	8 fl oz	24 fl oz	7	0.5	Maximum rate is lower for powdery mildew. Gummy stem blight suppression is only for watermelon, squash, pumpkin, and melons. See label for individual brands.
	3	Procure 480SC (triflumizole)	8 oz	40 oz	0	0.5	Follow resistance management guidelines on label. Labeled for all cucurbits.
	3 & M5	Muscle ADV (tebuconazole + chlorothalonil)	1.6 pt	6.4 pt	See label	See label	See label
	3 & 33	Viathon (tebuconazole + potassium phosphite)	3 pt	12 pt	7	0.5	See label
	7	Fontelis (penthiopyrad)	16 fl oz	67 fl oz/ year	1	0.5	Maximum rate is for year. Do not make more than 2 app sequentially
	7	Endura (boscalid)	6.5 oz	26 oz	0	0.5	Labeled for all cucurbits. Do not make more than one application of Endura before alternating to another labeled fungicide with a different mode of action for at least one application. (suppression)
	7	Luna Privilege (fluopyram)	6.84 fl oz	13.7 fl oz	See label	0.5	Do not make more than 2 app sequentially or any FRAC 7 containing fungicide
	7 & 3	Luna Experience (fluopryram + tebuconazole)	17 fl oz	34 fl oz	7	0.5	Only labeled for watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 3 fungicide.
	7 & 11	Pristine 38WG (boscalid + pyraclostrobin)	18.5 oz	74 oz	0	0.5	Labeled for all cucurbits. Limit is 4 appl/ crop & alternate chemistry.
	7 & 11	Luna Sensation (fluopryram + trifloxystrobin)	7.6 fl oz	27.1 fl oz	0	0.5	Only labeled on watermelon. No more than 2 sequential apps before rotating to a non-FRAC 7 and non-FRAC 11 fungicide

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 & 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	0	0.5	Labeled for all cucurbits. Do not make more than one application before alternating to a non-FRAC 7 or non-FRAC 11 group fungicide
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	80 fl oz	7	0.5	Labeled for all cucurbits. Do not make more than two consecutive applications.
	9 & 12	Switch 62.5WG (cyprodinal + fludioxonil)	14 oz	See label	1	0.5	Labeled for all cucurbits. Do not apply more than 56 oz/A per plot of land per year. Do not make more than two consecutive applications before switching to fungicide with a different mode of action.
	11	Cabrio 20EG (pyraclostrobin)	16 fl oz	64 fl oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/ cucumbers Subgroup 9B only.
	11	Flint 50WP (trifloxystrobin)	2 oz	8 oz	0	0.5	Limit is 4 appl/crop & alternate chemistry. Maximum rate is higher for downy mildew suppression. Labeled for all cucurbits.
	11	Aframe, Azoxystar, Equation, Quadris Satori, Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	4 hr	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	11	Sovran (kresoxim-methyl)	4.8 oz	19.2 oz	0	0.5	Follow resistance management guidelines on label. Labeled for all cucurbits.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.2 pt	See label	1	0.5	Limit is 4 appl/crop for all QoI fungicides. Do not make more than one consecutive application. Labeled for all cucurbits. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	1	0.5	Must be rotated with a non-QoI containing fungicide. Labeled for all cucurbits.
	13	Quintec (quinoxyfen)	6 fl oz	See label	3	0.5	Do no make more than 4 appl. Do not make more than two consecutive appls . Not labeled on all cucurbits; labeled on various melons, cantaloupe, winter squash, gourds, pumpkins, and watermelon.
	19	Oso 5% SC, PH-D (polyoxin D zinc salt)	13 fl oz	See label	0	4 hr	See label
	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventively prior disease development. Suppression of disease. Labeled for all cucurbits.
	27 & M5	Ariston (chlorothalonil + cymoxanil)	3.0 pt	17.5 pt	3	0.5	See label
	33	Confine Extra, Nutrol, Rampart (mono- and di- potassium salts of phospohorus acid/ potassium phosphite)	See label	See label	See label	Seel label	See label for instructions
	U6	Torino (cyflufenamid)	3.4 oz	6.8 oz	0	4 hr	Limit is 2 appl. per year. Labeled for all cucurbits.
	U8	Vivando (Metrafenone)	15.4 fl oz	42.2 fl oz	0	0.5	Supplemental label. See label for instructions

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Pythium	4	Apron XL Ridomil Gold SL Ultra Flourish Orondis Gold B (mefenoxam) Acquire, Allegiance FL, Metalaxyl 2E, Metastar 2E, Metastar ST, Sebring 318 FS, Sebring 480 FS (metalaxyl)	See label		See label	See label	See label
	4 &11	Uniform (mefonoxam & azoxystrobin)	See label			0	Apply 0.34 fl oz/1000 ft. of row as in-furrow spray in a minium of 5 gal. of water per acre at planting. Make only one application per season.
	28	Previcur Flex Promess (propamocarb hydrochloride)	1.2 pt	6 pt	2	0.5	Use a tank mix partner. See label for directions using a contact fungicide and Pythium suppression. Labeled for all cucurbits.
Target spot	3	Topguard (Flutriafol)	14 fl oz	56 fl oz	0	0.5	See label
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Incognito 85 WDG, 3336 EG, 3336 F, 3336 WP, NuFarm T-Methyl 4.5F, NuFarm T-Methyl 70 WSB, Topsin M 70WP, Topsin 4.5FL, Topsin M WSB, Thiophanate methyl 85WDG, Topsin M 70WDG, T-methyl E-Ag 70WSB	SEE INDIVIDUAL LABELS		1	1	Follow resistance management guidelines on label. Labeled for all cucurbits.
	11	Cabrio 20EG (pyraclostrobin)	16 fl oz	64 fl oz	0	0.5	4 appl maximum. Maximum number of sequential applications is one. Maximum rate is less for downy mildew. Labeled for all cucurbits.
	11	Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Maximum of 4 applications per season, and a minimum interval of 7 days between application. See label for more information. Labeled for use on squash/ cucumbers Subgroup 9B only.
	11	Aframe, Quadris (azoxystrobin)	15.5 fl oz	92.3 fl oz	1	0	Limit is 4 appl/crop & alternate chemistry. Labeled for all cucurbits. See label for tankmixing restrictions.
	7 & 11	Merivon (fluxapyroxad + pyraclostrobin)	5.5 fl oz	16.5 fl oz	0	0.5	Labeled for all cucurbits. Do not make more than one application before alternating to a non-FRAC 7 or non-FRAC 11 group fungicide
	19	Oso 5% SC, PH-D (polyoxin D zinc salt)	See label	See label	0	4 h	See label
	27 & M5	Ariston (chlorothalonil + cymoxanil)	3.0 pt	17.5 pt	3	0.5	See label
Scab	M1	Cueva (copper compound)	SEE LABEL		0	4	SEE LABEL FOR CROPS LABELED
	M3	(mancozeb) **Many brands available:**	SEE INDIVIDUAL LABELS		5	1	Labeled for all cucurbits.

Table 6.11. Cucurbit fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
		Dithane F45 Rainshield, Dithane M45, Fortuna 75WDG, Koverall, Manzate Flowable, Manzate Max, Manzate Pro-Stick, Penncozeb 75DF, Penncozeb 80WP, Roper DF Rainshield					
	M1 & M3	ManKocide (Copper hydroxide & Mancozeb)	3 lb	24 lb	5	2	Labeled on all cucurbits. Some cantaloupe varieties are sensitive. See label.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Choloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720 SST, Equus DF, Initiate 720, Initiate ZN, Orondis Opti B	SEE INDIVIDUAL LABELS		0	1	Labeled for all cucurbits. Recommended maximum rate is less for certain diseases including downy mildew. Follow label recommendations on watermelon after fruit set. Do not apply to mature watermelons under dry, hot and other environmental conditions listed on label.
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	3.25 pt	See label	7	2	Limit is 4 appl/crop. Labeled for all cucurbits.
	19	Oso 5% SC, PH-D (polyoxin D zinc salt)	See label	See label	0	4 h	See label
	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz	8 oz	0	0.5	Apply preventively prior disease development. Suppression of disease. Labeled for all cucurbits.

[1] FRAC code (fungicide group): Number (1 through 46) and letter U is used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet. Source: FRAC Code List 2014; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 7. Eggplant Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Eggplant, Oriental, Thai, and Indian eggpalnt - *Solanum melongena*.

Table 7.1. Planting information for eggplant.

Planting dates	Eggplant	Japanese / Chinese / Indian Eggpalnt	Thai Eggplant
North Florida	Aug/Feb - Mar	Feb - Mar	Feb - Mar
Central Florida	Aug - Sept/Jan - Feb	Aug - Sept; Jan - Feb	Aug - Sept; Jan – Feb
South Florida	Aug - Feb	Aug - Feb	Aug - Feb
Planting information			
Distance between rows (in)	36 - 72	36 – 72	36 – 72
Distance between plants (in)	18 - 40	18 – 40	36 – 60
Seeding depth (in)	0.5-0.75	0.5 – 0.75	0.5 – 0.75
Seed per acre to seed (lb)	1	0.25 – 0.5	0.25 – 0.5
Seed per acre to transplant (lb)	0.25 - 0.50		
Days to maturity from seed	90 - 115		
Days to maturity from transplant	70 - 90		
Plant population (acre)	9,680	9,680	9,680

Information on “Asian” solanums is included in this chapter. The Asian solanum group includes three types of eggplant and

bird’s eye pepper (Thai pepper). Pea eggplant, which was discussed in previous editions of the Handbook, is on the Federal Noxious Weed list, so it has not included in the current version. The harvestable product includes fruits which are eaten at the immature or mature stage. All can be grown on raised beds with or without plastic mulch and using either drip or subsurface irrigation. As with most eggplants, these types tend to be short-lived perennials, especially the Thai eggplant which is a relatively compact, stocky plant. They can be severely pruned or ratooned and allowed to regrow if staking does not prohibit this operation. Fertilizer recommendations for eggplant should be used for the three types of eggplant, while those for peppers should be followed for bird’s eye peppers. These crops can be started from seed or transplants. All the indeterminate types of eggplant needsome type of staking support.

Cultivars

For more information on eggplant variety descrptions and disease resitistace see use the link below

http://edis.ifas.ufl.edu/pdffiles/HS/HS124300.pdf

1. TRADITIONAL TYPES

Classic. Erect, vigorous plant glossy, glossy deep purple-black elongated oval, green calyxed fruit, medium tall upright plant, fancy fruit appearance. Heavy yields of high quality fruit. Does not perform well in cooler weather. R to ToM.

Nadia. Oval long, vigorous plant with good fruit set under cool conditions. Very firm, attractive, purple-black fruit with long harvest period, and set well under cool conditions.

Night Shadow. Elongate oval, widely adapted with high yield potential. Strong plants produce firm fruit which maintain rich, dark glossy black color right through harvest. R to ToM.

Santana. Tall, upright plant with few spines, firm, white flesh, glossy black-purple exterior with attractive bright green calyx. Continuous setting.

Triviata. Fruit are half-long in shape, very uniform in size and very attractive shiny purple in color. Strong growing, well balanced plant.

2. SPECIALTY TYPES

Zebra. Elongated oval, purple with white stripes, very attractive with good flavor.

Megal. Italian cylindrical fruit, purple black color, very uniform, excellent shelf life and flavor, few spines, early maturity. R to CM, ToM.

Vitoria. Very long cylindrical, deep purple Imperial type, green calyx, mild flavor. R to ToM.

Millionaire. Slender, oriental type, dark purple fruit color, purple calyx, early maturing.

Italian pink. Open pollinated cultivar, oval fruit, cream/rose color, mature fruit color is rose pink, purple calyx.

Birgah. A Sicilian style eggplant with a round, heavy, firm fruit, deep purple color and sweet taste and white flesh.

Ghostbuster. Hybrid variety to produces oval shaped white fruit that are 6-7 inches long.

DISEASE KEY: CM = cucumber mosaic, ToM = tomato mosaic, R = resistant, IR = intermediate resistance, T = tolerant.

Table 7.2. Asian eggplant cultivars

Oriental (Japanese) eggplant		
Black Shine	Money Maker 2	Hybrid Mangan
Oriental (Chinese) eggplant		
Bride Hybrid	Ma-Zu Purple	Hybrid Purple Charm
Thai eggplant		
White: Hybrid White Ball	Purple: Round Purple	Variegated: Hybrid Tiger
Green: Green Beauty	Purple: Hybrid Violet Prince	Variegated: Petch Siam
Indian eggplant (dark, wine colored)		
Hybrid Bharata	Hybrid Chu-Chu	

Table 7.3. Herbicides approved for managing weeds in eggplant.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA Code	Weeds controlled / remarks
Bensulide **5.0 - 6.0**	(Prefar) 4 E 5 - 6 qt.	8	Annual broadleaves and grasses. Incorporate 2 - 4 in. with mechanical cultivation or irrigation.
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Apply as a pre-plant burndown for emerged broadleaf weeds upto 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pre-transplant interval.
Flumioxazin **up to 0.128**	(Chateau) 51 WDG up to 4 oz.	14	Annual broadleaves. Apply to row middles of raised plastic mulched beds that are at least 4 in. higher than the treated row middles and 24 in. bed width. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank mix with a burndown herbicide to control emerged weeds.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves and grasses. Apply as a preplant burndown. Consult label for individual product directions.
Halosulfuron **0.024 - 0.05**	(Sandea, Profine) 75 DF 0.5 - 1.0 oz.	2	Broadleaves and yellow/purple nutsedge suppression. Apply to row middles only. Do not exceed 2 oz./A per 12 month period. 30 day PHI.
Lactofen **0.25 - 0.5**	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaves. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to row middles only with shielded or hooded sprayers. Cobra contacting green foliage or fruit can cause excessive injury. Drift of cobra treated soil particles onto plants can cause injury. Limit of 1 PRE and 1 POST application per growing season. 30 day PHI.
***S*-metolachlor** **0.64 - 0.95**	(Dual Magnum) 7.62 EC 0.67 - 1.0 pt.	15	Annual broadleaves, grasses and yellow / purple nutsedge suppression. Label is a Third Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the finished bed immediately before laying the plastic. Do not exceed 1.68 pt. of Dual Magnum/A per crop cycle. 60 day PHI.
Napropamide **1.0 - 2.0**	(Devrinol) 50 DF 2.0 - 4.0 lb. (Devrinol 2-XT) 2-4 quarts	15	Annual broadleaves and grasses. Transplanted eggplant only.Use the lower rate on light soils (coarse textured-sandy). Do not apply more than 4 lbs/A. per crop cycle.
Paraquat **0.5 - 1.0**	(Gramoxone) 2 SL 2.0 - 4.0 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Surfactant recommended.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds
Pendimethalin **0.48 - 0.72**	(Prowl H_20) 3.8 1.0 - 1.5 pt.	3	Broadleaves and grasses. Apply to row middles or under the plastic. Do not exceed 3.0 pt./A per year. 70 day PHI.
Pyraflufen **0.001 - 0.003**	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaves less than 4 in. tall or rosttes less than 3 in. diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.

Table 7.3. Herbicides approved for managing weeds in eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA Code**	**Weeds controlled / remarks**
Trifluralin **0.5**	(Treflan, Triflurex) 4 EC 1 pt.	3	Annual broadleaves and grasses. Do not apply in Dade County. Incorporate 4 in. or less within 8 hr. of application. Results in Florida are erratic on soils with low organic matter and clay contents. Do not apply after transplanting. Not all trifluralin herbicides are labeled in eggplant so consult labels before application.
			***** POSTTRANSPLANT *****
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Emerged broadleaves. Apply as a hooded application to row middles only. Do not exceed 6.1 fl. oz./A. per cropping season. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0 day PHI.
Clethodim **0.09 - 0.13** **0.07 - 0.25**	(Select, Arrow) 2 EC 6 - 8 fl.oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Perennial and annual grasses. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1 % v/v or a nonionic surfactant with Select Max. 20 day PHI.
DCPA **6.0 - 7.5**	(Dacthal) W-75 8 - 10 lb. (Dacthal) 6 F 8 - 10 pt.	3	Annual broadleaves and grasses. Apply to weed-free soil 6 to 8 wk. after crop is established and growing rapidly or to moist soil in row middles after crop establishment. Note label precautions against replanting non-registered crops within 8 months.
Diquat **0.5**	(Reglone Dessiccant) 1 qt.	22	Broadleaves and grasses. Apply to row middles only. Maximum of 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. 30 day PHI.
Halosulfuron **0.024 - 0.05**	(Sandea, Profine) 75 DF 0.5 - 1.0 oz.	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Include a nonionic surfactant. Do not exceed 2 oz./A per 12 month period. 30 day PHI.
Lactofen **0.25 - 0.5**	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaves. Apply to row middles only with shielded or hooded sprayers. Cobra contacting green foliage or fruit can cause excessive injury. Drift of Cobra treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. Surfactant recommended. 30 day PHI.
***S*-metolachlor** **0.95**	(Dual Magnum) 7.62 EC 1.0 pt.	15	Annual broadleaves and grasses. Yellow/purple nutsedge suppression. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Direct spray solution to row middles only. Do not exceed 1.68 pt. of Dual Magnum/A per crop. 60 day PHI.
Paraquat **0.5**	(Gramoxone) 2 SL 2 pt. (Firestorm) 3 SL 1.3 pt.	22	Emerged broadleaves and grasses. Direct spray over emerged weeds 1 to 6 inches tall in row middles between mulched beds. Use low pressure and shields to control drift. Do not apply more than 3 times per season. Nonionic surfactant recommended.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Direct spray to row middles. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
Pendimethalin **0.48 - 0.72**	(Prowl H_20) 3.8 1.0 - 1.5 pt.	3	Broadleaves and grasses. May be applied post transplant to row middles if previously untreated. Do not exceed 3.0 pt./A per year. 70 day PHI.
Sethoxydim **0.19 - 0.28**	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Actively growing grasses. A total of 4.5 pt./A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 20 day PHI.
			***** POSTHARVEST *****
Diquat **0.5**	(Reglone Dessiccant) 2.0 pt.	22	Minimum of 35 gal./A. Thorough coverage is required. Nonionic surfactant recommended.

Table 7.4. Insecticides approved for managing insect pests of eggplant.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
Aphids (including green peach aphid, potato aphid, aphid transmitted viruses)	1A	***Lannate LV; *SP** (methomyl)	**LV: 0.75-3.0 pt SP: 0.25-1.0 lb**	No more than 15 pints/A per crop. No more than 5 lbs/A per crop.	5	48	No more than 10 applications per crop.
	1A	***Vydate L** (oxamyl)	**2-4 pt (foliar)**	Do not apply more than 24 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	1B	**Malathion 8F** (malathion)	1.56 pt	Maximum application/A per crop is 6.24 pints.	3	12	Maximum number of applications is 4.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.Maximum of 11 oz/ acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7-10.5 fl oz	Maximum 10.5 fl. oz. /A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the direction for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21	12	Planthouse: 1 application. See label.
	4A	**Assail 30 SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16.0 ozs. /A per growing season, including any pre-transplant applications of acetamiprid.	7	12	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	Platinum	5.0-11.0 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4A	Platinum 75SG (thiamethoxam)	1.66-367.0z	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	**Scorpion 35SL** Insecticide (dinotefuran)	Foliar: 2-7 fl oz Soil: 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz soil: 5-6.0 oz	Do not apply more than 6 oz, foliar; or 12 oz, soil, per season.	foliar - 1 soil-21	12	Do not use both application methods. No more than 3 applications per season.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 oz	Do not exceed a total of 13 fl. oz./A.	30	12	May be applied to soil by one of several methods—see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	0	12	Apply before populations build to damaging levels. Minimum of 7 days between applications. Do not make more than two applications.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	Do not apply more than 8.4 oz/acre per season.	0	12	Begin applications before pests reach damaging levels.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V		0	12	OMRI-listed.
	un	**Mycotrol O** (*Beauvaria bassiana* Strain GHA)	1/4 quart -3.0 quarts/100 gallons water		0	4	Product contains live spores of a naturally-occurring fungus. Some fungicides may interfere with efficacy. OMRI listed.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qt		0	4	Begin applications before pests reach damaging levels.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.
	un	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	3-6 qts/100 gal (JMS) 1-2 gal/100 gal water		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Beetles (including blister beetle, Colorado potato beetle, cucumber beetle, flea beetle)	1A	**Carbaryl 4L** (carbaryl)	1/2 quart-2 quarts	Do not apply more than a total of 8 quarts /A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	80S: 0.63-2.5 XLR, 4F: 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	1A	*Vydate L (oxamyl)	2-4 pt (foliar)	Do not apply more than 24 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 2 lb ai per acre per season. (128 oz)	3	12	
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	Do not apply more than 0.35 lb ai per acre per season.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4-9.6 oz	Do not apply more than 0.6 lbs ai/acre per season.	3	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)		Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7-10.5 fl oz	Maximum 10.5 fl. oz. /A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the direction for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Assail 30 SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16.0 ozs. /A per growing season, including any pre-transplant applications of acetamiprid.	7	12	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Platinum**	5.0-11.0 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-367.0z	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	**Scorpion 35SL** Insecticide (dinotefuran)	Foliar: 2-7 fl oz Soil: 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz soil: 5-6.0 oz	Do not apply more than 6 oz, foliar; or 12 oz, soil, per season.	foliar - 1 soil - 21	12	Do not use both application methods. No more than 3 applications per season.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 oz	Do not exceed a total of 13 fl. oz./A.	30	12	May be applied to soil by one of several methods—see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz. /A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.
Caterpillars (including cabbage looper, imported cabbageworm, corn earworm, foilage feeding caterpillar, garden webworm, hornworms, loopers, salt march caterpillar, tobacco budworm, tomato fruitworm); including subset Armyworms (beet armyworm, fall armyworm, southern armyworm).	1A	**Carbaryl 4L** (carbaryl)	1/2 quart-2 quarts	Do not apply more than a total of 8 quarts /A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	***Lannate LV;** *SP (methomyl)	LV: 0.75-3.0 pt SP: 0.25-1.0 lb	LV: No more than 15 pints/A per crop. SP: No more than 5 lbs/A per crop.	5	48	No more than 10 applications per crop.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S**: 0.63-2.5 lb **XLR, 4F**: 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 2 lb ai per acre per season. (128 oz)	3	12	
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	Do not apply more than 0.35 lb ai per acre per season.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	Maximum of 4 applications (0.8 lb ai/acre) per season.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4-9.6 oz	Do not apply more than 0.6 lbs ai/acre per season.	3	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 oz	Do not exceed a total of 13 fl. oz./A.	30	12	May be applied to soil by one of several methods—see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	No more than 28.8 oz/acre per season.	7	12	
	11A	**Crymax WDG** *(Bacillus thuringiensis* subspecies *kurstaki)*	0.5-2.0 lb		0	4	Use high rate for armyworms. Treat when larvae are young. Not for organic production.
	11A	**Deliver** *(Bacillus thuringiensis* subspecies *kurstaki)*	0.25-1.5 lb		0	4	Use higher rates for armyworms. OMRI-listed[2].
	11A	**DiPel DF** *(Bacillus thuringiensis* subspecies *kurstaki)*	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in greenhouses. OMRI listed[2].
	11A	**Javelin WG** *(Bacillus thuringiensis* subspecies *kurstaki)*	0.12-1.50 lb		0	4	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11B	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki)*	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	11B	**Xentari DF** *(Bacillus thuringiensis* subspecies *aizawai)*	0.5-2.0 lb		0	4	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	16 & 28	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Apply more than 38 fl oz per acre per season.	1	12	Do not apply more than 3 times per season. Use 14 to 17 fl oz per acre to control whiteflies, leafhoppers, and planthoppers.
	18	**Confirm 2F** (tebufenozide)	6-16 fl oz	Do not apply more than 64 ounces product per season.	7	4	Do not apply more than 16 ounces per application.
	18	**Intrepid 2F** (methoxyfenozide)	4-16 fl oz	Do not apply more than 64 oz product per season.	1	4	Do not apply more than 16 oz per application.
	28	**Belt SC**	1.5 fl oz	Do not apply more than 4.5 fl oz per acre per season.	1	12	
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Checkmate TPW-F** (pheromone)	1.2-6.0 fl oz		0	0	For mating disruption of tomato pinworm. See label for details of use.
	un	**Grandevo** Chromobacterium subtsugae strain PRAA4-1	1-3 lb		0	4	Can be used in organic production. OMRI-listed.
	un	**MBI-203 EP** (*Chromobacterium subtsugae*)	4.0-12.0 quarts		0	4	OMRI listed. Can be used in the greenhouse.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
Fire Ants	7A	**Extinguish** (S-Methoprene)	1.0-1.5 lb		0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb		1	12	Apply when ants are actively foraging.
Grasshoppers	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	[(1)]Suppression only (2) First and second instars only.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	(1) Does not control western flower thrips.
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil**: 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz **soil**: 5-6.0 oz	Do not apply more than 6 oz, foliar; or 12 oz, soil, per season.	**foliar -** 1 **soil** - 21	12	Do not use both application methods. No more than 3 applications per season.
Lace bugs	1A	**Carbaryl 4L** (carbaryl)	1/2 quart-2 quarts	Do not apply more than a total of 8 quarts /A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F** : 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	1B	**Malathion 8F** (malathion)	1.56 pt	Maximum application/A per crop is 6.24 pints.	3	12	Maximum number of applications is 4.
Leafhoppers	1A	**Carbaryl 4L** (carbaryl)	1/2 quart-2 quarts	Do not apply more than a total of 8 quarts /A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F**: 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7-10.5 fl oz	Maximum 10.5 fl. oz. /A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the direction for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum**	5.0-11.0 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-367.0z	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply if imidacloprid or thiamethoxam have been used at planting.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil**: 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 oz	Do not exceed a total of 13 fl. oz./A.	30	12	May be applied to soil by one of several methods—see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 2 7.2 fl. oz./A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
	16 & 28	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Apply more than 38 fl oz per acre per season.	1	12	Do not apply more than 3 times per season. Use 14 to 17 fl oz per acre to control whiteflies, leafhoppers, and planthoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	un	**Azatin XL** (azadirachtin)	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V		0	12	OMRI-listed.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.
	un	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	3-6 qts/100 gal (JMS) 1-2 gal/100 gal water		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Liriomyza leafminers	1A	***Vydate L** (oxamyl)	2-4 pt (foliar)	Do not apply more than 24 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 2 lb ai per acre per season. (128 oz)	3	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Pounce 25 W** (permethrin)	6.4-9.6 oz	Do not apply more than 0.6 lbs ai/acre per season.	3	12	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area. Supplemental label (expires12-30-13) for rates above 2.1 oz per acre.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2-7 fl oz Soil: 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz. /A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qt		0	4	Begin applications before pests reach damaging levels.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.
	--	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	3-6 qts/100 gal (JMS) 1-2 gal/100 gal water		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Mealybug	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
Mites (including banks grass mite, broad mite, carmine spider mite, tomato russett mite, two spotted spider mite)	1A	***Vydate L** (oxamyl)	2-4 pt (foliar)	Do not apply more than 24 pt per acre per season.	1	48	
	1B	***Dibrom 8 EC** (naled)	1	Do not apply more than 6 pints/A per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperature is over 90°F.
	1B	**Malathion 8F** (malathion)	1.56 pt	Maximum application/A per crop is 6.24 pints.	3	12	Maximum number of applications is 4.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	Maximum of 4 applications (0.8 lb ai/acre) per season.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz. /A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.
	10B	**Zeal Miticide** (etoxazole)	2-3 oz	Do not apply more than 3 oz./A per season.	7	12	Do not make more than one application per season. Do not use with an adjuvant or surfactant.
	12B	***Vendex 50 WP** (fenbutatin-oxide)	2-3 lb	Apply no more than 9 lbs/A per year.	3	48	Apply when mites first appear. No more than 3 applications per year.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	Do not apply more than 62 fl. oz/A per season.	1	12	Allow a minimum of 21 days between treatments. Do not make more than two applications per year. Do not use an adjuvant.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than 2 applications per season.
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	7	12	No more than 3 applications.
	un	**Acramite-50WS** (bifenazate)	0.75-1.0 lb	One application per season.	3	12	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**MET52 EC** (*Metarhizium anispoliae* strain F52)	drench: 40-80 fl. oz.; foliar: 0.5 pint - 2qt		0	0	
	un	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V		0	12	OMRI-listed.
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.
	un	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	3-6 qts/100 gal (JMS) 1-2 gal/100 gal water		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
Plant bugs and Tarnished plant bug	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F**: 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	Do not apply more than 8.4 oz/acre per season.	0	12	Begin applications before pests reach damaging levels.
	un	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V		0	12	OMRI-listed.
Planthoppers	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
Psyllids	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
Soil insects (garden symplyan)	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
Stinkbugs (including brown stink bug, green stink bug, southern green stink bug, squash bug)	1A	**Carbaryl 4L** (carbaryl)	1/2 quart-2 quarts	Do not apply more than a total of 8 quarts /A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F**: 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	Maximum of 4 applications (0.8 lb ai/acre) per season.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz **soil**: 5-6.0 oz	Do not apply more than 6 oz, foliar; or 12 oz, soil, per season.	**foliar -** 1 **soil** - 21	12	Do not use both application methods. No more than 3 applications per season.
	4A/28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Limited to 14 oz/acre per growing season.	1	12	
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips: check label for species controlled (eastern flower thrips, western flower thrips, Florida flower thrips, foliar feeding thrips, chilli thrips, melon thrips)	1A	**Carbaryl 4L** (carbaryl)	1/2 quart-2 quarts	Do not apply more than a total of 8 quarts /A per crop per year.	3	12	Toxic to honeybees and other bees.
	1A	**Sevin 80 S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F:** 0.5-2 qt	Do not apply more than 8 qt or 10 lb per acre per crop.	3	12	Do not apply more than seven times. Applications must be at least 7 days apart. Do not apply to crops or weeds in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Maximum amount per season: 16.8 fl oz per acre.	7	12	Do not apply at less than 7-day intervals.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7-10.5 fl oz	Maximum 10.5 fl. oz. /A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the direction for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Assail 30 SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16.0 ozs. /A per growing season, including any pre-transplant applications of acetamiprid.	7	12	Begin applications for whiteflies when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5.0-11.0 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-367.0z	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Scorpion 35SL Insecticide** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil**: 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-4 oz **soil:** 5-6.0 oz	Do not apply more than 6 oz, foliar; or 12 oz, soil, per season.	**foliar -** 1 **soil** - 21	12	Do not use both application methods. No more than 3 applications per season.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 oz	Do not exceed a total of 13 fl. oz./A.	30	12	May be applied to soil by one of several methods—see label.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz. /A in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**MET52 EC** (*Metarhizium anispoliae* strain F52)	drench: 40-80 fl. oz.; foliar: 0.5 pint - 2qt		0	0	
	un	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V		0	12	OMRI-listed.
	un	**Mycotrol O** (*Beauvaria bassiana* Strain GHA)	1/4 quart -3.0 quarts/100 gallons water		0	4	Product contains live spores of a naturally-occurring fungus. Some fungicides may interfere with efficacy. OMRI listed.
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qt		0	4	Begin applications before pests reach damaging levels.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.
	un	**Ultra-Fine Oil** **JMS Stylet-Oil** **Saf-T-Side** (oil, insecticidal)	3-6 qts/100 gal (JMS) 1-2 gal/100 gal water		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Weevils	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 0.3 lb ai/acre per season.	1	12	Do not make applications less than 7 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	This product can kill bees and other insect pollinators.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL (azadirachtin)**	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
Whiteflies	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Hero** (bifenthrin & zeta-cypermethrin)	4.5-11.2 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	4	**Platinum**	5.0-11.0 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4	**Platinum 75SG** (thiamethoxam)	1.66-367.0z	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	30	12	For most crops that are not on the label, a 120-day plant-back interval must be observed. To manage resistance, avoid using Provado or other related pesticides (Actara, Assail) in conjunction with Platinum.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Do not use if a soil application of a neonicotinoid has been used.
	4A	**Admire Pro** (imidacloprid) (for rates for other brands, see labels)	7-10.5 fl oz	Maximum 10.5 fl. oz. /A per crop per season.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the direction for use to protect pollinators. Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21	12	**Planthouse:** 1 application. See label.
	7C	**Knack IGR** (pyriproxyfen)	8-10 fl oz	Do not exceed 20 fl. oz./A per season.	1	12	Immature insects only. Apply when nymphs first appear. Make no more than two applications.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	0	12	Apply before populations build to damaging levels. Minimum of 7 days between applications. Do not make more than two applications.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Immature insects only. No more than 2 applications per crop cycle.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than 2 applications per season.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	7	12	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatment is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop	1	4	
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Apply more than 38 fl oz per acre per season.	1	12	Do not apply more than 3 times per season. Use 14 to 17 fl oz per acre to control whiteflies, leafhoppers, and planthoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** **(azadirachtin)**	5-21 oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**MET52 EC** (*Metarhizium anispoliae* strain F52)	drench: 40-80 fl. oz.; foliar: 0.5 pint - 2qt		0	0	
	un	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V		0	12	OMRI-listed.
	un	**Mycotrol O** (*Beauvaria bassiana* Strain GHA)	1/4 quart -3.0 quarts/100 gallons water		0	4	Product contains live spores of a naturally-occurring fungus. Some fungicides may interfere with efficacy. OMRI listed.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qt		0	4	Begin applications before pests reach damaging levels.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.		0	4	OMRI listed.

Table 7.4. Insecticides approved for managing insect pests of eggplant. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	un	**Ultra-Fine Oil**	3-6 qts/100 gal (JMS)		0	4	Do not exceed four applications per season. Stylet-oil will not control aphids or beetles. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
		JMS Stylet-Oil	1-2 gal/100 gal water				
		Saf-T-Side (oil, insecticidal)					

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.2 April 2012. Number codes (1 through 28) are used to distinguish the main insectide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 7.5. Eggplant fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
Alternaria blight/ Early blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, COC WDG, COC DF, COC WP, Copper Count N, Cueva, Cuprofix Ultra 40D, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 & M2	Top Cop with Sulfur (basic copper sulfate + sulfur)	2 qt			1	
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	7	Endura (boscalid)	3.5 oz	21 oz	0	0.5	
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	9 & 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Follow resistance management recommendations on label
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	Aftershock Evito 480 EC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Do not use in greenhouse production, see label for additional instructions.
	11	Flint, Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	

Table 7.5. Eggplant fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	
Anthracnose	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 & M2	Top Cop with Sulfur (copper sulfate + sulfur)	2 qt			1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720 SST, Initiate	**SEE INDIVIDUAL LABELS**		See label	0.5	
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	12	
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	See label	Disease suppression only
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	7	0.5	
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	Flint, Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11	**Many brands available:** Quadris, Aframe, Azoxystar, Equation, Satoria, Willowood Azoxy (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	See individual labels
	11 & 3	Quadris top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl. oz	0	0.5	
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	19	Ph-D (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	Disease suppression only
Phomopsis blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Master Cop, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 & M2	Top Cop with Sulfur (basic copper sulfate + sulfur)	2 qt			1	

Table 7.5. Eggplant fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Powdery mildew	M2	(sulfur) **Many brands available:** Cosavet DF, Kumulus DF Fungicide-Acaricide, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Suffa, Sulfur 90 W/ Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Echo 720, Equus 720 SST, Initiate	SEE INDIVIDUAL LABELS			0.5	
	3	Rally 40WSP Sonoma 40WSP (myclobutanil)	**SEE INDIVIDUAL LABELS**		0	1	
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	12	
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	9 & 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Follow resistance management recommendations on label
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	**Many brands available:** Quadris, Aframe, Azoxystar, Equation, Satori, Willowood Azoxy (azoxystrobin)					See individual labels
	11 & 3	Quadris top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl. oz	0	0.5	
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	13	Quintec (quinoxyfen)	6 fl oz	24 fl oz	3	12 hr	See label.
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	See label	0	4 hr	
	U8	Vivando (metrafenone)	15.4 fl oz	46.2	0	12	Apply prior to symptoms of powdery mildew
Damping off (Pythium, Rhizoctonia and other seed-borne and soil-borne fungi)	M3	Signet 480 FS (thiram)	6.5 fl oz/ 100 lb seed			1	
	4	(mefenoxam) **Many brands available:** Apron XL, Ridomil Gold SL, Ridomil Gold EC, Ultra Flourish	SEE INDIVIDUAL LABELS			2	
	4	(metalaxyl) **Many brands available:** Acquire, Allegiance FL, Metastar 2E, Sebring 2.65 ST, Sebring 318 FS, Sebring 480 FS	SEE INDIVIDUAL LABELS				
	11	Dynasty (azoxystrobin)	0.38 fl oz/ 100 lb seed			4 hr	
	11	**Many brands available:** Quadris, Aframe, Azoxystar, Equation, Satori, Willowood Azoxy (azoxystrobin)	See label		0	4 hr	For Rhizoctonia seedling rot

Table 7.5. Eggplant fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	
	12	Maxim 4 FS Spirato 480 FS Dynashield (fludioxonil)	0.16 fl oz/ 100 lb seed			0.5	See individual labels
Crown rot (*Phythophthora capsici*)	4	Metastar 2E AG (metalaxyl)	8 pt	12 pt	7	2	See label for specific instructions
	4	Ridomil Gold SL Ridomil Gold EC Ultra Flourish (mefenoxam)	SEE INDIVIDUAL LABELS				
	40 & 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	4		See label
Phytophthora blight and Crown rot	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Cueva, C-O-C WDG	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	11	Aftershock Evito 480 EC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	For disease suppression only; Do not use in greenhouse production
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	Flint, Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Disease supression only
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	Disease suppression only
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	
	29	Omega 500F (fludioxonil)	1.5 pt	9 pt	12	30 days	
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	
	40 & 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	4		See label
	U15 & 4	Oronidis Gold 200 and B (A= oxathiapiprolin + B=mefenoxam)	4.8 fl oz oxathiapiprolin + 0.5 pt mefenoxam	19.2 fl oz oxathiapiprolin per year and maximum amounts for mefenomam and metalyxl per season			See individual labels; Follow resistance management recommendations on label
	U15 & M5	Orondis Opti A and B (A= oxathiapiprolin + B=chlorothalonil)	1.5 fluid oz. oxathiapiprolin + 1.5 pt chlorothalonil	19.2 fl oz oxathiapiprolin per year and 12 pt of chlorothalonil per season			See individual labels; Follow resistance management recommendations on label

Table 7.5. Eggplant fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	U15 & 40	Orondis Ultra A and B (A= oxathiapiprolin + B=mandipropamid)	1.64 fluid oz oxathiapiprolin + 8 fl oz mandidpropamid	19.2 fl oz oxathiapiprolin per year and 32 fl oz mandipropamid per year			See individual labels; Follow resistance management recommendations on label
Gray leaf spot	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	11	Flint, Gem (trifloxystrobin)	3.0 oz	16 oz	3	0.5	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl. oz	0	0.5	
Septoria leaf spot	M1	Cueva (copper octanoate)	SEE LABEL				
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	
	11	Cabrio EG (pyraclostrobin)	16 oz	96 oz	0	0.5	
	11	Flint, Gem Fungicide (trifloxystrobin)	3.0 oz	16 oz	3	0.5	Disease suppression only
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	
	11	Reason 500SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Disease suppression only
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24 fl oz	7	0.5	

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 8. Leafy Vegetable Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

I. Lettuce, Endive, and Escarole Botany and Planting

Lettuce - *Lactuca sativa,* Asteraceae (Compositae)
Endive - *Cichorium endiva*
Escarole - *Cichorium endive*

Table 8.1. Planting information for lettuce, endive and escarole.

Planting dates	Crisphead	Butterhead	Romaine	Endive	Escarole
North Florida	Sept - Oct; Jan - Feb	Sept - Oct; Jan - Feb	Aug - Oct; Jan - Feb	Aug - Oct; Jan - Feb	Aug - Oct; Jan - Feb
Central Florida	Sept - Feb	Sept - Feb	Aug - Feb	Aug - Feb	Aug - Feb
South Florida	Sept - Feb	Sept - Feb	Sept - Mar	Sept - Mar	Sept - Mar
Planting information					
Distance between rows (in)	18 - 30	18 - 30	18 - 30	18 - 30	18 - 30
Distance between plants (in)	8 - 12	9	12	14 - 16	14 - 16
Seeding depth (in)	0.25	0.25	0.25	0.25	0.25
Seed per acre (lb)	1 - 3	1 - 3	2 - 4	3 - 4	3 - 4
Days to maturity from seed	70 - 95	60 - 80	60 - 80	60 - 80	60 - 80
Plant populations (acre)	43,560	38,720	29,040	24,891	24,891

Cultivars

Table 5.2. Lettuce, endive and escarole cultivars.

Green Saladbowl	Romaine (green)	Red Leaf	Crisphead	Endive	Escarole
Green Star	Concept	Galatic	Gator	Frisan	Full Heart NR 65
Tropicana	Kalura	New Red Fire	Gulfstream	Marcant	Twinkle
Two Star	Medallion	Red Saladbowl	Raleigh	Salad King	
	Terrapin	Vulcan	Summer Crisp (red)		
	Snappy				
	Fusion				
Boston	**Romaine (red)**	**Oakleaf (green)**	**Bibb**		
Florida Butter Crisp	Outredeous	Royal Oak	Cherokee		
Ermosa	Rosalita	Ferrari	Floribibb		
Margarita					

II. Spinach
Botany and Planting

Spinach - *Spinacia oleracea*

Table 8.3. Planting information for spinach.

Planting dates	
North and Central Florida	Sept - Mar
South Florida	Oct - Feb
Planting information	
Distance between rows (in)	12 - 36
Distance between plants (in)	2 - 6
Seeding depth (in)	0.5
Seed per acre (lb)	10 - 15
Days to maturity from seed	45 - 60
Plant population (acre)	261,136

Cultivars

Table 8.4. Spinach cultivars.

Smooth leaf	
A&C #30 (H)	Space (H)
Semi-savoy leaf	
Chinook II (H)	Gladiator (H)
Melody (H)	Skookum (H)
Tyee (H)	Ashley (H)
Seaside	
Savoy leaf	
Ambassador (H)	Hybrid 612 (H)
H = hybrid	

Table 8.5. Herbicides approved for managing weeds in lettuce, escarole, and endive.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
			*** PREEMERGENCE ***	
Benefin 1.2	**(Balan) 2 lb.**	3	Lettuce	Annual broadleaf and grass weeds. Apply before seeding or transplanting. Incorporate with cultivation or irrigation into the top 2 to 3 in. of the final bed
Bensulide 5.0 - 6.0	**(Prefar) 4 E 5 - 6 qt.**	8	Leafy vegetables	Annual broadleaf and grass weeds. Incorporate with cultivation or irrigation. Do not use on spinach or Swiss chard.
Carfentrazone up to 0.031	**(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.**	14	Leafy vegetables	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	**(various formulations) consult labels**	9	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burn down. Consult label for individual product directions.
Imazethapyr 0.016 - 0.031	**(Pursuit) 2 EC 1 - 2 fl. oz.**	2	Lettuce, endive, escarole	Broadleaf weeds. Apply in fields with 40% organic matter or greater. Do not apply more than 2 applications per crop. A maximum of 4 oz. of product per crop season. Should be applied in 2 or more gallons of water per acre. Potential for rotational crop injury is highly variable. Label is a Third-Party registration (TPR, Inc.). Use without having a signed authorization and waiver fo liability agreement is a misuse of the product. PHI 30 days.
Paraquat 0.5 - 1.0	**(Gramoxone) 2 SL 2 - 4 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.**	22	Lettuce, endive, escarole	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Do not make more than 3 applications per year.
Pelargonic acid	**(Scythe) 4.2 EC 3 - 10% v/v**	27	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown before planting.
Pronamide 1.0 - 2.0	**(Kerb) 50 WP 2.0 - 4.0 lb.**	3	Head lettuce, endive, escarole	Certain annual broadleaf and grass weeds. Overhead irrigate with 1 to 2 in. following applications. Observe rotational restrictions to other crops. Not recommended for soils with high organic matter. PHI 55 days.
Pyraflufen 0.001 - 0.003	**(ET Herbicide/Defoliant) 0.5 - 2.0 fl. oz.**	14	Leafy vegetables	Emerged broadleaf weeds. Apply as a preplant burndown 1 day prior to planting. Include an NIS at 0.25% or COC at 1.0% to the spray solution
Trifluralin 0.5	**(Treflan, Trifluralin) 4 EC 1.0 pt. (Trifluralin) 10 G 5 lb.**	3	Endive, escarole, radicchio	Annual broadleaf and grass weeds. Apply as preplant incorporate to mineral soils only.

Table 8.5. Herbicides approved for managing weeds in lettuce, escarole, and endive. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
			*** POSTEMERGENCE ***	
Carfentrazone up to 0.031	**(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.**	14	Leafy vegetables	Emerged broadleaf weeds. Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides.
Clethodim 0.09 - 0.13 0.07 - 0.13	**(Select, Arrow) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.**	1	Leafy vegetables	Emerged annual and perennial grass weeds. For repeat application, minimum of 14 days between applications. PHI 14 days
Imazethapyr 0.016 - 0.031	**(Pursuit) 2 EC 1 - 2 fl. oz.**	2	Lettuce, endive, escarole	Broadleaf weeds. Apply in fields with 40% organic matter or greater. Apply postemergence after 3 - 4 true leaf stage. Do not apply more than 2 applications per crop. A maximum of 4 oz. per crop season. Potential for rotational crop damage is highly variable. Label is a Third-Party registration (TPR, Inc.). Use without having a signed authorization and waiver for liability agreement is a misuse of the product. PHI 30 days.
Paraquat 0.3 - 0.5	**(Gramoxone) 2 SL 1.2 - 1.9 pt.**	22	Lettuce	Emerged broadleaf and grass weeds. Row middles only. Consult individual labels for not all formulations are labelled for this use pattern. Include a NIS at 0.25% v/v. PHI 24 hrs.
Pelargonic acid	**(Scythe) 4.2 EC 3 - 10% v/v**	27	Leafy vegetables	Emerged broadleaf and grass weeds. Apply as a directed or shielded spray to row middles.
Sethoxydim 0.19 - 0.28	**(Poast) 1.5 EC 1.0 - 1.5 pt.**	1	Head/leaf lettuce, endive, radicchio	Emerged grass weeds. Do not exceed 3.0 pt./A. per season. Include a crop oil concentrate. Head lettuce and radicchio PHI 30 days. Leaf lettuce and endive PHI 15 day.

Table 8.6. Herbicides approved for managing weeds in spinach.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
			*** PREPLANT / PREEMERGENCE ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burn down treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burn down treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pyraflufen 0.001 - 0.003	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
			*** POSTEMERGENCE ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides. PHI 0 days.
Clopyralid 0.06 - 0.12	(Clopyr Ag) 3 EC 0.17 - 0.33 pt.	4	Certain broadleaf weeds. Do not exceed a total of 0.5 pt./A per growing season. Apply in the 2- to 5-leaf stage of crop growth. PHI 21 days.
Clethodim 0.09 - 0.13 0.07 - 0.25	(Arrow, Select) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Perennial and annual grass weeds. Use higher rates under heavy grass pressure or larger grass weeds. Read the label for required surfactant. PHI 14 days.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar applied herbicide with no residual control. may be tank mixed with several soil residual compounds.
Sethoxydim 0.19 - 0.28	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Controls emerged grass weeds. A total of 3.0 pt./A. applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 15 days.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive).

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Aphids	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3 pt; **SP:** 0.5-1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Do not apply more than 24 pt LV per acre per crop or 8 lb SP. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Do not apply more than 12 pt LV per acre/crop or 4 lb SP.
	1B	***Diazinon AG500, 50W** (diazinon)	**AG500:** 0.5-1 pt; **50W:** 0.5-1 lb	72	10 (foliar)	Do not apply more than once. **Head and leaf lettuce only.**
	1B	**Dimethoate 4 EC** (dimethoate)	0.5 pt	48	14	**Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.**
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.6 pt; **8F:** 1-1.25 pt, 1.88 pt for leaf and head lettuce	**5EC:** 12; **8F:** 24	7, 14 for head and leaf lettuce	Do not apply more than twice per year.
	1B	**Orthene 97** (acephate)	0.5-1.0 lb	24	21	**Crisphead head lettuce only**. Do not apply more than 2 and 1/8 lb per crop cycle.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	**Head lettuce only**.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied.
	3A	***Pounce 25 W** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season for leafy vegetables other than lettuce (maximum of 0.8 lb ai/acre)
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed[2].
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid)	soil: 4.4-10.5 fl oz, foliar:1.3 fl oz	12	soil: 21, foliar:7	Do not apply more than 10.5 fl oz per acre per year if applied to soil or 6.5 fl oz if applied to foliage.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz	12	7	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	**foliar:** 3-4 fl oz; **soil:** 9-12 fl oz	12	**foliar:** 7; **soil:** Apply at planting	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum =3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz	12	**Foliar:** 7; **Soil:** 21	No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied using one of several soil application methods.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4.0-7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl oz	4	1	Maximum allowed per crop season =28 fl oz per acre. Maxium crop seasons per year=3.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Do not exceed 5.5 oz product per acre per season.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	3	Do not apply more than 10 fl oz/acre/crop. See label for information about the use of adjuvants.
	28	**Exirel** (cyazypyr)	7-20.5 fl oz	12	1	Do not apply a total of more than 0.4 lb ai/acre of cyazypyr or chlorantraniliprole containing products per crop whether applications are made to soil or foliage.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	pH of application solution must be between 4 and 6.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive). (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0-4.0 qt	4	0	
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
Beetles (including, cucumber beetle, flea beetles, ground beetles) and **weevils**	1A	**Sevin 80S, XLR, 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2.0 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	**Head lettuce only**.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	**Head and leaf lettuce only**. (1) First and second instars only. Do not apply more than 0.96 pints per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	**Head and leaf lettuce only**. Do not apply more than 0.3 lb ai/acre per season. (1) 1st and 2nd instar larvae only.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees. Only **Flea beetles.**
	4A	**Admire Pro** (imidacloprid)	soil: 4.4-10.5 fl oz, foliar:1.3 fl oz	12	soil: 21, foliar:7	Do not apply more than 10.5 fl oz per acre per year if applied to soil or 6.5 fl oz if applied to foliage. **Only flea beetles and only foliar.**
	4A	**Belay 50 WDG** (clothianidin)	**foliar:** 3-4 fl oz; **soil:** 9-12 fl oz	12	**foliar:** 7; **soil:** Apply at planting	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. **Only flea beetles and only foliar.**
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum =3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides. **Only flea beetles**
	4A	**Scorpion 35 SL insecticide, Venom Insecticide** (dinotefuran)	**Scorpion 35 SL: Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz; **Venom: foliar: 1.0-3.0 oz; soil: 5.0-6.0 oz**	12	**Foliar:** 7; **Soil:** 21	**Scorpion 35 SL:** No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label. Flea beetles. **Venom:** Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. See pollinator protection restrictions on label.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied using one of several soil application methods.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4.0-7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi or 0.172 lb ai of thiamethoxam or 0.2 lb ai of chlorantraniliprole per acre per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive). (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Caterpillars (including armyworm, corn earworm, green, cloverworm, tobacco budworm, lesser cornstalk borer, loopers, cutworm, catepillar, grubs, root maggots, wireworms)	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3 pt; **SP:** 0.5-1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Do not apply more than 24 pt LV per acre per crop or 8 lb SP. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Do not apply more than 12 pt LV per acre/crop or 4 lb SP.
	1A	***Larvin 3.2** (thiodicarb)	16-30 fl oz	48	14	Do not exceed 1.5 lb active ingredient per acre per season (60 fl oz).
	1A	**Sevin 80S, XLR, 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2.0 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	1B	***Diazinon AG500, 50W** (diazinon)	**AG500:** 1-2 qt, 1-4 qt for endive (escarole); **50W:** 2-4 lb, 2-8 lb for endive (escarole)	**AG500:** 72 – head & leaf; **50W:** 96 – endive (escarole)	preplant	See label. **Head and leaf lettuce, endive (escarole) only.**
	1B	**Orthene 97** (acephate)	0.5-1.0 lb	24	21	**Crisphead head lettuce only**. Do not apply more than 2 and 1/8 lb per crop cycle.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 2.0 lb ai/acre per season. (128 oz)
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	4.8-9.6 fl oz	12	7	**Head lettuce only**. Do not apply more than 0.35 lb ai. per acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	**Head lettuce only**.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	**Head and leaf lettuce only**. (1) First and second instars only. Do not apply more than 0.96 pints per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied.
	3A	***Pounce 25 W** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season for leafy vegetables other than lettuce (maximum of 0.8 lb ai/acre)
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	**Head and leaf lettuce only**. Do not apply more than 0.3 lb ai/acre per season. (1) 1st and 2nd instar larvae only.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied using one of several soil application methods.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4.0-7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season.
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1, except 3 for turnip greens	See label for resistance management recommendations. Do not apply more than 29 oz per acre per crop, or more than twice in succession. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1, 3 for turnip greens and other leaves of root, tuber, legume vegetables	Includes turnip greens. Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	Do not make more than 2 sequential applications without rotation to another product with a different mode of action.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed[2].
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive). (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	18	**Intrepid 2F** (methoxyfenozide)	4-10 fl oz	4	1	Do not apply more than 64 fl oz/acre per season.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	12	3	Do not apply more than 24 ounces of product per acre per crop.
	28	**Belt SC** (flubendiamide)	1.5 fl oz	12	1	Do not apply more than 4.5 fl oz/acre per season.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	4	1	Can be applied by drip chemigation, to soil at planting or used as a foliar spray.
	28	**Exirel** (cyazypyr)	7-20.5 fl oz	12	1	Do not apply a total of more than 0.4 lb ai/acre of cyazypyr or chlorantraniliprole containing products per crop whether applications are made to soil or foliage.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	pH of application solution must be between 4 and 6.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Kryocide** (cryolite)	8-20 lb	12	14	Do not apply more than 160 1b/acre/season. **For leaf and head varieties of lettuce**.
	un	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed[2].
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
Stink bugs, plant bugs, meadow spittlebug	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	**Head lettuce only**.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	**Head and leaf lettuce only**. (1) First and second instars only. Do not apply more than 0.96 pints per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	**Head and leaf lettuce only**. Do not apply more than 0.3 lb ai/acre per season. (1) 1st and 2nd instar larvae only.
	4A	**Scorpion 35 SL insecticide, Venom Insecticide** (dinotefuran)	**Scorpion 35 SL: Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz; **Venom: foliar: 1.0-3.0 oz; soil: 5.0-6.0 oz**	12	**Foliar:** 7; **Soil:** 21	**Scorpion 35 SL:** No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label. **Venom:** Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. See pollinator protection restrictions on label.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
Fire ants	7A	**Extinguish** ((S)-methoprene)	1-1.5 lb	0	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers, Mole crickets	1B	***Diazinon AG500, 50W** (diazinon)	**AG500:** 1-2 qt, 1-4 qt for endive (escarole); **50W:** 2-4 lb, 2-8 lb for endive (escarole)	**AG500:** 72 – head & leaf; **50W:** 96 – endive (escarole)	preplant	See label. **Head and leaf lettuce, endive (escarole) only.**
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	**Head and leaf lettuce only**. (1) First and second instars only. Do not apply more than 0.96 pints per acre per season.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive). (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	**Head and leaf lettuce only**. Do not apply more than 0.3 lb ai/acre per season. (1) 1st and 2nd instar larvae only.
	4A	**Scorpion 35 SL insecticide, Venom Insecticide** (dinotefuran)	**Scorpion 35 SL: Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz; **Venom: foliar: 1.0-3.0 oz; soil: 5.0-6.0 oz**	12	**Foliar:** 7; **Soil:** 21	**Scorpion 35 SL:** No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label. **Venom:** Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. See pollinator protection restrictions on label.
Leafhopper	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3 pt; **SP:** 0.5-1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Do not apply more than 24 pt LV per acre per crop or 8 lb SP. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Do not apply more than 12 pt LV per acre/crop or 4 lb SP.
	1A	**Sevin 80S, XLR, 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2.0 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	1B	**Dimethoate 4 EC** (dimethoate)	0.5 pt	48	14	**Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.**
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.6 pt; **8F:** 1-1.25 pt, 1.88 pt for leaf and head lettuce	**5EC:** 12; **8F:** 24	7, 14 for head and leaf lettuce	Do not apply more than twice per year.
	1B	**Orthene 97** (acephate)	0.5-1.0 lb	24	21	**Crisphead head lettuce only**. Do not apply more than 2 and 1/8 lb per crop cycle.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 2.0 lb ai/acre per season. (128 oz)
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	**Head lettuce only**.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	1	**Head and leaf lettuce only**. (1) First and second instars only. Do not apply more than 0.96 pints per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	**Head and leaf lettuce only**. Do not apply more than 0.3 lb ai/acre per season. (1) 1st and 2nd instar larvae only.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid)	soil: 4.4-10.5 fl oz, foliar:1.3 fl oz	12	soil: 21, foliar:7	Do not apply more than 10.5 fl oz per acre per year if applied to soil or 6.5 fl oz if applied to foliage.
	4A	**Belay 50 WDG** (clothianidin)	**foliar:** 3-4 fl oz; **soil:** 9-12 fl oz	12	**foliar:** 7; **soil:** Apply at planting	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum =3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide, Venom Insecticide** (dinotefuran)	**Scorpion 35 SL: Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz; **Venom: foliar: 1.0-3.0 oz; soil: 5.0-6.0 oz**	12	**Foliar:** 7; **Soil:** 21	**Scorpion 35 SL:** No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label. **Venom:** Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. See pollinator protection restrictions on label.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied using one of several soil application methods.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl oz	4	1	Maximum allowed per crop season =28 fl oz per acre. Maxium crop seasons per year=3.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive). (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	12	7	Insect growth regulator. Do not make more than 2 applications per season per crop or 4 per year. Allow 7 days between applications.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** Oil, insecticidal	3-6 qt/100 gal (JMS); 1-2 gal/100 gal	4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].
Leafminer	1B	***Diazinon AG500, 50W** (diazinon)	**AG500:** 0.5-1 pt; **50W:** 0.5-1 lb	72	14 (foliar)	Do not apply more than once. **Head and leaf lettuce only.**
	1B	**Dimethoate 4 EC** (dimethoate)	0.5 pt	48	14	**Leaf lettuce only, not for head lettuce. Also for endive (escarole) and Swiss chard.**
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed[2].
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1, except 3 for turnip greens	See label for resistance management recommendations. Do not apply more than 29 oz per acre per crop, or more than twice in succession. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1, 3 for turnip greens and other leaves of root, tuber, legume vegetables	Includes turnip greens. Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC**	1.75-3.50 fl oz	12	7	No more than 2 sequential applications. Must be mixed with an adjuvant-see label for types. Highly toxic to foraging bees.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	Do not make more than 2 sequential applications without rotation to another product with a different mode of action.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Limited to six applications for head lettuce and five applications for other leafy vegetables.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	4	1	Can be applied by drip chemigation, to soil at planting or used as a foliar spray.
	28	**Exirel** (cyazypyr)	7-20.5 fl oz	12	1	Do not apply a total of more than 0.4 lb ai/acre of cyazypyr or chlorantraniliprole containing products per crop whether applications are made to soil or foliage.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	pH of application solution must be between 4 and 6.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0-4.0 qt	4	0	
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** Oil, insecticidal	3-6 qt/100 gal (JMS); 1-2 gal/100 gal	4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].
Mites (including carmine spider mite, twospotted spider mite)	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.6 pt; **8F:** 1-1.25 pt, 1.88 pt for leaf and head lettuce	**5EC:** 12; **8F:** 24	7, 14 for head and leaf lettuce	Do not apply more than twice per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	**Head lettuce only**.

Table 8.7. Insecticides approved for managing insect pests of lettuce and other leafy greens (non-Brassica, including escarole and endive). (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	1	**Head and leaf lettuce only**. Do not apply more than 0.3 lb ai/acre per season. (1) 1st and 2nd instar larvae only.
	6	***Agri-Mek SC**	1.75-3.50 fl oz	12	7	No more than 2 sequential applications. Must be mixed with an adjuvant-see label for types. Highly toxic to foraging bees.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** Oil, insecticidal	3-6 qt/100 gal (JMS); 1-2 gal/100 gal	4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].
Thrips (check label for species controlled)	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3 pt; **SP:** 0.5-1.0 lb	48	10, or 7 for lowest rates for lettuce only	**Head varieties:** Do not apply more than 24 pt LV per acre per crop or 8 lb SP. **Leaf varieties and endive (escarole), dandelions, Swiss chard:** Do not apply more than 12 pt LV per acre/crop or 4 lb SP.
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1, except 3 for turnip greens	See label for resistance management recommendations. Do not apply more than 29 oz per acre per crop, or more than twice in succession. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1, 3 for turnip greens and other leaves of root, tuber, legume vegetables	Includes turnip greens. Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** Oil, insecticidal	3-6 qt/100 gal (JMS); 1-2 gal/100 gal	4	0	Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3 February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 8.8 Insecticides approved for managing insect pests of spinach.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.6 pt; **8F:** 1.0 pt	12	7	Do not apply more than twice per year.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season (5 applications at high rate).
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 0.6 lb ai/acre per season (no more than 3 applications at highest rate).
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed2
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	0	Apply before pests reach damaging levels. Highly toxic to foraging bees.
	4A	**Admire Pro** (imidacloprid)	soil: 4.4-10.5 fl oz, foliar:1.3 fl oz	12	soil: 21, foliar:7	Do not apply more than 10.5 fl oz per acre per year if applied to soil or 6.5 fl oz if applied to foliage.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz	12	7	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season or apply more often than every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	**foliar:** 3-4 fl oz; **soil:** 9-12 fl oz	12	**foliar:** 7; **soil:** Apply at planting	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum =3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz	12	**Foliar:** 7; **Soil:** 21	No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied using one of several soil application methods. One application per season.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4.0-7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season. Do not use an adjuvant.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl oz	4	1	Maximum allowed per crop season =28 fl oz per acre. Maxium crop seasons per year=3.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids first appear, before populations build to damaging levels. Two applications may be needed to control persistent aphid populations.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	3	Do not apply more than 10 fl oz/acre/crop. See label for information about the use of adjuvants.
	28	**Exirel** (cyazypyr)	7-20.5 fl oz	12	1	Do not apply a total of more than 0.4 lb ai/acre of cyazypyr or chlorantraniliprole containing products per crop whether applications are made to soil or foliage.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	pH of application solution must be between 4 and 6.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	un	**Aza-Direct, Azatin XL, Neemix 4.5 EC** (azadirachtin)	**Aza-Direct:** 1-2 pt, up to 3.5, if needed; **Azatin XL:** 5-21 fl oz; **Neemix 4.5 EC:** 4-16 fl oz	**Aza-Direct, Azatin XL:** 4; **Neemix 4.5 EC:** 12	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].

Table 8.8 Insecticides approved for managing insect pests of spinach. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	un	**Trilogy** (extract of neem oil)	1.0-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Beetles (including cucumber beetle, flea beetles, darkling beetles). Also **Weevils.**	1A	**Sevin 80S, XLR, 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2.0 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Mustang**(zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed2
	4A	**Admire Pro** (imidacloprid)	**foliar:**1.3 fl oz	12	**foliar:**7	Do not apply more 6.5 fl oz to applied to foliage. **Flea beetles only.**
	4A	**Belay 50 WDG** (clothianidin)	**foliar:** 3-4 fl oz	12	**foliar:** 7	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum =3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL; Venom** (dinotefuran)	**Scorpion 35 SL: Foliar:** 2-5.25 fl; **Venom: Foliar:** 1.0-3 oz	12	**Foliar:** 7	No more than 2 applications at highest rate per acre per season. **Flea beetles only.** See pollinator protection restrictions on label.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4.0-7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season. Do not use an adjuvant.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3 pt; **SP:** 0.5-1.0 lb	48	7	Do not use more than 4 lb of SP, or 12 pt of LV per acre/season. Do not apply to seedlings less than 3" diameter.
Caterpillars (including armyworms, corn earworm, green cloverworm, tobacco budworm, lesser cornstalk borer, loopers, cutworms). Also **grubs, root maggots, wireworms**	1A	***Larvin 3.2** (thiodicarb)	16-30 fl oz	48	14	Do not exceed 60 fl oz per acre per season (1.5 lb).
	1A	**Sevin 80S, XLR, 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2.0 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	1B	***Diazinon AG500, 50W** (diazinon)	**AG500:** 2.0-4.0 qt; **50W:** 4.0-8.0 lb	72	preplant	Do not make more than one soil application per year
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	
	3A	***Mustang**(zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 0.6 lb ai/acre per season (no more than 3 applications at highest rate).
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed[2].
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.

Table 8.8 Insecticides approved for managing insect pests of spinach. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed[2].
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. See label for rates for specific pests. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	4	1	Insect growth regulator. Do not make more than 4 applications per year or 2 applications per crop. Allow 7 days between applications.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	pH of application solution must be between 4 and 6.
	28, 16	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	12	7	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use high rate for leafhoppers and whiteflies.
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Kryocide** (cryolite)	8-20 lb	12	14	Do not apply more than 160 1b/acre/season.
	un	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed[2].
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	
Stink bugs, plant bugs, meadow spittlebug	1B	**OP's here**				
	3A	**Additional pyrethroids here**				
	3A	***Mustang**(zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed2
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz	12	**Foliar:** 7; **Soil:** 21	No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1.0-3.0 oz; **soil:** 5.0-6.0 oz	12	**foliar** - 7**soil -** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. See pollinator protection restrictions on label.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Fire ants	7A	**Extinguish** ((S)-methoprene)	1-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.

Table 8.8 Insecticides approved for managing insect pests of spinach. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Grasshoppers, mole crickets	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed2
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz; **Soil:** 9-10.5 fl oz	12	**Foliar:** 7; **Soil:** 21	No more than 2 applications at highest rate per acre per season. See pollinator protection restrictions on label.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1.0-3.0 oz; **soil:** 5.0-6.0 oz	12	**foliar** - 7**soil -** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. See pollinator protection restrictions on label.
Leafhopper	1A	**Sevin 80S, XLR, 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2.0 qt	12	14	Repeat as needed, up to 5 times, at least 7 days apart.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.6 pt; **8F:** 1.0	12	7	Do not apply more than twice per year.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season (5 applications at high rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum amount per acre per season: 12.8 fl oz.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	7	
	3A	***Mustang**(zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 25.8 fl oz of product/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 0.6 lb ai/acre per season (no more than 3 applications at highest rate).
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed2
	4A	**Admire Pro** (imidacloprid)	soil: 4.4-10.5 fl oz, foliar:1.3 fl oz	12	soil: 21, foliar:7	Do not apply more than 10.5 fl oz per acre per year if applied to soil or 6.5 fl oz if applied to foliage.
	4A	**Belay 50 WDG** (clothianidin)	**foliar:** 3-4 fl oz; **soil:** 9-12 fl oz	12	**foliar:** 7; **soil:** Apply at planting	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees.
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum =3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL; Venom** (dinotefuran)	**Scorpion 35 SL: Foliar:** 2-5.25 fl; **Venom: Foliar:** 1.0-3 oz	12	**Foliar:** 7	No more than 2 applications at highest rate per acre per season. **Flea beetles only.** See pollinator protection restrictions on label.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied using one of several soil application methods. One application per season.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4.0-7.0 oz	12	7	Do not exceed a total of 14 oz of Voliam Flexi per acre per season. Do not use an adjuvant.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl oz	4	1	Maximum allowed per crop season =28 fl oz per acre. Maxium crop seasons per year=3.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	12	7	Insect growth regulator. Do not make more than 2 applications per season per crop or 4 per year. Allow 7 days between applications.
	16, 28	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	12	7	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use high rate for leafhoppers and whiteflies.
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.

Table 8.8 Insecticides approved for managing insect pests of spinach. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed[2].
Leafminer	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC**	1.75-3.50 fl oz	12	7	No more than 2 seNo more than 2 sequential applications. Maximum of 10.25 fl oz per acre per season. Must be mixed with a non-ionic activator type wetting, spreading, and/or penetrating adjuvant, but not a binder sticker type adjuvant.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	No more than 5 applications per crop.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	4	1	Insect growth regulator. Do not make more than 4 applications per year or 2 applications per crop. Allow 7 days between applications.
	28	**Exirel** (cyazypyr)	7-20.5 fl oz	12	1	Do not apply a total of more than 0.4 lb ai/acre of cyazypyr or chlorantraniliprole containing products per crop whether applications are made to soil or foliage.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	pH of application solution must be between 4 and 6.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed[2].
Mites (including carmine spider mite, twospotted spider mite	6	***Agri-Mek SC**	1.75-3.50 fl oz	12	7	No more than 2 seNo more than 2 sequential applications. Maximum of 10.25 fl oz per acre per season. Must be mixed with a non-ionic activator type wetting, spreading, and/or penetrating adjuvant, but not a binder sticker type adjuvant.
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
Thrips (check label for species controlled)	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	_	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed[2].
	--	**M-Pede 49%**Soap, insecticidal	1-2% V/V	12	0	OMRI-listed[2].
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3 February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 8.9. Lettuce fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Alternaria	7	Fontelis 1.67SC (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11	33	1	0.5	Alternate with fungicides with dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Quadris (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.
Bacterial blight	M1	(copper compounds) **Many brands available:** Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Stretch, Tenn Cop, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
Basal rot	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	12	Cannonball WP (fludioxonil)	7 oz	28 oz	0	0.5	
Botrytis rot	7	Endura 70WG (boscalid)	11 oz	22 oz	14	0.5	
	7	Fontelis 1.67 SC (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11	33	1	0.5	Alternate with fungicides with dissimilar modes of action.
	14	Botran 75W (dichloran)	5.33 lb	5.33 lb	14	0.5	
Cercospora leaf spot	7	Fontelis 1.67SC (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11	33	1	0.5	Alternate with fungicides with dissimilar modes of action.
	12	Cannonball WP (fludioxonil)	0.5 oz	1.5 lb	14	0.5	
Damping off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lbs of seed			1	Seed treatment only.

Table 8.9. Lettuce fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Downy mildew	M1	(copper compounds) **Many brands available:** Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, Cueva, Kocide 3000, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Stretch, Tenn Cop, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M3	(mancozeb) **Many brands available:** Dithane M45, Dithane F45 Rainshield, Koverall, Mankocide, Manzate Flowable, Manzate Pro-stick	**SEE INDIVIDUAL LABELS**		10	1	
	4	Orondis Gold B (mefenoxam)	2.0 pt	2.0 pt	7	2	Do not make more than 1 soil application per crop.
	4	Ridomil Gold SL (mefenoxam)	0.25 pt	1.0 pt	7	2	Must be applied in a tank-mixture with full rate of another downy mildew registered product.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate with fungicides with dissimilar modes of action.
	15	Acrobat 50WP (dimethomorph)	6.4 oz	32 oz	0	0.5	
	15	Forum (dimethomorph)	6 fl oz	30 fl oz	0	0.5	Must be applied as a tank-mix with a fungicide of dissimilar mode of action.
	21	Ranman SC (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	21	Actigard 50WG (acibenzolar)	1 oz	4 oz	7	0.5	Apply preventatively. See label for details.
	27	Curzate (cymoxanil)	5 oz	30 oz	3	0.5	Must be applied as a tank-mix with a fungicide of dissimilar mode of action.
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	24 oz	3	0.5	
	28	Previcur Flex (propamocarb)	2 pt	8 pt	2	0.5	
	28	Promess (propamocarb)	2 pt	8 pt	2	0.5	
	33	Aliette 80WDG (fosetyl Al)	5 lb	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	Legion 80WDG (fosetyl-Al)	5 lb	20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.
	33	Linebacker WDG (fosetyl-Al)	5 lb	20 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides.

Table 8.9. Lettuce fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt		0	4 hr	See label for details.
	40	Forum (dimethomorph)	6 fl oz	30 fl oz	0	0.5	Do not apply alone in sequential applications.
	40	Orondis Ultra B (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 4 applications. Do not make more than 2 sequential applications. Do not exceed more than 33% of total foliar applications.
	40	Revus 250SC (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 2 sequential applications. See label for soil applications.
	43	Presidio 4L (fluopicolide)	3-4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. Do not exceed two sequential applications. See label for soil applications.
	45 & 40	Zampro SC (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	0.5	
	U15	Orondis Gold A (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	0	4 hr	Intended for use with Orondis Gold B (mefenoxam). See label for details. Do not exceed 4 applications. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
	U15	Orondis Ultra A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz	0	4 hr	Intended for use with Orondis Ultra B (mandipropamid). See label for details. Do not exceed 4 applications. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
Gray mold	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
Powdery mildew	M2	(sulfur) **Many brands available:** Crusade DF, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M3	(mancozeb) **Many brands available:** Dithane M-45, Dithane F45 Rainshield, Koverall, Mankocide, Manzate Flowable, Manzate Pro-stick	**SEE INDIVIDUAL LABELS**		10	1	
	3	Procure 480SC (fludioxinil)	8 fl oz	18 fl oz	0	0.5	
	3	Rally 40WSP (myclobutanil)	5 oz	20 oz	3	1	Supplemental label.
	3	Sonoma 40WSP (myclobutanil)	5 oz	20 oz	3	1	

Table 8.9. Lettuce fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7	Fontelis 1.67 SC (pentiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33	1	0.5	Alternate with fungicides with dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
	13	Quintec (quinoxyfen)	6 fl oz	24 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
Pythium damping off	4	Sebring 2.65ST (metalaxyl)	0.75 fl oz/ 100 lb of seed			1	Seed treatment only.
Pythium seedling blight	4	Acquire, Allegiance FL (metalaxyl)	0.75 fl oz/ 100 lb seed			1	Seed treatment only.
	4	Apron XL LS (mefenoxam)	0.64 fl. oz./ 100 lb seed				
	4	Metastar 2E AG (metalaxyl)	8 pt				Apply as a broadcast soil application and incorporate into top 2 inches.
Pythium seedling diseases	4	Ridomil Gold EC Ridomil Gold GR Ultra Flourish (mefenoxam)	2 pt 40 lb 4 pt			2 2 2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 & 11	Uniform SC (fludioxonil)	0.34 fl oz/ 1000 ft of row	1 appl.		0	Soil incorporated.
Rhizoctonia bottom rot	2	(iprodione) **Many brands available:** Enclosure 4F, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	2 pt	6 pt	14	1	
Rhizoctonia	7	Endura 70WG (boscalid)	11 oz	22 oz	14	0.5	
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Sclerotinia drop	2	(iprodione) **Many brands available:** Enclosure 4F, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4F	2 pt	6 pt	14	1	
	7	Endura 70WG (boscalid)	11 oz	22 oz	14	0.5	
	7	Fontelis 1.67SC (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11	33	1	0.5	Alternate with fungicides with dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.

Table 8.9. Lettuce fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	14	Botran 75W (dichloran)	5.33 lb	5.33 lb	14	0.5	
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Septoria	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
	7	Fontelis 1.67SC	24 fl oz	72 fl oz	3	0.5	
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11	33	1	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.
	4 & 11	Uniform SC	0.34 fl oz/ 1000 ft of row	1 appl.		0	Soil incorporated.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 8.10. Escarole and Endive fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Alternaria leaf spot	3	Procure 480SC (triflumazole)	8 fl oz	18 fl oz	0	0.5	
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action
	11	Quadris (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides of dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
Bacterial blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF	**SEE INDIVIDUAL LABEL**		1	Varies by product from 4 hr to 2 days	

Table 8.10. Escarole and Endive fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Basal rot	9 & 12	Switch 62.5WDG	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications.
Septoria **Gray mold** **Sclerotinia**		(cyprodinil + fludioxonil)					
	12	Cannonball WP (fludioxonil)	7 oz	28 oz	0	0.5	
	14	Botran 75W (dichloran)	5.33 lb	5.33 lb	14	0.5	
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Botrytis rot	7	Endura (boscalid)	9.0 oz	18 oz	14	0.5	See label for details.
	14	Botran 75W (dichloran)	5.33 lb	5.33 lb	14	0.5	
Cercospora leaf spot **Septoria leaf spot**	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Quadris (azoxystrobin)	15.4 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.
Damping off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lbs of seed			1	Seed treatment only.
Downy mildew	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, Champ DP, Champ Formula 2, Champion++, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kop-hydroxide, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF	**SEE INDIVIDUAL LABEL**		1	Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Crusade DF, Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W	**SEE INDIVIDUAL LABEL**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	4	Orondis Gold B (mefenoxam)	2.0 pt	2.0 pt	7	2	Do not make more than 1 soil application per crop
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate with fungicides with dissimilar modes of action.
	U15	Orondis Gold A (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	0	4 hr	Intended for use with Orondis Gold B (mefenoxam). See labels for details. Do not exceed 4 appl. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
	U15	Orondis Ultra A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz	0	4hr	Intended for use with Orondis Ultra B (mandipropamid). See labels for details. Do not exceed 4 appl. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.

Table 8.10. Escarole and Endive fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	21	Ranman SC (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	24 oz	3	0.5	
	33	Aliette 80WDG Legion 80WDG Linebacker WDG (fosetyl-Al)	5 lb 5 lb 5 lb	35 lb 20 lb 20 lb	3 3 3	0.5 0.5 0.5	Caution should be used when applying in a management program including copper fungicides.
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt		0	4 hr	See label for details.
	40	Forum (dimethopmorph)	6.0 fl oz	30 fl oz	0	0.5	Do not apply sequentially.
	40	Orondis Ultra B (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 4 appl. per crop. Do not make more than 2 seq. applications. Do not exceed more than 33% of total foliar applications.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Do not exceed 2 sequential applications. See label for soil applications.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. Do not exceed two sequential applications.
	45/40	Zampro SC (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	0	0.5	Do not exceed 2 sequential appl.
Powdery mildew	M2	(sulfur) **Many brands available:** Microfine Sulfur, Micro Sulf, Microthiol Disperss, Sulfur 90W	**SEE INDIVIDUAL LABEL**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	Procure 480SC (triflumazole)	8 fl oz	18 fl oz	0	0.5	
	7	Fontelis 1.67SC (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Alternate with fungicide with dissimilar modes of action after 2 applications. See label for details.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	64 oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
Pythium damping off	4	Sebring 2.65ST (metalaxyl)	0.7 fl oz/ 100 lbs of seed			2	Seed treatment only.
Pythium seedling blight	4	Acquire Allegiance FL (metalaxyl)	0.75 fl oz/ 100 lb seed			1	Seed treatment only.
	4	Metastar 2E AG (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches.

Table 8.10. Escarole and Endive fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
	4	Apron XL LS (mefenoxam)	0.64 fl. oz./100 lb seed			2	
Pythium seedling diseases	4	Ridomil Gold EC	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
		Ridomil Gold GR	40 lb			2	
		Ultra Flourish (mefenoxam)	4 pt			2	
Sclerotinia diseases	7	Endura (boscalid)	10.0 oz	18 oz	14	0.5	See label for details.
	11	Quadris (azoxystrobin)	15.2 fl oz	2.88 qt	0	4 hr	Alternate with fungicides with dissimilar modes of action.
Various seedling diseases	4 & 11	Uniform SC (azoxystrobin + mefenoxam)	0.34 fl oz/1000 ft of row	1 appl.		0	Soil incorporated.
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 8.11. Spinach fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
Anthracnose	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, COC DF, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Mastercop, Nordox, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Top Cop w/ Sulfur	SEE INDIVIDUAL LABELS			Varies by product from 4 hr to 2 days	
Downy mildew	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, Champion++, COC DF, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Top Cop w/ Sulfur	SEE INDIVIDUAL LABELS			Varies by product from 4 hr to 2 days	

Table 8.11. Spinach fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	M2	(sulfur) **Many brands available**: Crusade DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Suffa, Sulfur 90W, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	4	Orondis Gold B (mefenoxam)	2.0 pt	2.0 pt	21	2	Do not make more than 1 soil application per crop.
	4	Ridomil Gold SL (mefenoxam)	0.25 pt	0.5 pt	21	2	Shank application. A total of two applications may be made.
	4 & M1	Ridomil Gold/Copper WP (mefenoxam + copper hydroxide)	2 lb	4 lb	21	2	Follow Ridomil Gold EC at planting. Apply no more than 2 foliar applications.
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33	1	0.5	Apply only in water with no adjuvants or tank-mixtures. Alternate with dissimilar modes of action.
	11	Cabrio EG (pyraclostrobin)	16 oz	48 oz	0	0.5	Limit is 3 appl./crop & alternate chemistry.
	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	27	Curzate 60DF (cymoxanil)	5 oz	30 oz	1	0.5	Use only in combination with a broad spectrum protectant such as copper funicides
	27 & 11	Tanos 50DF (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with another FRAC group 11 fungicide.
	33	Aliette80WDG Legion 80WDG Linebacker 80WDG (fosetyl-Al)	5 lbs	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides or adjuvants.
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt		0	4 hr	See label for details.
	40	Orondis Ultra B (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 4 applications. Do not make more than 2 sequential applications. Do not exceed more than 33%of total foliar applications.
	40	Revus 2.08F (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Do not exceed 2 sequential applications. See label for soil applications.
	40 & 45	Zampro SC (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	0	0.5	Do not exceed 2 sequential appl.
	43	Presidio 4L (fluopicolide)	4 oz	1 pt	2	0.5	Must be tank-mixed with a fungicide of a different mode of action. See label for rotational restrictions.
	21	Actigard 50WG (acibenzolar)	0.75 oz	2.25 oz	7	0.5	See label for specific conditions.

Table 8.11. Spinach fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	U15	Orondis Gold A (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	1	4 hr	Intended for use with Orondis Gold B (mefenoxam). See label for details. Do not exceed 4 applications. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
	U15	Orondis Ultra A (oxathiapiprolin)	4.9 fl oz	19.2 fl oz	0	4 hr	Intended for use with Orondis Ultra B (mandipropamid). See label for details. Do not exceed 4 applications. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
White rust		(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, Champion++, COC DF, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Top Cop w/ Sulfur	SEE INDIVIDUAL LABELS			Varies by product from 4 hr to 2 days	
	4	Ridomil Gold SL (mefenoxam)	0.25 pt	0.5 pt	21	2	Shank application. A total of two applications may be made.
	4 & M1	Ridomil Gold/Copper WP (mefenoxam + copper hydroxide)	2 lb	4 lb	21	2	Follow Ridomil Gold EC at planting. Apply no more than 2 foliar applications.
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33	1	0.5	Apply only in water with no adjuvants or tank-mixtures. Alternate with dissimilar modes of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	21	Ranman (cyazofamid)	2.75 fl oz	13.75 fl oz	0	0.5	Do not make more than 3 sequential applications.
	33	Aliette80WDG Legion 80WDG Linebacker 80WDG (fosetyl-Al)	5 lbs	35 lb	3	0.5	Caution should be used when applying in a management program including copper fungicides or adjuvants.
	43	Presidio 4L (fluopicolide)	4 oz	1 pt	2	0.5	Must be tank-mixed with a fungicide of a different mode of action. See label for rotational restrictions.
	P	Actigard 50WG (acibenzolar)	0.75 oz	2.25 oz	7	0.5	See label for specific conditions.
Cercospora spot	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, COC DF, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Nordox, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Top Cop w/ Sulfur	SEE INDIVIDUAL LABELS			Varies by product from 4 hr to 2 days	

Table 8.11. Spinach fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	7 &11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33	1	0.5	Apply only in water with no adjuvants or tank-mixtures. Alternate with dissimilar modes of action.
	M2	(sulfur) **Many brands available:** Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Do not make more than 2 sequential applications.
Damping-off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lb of seed			1	Seed treatment only.
Pythium seedling blight	4	Acquire, Allegiance FL (metalaxyl)	0.75 fl oz/100 lb of seed			1	Seed treatment only.
	4	Sebring 2.65ST (metalaxyl)	0.75 fl oz/100 lb of seed			1	Seed treatment only.
	4	Apron XL LS (mefenoxam)	0.64 fl. oz ./ 100 lb seed			2	Seed treatment only.
	4	Metastar 2E AG (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
Pythium seedling diseases	4	Ridomil Gold EC or SL (mefenoxam)	2 pts			2	Apply at seeding in a 7-12" band on soil over seed furrow
	4	Ridomil Gold GR (mefenoxam)	40 lb			2	
	4	Ultra Flourish (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Alternaria & Powdery Mildew	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Do not make more than 2 sequential applications.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	See label for details.
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
Stemphylium leaf spot	11	(azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.5 fl oz	2.88 qt	**0**	4 hr	Alternate with fungicides of dissimilar modes of action.
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lbs of seed			0.5	Seed treatment only.
	P	Actigard 50WG (acibenzolar)	0.75 oz	2.25 oz	7	0.5	Do not apply to young seedlings.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 9. Legume Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Cluster bean / Guar – *Cyamopsis tetragonolobus*
Edamame – *Gylcine max*
Fenugreek / Methi - *Trigonella foenum-gracum*
Hyacinth bean, lablab bean – *Lablab purpureus*
Lima bean - *Phaseolus lunatus*
Pigeon pea – *Cajanus cajan*
Snapbean - *Phaseolus vulgaris,* Fabaceae (Leguminosae).
Southernpea / Yard-long bean - *Vigna unguiculata.*
Snowpea - *Pisum sativum*
Winged bean – *Psophocarpus tetragonolobus*

Table 9.1. Planting information for legumes.

Planting dates	Snapbean bush	Snapbean pole	Lima bean bush	Lima bean pole	Southern pea	Snowpea
North Florida	Mar - Apr; Aug - Sept	Mar - Apr; Aug - Sept	Mar - Apr; Aug	Mar - Apr; Aug	Mar - July	Jan - Mar
Central Florida	Feb - Apr; Aug - Sept	Feb - Apr; Aug - Sept	Feb - Mar; Aug - Sept	Feb - Mar; Aug - Sept	Feb - Aug	Nov - Feb
South Florida	Sept - Apr	Sept - Apr	Sept - Apr	Sept - Apr	Sept - Apr	Nov - Feb
Planting information						
Distance between rows (in)	18 - 40	36 – 48	18 - 36	36 – 48	20 - 42	36, 2-row beds
Number of rows/bed	1 – 2					
Distance between rows/bed	10 - 12					
Distance between plants (in)	2 - 4	3 - 5	3 - 6	8 - 12	2 - 6	2 - 6
Seeding depth (in)	1 - 1.5	1 - 1.5	1 - 1.5	1 - 1.5	1 - 1.5	1 - 1.5
Seed per acre (lb)	45 - 80	30 - 45	40 - 60	20 - 40	15 - 30	25 - 50
Days to maturity from seed	45 - 60	50 - 70	60 - 80	80 - 100	75 - 90	60 - 80
Plant populations	52,272 - 172,240	58,000	116,160	21,780	104,544	87,120

Cultivars

Table 9.2. Commercial legume cultivars.

Green Bush			Yellow Bush	Green Pole	Lima
Achiever	Inspiration	Thoroughbred	Carson	Dade	Bridgeton
Ambition	Momentum	Valentino	Gold Mine	Macaslan	Cypress
BA 0958	Opportune	Vision	Golden Rod		Fordhook 242
Buffalo	3230		Gold Rush		Jackson Wonder
Caprice	Sybaris (BA 1007)				
Southern pea			**Snowpea**		
CA Blackeye No.5	Knuckle Purplehull	Texas Cream 40	Oregon Sugarpod II		
Cream 8	Magnolia	White Acre			
Cream 12	Pinkeye Purplehull	Zipper Cream			

Asian Legumes

The Asian legume group includes fruits (usually known as pods), which are eaten at the immature stage with edible immature seeds (green shell), and some young stem tips. The winged bean also has edible leaves and roots, though the latter do not appear to be cultivated commercially in the continental U.S. Pole bean, long bean (both dark and light green colors), and broad bean are commercially grown in south Florida. All the pole or indeterminate types can be grown on raised beds with or without plastic mulch using drip, overhead or subsurface irrigation. Fenugreek does not grow well in rocky soils, such as those found in Miami-Dade County. Pigeon peas are a semi-perennial shrub in warmer areas. Many pigeon pea and winged bean varieties are short day and only flower during the fall. There are some day neutral varieties available of both crops. Edamame varieties, especially those from seed companies in the U.S., are sensitive to daytime length, so care must be taken to select varieties for one's growing area. Japanese varieties are classified as "summer" or "fall" types, indicate when they flower. Fertilizer recommendations for pole, long or broad beans are generally applicable to this group. All of these crops are started from seed, though winged beans require scarification prior to planting. All the indeterminate types need some type of support, ranging from individual bamboo stakes to trellises. However, some bush type broad beans (Indian type) do not need trellis. For pest control products, these crops are included in the legume crop chapter.

Table 9.3. Planting information for Asian legumes.

Planting dates	**Cluster bean / Guar**	**Edamame**	**Fenugreek**	**Hyacinth bean**
North Florida	Mar – Apr; Aug	Mar - Apr; Aug	Mar - Apr; Aug	Mar - Apr; Aug
Central Florida	Feb – Mar; Aug – Sept	Feb - Mar; Aug - Sept	Feb - Mar; Aug - Sept	Feb - Mar; Aug - Sept
South Florida	Sept - Apr	Sept - Apr	Sept - Apr	Sept - Apr
Planting information				
Distance between rows (in)	24	20-30	9	20
Distance between plants (in)	6	2-6	2-3	4-6
Seeding depth (in)	1 - 1.5	1 - 1.5	1 - 1.5	1 - 1.5
Days to maturity from seed	90-120	80-120	90-120	90-120
Plant populations	43,560	87,120	348,480	78,409
Planting dates	**Pigeon pea**	**Snowpea**	**Winged bean**	**Yard-long bean**
North Florida	Not recommended	Jan - Mar	Not recommended	Mar - July
Central Florida	Not recommended	Nov - Feb	Not recommended	Feb - Aug
South Florida	Nov - Feb	Nov - Feb	Mar - Apr	Sept - Apr
Planting information				
Distance between rows (in)	24-36	36, 2-row beds	36	20 - 42
Distance between plants (in)	2 - 6	2 - 6	8	2 - 6
Seeding depth (in)	1 - 1.5	1 - 1.5	1 - 1.5	1 - 1.5
Days to maturity from seed	180 (early); 270-365 (late)	60 - 80	90 (day neutral varieties)	75 - 90
Plant populations	10,890	87,120	21,780	104,544

Table 9.4. Cultivars for Asian legumes.

Crop	**Life cycle**	**Cultivars**	**Trellising**
Broad bean	Annual		Yes
Bush type broad bean	Annual	Indian type	No
Cluster bean, Guar	Annual		Yes
Edamame	Annual	Green Legend, Lucky Lion, Tohya, Triple Play,	No
Fenugreek, methi	Annual		No
Hyacinth bean, lablab bean	Annual	Akahana Fugimame, Asia Purple, Asia White	No
Long bean (dark and light green color)	Annual		Yes
Pigeon pea (a short-lived perennial)	Short-lived perennial		No
Snow / snap (edible podded) pea	Annual	Oregon Sugarpod II	Yes
Winged bean, Goa bean	Annual	Winged Bean, Youdou	Yes
Yard-long bean	Annual	Bia-long, Stickless Wonder, Orient Wonder,	Yes

Table 9.5. Herbicides approved for Asian legumes.

Labels change frequently. Be sure to read a current product label before applying any chemical.				
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Crops**	**Weeds controlled / remarks**
			***** PREEMERGENCE *****	
Carfentrazone up to 0.031	**(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.**	14	Bean (all), pea (all)	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
EPTC 2.0 - 4.0	**(Eptam) 7 E 2.25 - 4.5 pt.**	8	Bean (green, dry)	Broadleaf and nutsedge weeds. Incorporate in the same operation to reduce volatilization. Do not exceed 9 pt./A per crop.
Fomesafen 0.25 - 0.38	**(Reflex) 2 EC 1.0 - 1.5 pt.**	14	Bean (dry, snap)	Annual broadleaf and grass weeds and nutsedge. Not for use in Miami-Dade county. Do not apply more than 1.5 pt./A per year.
Glyphosate	**(various formulations) consult labels**	9	Bean (all), pea (all)	Emerged broadleaf and grass weeds. Consult individual labels for restrictions.
Halosulfuron 0.02	**(Sandea) 75 DF 0.5 oz.**	2	Bean (blackeyed, cowpea, southern pea)	Broadleaf weeds and nutsedge. Apply after planting but before crop emergence. May cause significant, temporary stunting and delay maturity of peas, resulting in delayed harvest.
Imazethapyr 0.02	**(Pursuit) 2 L 1.5 fl. oz.**	2	Bean (snap)	Only one application a year. Preplant incorporate within 1 week of planting or preemergence application within 1 day after planting. PHI 30 days.
Imazethapyr 0.05	**(Pursuit) 2 L 3.0 fl. oz.**	2	Bean (dry, lima, southern pea, cowpea), pea (dry, English), chickpea	Only one application a year. Preplant incorporate within 1 week of planting or preemergence application within 1 day after planting. Can apply up to 4 oz./A to southern pea only. Consult label for preharvest interval.
Paraquat 0.5 - 1.0	**(Gramoxone) 2 SL 2 - 4 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.**	22	Bean (lima, snap), pea (all)	Emerged weeds. Apply prior, during, or after planting but before crop emergence. Only three applications a season. Use a nonionic surfactant.
Pelargonic acid	**(Scythe) 4.2 EC 3 -10% v/v**	27	Bean (all), pea (all)	Emerged weeds. Apply before crop emergence. Product is a contact, nonselectvie, foliar-applied herbicides. There is no residual activity.
Pendimethalin 0.5 - 0.75	**(Prowl) 3.3 EC 1.2 - 1.8 pt. (Prowl H20) 3.8 1.0 - 1.5 pt.**	3	Bean (dry. lima, snap, garbanzo) bean (southern pea, cowpea), chickpea	Annual broadleaf and grass weeds. Incorporate 1 - 2 in. deep within 7 days of application.
Pyraflufen 0.0008 - 0.003	**(ET Herbicide/Defoliant) 0.5 - 2.0 fl. oz.**	14	Bean (all), pea (all)	Emerged broadleaf and grass weeds. Plant 1 day after application. Apply as a preplant burndown treatment.
***S*-metolachlor 0.95 - 1.27**	**(Brawl, Dual Magnum) 7.62 EC 1.0 - 1.33 pt.**	15	Bean (lima, mung, pinto, snap), bean (southern pea), pea (English)	Annual broadleaf and grass weeds and yellow nutsedge. Consult label for rate based on soil type and specific tank mix directions.
Saflufenacil 0.027	(Sharpen) 3.42 SL **1.0 fl. oz.**	14	Bean (garbanzo), bean (dry, chickpea)	Broadleaf weeds. Apply as a preplant/preemergence burndown. Sequential application can be applied with 14 days between timings. Do not apply m ore than 2 fl. oz./A per season.
Trifluralin 0.5 - 0.75	**(Treflan, Trust) 4 EC 1.0 - 1.5 pt. (Treflan, Trifluralin) 10 G 5 - 7.5 lb.**	3	Bean (lima, mung, guar, snap), bean (southern pea), pea (dry, English)	Annual broadleaf and grass weeds. Incorporate 4 in. or less within 8 hr. Results in Florida are erratic on soils with low organic matter and clay content. Consult label for rotation restrictions.
			***** POSTEMERGENCE *****	
Bentazon **0.5 - 1.0**	(Basagran) 4 L **1.0 - 2.0 pt.**	6	Bean (dry, succulent), bean (southern pea), pea (garden, English)	Broadleaf weeds. Apply after the first trifoliate leaf is fully expanded in bean and three pairs of leaves in pea. Yellowing, bronzing, speckling, or leaf burning may occur under certain conditions. This injury is generally outgrown without delaying pod set or maturity. PHI 30 days.
Carfentrazone up to 0.031	**(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.**	14	Bean (all), pea (all)	Emerged broadleaf control. Direct application to row middles for burndown of emerged broadleaf weeds. Include crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Clethodim 0.094 - 0.25 0.07 - 0.25	**(Arrow) 2 EC 6 - 16 fl. oz. (Select Max) 1 EC 9 - 32 fl. oz.**	1	Bean (dry), pea (dry)	Annual and perennial grass control. Consult label for bean and pea types. PHI 30 days.

Table 9.5. Herbicides approved for Asian legumes. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.				
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Crops**	**Weeds controlled / remarks**
Clethodim **0.094 - 0.25** **0.07 - 0.125**	**(Arrow) 2 EC** **6 - 16 fl. oz.** **(Select Max) 1 EC** **9 - 32 fl. oz.**	1	Bean (succulent), pea (succulent)	Annual and perennial grass control. Consult label for bean types. PHI 21 days.
EPTC **3.1 -4.0**	**(Eptam) 7 E** **3.5 - 4.5 pt.**	8	Bean (green, dry)	Broadleaf and nutsedge weeds. Apply as layby treatment during the last cultivation of the season. Direct spray solution to the base of the crop. Do not exceed 9 pt./A per crop.
Fluazifop **0.19 - 0.38**	**(Fusilade DX) 2 EC** **12 - 24 fl. oz.**	1	Bean (dry)	Annual and perennial grass weeds. Do not apply to cowpea. Do not apply more than 48 fl. oz./A per season. Include a COC or NIS in the spray solution. PHI 60 days.
Fomesafen **0.25 - 0.38**	**(Reflex) 2 EC** **1.0 - 1.5 pt.**	14	Bean (dry, snap)	Annual broadleaf and grass weeds and nutsedge. Not for use in Miami-Dade County. Consult label for rate based on size of specific weed species. Some bronzing, crinkling, or spotting may occur, but the crop will outgrow these effects and develop normally. Do not apply more than 1.5 pt./A per year.
Halosulfuron **0.02 - 0.03**	**(Sandea) 75 DF** **0.5 - 0.66 oz.**	2	Bean (dry)	Broadleaf weeds and nutsedge. Row middles only. Avoid contact with planted crop. If crop grown on plastic, keep the application off the plastic. Do not apply more than 1 oz./A per crop.
Halosulfuron **0.02 - 0.03**	(Sandea) 75 DF **0.5 - 0.66 oz.**	2	Bean (snap, lima)	Broadleaf weeds and nutsedge. Directed sprays. Apply after the two to four trifoliate leaf stage but before flowering.
Imazethapyr **0.14**	**(Pursuit) 2 L** **3.0 oz.**	2	Bean (dry), bean (southern pea), pea (dry, English)	Do not apply before bean has at least one trifoliate leaf. Apply to peas at least 3 in. in height, but prior to the fifth node and before flowering. Consult label for preharvest intervals.
Pelargonic acid	**(Scythe) 4.2 EC** **3 - 10% v/v**	27	Bean (all), pea (all)	Emerged weeds. Row middles only. Use a shielded sprayer directed to the row middles to reduce drift to the crop.
Quizalofop **0.04 - 0.08**	**(Assure II)** **6 - 12 fl. oz.**	1	Bean (snap, dry), pea (succulent, dry)	Annual and perennial grass weeds. Allow 7 days between sequential applications to allow for regrowth. Include a COC or NIS in the spray solution. PHI 30 days for succulent pea and dry bean. PHI 60 days for dry pea.
Sethoxydim **0.19 - 0.47**	**(Poast) 1.5 EC** **1.0 - 2.5 pt.**	1	Bean (dry, succulent), pea (dry, succulent)	Growing grass weeds. Decreased efficacy if weeds are under stress. Do not exceed 4.0 pt./A per season. Include a crop oil concentrate in the spray solution. PHI 30 days for dry bean and dry pea. PHI 15 days for succulent bean and succulent pea.

Table 9.6 Insecticides approved for managing insect pests of beans and peas.

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.							
Insects	**MOA Code[1]**	**Trade Name Active Ingredient**	**Rate Product/acre**	**Maximum rate/acre per season**	**REI hours**	**Days to Harvest**	**Remarks[2]**
Aphids	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3 pt **SP:** 0.25-1.0 lb	10 applications only	48	See label: varies with rate and crop use	Poison. Highly toxic to fish, aquatic invertebrates and mammals.
	1B	***Dibrom 8E** (naled)	1-1.5 pt	4.5 pt	48	1	Ground application only, not for cowpeas and field peas intended for livestock feed. Toxic to fish and wildlife. Poison. Corrosive.
	1B	**Dimethoate 4EC** (dimethoate)	0.5-1 pt	2.0 pts/year	48	0-mechanical harvesting	Do not feed treated vines. Do not use on field peas. Highly toxic to bees. See label.
	1B	**Malathion 8F** (malathion)	1.0 pt	2 applications only	12	3	Green and dried peas only. Do not graze or feed forage to livestock. Highly toxic to bees, fish and invertebrates.
	1B	**Orthene 97** (acephate)	0.25-1.0 lb	2.0 lb a.i.	24	14 - dry, succulent 1 - lima beans, succulent form	Do not use on green beans (string, wax, snap). Do not feed treated vines or seed to livestock. Toxic to birds and bees. See label.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	3A	***Asana XL** (esfenvalerate)	5.8-9.6 fl oz	0.2 lb a.i. 4 applications at highest rate	12	3 - snap 21- dry beans and peas	Do not feed or graze livestock on treated vines. Toxic to fish & aquatic invertebrates. Do not apply if bees are visiting treated areas.
	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent 19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 fl oz/ 1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	4A	**Admire Pro** (imidacloprid)	soil: 7-10.5 fl oz; foliar: 1.2 fl oz	soil: 10.5 fl oz foliar: 3.6 fl oz	12	21-soil 7 - foliar	Do not apply to both soil and foliage. Do not use other 4A insectiicides if imidacloprid is used. Bee hazard.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	16 oz	12	7	Edible podded legumes,succulent shelled peas and beans. Toxic to birds, and aquatic invertebrates.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14 fl oz	28.0 fl oz/year	4	7	Minimum interval between applications: 10 days. Toxic to aquatic invertebrates
	23	**Movento (spirotetramat)**	4-5 fl oz	10.0 fl oz	24	1: succulent 7: dry	Toxic to aquatic invertebrates and honey bee larvae.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	no limit	4	0	May be used in greenhouses. Contact dealer if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb		4	0	OMRI-listed[2]. Succulent or dried. Do not apply if bees are visiting treatment area.
	--	**M-Pede 49% EC** Soap, insecticidal	0.25-4.0% v/v	7-10 day interval	12	0	OMRI-listed[2]. Use with a companion insecticide.
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal (others)	no limit	4	0	OMRI-listed[2]. Toxic to fish.
	un	**Aza-Direct** (azadirachtin)	1-2 pt	3.5 pt	4	0	OMRI-listed[2]. Anti-feedant, repellent, insect growth regulator. Toxic to fish.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	20 gm a.i.	12	0	OMRI-listed[2] Insect Growth Regulator and feeding repellent. Does not kill adult insects.
	un	**Trilogy** (extract of neem oil)	1.0-2.0% v/v		4	0	OMRI-listed[2]. Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
Armyworm, corn earworm, lesser cornstalk borer, loopers, cutworm, catepillar, grubs, root maggots, wireworms	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3 pt**SP:** 0.25-1.0 lb	10 applications only	48	See label: varies with rate and crop use	Poison. Highly toxic to fish, aquatic invertebrates and mammals.
	1A	**Sevin 4 F** (carbaryl)	**4F:** 0.5-1.5 qt	4 applications/year	12	13-fresh beans & peas, 14-grazing or forage, 21-dried beans, seed, or hay	Use on succulent shelled peas and beans prohibited. Highly toxic to bees and aquatic invertebrates.
	1B	***Diazinon 50W, AG500** (diazinon)	**50W:** 4-8 lb**AG500:** 2-4 qt	one application/year	72	broadcast at planting	Succulent beans and peas only. Soil application only. Poison. Toxic to bees, birds, fish and wildlife.
	1B	***Dibrom 8E** (naled)	1-1.5 pt	4.5 pt	48	1	Ground application only, not for cowpeas and field peas intended for livestock forage. Toxic to fish and wildlife. Danger. Corrosive.
	1B	**Orthene 97** (acephate)	0.25-1.0 lb	2.0 lb a.i.	24	14 -dry or succulent 1 - lima beans, succulent form	Do not use on green beans (string, wax, snap). Do not feed treated vines or seed to livestock. Toxic to birds and bees. See label.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	3A	***Asana XL**(esfenvalerate)	5.8-9.6 fl oz	0.2 lb a.i.4 applications at highest rate	12	3 - snap 21-dry beans & peas	Do not feed or graze livestock on treated vines. Toxic to fish & aquatic invertebrates. Do not apply if bees are visiting treated areas.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz – dry beans & peas; 0.8-2.1 fl oz – southern pea	6.4 fl oz-dry beans & peas 10.5 fl oz-southern peas	12	7 – dry beans & peas; 3 – southern pea	**Not for use on succulent beans or peas.** Do not feed treated vines or hay to livestock. Toxic to fish & aquatic invertebrates.
	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	***Capture LFR** (bifenthrin)	3.4-6.8 fl oz	0.1 lb a.i. at plant0.2 lb a.i. peas 0.3 lb a.i. beans	12		Do not exceed allowed amounts including use of other products containg bifenthrin applied at plant or foliar. Toxic to aquatic organisms and bees.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	0.06 lb a.i. or 0.38 pt	24	7 – edible podded and succulent shelled, 21 – dry beans and peas.	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay. Exteremly toxic to fish, bees and wildlife.
	3A	***Mustang** (zeta-cypermethrin)	1.28-4.0 oz	24 oz	12	1 - succulent; 21 - dried shelled peas or beans	Can also be applied at planting for control of cutworms, white grubs and wireworms (see label). Extremely toxic to bees, fish and aquatic invertebrates.
	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 floz/1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	7 - edible podded and succulent shelled; 21 - dried, shelled	Toxic to aquatic organisms and wildlife. Do not graze livestock in treated areas.
	5	**Entrust SC** (spinosad)	3-6 fl oz	12 fl oz	4	28	OMRI-listed[2]. Do not feed forage or hay to dairy or meat cattle.
	5	**Radiant SC** (spinetoram)	3-8 fl oz	succulent-39 fl oz/acre/ yearsoybean- 14 fl oz/year	4	3 – succulent; 28 – dry	Time applications to small larvae.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb		4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb		4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects. Toxic to aquatic invertebrates, do not spray when bees are visiting treated area.
	18	**Intrepid 2F** (methoxyfenozide)	4-16 fl oz	64.0 fl oz/year	4	7	
	22	**Avaunt** (indoxacarb)	3.5 oz	14.0 oz	12	7	Southern pea (dry) varieties only. Highly toxic to mammals, birds, fish and aquatic invertebrates
	28	**Belt SC** (flubendiamide)	2-3 fl oz	6 floz	12	1 – edible podded and succulent shelled; 14 – dry; 3 – forage	Toxic to aquatic invertebrates
	28	**Coragen** (chlorantraniliprole with rynaxypyr)	3.5-7.5 fl oz	15.4 fl oz or 0.2 lb a.i of chlorantraniliprole products per acre per year.	4	1	Foliar application only. Toxic to aquatic organisms.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal		4	0	May be used in greenhouses. Contact dealer if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
	un	**Aza-Direct** (azadirachtin)	1-3.5 pt		4	0	OMRI-listed[2]. Anti-feedant, repellent, insect growth regulator. Toxic to fish and aquatic invertebrates.
Cucumber beetle, bean leaf beetle, Mexican bean beetle, Cowpea curculio	1A	***Lannate LV, *SP** (methomyl)	LV: 0.75-3 ptSP: 0.25-1.0 lb	10 applications only	48	See label: varies with rate and crop use	Poison. Highly toxic to fish, aquatic inverterbrates and mammals.
	1A	**Sevin 80S, 4 F** (carbaryl)	**4F:** 0.5-1.5 qt		12	13-fresh beans & peas, 14-grazing or forage,21-dried beans, seed, or hay	Repeat, as needed, up to 4 times. Applications should be at least 7 days apart. Higly toxic to bees.
	1B	**Orthene 97** (acephate)	0.25-1.0 lb	2.0 lb a.i.	24	14 -dry or succulent 1 - lima beans, succulent form	Do not use on green beans (string, wax, snap). Do not feed treated vines or seed to livestock. Toxic to birds and bees. See label.
	1B	**Dimethoate 4EC** (dimethoate)	0.5-1 pt	2.0 pts/year	48	0: mechanical harvesting	Do not feed treated vines. Do not use on field peas. Highly toxic to bees. See label.
	1B	***Thimet 20 G** (phorate)	4.5-7.0 oz/1000 ft row. No more than 7.6 lb a.i./acre	one application	48	60	Poison. Label pending in Fla. Do not graze livestock on treated forage. No direct contact with seed. At plant only.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz – dry beans & peas; 0.8-2.1 fl oz – southern pea	6.4 fl oz-dry beans & peas 10.5 fl oz-southern peas	12	7 – dry beans & peas; 3 – southern pea	**Not for use on succulent beans or peas.** Do not feed treated vines or hay to livestock. Toxic to fish & aquatic invertebrates.
	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	0.38 pt	24	7 – edible podded and succulent shelled, 21 – dry beans and peas.	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay. Toxic to bees,fish and wildlife
	3A	***Mustang** (zeta-cypermethrin)	1.28-4.0 oz	24 oz	12	1 - succulent; 21 - dried shelled peas or beans	Can also be applied at planting for control of cutworms, white grubs and wireworms (see label). Extremely toxic to bees, fish and aquatic invertebrates.
	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 fl oz/1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92	7.68 fl oz	24	7 - edible podded and succulent shelled; 21 - dried, shelled	Toxic to aquatic organisms and wildlife. Do not graze livestock in treated areas.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	3 applications	12	7	Edible podded legumes and succulent shelled peas and beans. Toxic to birds, bees and fish.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects. Toxic to aquatic invertebrates, do not spray when bees are visiting treated area.
	un	**Aza-Direct** (azadirachtin)	1-3.5 pt		4	0	OMRI-listed[2]. Anti-feedant, repellent, insect growth regulator. Toxic to fish and aquatic invertebrates.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	20 gm a.i.	12	0	OMRI-listed[2] Insect Growth Regulator and feeding repellent. Does not kill adult insects.
Fire ants	7A	**Extinguish** ((S)-methoprene)	1-1.5 lb broadcast	as needed	4	0	Insect Growth Regulator. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	0.134 lb a.i.	12	1	Insect Growth Regulator. Apply at first sign of ant activity. Toxic to fish and aquatic invertebrates.
Grasshoppers	1B	**Dimethoate 4EC** (dimethoate)	0.5-1 pt		48	0: mechanical harvesting	Do not feed treated vines. Highly toxic to bees.
	3A	***Asana XL** (esfenvalerate)	5.8-9.6 fl oz	0.2 lb a.i./acre. 4 applications at highest rate	12	3 - snap21-dry beans and peas	Do not feed or graze livestock on treated vines. Toxic to bees & fish.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz – dry beans & peas; 0.8-2.1 fl oz – southern pea	6.4 fl oz-dry beans & peas 10.5 fl oz-southern peas	12	7 – dry beans & peas; 3 – southern pea	Not for use on succulent beans or peas. Do not feed treated vines or hay to livestock. Toxic to fish & aquatic invertebrates.
	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	0.06 lb a.i. or 0.38 pt	24	7 – edible podded and succulent shelled, 21 – dry beans and peas.	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay. Exteremly toxic to fish, bees and wildlife.
	3A	***Mustang** (zeta-cypermethrin)	1.28-4.0 oz	24 oz	12	1 - succulent; 21 - dried shelled peas or beans	Can also be applied at planting for control of cutworms, white grubs and wireworms (see label). Extremely toxic to bees, fish and aquatic invertebrates.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	7 - edible podded and succulent shelled; 21 - dried, shelled	Toxic to aquatic organisms and wildlife. Do not graze livestock in treated areas.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	no limit	4	0	May be used in greenhouses. Contact dealer if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
Leafhopper	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3 pt**SP:** 0.25-1.0 lb	10 applications only	48	See label: varies with rate and crop use	Poison. Highly toxic to fish, aquatic inverterbrates and mammals.
	1B	***Dibrom 8E** (naled)	1-1.5 pt	4.5 pt/acre	48	1	Ground application only, not for cowpeas and field peas intended for livestock feed. Toxic to fish and wildlife. Poison. Corrosive.
	1B	**Dimethoate 4EC** (dimethoate)	0.5-1 pt	2.0 pts/year	48	0: mechanical harvesting	Do not feed treated vines. Do not use on field peas. Highly toxic to bees. See label.
	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	***Mustang** (zeta-cypermethrin)	1.28-4.0 oz	24 oz	12	1 - succulent; 21 - dried shelled peas or beans	Can also be applied at planting for control of cutworms, white grubs and wireworms (see label). Extremely toxic to bees, fish and aquatic invertebrates.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	7 - edible podded and succulent shelled; 21 - dried, shelled	Toxic to aquatic organisms and wildlife. Do not graze livestock in treated areas.
	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 fl oz/1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	4A	**Admire Pro** (imidacloprid)	soil: 7-10.5 fl oz; foliar: 1.2 fl oz	soil: 10.5 fl oz foliar: 3.6 fl oz	12	21-soil 7 - foliar	Do not apply to both soil and foliage. Do not use other 4A insectiicides if imidacloprid is used. Bee hazard.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans. Toxic to birds, and aquatic invertebrates.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	28.0 fl oz/year	4	7	Minimum interval between applications: 10 days. Toxic to aquatic invertebrates
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz.	27.2 fl oz	12	14	For succulent beans only. Allow 14 days between applications.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	no limit	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
	--	**M-Pede 49% EC** (soap, insecticidal)	0.25-4.0 % v/v	7-10 day intervals	12	0	OMRI-listed[2]. Use with a companion insecticide.
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal (others)		4	0	OMRI-listed[2]. Toxic to fish.
	un	**Aza-Direct** (azadirachtin)	1-3.5 pt		4	0	OMRI-listed[2]. Anti-feedant, repellent, insect growth regulator. Toxic to fish and aquatic invertebrates.
***Liriomyza* leafminers**	5	**Entrust SC** (spinosad)	3-6 fl oz	12 fl oz	4	28 days	OMRI-listed[2]. Do not feed forage or hay to dairy or meat cattle.
	5	**Radiant SC** (spinetoram)	3-8 fl oz	succulent-39 fl oz/acre/year soybean- 14 fl oz/year	4	3 – succulent; 28 – dry	Time applications to small larvae.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	3.5 oz	12	7	**Dry beans only**. Must be mixed with a non-ionic activator type wetting, spreading and/or penetrating adjuvant. Do not use binder or sticker type adjuvants. Toxic to fish and wildlife.
	17	**Trigard** (cyromazine)	2.66 oz	0.75 lb a.i.	12	7	Not for use on soybeans or peas.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	15.4 fl oz or 0.2 lb a.i of chlorantraniliprole products per acre per year.	4	1	Foliar application only. Toxic to aquatic organisms.
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal (others)	no limit	4	0	Organic Stylet -Oil and Saf-T-Side are OMRI-listed[2]. Toxic to fish.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		12	0	Acts as IGR and feeding repellent. Does not kill adult insects. OMRI-listed[2].
Lygus bug, stink bug, kudzu bug, plant bug	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3 pt**SP:** 0.25-1.0 lb	10 applications only	48	See label: varies with rate and crop use	Poison. Highly toxic to fish, aquatic inverterbrates and mammals.
	1A	**Sevin 80S, 4 F** (carbaryl)	**4F:** 0.5-1.5 qt	4 applications/year	12	13-fresh beans & peas, 14-grazing or forage,21-dried beans, seed, or hay	Use on succulent shelled peas and beans prohibited. Highly toxic to bees and aquatic invertebrates.
	1B	***Dibrom 8E** (naled)	1-1.5 pt		48	1	Ground application only. Do not use on cowpeas and field peas for livestock feeding.
	1B	**Dimethoate 4EC** (dimethoate)	0.5-1 pt	2.0 pts/year	48	0: mechanical harvesting	Do not feed treated vines. Do not use on field peas. Highly toxic to bees. See label.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz – dry beans & peas; 0.8-2.1 fl oz – southern pea	6.4 fl oz-dry beans & peas 10.5 fl oz-southern peas	12	7 – dry beans & peas; 3 – southern pea	**Not for use on succulent beans or peas.** Do not feed treated vines or hay to livestock. Toxic to fish & aquatic invertebrates.
	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent 19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	0.06 lb a.i. or 0.38 pt	24	7 – edible podded and succulent shelled, 21 – dry beans and peas.	For control before larvae bore into the plant stalk or pods. Do not graze livestock in treated areas or harvest vines for forage or hay. Exteremly toxic to fish, bees and wildlife.
	3A	***Mustang** (zeta-cypermethrin)	1.28-4.0 oz	24 oz	12	1 - succulent; 21 - dried shelled peas or beans	Can also be applied at planting for control of cutworms, white grubs and wireworms (see label). Extremely toxic to bees, fish and aquatic invertebrates.
	3A	**Pyganic 5.0** (pyrethrins)	1.0-18 oz	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	7.68 fl oz	24	7 - edible podded & succulent shelled; 21 - dried, shelled	Toxic to aquatic organisms and wildlife. Do not graze livestock in treated areas.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz		12	1	See label for rates for specific pests. Do not apply more than 36 fl oz per acre per season. Do not apply more often than every 7 days. Rimon disrupts molting and has no effect on adult insects.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal		4	0	May be used in greenhouses. Contact dealer if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
	--	**M-Pede 49% EC** (soap, insecticidal)	0.25-4.0 % v/v	7-10 day intervals	12	0	OMRI-listed[2]. Use with a companion insecticide.
	un	**Aza-Direct** (azadirachtin)	1-2 pt (max 3.5 pt)		4	0	Anti-feedant, repellent, insect growth regulator. OMRI-listed2. Toxic to fish.
Mites: two spotted, southern red	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent 19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish.
	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 fl oz/ 1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	3.5 oz	12	7	**Dry beans only**. Must be mixed with a non-ionic activator type wetting, spreading and/or penetrating adjuvant. Do not use binder or sticker type adjuvants. Toxic to fish and wildlife.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz		12	7	Do not make more than two applications per year. S**ucculent beans, including succulent soybean vegetable, only.**
	21A	**Portal** (fenpyroximate)	2.0 pt	4.0 pt	12	1	Snap bean only. Allow 14 days between applications. Highly toxic to fish and aquatic invertebrates.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb		4	0	OMRI-listed[2]. Succulent or dried. Do not apply if bees are visiting treatment area.
	--	**M-Pede 49% EC** (soap, insecticidal)	0.25-4.0% v/v	7-10 day intervals	12	0	OMRI-listed[2]. Use with a companion insecticide.
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal (others)	no limit	4	0	OMRI-listed[2]. Toxic to fish.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	un	**Acramite-50 WS** (bifenazate)	1.0-1.5 lb		12	3	**Succulent beans and peas and succulent shelled soybeans**.
	un	**Aza-Direct** (azadirachtin)	1-3.5 pt		4	0	OMRI-listed[2]. Anti-feedant, repellent, insect growth regulator. Toxic to fish and aquatic invertebrates.
	un	**Trilogy** (extract of neem oil)	1.0-2.0% v/v		4	0	OMRI-listed[2]. Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
Thrips	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 fl oz/ 1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	16 oz	12	7	Edible podded legumes and succulent shelled peas and beans. Limited to 3 applications per season. Toxic to birds, and aquatic invertebrates.
	5	**Entrust SC** (spinosad)	3-6 fl oz	12 fl oz	4	OMRI-listed[2]. Do not feed forage or hay to dairy or meat cattle.	OMRI-listed[2]. Do not feed forage or hay to dairy or meat cattle.
	5	**Radiant SC** (spinetoram)	3-8 fl oz	succulent-39 fl oz/acre/year soybean- 14 fl oz/year	4	3 – succulent; 28 – dry	Time applications to small larvae.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects. Toxic to aquatic invertebrates. Do not spray when bees are visiting treated area.
	23	**Movento (spirotetramat)**	4-5 fl oz	10.0 fl oz	24	1: succulent 7: dry	Toxic to aquatic invertebrates and honey bee larvae.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	no limit	4	0	May be used in greenhouses. Contact dealer if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb		4	0	OMRI-listed[2]. Succulent or dried. Do not apply if bees are visiting treatment area.
	--	**M-Pede 49% EC** (soap, insecticidal)	0.25-4.0% v/v	7-10 day intervals	12	0	OMRI-listed[2]. Use with a companion insecticide.
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal (others)	no limit	4	0	OMRI-listed[2]. Toxic to fish.
	un	**Aza-Direct** (azadirachtin)	1-3.5 p)		4	0	OMRI-listed[2]. Anti-feedant, repellent, insect growth regulator. Toxic to fish and aquatic invertebrates.
	un	**Trilogy** (extract of neem oil)	0.5-2% V/V		4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Whiteflies	3A	***Brigade 2 EC** (bifenthrin)	1.6-6.4 fl oz	12.8 fl oz succulent 19.2 fl oz dry	12	3 – succulent; 14 – dry	Toxic to bees and fish. Tank mix with 1B product for better control.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	0.3 lba.i./acre	12	1 - succulent; 21 - dried shelled peas or beans	Do not make applications less than 5 days apart. Not for soybeans. Do not apply more than 0.3 lb ai/acre per season. Can also be applied at planting for control of cutworms, white grubs and wireworms (see label). Tank mix with 1b Product of better control.

Table 9.6 Insecticides approved for managing insect pests of beans and peas. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	Maximum rate/acre per season	REI hours	Days to Harvest	Remarks[2]
	3A	**Pyganic 5.0** (pyrethrins)	0.26-18 fl oz/1000 cu ft	no limit	12	0	OMRI-listed[2]. Treat when insects first appear.
	4A	**Admire Pro** (imidacloprid)	soil: 7-10.5 fl oz; foliar: 1.2 fl oz	soil: 10.5 fl oz foliar: 3.6 fl oz	12	21-soil 7 - foliar	Do not apply to both soil and foliage. Do not use other 4A insectiicides if imidacloprid is used. Bee hazard.
	4A	**Assail 30SG** (acetamiprid)	2.5-5.3 oz	3 applications	12	7	Edible podded legumes and succulent shelled peas and beans. Toxic to birds, bees and fish.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	28.0 fl oz/year	4	7	Minimum interval between applications: 10 days. Toxic to aquatic invertebrates.
	7C	**Knack IGR** (pyriproxyfen)	8-10 fl oz		12	7	Do not make more than 2 applications per season.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	36.0 fl oz	12	1	Rimon disrupts molting and has no effect on adult insects. Toxic to aquatic invertebrates, do not spray when bees are visiting treated area.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz.	27.2 fl oz	12	14	For succulent beans only. Allow 14 days between applications.
	23	**Movento** (spirotetramat)	4-5 fl oz	10.0 fl oz	24	1: succulent 7: dry	Toxic to aquatic invertebrates and honey bee larvae.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal		4	0	May be used in greenhouses. Contact dealer if an adjuvant must be used. Not compatible in tank mix with fungicides. May be pathogenic to bees.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb		4	0	OMRI-listed[2]. Succulent or dried. Do not apply if bees are visiting treatment area.
	--	**M-Pede 49% EC** (soap, insecticidal)	0.25-4.0% v/v	7-10 day intervals	12	0	OMRI-listed[2]. Use with a companion insecticide.
	--	**Sun Spray 98.8%, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal (others)	no limit	4	0	OMRI-listed[2]. Toxic to fish.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	20 gm a.i.	12	0	OMRI-listed[2] Insect Growth Regulator and feeding repellent. Does not kill adult insects.
	un	**Trilogy** (extract of neem oil)	1.0-2.0% v/v		4	0	OMRI-listed[2]. Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

* Restricted use insecticide.

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Anthracnose	M1	(copper compounds) **Many brands available:** Cueva, Kentan DF, Nordox, Nordox 75 WG	**SEE INDIVIDUAL LABELS**		Varies	Varies from 4 hr to 2 days	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF,Echo ZN, Equus 500 ZN-Fungicide, Equus –DF Fungicide, Equus 720 SST, Initiate 720	**SEE INDIVIDUAL LABELS**		7 or 14	12 hr	Do not use on crops for livestock
	M1 & M1	Badge SC Badge X2 (copper hydroxide; copper oxychloride)	2 pt	16.6 pt 16.9 pt	0	1 (greenhouse) 2 (field)	
		C-O-C-S WDG 9 (basic copper sulfate; copper oxychloride)	1.5 lb	9.2 lb		2	
	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Incognito 85 WDG, Nufarm T-Methyl 4.5F, Thiophanate Methyl 85-WDG, Topsin 4.5FL Fungicide, Topsin M WSB Fungicide	**SEE INDIVIDUAL LABELS**		14 to 28 (see label)	1 (succulent beans) 3 (dry beans)	Apply once at 50-70% bloom or twice (max.=1 ½ lbs/appl.) with first at 10-30% bloom and second at peak bloom.
	3	Tilt (propiconazole)	4 fl oz	12 oz	7	12 hr	Supplemental label: For control of web blight casued by *Rhizoctonia solani*. Not labeled for cowpea used for livestock feed.
	3	Rancona 3.8 FS (ipconazole)	0.085 fl oz/ 100 l seed			12 hr	For suppressing seed borne anthracnose of dry bean.
	7	Fontelis Vertisan (penthiopyrad)	30 fl oz 20 fl oz	72 fl oz 41 fl oz	0 (Fontelis) 21 (Vertisan)	12 hr	No more than 2 sequential appl. Before alternating to a non-FRAC 7 fungicide. Vertisan only labeled for dry edible beans.
	7 & M3	Vitaflo-280 (carboxin; thiram)	4.0 fl oz per 100 lb seed			1	Seed treatment. Not effective in control of anthracnose if seed is highly infected.
	7 & 11	Priaxor (fluxapyroxad; pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.
	11	Headline Headline SC (pyraclostrobin)	9 fl oz 9 fl oz	18 fl oz 18 fl oz	7 or 21 7	4 hr 12 hr	No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11	Aframe Equation SC Quadris Satori Fungicide Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	14 (dry) 0 (succulent)	4 hr	No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11 & M5	Quadris Opti (azoxystrobin; chlorothalonil)	2.4 pt	9.6 pt	14 (dry)	12 hr	Only labeled for dry edible beans. Limit 4 appl/crop. No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quilt Xcel Quilt Fungicide Willowood Azoxyprop Xtra (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	14 (dry) 7 (succulent)	12 hr	Supplemental label: Do not use on cowpea cultivars intended for livestock.
Ascochyta blight	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF,Echo ZN, Equus 500 ZN-Fungicide, Equus –DF Fungicide, Equus 720 SST, Initiate 720	**SEE INDIVIDUAL LABELS**		7 or 14	12 hr	Do not use on crops for livestock
	3	Tilt (propiconazole)	4 fl oz	12 oz	7	12 hr	Supplemental label: For control of web blight casued by *Rhizoctonia solani*. Not labeled for cowpea used for livestock feed.
	3	Proline 480SC (prothioconazole)	5.7 fl oz	17.1 fl oz	7	12 hr	Only labeled for chickpea, lentils and dry-edible peas and beans.
	7	Endura (boscalid)	11 oz	22 oz	21 (dry) 7 (succulent)	12 hr	Limit 2 appl/crop & alternate chemistry
	7	Fontelis Vertisan (penthiopyrad)	30 fl oz 20 fl oz	72 fl oz 41 fl oz	0 (Fontelis) 21 (Vertisan)	12 hr	No more than 2 sequential appl. Before alternating to a non-FRAC 7 fungicide. Vertisan only labeled for dry edible beans.
	7 & 3	Propulse (fluopyram + prothioconazole)	10.3 fl oz	20.5 fl oz	14	2	For dry-edible beans and peas. Do not use on crops for livestock.
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.
	11	Aproach (picoxystrobin)	12 fl oz	24 fl oz	14 (seed)	12 hr	Do not tank mix with an adjuvant or crop oil when spraying dry beans or peas.
	11	Headline (pyraclostrobin)	9 fl oz	18 fl oz	7 or 21	4 hr	No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11	Aframe Azoxystar Equation SC Quadris Satori Fungicide Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	92.3 fl oz	14 (dry) 0 (succulent)	4 hr	No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	9.6 pt	14 (dry)	12 hr	Only labeled for dry edible beans. Limit 4 appl/crop. No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11 & 3	Quilt Xcel Quilt Fungicide Willowood Azoxyprop Xtra (azoxystrobin + propiconazole)	14 fl oz	42 fl oz	14 (dry) 7 (succulent)	12 hr	Supplemental label: Do not use on cowpea cultivars intended for livestock.

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Bacterial brown spot, Bacterial blight, Common blight, Halo blight	M1	(copper compounds) **Many brands available:** Basic Copper 53, Champ DP Dry Prill, Champ Formula 2 Flowable, Champ WG, Champion++, Copper -Count-N, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Kop-Hydroxide, MasterCop, Nordox, Nordox 75 WG, Nu Cop 50 WP, Nu-Cop 3 L, NuCop 50 DF, Nu-Cop HB	SEE INDIVIDUAL LABELS		Varies	Varies from 4 hr to 2 days	
Botrytis or Gray mold	M1	Cueva (copper octanoate)	2 gal		0	4 hr	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 90 DF, Echo ZN, Equus 500 ZN-Fungicide, Equus –DF Fungicide, Equus 720 SST, Initiate 720	**SEE INDIVIDUAL LABELS**		7 or 14	12 hr	Do not use on crops for livestock
	1	Topsin 4.5 FL Fungicide, Topsin M WSB Fungicide (thiophanate-methyl)	**SEE INDIVIDUAL LABELS**		14 to 28 (see label)	1 (succulent) 3 (dry)	Apply once at 50-70% bloom or twice (max.=1 ½ lbs/appl.) with first at 10-30% bloom and second at peak bloom.
	3	Rancona 3.8 FS (ipconazole)	0.085 fl oz/ 100 lb seed			12 hr	For protection against seed borne *Botrytis*.
	7	Endura (boscalid)	11 oz	22 oz	7 (succulent)	12 hr	Limit 2 appl/crop & alternate chemistry
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	12 hr	
	7	Vertisan (penthiopyrad)	20 fl oz	41 fl oz	21	12 hr	Only labeled for dried shelled beans and peas.
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.
	7 & M3	Vitaflo-280 (carboxin + thiram)	4 fl oz/100 lb seed			1	For protection against seed borne *Botrytis*.
Cercospora leaf spot	M1	(copper compounds) **Many brands available:** Kentan DF, Kocide DF, Nordox, Nordox 75 WG	**SEE INDIVIDUAL LABELS**		Varies	Varies from 4 hr to 2 days	
	M5	(chlorothalonil) **Many brands available:** Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Equus –DF Fungicide, Equus 720 SST, Initiate 720	**SEE INDIVIDUAL LABELS**		7 or 14	12 hr	Do not use on crops for livestock
	7	Fontelis (penthiopyrad)	30 fl oz	72 fl oz	0	12 hr	

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	7	Vertisan (penthiopyrad)	20 fl oz	41 fl oz	21	12 hr	Only labeled for dried shelled beans and peas.
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.
	11	Aproach (picoxystrobin)	12 fl oz	24 fl oz	14 (seed)	12 hr	Do not tank mix with an adjuvant or crop oil when spraying dry beans or peas.
	11	Headline, Headline SC (pyraclostrobin)	9 fl oz	18 fl oz	7	12 hr	Limit 2 appl/crop & alternate chemistry
Downy mildew	M1	(copper compounds) **Many brands available:** Basic Copper 53, Champ Formula 2 Flowable, Champion++, Cueva, Cuprofix Ultra 40 Disperss, Cuproxat, Kentan DF, Kocide 2000 Funicide, Kocide 3000, Nordox, Nordox 75 WG	SEE INDIVIDUAL LABELS			4 hr to 2 days (see label)	
	M1 & M2	Top Cop with Sulfur (basic copper sulfate; sulfur)	4 pt		0	1	Do not use in aluminum tanks
	M1 & 4	Ridomil Gold /Copper (copper hydroxide; mefenoxam)	2 lb	8 lb	3	2	Limit 4 appl./crop
	M5	(chlorothalonil) **Many brands available:** Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF,Echo ZN, Equus 500 ZN-Fungicide, Equus –DF Fungicide, Equus 720 SST, Initiate 720	**SEE INDIVIDUAL LABELS**		7 or 14	12 hr	Do not use on crops for livestock
	4	Ridomil Gold SL	0.2 pt	0.8 pt	3	2	Must be tank mixed with other effective fungicides.
		Ultra Flourish (mefenoxam)	0.4 pt	2.0 pt (soil) 1.6 pt (foliar)	3	2	
	7 & 11	Priaxor (fluxapyroxad; pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.
	11	Headline, Headline SC (pyraclostrobin)	9 fl oz	18 fl oz	7	12 hr	Limit 2 appl/crop & alternate chemistry
	21	Ranman 400SC Fungicide (cyazofamid)	2.75 fl oz	16.5 fl oz	0	12 hr	Not labeled for cowpea used for livestock feed. Limit 6 appl./crop. No more than three sequential appl. before rotating chemistry.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	
	40	Forum Fungicide (dimethomorph)	6 fl oz	30 fl oz		12 hr	Labeled for lima beans intended for harvest as succulent seed only. Limit 5 appl./season. Do not add spreading/penetrating adjuvant.
Phytophthora	4	Acquire Allegiance Dry Allegiance LS Allegiance FL Dyna-Shield metalaxyl 318 FS Metastar ST Seed Treatment Sebring 318 FS Sebring 480 FS (metalaxyl)	1.2 fl oz/ 100 lb seed (Allegiance LS); 0.75 fl oz (others)			1	Seed treatment

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	4	Apron XL (mefenoxam)	0.64 fl oz/ 100 lbs of seed			2	Seed treatment only
	12 & 4	Apron Maxx RFC	1.5 fl oz/100 lbs seed			2	Seed treatment only
		Apron Maxx RTA (mefenoxam; fludioxonil)	5 fl oz/100 lbs seed			2	Seed treatment only
Pod tip rot	3	Rally 40WSP Fungicide Sonoma 40 WSP (myclobutanil)	4-5 oz	1.25 lb	0	1	30-day plantback interval
Powdery mildew	M2	(sulfur) **Many brands available:** Crusade DF, Kumulus DF Fungicide-Acaricide, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Sulfur-DF, Wettable Sulfur, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	SEE INDIVIDUAL LABELS			1	Do not apply during periods of warm weather to avoid phytotoxicity
	M1 & M2	Top Cop with Sulfur (basic copper sulfate; sulfur)	2 qt		0	1	Do not use in aluminum tanks
	7	Fontelis	30 fl oz	72 f oz	0	12 hr	
		Vertisan (penthiopyrad)	20 fl oz	41 fl oz	21 (seed) 0 (hay)	12 hr	
	11	Headline, Headline SC (pyraclostrobin)	9 fl oz	18 fl oz	7	12 hr	Limit 2 appl/crop & alternate chemistry
	7 & 11	Priaxor (fluxapyroxad; pyraclostrobin)	8 fl oz	16 fl oz	7 (succulent) 21 (dry)	12 hr	Do not make more than 2 applications per season
Pythium damping-off & root rot	4	Acquire Allegiance Dry Allegiance LS Allegiance FL Dyna-Shield metalaxyl 318 FS Metastar ST Seed Treatment Sebring 318 FS Sebring 480 FS (metalaxyl)	1.2 fl oz/ 100 lb seed (Allegiance LS); 0.75 fl oz (others)			1	Seed treatment
	4	Metastar 2E (metalaxyl)	4 pt			2	Preplant incorporated at planting or soil surface after planting. Do not use in greenhouse or field-grown bedding plants.
	4	Apron XL (mefenoxam)	0.64 fl oz/ 100 lb seed			2	Seed treatment only
	4	Ridomil Gold SL (mefenoxam)	0.2 pt	0.8 pt	3	2	Must be tank mixed with other effective fungicides.
	4	Ultra Flourish (mefenoxam)	2 pt			2	Apply as a broadcast soil application at preplant or as a surface application at planting
	11 & 4	Uniform Fungicide (azoxystrobin; mefenoxam)	0.34 fl oz/ 1000 row ft			0	Make only one application per season

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Rhizoctonia diseases (root & stem rot)	7 & M3	HM-1345 Vitaflo-280 (carboxin; thiram)	4 fl oz per 100 lb seed			1	Seed treatment
	4 & 12	Apron Maxx RFC (mefenoxam; fludioxonil)	1.5 fl oz/ 100 lbs seed			2	Seed treatment only
	4 & 12	Apron Maxx RTA (mefenoxam; fludioxonil)	5 fl oz/100 lbs seed			2	Seed treatment only
	4 & 14	Ridomil Gold PC GR (mefenoxam; PCNB)	12 oz / 1000 row feet			2	Do not use on crops for livestock. Apply directly soil surrounding seed at planting.
	3	Rancona 3.8 FS (ipconazole)	0.085 fl oz/ 100 lb seed			12 hr	Seed treatment for protection against *Rhizoctonia solani.*
	11	Trilex Flowable (trifloxystrobin)	0.32 fl oz/100 lbs seed			12 hr	Seed treatment only
	12	Dyna-Shield Fludioxonil Maxim 4FS Spirato 480FS (fludioxonil)	0.16 fl oz/100 lbs seed			12 hr	Seed treatment only
Rust	M1 & M2	Top Cop with Sulfur (basic copper sulfate; sulfur)	4 pt		0	1	Do not use in aluminum tanks
	M2	(sulfur) **Many brands available:** Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	SEE INDIVIDUAL LABELS			1	Do not apply during periods of warm weather to avoid phytotoxicity
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90 DF, Echo ZN, Equus 500 ZN-Fungicide, Equus –DF Fungicide, Equus 720 SST, Initiate 720	**SEE INDIVIDUAL LABELS**		7 or 14	12 hr	Do not use on crops for livestock
	M2 & 3	Unicorn (sulfur; tebuconazole)	3.75 lb	15 lb (fresh) 7.5 lb (dry)	14	12 hr	Do not mix with other DMI fungicides.
	3	Rally 40WSP Fungicide Sonoma 40 WSP (myclobutanil)	5 oz	1.25 lb	0	1	30-day plantback interval
	3	Monsoon Onset 3.6L Orius 3.6F Tebustar 3.6L Teledo (tebuconazole)	6 fl oz	24 fl oz (fresh) 12 fl oz (dry)	7 (fresh) 14 (dry)	12 hr	
	3	Tilt (propiconazole)	4 fl oz	12 oz	7	12 hr	Supplemental label: For control of web blight casued by *Rhizoctonia solani*. Not labeled for cowpea used for livestock feed.
	3	Proline 480SC (prothioconazole)	5.7 fl oz	17.1 fl oz	7	12 hr	Only labeled for chickpea, lentils and dry-edible peas and beans.

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	7	Fontelis Vertisan (penthiopyrad)	30 fl oz 20 fl oz	72 fl oz 41 fl oz	0 (Fontelis) 21 (Vertisan)	12 hr	No more than 2 sequential appl. Before alternating to a non-FRAC 7 fungicide. Vertisan only labeled for dry edible beans.
	7 & 11	Priaxor (fluxapyroxad; pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.
	11	Aproach (picoxystrobin)	12 fl oz	24 fl oz	14 (seed)	12 hr	Do not tank mix with an adjuvant or crop oil when spraying dry beans or peas.
	11	Headline Headline SC (pyraclostrobin)	9 fl oz	18 fl oz	7 (succulent) 21 (dry)	12 hr	No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11	Aframe Azoxystar Quadris Satori Fungicide Willowood Axoxy 2SC (azoxystrobin)	6 fl oz	92.3 fl oz	14 (dry beans) 0 (succulent)	4 hr	No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11 & M5	Quadris Opti (azoxystrobin; chlorothalonil)	2.4 pt	9.6 pt	14 (dry)	12 hr	Only labeled for dry edible beans. Limit 4 appl/crop. No more than 2 sequential appl. before alternating to a non-FRAC 11 fungicide.
	11 & 3	Quilt Xcel Quilt Fungicide Willowood Azoxyprop Xtra (azoxystrobin; propiconazole)	14 fl oz	42 fl oz	14 (dry) 7 (succulent)	12 hr	Supplemental label: Do not use on cowpea cultivars intended for livestock.
White mold	1	(thiophanate-methyl) **Many brands available:** Cercobin, Incognito 4.5F, Nufarm T-methyl 4.5F, Thiophanate-methyl 85-WDG, Topsin 4.5FL Fungicide, Topsin M WSB Fungicide	**SEE INDIVIDUAL LABELS**		14 to 28 (see label)	1 (succulent) 3 (dry)	Apply once at 50-70% bloom or twice (max.=1 ½ lbs/appl.) with first at 10-30% bloom and second at peak bloom.
	2	Iprodione 4L AG Fungicide Meteor Nevado 4F Rovral 4 Flowable (iprodione)	2 pt	4 pt	0	1	Limit 2 applications per season. Not for use as livestock feed
	3	Proline 480SC (prothioconazole)	5.7 fl oz	17.1 fl oz	7	12 hr	Only labeled for chickpea, lentils and dry-edible peas and beans.
	7	Endura (boscalid)	11 oz	22 oz	7 (succulent)	12 hr	Limit 2 appl/crop & alternate chemistry
	7	Fontelis Vertisan (penthiopyrad)	30 fl oz 20 fl oz	72 fl oz 41 fl oz	0 (Fontelis) 21 (Vertisan)	12 hr	No more than 2 sequential appl. Before alternating to a non-FRAC 7 fungicide. Vertisan only labeled for dry edible beans.
	11	Aproach (picoxystrobin)	12 fl oz	24 fl oz	14 (seed)	12 hr	Do not tank mix with an adjuvant or crop oil when spraying dry beans or peas.
	7 & 3	Propulse (fluopyram; prothioconazole)	10.3 fl oz	20.5 fl oz	14	2	For dry-edible beans and peas. Do not use on crops for livestock.
	7 & 11	Priaxor (fluxapyroxad; pyraclostrobin)	8 fl oz	16 fl oz	7 or 21	12 hr	Limit 2 appl/season. Crop can not be used for livestock until 14 days after last application.

Table 9.7. Bean, pea, and other legume fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	9 & 12	Switch 62.5 WG (cyprodinil; fludioxonil)	14 oz	56 oz	7	12 hr	
	14	Blocker 4F Fungicide (PCNB)	2 pt		0	12 hr	Avoid tank mixing with highly acidic pesticides as this may reduce efficacy; Apply to seed furrow and covering soil; Do not spray seed directly.
	14	Botran 5F (DCNA dicloran)	1.6 qt	3.2 qt	2	12 hr	Do not feed treated plants to livestock
	29	Omega 500F (fluazinam)	0.85 pt	1.75 pt	14 (edible-podded and succulent beans)	2	

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 10. Minor Vegetable Crop Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Celery, Okra, and Parsley Botany and Planting

Celery - *Apium graveolens,* Apiaceae (Umbelliferae)
Okra – *Abelmoschus esculentus*, Malvaceae
Parsley - *Petroselinum crispum,* Apiaceae (Umbelliferae)

Table 10.1. Planting information for celery, okra, parsley.

	Celery	Okra	Parsley
North Florida	Aug - Feb	Mar - Jun	Sept - Mar
Central Florida	Sept - Mar	Feb - Aug	Sept - Mar
South Florida	Oct - Mar	Jan – Mar/ Aug - Oct	All year
Distance between rows (in)	18-40	36 - 60	6 - 12
Distance between plants (in)	6-12	4 - 10	drilled
Seeding depth (in)	on surface	0.5 - 1.0	0.25
Seed per acre (lb)	1 - 2	6 - 81	6 - 8
Days to maturity from seed	75 - 90	60 - 70	70 - 80
Plant population (acre)	58,080	43,560	1 million+

Cultivars

Table 10.2. Common cultivars of celery, okra, and parsley.

Celery	Okra		Parsley
Floribelle - M9	Annie Oakley II (H[1])	Millionaire (H)	Forest Green (CL[1])
June Belle	Cajun Delight (H)	North and South (H)	Jade (CL, H)
Florida 683	Clemson Spineless	Spike (H)	Improved Market Gardeners (CL)
	Clemson Spineless 80		Dark Green Italian (PL)

[1] H=hybrid, CL=curley leaf, PL=plain leaf

Table 10.3. Herbicides approved for managing weeds in celery.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
		*** PREPLANT / PREEMERGENCE ***	
Bensulide 5.0 - 6.0	(Prefar) 4 E 5 - 5 qt.	8	Broadleaf and grass weeds. Incorporate mechanically 1 - 2 in. deep or with irrigation 2 - 4 in. deep.
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burn down. Consult label for individual product directions.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burn down treatment. Scythe is a contact and nonresidual and can be tank mixed residual preemergence herbicides to lengthen control.
Prometryn 1.0 - 2.0	(Caparol) 4 L 2 - 4 pt.	5	Most annual broadleaf and grass weeds. Do not exceed one application. Consult label for rotational crop restrictions.
Pyraflufen ethyl 0.0008 - 0.003	(ET Herbicide/Defoliant) 0.5 - 2.0 fl. oz.	14	Broadleaf and grass weeds. Burndown preplant application 1 day before planting. Include a NIS or COC in the spray solution.
***S*-metolachlor 0.95 - 1.26**	(Dual Magnum) 1.0 - 1.33 pt.	15	Broadleaf, grass weeds and nutsedge. Label is a third party registration (TPR, Inc.) and authorization and waiver agreements must be obtained prior to use. Rates are based on organic matter.

Table 10.3. Herbicides approved for managing weeds in celery. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
Trifluralin 0.5	(Treflan, Trifluralin) 4 EC 1 pt. (Treflan, Trifluralin) 10 G 5 lb.	3	Annual broadleaf and grass weeds. Do not apply to muck soils. Mineral soils with 2 - 5% organic material, apply 0.75 lb. a.i./A. Incorporate 4 in. or less with 8 hr. of application.
		***** POSTTRANSPLANT / POSTEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides. Do not exceed 6.1 fl. oz. per cropping season. PHI 0 days.
Clethodim 0.09 - 0.13 **0.07 - 0.13**	(Select, Arrow) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days.
Linuron 0.5 - 1.0	(Lorox DF) 50 DF 1 - 2 lb.	7	Broadleaf and grass weeds. Apply after transplanting but before celery is 8 in. tall. Do not apply when temperatures exceed 85F nor as a tank mix with surfactants, nitrogen, or fertilizer solution. PHI 45 days.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles with hooded or shielded sprayer. Product is a contact, nonselective herbicide with no residual control. May be tank mixed with several soil residual compounds.
Prometryn 0.8 - 1.6	(Caparol) 4 L 1.6 - 3.2 pt.	5	Broadleaf weeds. Apply one application during the 2 to 6 wk. period after transplanting. Weeds should not exceed 2 in.
***S*-metolachlor 0.95 - 1.26**	(Dual Magnum) 1.0 - 1.33 pt.	15	Broadleaf, grass weeds and nutsedge. Label is a third party registration (TPR, Inc.) and authorization and waiver agreements must be obtained prior to use. Rates are based on organic matter
Sethoxydim 0.28	(Poast) 1.5 EC 1.5 pt.	1	Emerged grass weeds. A maximum of 3 pt./A per season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days.
		***** CELERY SEEDBEDS *****	
Prometryn 0.6 - 0.8	(Caparol) 4 L 1.2 - 1.6 pt.	5	Broadleaf weeds. Apply once per year to seedbeds. Apply after celery has 2-5 true leaves. Apply after seedbed covers have been removed for at least one week.

Table 10.4. Herbicides approved for managing weeds in okra.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
		***** PREEMERGENCE *****	
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Flumioxazin up to 0.128	(Chateau) 51 WDG up to 4 oz.	14	Annual broadleaf weeds. Apply to row middles of raised plastic mulched beds that are at least 4 in. higher than the treated row middle and 24 in. bed width. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization is a waiver of liability is a misuse of the product. Tank mix with a burn down herbicide to control emerged weeds. 0 day pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weed control. Apply as a preplant burn down for emerged weeds. Read label for individual product directions.
Lactofen 0.25 - 0.5	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaf weeds. Apply to row middles only with a shielded or hooded sprayer. A minimum of 24 fl. oz./A is required for residual control. Add a crop oil concentrate or nonionic surfactant for control emerged weeds. Registration is through Third Party Registrations, Inc. (TPR, Inc.) and a copy of the label must be on-hand at time of application. PHI 30 days.

Table 10.4. Herbicides approved for managing weeds in okra. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
Mesotrione 0.19	(Callisto) 4 L 6 fl. oz.	28	Broadleaf and grass weeds. Apply to row middles only. Leave one foot untreated area or 6" on either side of the plant row. Injury risk is greatest on coarse textured soils (sand, sandy loam, or loamy sand). Apply as one preemergence application OR one postemergence application. Callisto will cause whitening of the okra leaves.
Paraquat 0.5 - 1.0	(Gramoxone) 2 SL 2.0 - 4.0 pt.	22	Emerged broadleaf and grass weed control. Apply one application before crop emergence. Do not exceed 8 pt./A per season.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Broadleaf and grass weeds. Scythe is a contact, nonselective herbicide with no residual activity. May be tank mixed with trifluralin for soil residual activity. Consult label for rates and other information.
Prometryn 0.75 - 1.5	(Caparol) 4 L 1.5 - 3.0 pt.	5	Apply after planting, but before crop emergence. Apply as one PRE application at 3 pt. Or 1 PRE application at 1.5 pt. followed by one POST-directed application at 1.5 pt. Do not exceed 3 pt./A per crop cycle.
Trifluralin 0.5 - 0.75	(Treflan, Trifluralin) 4 EC 0.5 - 1.5 pt. (Treflan, Trifluralin) 10 G 5.0 - 7.5 lb.	3	Annual broadleaf and grass weeds. Incorporate 4 in. or less within 8 hr. Results in Florida are erratic on soils with low organic matter and clay contents. Note precautions against planting non-registered crops within 5 months.
			***** POSTEMERGENCE *****
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply to row middles only with a hooded sprayer. Maximum rate of 0.096 lb. a.i./ A per season. Rates apply to mineral and muck soils. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply to row middles only with a hooded sprayer. PHI 14 days.
Halosulfuron 0.024 - 0.05	(Sandea) 75 WG 0.5 - 1.0 oz.	2	Broadleaf and purple/yellow nutsedge weeds. Apply to row middles of direct-seeded or transplanted okra. If plastic is used, prevent herbicide contact with the plastic. Do not apply more than 2 oz./A per 12-month period. PHI 30 days.
Lactofen 0.25 - 0.5	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaf weeds. Apply to row middles only with a shielded or hooded sprayer. A minimum of 24 f. oz./A is required for residual control. Add a crop oil concentrate or nonionic surfactant for control of emerged weeds. One POST application may be made per growing season at 18 days after transplanting. Cobra contacting green foliage or fruit can cause excessive injury. Registration is through Third Party Registration, Inc. and a copy of the label must be on hand at time of application. PHI 30 days.
Mesotrione 0.09	(Callisto) 4 L 3 fl. oz.	28	Broadleaf and grass weeds. Direct spray with hooded sprayer to minimize contact with okra plants. Okra must be at least 3 in. tall. Use of a nonionic surfactant is required. Injury risk is greatest on coarse textured soils. Apply as one preemergence or one postemergence application. PHI 28 days.
Paraquat 0.5 - 1.0	(Gramoxone) 2 SL 2.0 pt.	22	Emerged broadleaf and grass weeds. Apply to row middles only and do not allow contact to okra plants. Limit of 2 applications after crop emergence. Do not exceed 8 pt./A preseason. PHI 60 days.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Broadleaf and grass weeds. Apply to row middles only with a shielded sprayer.
Prometryn 0.75	(Caparol) 4 L 1.5 pt.	5	Apply 1 postemergence application directed to the base of the crop. If a PRE application was made do not exceed 3 pt./A. PHI 14 days.
Sethoxydim 0.19 - 0.28	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Grass weeds. Efficacy will be decreased if grass weeds are under stress. Include a crop oil concentrate or methylated seed oil in the spray. PHI 14 days.

Table 10.5. Herbicides approved for managing weeds in parsley.

Labels change frequently. Be sure to read a current product label before applying any chemical.				
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Crops**	**Weeds controlled / remarks**
		*** **PREEMERGENCE** ***		
Bensulide **5.0 - 6.0**	(Prefar) 4 E 5 - 6 qt.	8	Parsley	Annual broadleaf and grass weeds. Incorporate or irrigate 1-2 in. deep within 36 hr. of application. Consult label for rotation restrictions.
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Parsley, cilantro	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult label	9	Parsley, cilantro	Control emerged broadleaf and grass weeds. Consult individual labels for restrictions.
Linuron **0.5 - 1.5**	(Lorox DF) 50 DF 1 - 3 lb.	7	Parsley, cilantro	Mineral and muck soils. Apply after planting and before crop emergence. Use lower rates on coarse soils.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Parsley, cilantro	Controls emerged weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar applied herbicide. There is no residual activity.
Prometryn **1.0 - 1.6**	(Caparol) 4 L 1.0 pt.	5	Parsley, cilantro	A single preemergence application can be applied up to 14 days after planting. A second application can be made up to 30 days prior to harvest. Do not apply on sand or loamy sand. Read label for rotation restrictions.
Pyraflufen **0.001 - 0.003**	(ET Herbicide/Defoliant) 0.5 - 2.0 fl. oz.	14	Parsley	Emerged broadleaf and grass weeds. Plant 1 day after application. Apply as a preplant burndown treatment.
		*** **POSTEMERGENCE** ***		
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Parsley, cilantro	Emerged broadleaf control. Post-direct hooded application to row middles. Read the label for adjuvant requirements. PHI 0 days.
Clethodim **0.10 - 0.13** **0.07 - 0.13**	(Arrow, Select) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Parsley, cilantro	Annual and perennial grass control. Read the label for required adjuvants.
Linuron **0.5**	(Lorox DF) 50 DF 1 lb.	7	Parsley, cilantro	Apply after the crop has a minimum of 3 true leaves or crop injury may result. Apply when weeds are in the 1 to 3 true leaf stage. Do not exceed 3 lb. of Lorox per acre per season. PHI 30 days.
Prometryn **0.5**	(Caparol) 4 L 1.0 pt.	5	Parsley, cilantro	An application can be made up to 30 days prior to harvest. Another application can be applied after harvest to the new regrowth. Do not use on sand or loamy sands. Read label for rotation restrictions.
Sethoxydim **0.19 - 0.28**	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Parsley, cilantro	Growing grass weeds. Decreased efficacy if weeds are under stress. Do not exceed 3.0 pt./A per season. Include a COC in the spray solution. PHI 15 days.

Table 10.6. Insecticides approved for managing insect pests of celery.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes[2]
Actara (thiamethoxam)	1.5-5.5 oz	12	7	aphids, flea beetles, leafhoppers, whiteflies	4A	Do not use if other 4A insecticides have been or will be used.
Admire Pro (imidacloprid)	4.4-10.5 fl oz	12	45	aphids, leafhoppers, whiteflies, foliage feeding thrips	4A	Do not apply more than 0.38 lb ai (10.5 fl oz product) per acre per year.
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11A	Apply when larvae are small for best control. OMRI-listed[2].
***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	7	*Liriomyza* leafminers, spider mites	6	No more than 2 sequential applications. Must be used with an adjuvant (but not binder sticker types). Not for use on leafy vegetables grown for transplant.
***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	beet armyworm, cabbage looper, corn earworm, cutworms, fall armyworm, leafminers	3A	Do not apply more than 128 oz/acre per season.
Assail 30SG (acetamiprid)	2.0-4.0 oz	12	7	aphids, whiteflies	4A	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season or apply more often than every 7 days.
Avaunt (indoxacarb)	3.5 oz	12	3	beet armyworm, cabbage looper,	22	Do not apply more than 14 ounces of product per acre per crop.
Aza-Direct (azadirachtin)	1-2 pt, up to 3.5 pt	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator.
***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	beet and southern armyworm (1st and 2nd instars), cabbage looper, corn earworm, cutworms, flea beetles, grasshoppers, potato leafhopper, saltmarsh caterpillar, thrips, vegetable weevil, yellowstriped armyworm, suppression of adult whitefly	3A	Maximum of 12.8 fl oz per acre per season.
Belay Insecticide (clothianidin)	3-4 fl oz	12	7	aphids, flea beetles, leafhoppers, whiteflies (suppression)	4A	Regardless of application method, do not apply more than 0.2 lb ai/acre per year (12 fl oz). Do not apply at intervals of less than 10 days. Highly toxic to bees--do not allow drift to flowering weeds or nearby crops in bloom.
Belay Insecticide (clothianidin)	9-12 fl oz (soil application)	12	21	aphids, flea beetles, leafhoppers, leafminers (suppression), earwigs, crickets, grasshoppers, whiteflies (suppression)	4A	See label for application methods. Regardless of application method, do not apply more than 0.2 lb ai/acre per year (12 fl oz).
Belay 50 WDG (clothianidin)	1.6-2.1 oz	12	7	aphids, flea beetles, suppression of leafminers and whiteflies	4A	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Toxic to bees. Do not allow drift to flowering weeds or nearby crops in bloom.
Belay 50 WDG (clothianidin)	4.8 -6.4 oz (soil application)	12	Apply at planting	aphids, flea beetles, leafhoppers, leafminers (suppression), whiteflies (suppression)	4A	Do not apply more than 6.4 oz per acre per season. See label for application instructions.
Beleaf 50 SG (flonicamid)	2.0-2.8 oz	12	0	aphids, plant bugs	9C	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Belt SC (flubendiamide)	1.5 fl oz	12	1	armyworms, corn earworm, green cloverworm, loopers, saltmarsh caterpillar, tobacco budworm	28	Do not apply more than 4.5 fl oz/acre per season.
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11A	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed[2].
BotaniGard ES (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with most fungicides.

Table 10.6. Insecticides approved for managing insect pests of celery. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes[2]
Closer SC (sulfoxaflor)	1.5-5.75 fl oz	12	3	aphids, silverleaf or sweetpotato whitefly	4C	Do not make more than 2 consecutive or 4 total applications per crop.
Coragen (rynaxypyr)	3.5-7.5 fl oz	4	1	beet armyworm, cabbage looper, corn earworm, leafminers, suppression of whitefly nymphs	28	May be applied via drip chemigation in addition to foliar and various soil application methods.
Courier 40SC (buprofezin)	9.0-13.6 fl oz	12	7	leafhoppers, planthoppers, whiteflies	16	Do not make more than 2 applications per crop cycle. IGR targets immatures.
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11A	Use high rate for armyworms. Treat when larvae are young.
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11A	Use higher rates for armyworms. OMRI-listed[2].
Dimethoate 4EC (dimethoate)	1 pt	48	7	leafminers	1B	Do not apply more than 3 pt per acre per year.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11A	Treat when larvae are young. Good coverage is essential. See label for rates for specific pests. For organic production.
Durivo (thiamethoxam, chlorantraniliprole)	10.0-13.0 fl oz	12	30	aphids, beet armyworm, cabbage looper, corn earworm, fall armyworm, flea beetles, leafhoppers, whiteflies	4A, 28	Do not exceed more than 13 fl oz per acre per season.
Entrust SC (spinosad)	1.5-10.0 fl oz	4	1	armyworms, cabbage looper, leafminers, thrips	5	See label for resistance management recommendations. Apply no more than 29 oz per acre per year. OMRI-listed[2].
Exirel (cyazypyr)	7.0-20.5 fl oz	12	1	beet armyworm, cabbage looper, corn earworm, cutworms, diamondback moth, fall armyworm, green peach aphid, leafminers, whitefly	28	Do not apply more than 0.4 lb ai of cyazypyr or cyantraniliprole-containing products (such as Verimark) per crop whether applications are made to soil or foliage.
Extinguish ((S)-methoprene)	1-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grandevo *Chromobacterium subtsugae* strain PRAA4-1	1-3 lb	4	0	aphids, armyworm, cabbage looper, cutworms, diamondback moth, green cloverworm, mites, tobacco budworm, thrips, whiteflies	_	Can be used in organic production. OMRI-listed[2].
Fulfill (pymetrozine)	2.75 oz	12	7	aphids, suppression of whiteflies	9B	Apply when aphids first appear, before populations build to damaging levels. Two applications (maximum allowed) may be needed to control persistent aphid populations.
Intrepid 2F (methoxyfenozide)	4-10 fl oz	4	1	armyworms, cabbage looper, webworms	18	Do not apply more than 64 fl oz per acre per season.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	most caterpillars, but not Spodoptera species (armyworms)	11A	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3 pt **SP:** 0.25-1.0 lb	48	7	armyworms, aster leafhopper, beet armyworm, loopers, variegated cutworm	1A	Do not apply more than 24 pt of LV or 8 lb SP per acre per season.
***Larvin 3.2** (thiodicarb)	16-30 fl oz	48	14	armyworms, beet armyworm, cabbage looper, corn earworm, fall armyworm, southern armyworm	1A	Do not exceed 60 fluid ounces of Larvin per acre per season.
Malthion 5EC (malathion)	2.4 pt	24	7	aphids, spider mites	1B	Maximum number of applications per year is two and minimum retreatment interval is 7 days.
Malathion 8F (malathion)	1-1.5 pt	24	7	aphids, spider mites	1B	Do not apply more than twice per year.

Table 10.6. Insecticides approved for managing insect pests of celery. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes[2]
Movento (spirotetramat)	4.0-5.0 fl oz	24	3	aphids, whiteflies	23	Do not apply more than 10 fl oz/acre/crop.
M-Pede 49% EC (Soap, insecticidal)	1-2% V/V	12	0	whiteflies	--	OMRI-listed[2].
***Mustang** (zeta-cypermethrin)	2.4-4.3 fl oz	12	1	corn earworm, cucumber beetles, cutworms, flea beetles, leafhoppers, saltmarsh caterpillar, tobacco budworm, aphids, whiteflies, armyworms, ground beetles, crickets, loopers, *Lygus* bugs, stink bugs, wireworm adults	3A	A maximum of 0.3 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
Neemix 4.5 EC (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, cutworms, leafminers, webworms, whiteflies	un	IGR and feeding repellant. OMRI-listed[2].
Orthene 97 (acephate)	0.5-1.0 lb	24	21	cabbage looper, fall armyworm, green peach aphid	1B	Do not use more than 2 lb aiper acre per season. All tops must be removed before shipment.
Platinum 75SG (thiamethoxam)	1.66-3.67 oz	12	30	aphids, flea beetles, leafhoppers, leafminers (suppression), whiteflies	4A	Maximum = 11 oz/acre or 3.67 oz/ acre (75SG) per season. Do not use in conjunction with other 4A insecticides.
***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	beet armyworm, corn earworm, fall armyworm, *Liriomyza* leafminers, loopers, tobacco budworm	6	Provides suppression of leafminers. Rotate with other products with different modes of action.
PyGanic Crop Protection EC 5.0 (pyrethrins)	4.5-18 fl oz	12	0	Aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, whiteflies, others	3A	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed[2].
Radiant SC (spinetoram)	5-10 fl oz	4	1	armyworms (not yellowstriped), cabbage looper, corn earworm, *Liriomyza* leafminer, thrips	5	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
Requiem EC (extract of *Chenopodium ambrosioides*)	2.0-4.0 qt	4	0	green peach aphid, suppression of *Liriomyza* leafminers, potato aphid, turnip aphid, whiteflies	un	Apply before pests reach damaging levels.
Scorpion 35 SL insecticide (dinotefuran)	**Foliar:** 2-5.25 fl oz **Soil:** 9-10.5 fl oz	12	foliar - 7, soil - 21	brown stink bug, cucumber beetle, flea beetles, grasshoppers, green stink bug, harlequin bug, leafhoppers, leafminers, southern green stink bug, thrips, whiteflies, suppression of green peach aphid	4A	Use only one application method: foliar or soil. Maximum amount that can be applied per season: foliar, 10.5 fl oz; soil, 21 fl oz.
Sevin XLR; 4F; 80S (carbaryl)	**XLR; 4F:** 0.5-2 qt **80S:** 0.63-2.5 lb	12	14	armyworms, aster leafhopper, corn earworm, fall armyworm, flea beetles, leafhoppers, Lygus bug, spittlebugs, stink bugs, tarnished plant bug	1A	Repeat, as needed, up to 5 times, with at least 7 days between applications.
Sivanto 200 SL (flupyradifurone)	7-14 fl oz	4	1	aphids, leafhoppers, whiteflies	4D	Maxium allowed per crop season per acre = 28 fl oz. Maximum crop seasons per year = 3.
SunSpray 98.8%, **JMS Stylet-Oil, Saf-T-side, others** **(**Oils, insecticidal)	3-6 qt/100 gal (JMS) 1-2 gal/100 gal	4	0	aphids, beetle larvae, leafhoppers, leafminers, mites, thrips, whiteflies (pests controlled vary by product)	--	See label for cautions on tank mixes. Organic Stylet-Oil and Saf-T-Side are OMRI-listed[2].
Torac Insecticide (tolfenpyrad)	14-21 fl oz	12	1	aphids (except lettuce aphid), flea beetles, leafhoppers, thrips, supression of lepidopteran pests and whiteflies	21A	Do not apply until at least 14 days after emergence or after transplanting. Do not apply more than 42 fl oz per acre per crop cycle and apply no more than twice per crop or 4 times per year. To protect pollinators, do not allow to drift to flowering weeds or nearby crops in bloom.
Trigard (cyromazine)	2.66 oz	12	7	leafminers	17	Do not make more than six applications per crop.
Trilogy (extract of neem oil)	0.5-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	un	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].

Table 10.6. Insecticides approved for managing insect pests of celery. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes[2]
Venom Insecticide (dinotefuran)	**foliar:** 1-3 oz	12	7	**Foliar**: brown stink bug, cucumber beetle, flea beetle, grasshopper, green stink bug, suppression of green peach aphid and potato aphid, southern green stink bug, whiteflies	4A	Do not apply more than 6 oz per acre per season (foliar) or 12 oz per acre per season (soil). Do not use both methods of application. Do not apply when bees are foraging or to blooming plants. Toxic to bees for more than 38 hours following treatment.
	soil: 5-6.0 oz			**Soil**: suppression of green peach aphid and potato aphid, leafhoppers, leafminers, whiteflies		
Verimark (cyazypyr)	5.0-13.5 fl oz	4	N/A: applied at planting	beet armyworm, corn earworm, cabbage looper, diamondback moth, green peach aphids, *Liriomyza* leafminers, whitefly	28	Do not apply more than 13.5 fl oz at planting or more than 0.4 lb ai/acre of cyantraniliprole-containing products per crop, whether applied to soil or foliage.
Vetica (flubendiamide and buprofezin)	12.0-17.0 fl oz	12	7	armyworms, cabbage looper, corn earworm, cutworms, green cloverworm, imported cabbageworm, leafhoppers, saltmarsh caterpillar, tobacco budworm, whitefly	28, 16	Do not apply more than three times per season or apply more than 38 fl oz per acre per season. Use high rate for leafhoppers and whitefly.
Voliam Flexi (thiamethoxam, chlorantraniliprole)	4.0-7.0 oz	12	7	aphids, beet armyworm, cabbage looper, corn earworm fall armyworm, flea beetles, leafhoppers, southern armyworm, tobacco budworm, whiteflies	4A, 28	Do not apply more than 14 oz per acre per growing season. An adjuvant may be used when applying to celery.
***Vydate L** (oxamyl)	2-4 pt	48	21	leafminers (except *Liriomyza trifolii*)	1A	Do not apply more than 24 pt/acre per season.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	caterpillars	11A	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 10.7. Insecticides approved for managing insect pests of okra crops.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Days to Harvest	REI (hours)	Remarks[2]
Aphids	1B	**Malathion 5EC** **Malathion 8** (malathion)	1.2 pt	1	12	Maximum of 5 applications per year.
	3A	***Brigade 2 EC** (bifenthrin)	2.1-6.4 fl oz	7	12	Do not apply more than 0.2 lb ai/acre per season.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	Treat when insects first appear. Harmful to bees. OMRI-listed.[2]
	4A	**Admire Pro** (imidacloprid) (see appropriate labels for other brands)	**soil:** 7-14 fl oz, **foliar:** 1.3-2.2 fl oz	**soil:** 21 **foliar:** 0	12	No more than 14 oz per acre per crop for soil application or 6.7 fl oz if used as a foliar spray.

Table 10.7. Insecticides approved for managing insect pests of okra crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Days to Harvest	REI (hours)	Remarks[2]
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz	7	12	Do not make more than 4 applications per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	**foliar:** 7-14 fl oz **soil:** 21-28 fl oz	**foliar:** 1 **soil:** 45	4	**Foliar:** Maximum allowed per acre per year: 28 fl oz. **Soil:** Maximum allowed: 28 fl oz per season with no more than 3 crop seasons per year.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	0	12	Do not apply more than 8.4 oz/acre per season.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
	23	**Movento** (spirotetramat)	4-5 fl oz	1	24	Do not apply more than 10 fl oz per acre per season.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	1	12	Do not apply more than a total of 0.4 lb ai per crop of cyazypyr or cyantraniliprole-containing products.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	0	4	Antifeedant, repellant, insect growth regulator. Rate depends on pest-see label.
	un	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	0	4	Can be used in organic production. OMRI-listed[2].
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	0	12	IGR and feeding repellant. OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2 -4 qt	0	4	Apply before pests reach damaging levels.
	--	**BotaniGard 22 WP, ES** (*Beauveria bassiana*)	**WP:** 0.5-2 **ES**: 0.5-2 qt/100 gal	0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	--	**SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil, Saf-T-Side, Others** (oil, insecticidal)	1-2 gal/100 gal **JMS:** 3-6 qt/100 gal (JMS)	0	4	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Beetles (including cucumber beetles, flea beetles)	1A	**Sevin 80S, 4F, XLR** (carbaryl)	**80S:** 1.25-1.88lb **4F, XLR:** 1-1.5 qt	3	12	Do not apply more than a total of 6 qt or 7.5 lb per acre per season.
	1B	**Malathion 5EC, 8** (malathion)	1.2 pt	1	12	Maximum of 5 applications per year.
	3A	***Capture LFR** (bifenthrin)	3.4-8.5 fl oz, at planting	N/A-applied at planting	12	For mixing with liquid fertilizer to apply to soil at planting.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	OMRI-listed.[2]
	3S	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	1	12	Do not make applications less than 7 days apart. Do not apply more than 0.3 lb ai/acre (25.8 fl oz of product) per season.
	4A	**Admire Pro** (imidacloprid)	**soil:** 7-14 fl oz, **foliar:** 1.3-2.2 fl oz	**soil:** 21 **foliar:** 0	12	No more than 14 oz per acre per crop for soil application or 6.7 fl oz if used as a foliar spray.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz	7	12	Do not make more than 4 applications per season.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].

Table 10.7. Insecticides approved for managing insect pests of okra crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Days to Harvest	REI (hours)	Remarks[2]
Caterpillars (including armyworms, loopers, tomato fruitworm -also known as corn earworm, caterpillars, cutworms)	1A	**Sevin 80S, 4F, XLR** (carbaryl)	**80S:** 1.25-1.88lb **4F, XLR:** 1-1.5 qt	3	12	Do not apply more than a total of 6 qt or 7.5 lb per acre per season.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	1	12	Florida only.
	3A	***Brigade 2 EC** (bifenthrin)	2.1-6.4 fl oz	7	12	Do not apply more than 0.2 lb ai/acre per season.
	3A	***Capture LFR** (bifenthrin)	3.4-6.8 fl oz	N/A-applied at planting	12	For mixing with liquid fertilizer to apply to soil at planting.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	OMRI-listed.[2]
	3S	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	1	12	Do not make applications less than 7 days apart. Do not apply more than 0.3 lb ai/acre (25.8 fl oz of product) per season.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	1	4	Do not apply more than 29 oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	1	4	Control of leafminers and thrips may be improved with an adjuvant.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies kurstaki)	0.5-2.0 lb	0	4	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	0	4	Use higher rates for armyworms. OMRI-listed[2].
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies kurstaki)	0.5-2.0 lb	0	4	Can be used in organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies kurstaki)	0.12-1.50 lb	1	4	Treat when larvae are young. Thorough coverage is essential. OMRI-listed2.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies aizawai)	0.5-2.0 lb	0	4	Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
	18	**Intrepid 2F** (methoxyfenozide)	4-16 fl oz	1	4	Do not apply more than 64 fl oz per acre per season.
	22	**Avaunt** (indoxacarb)	2.5-3.5 oz	3	12	Maximum = 14 oz/acre per crop
	28	**Belt SC** (flubendiamide)	1.5 fl oz	1	12	Do not apply more than 4.5 fl oz/acre per season.
	28	**Coragen** (chlorantraniliprole)	3.5-7.5 fl oz	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray. Make no more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	1	12	Do not apply more than a total of 0.4 lb ai per crop of cyazypyr or cyantraniliprole-containing products.
	28,16	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use high rate for whiteflies and leafhoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	0	4	Antifeedant, repellant, insect growth regulator.
	un	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	0	4	Can be used in organic production. OMRI-listed[2].
	un	**Neemix 4.5** (azadirachtin)	4.5-18 fl oz	0	12	IGR and feeding repellant. OMRI-listed[2].

Table 10.7. Insecticides approved for managing insect pests of okra crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Days to Harvest	REI (hours)	Remarks[2]
	--	**BotaniGard 22 WP, ES** (*Beauveria bassiana*)	**WP:** 0.5-2 qt/100 gal **ES**: 0.5-2	0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
Fire ants	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb	0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	1	12	Apply when ants are actively foraging.
Leafminers	3A	***Brigade 2 EC** (bifenthrin)	2.1-6.4 fl oz	7	12	Do not apply more than 0.2 lb ai/acre per season.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	1	4	Do not apply more than 29 oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	1	4	Control of leafminers and thrips may be improved with an adjuvant.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	1	12	Do not apply more than a total of 0.4 lb ai per crop of cyazypyr or cyantraniliprole-containing products.
	28	**Verimark** (cyantraniliprole)	5-10 fl oz	1	4	Apply at planting or through drip chemigation, but do not make more than 1 drip chemigation application per crop if an at planting application was made. Do not apply more than a total of 0.4 lb ai per crop of cyazypyr or cyantraniliprole-containing products (such as Exirel).
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	0	4	Antifeedant, repellant, insect growth regulator. Rate depends on pest-see label.
	un	**Neemix 4.5** (azadirachtin)	4.5-18 fl oz	0	12	IGR and feeding repellant. OMRI-listed[2].
	--	**SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil, Saf-T-Side, Others** (oil, insecticidal)	1-2 gal/100 gal **JMS:** 3-6 qt/100 gal (JMS)	0	4	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Mites	1B	**Malathion 5EC Malathion 8** (malathion)	1.2 pt	1	12	Maximum of 5 applications per year.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	OMRI-listed.[2]
	10B	**Zeal** (etoxazole)	2.0-3.0 oz	7	12	Do not make more than one application per season. Do not use with an adjuvant or surfactant.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	7	12	Two applications per year, at least 21 days apart.
	21A	**Portal** (fenpyroximate)	2.0 pt	1	12	Do not make more than two applications per season.
	23	**Movento** (spirotetramat)	4-5 fl oz	1	24	Do not apply more than 10 fl oz per acre per season.
	un	**Acramite-50WS** (bifenazate)	0.75-1.0 lb	3	12	One application per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Trilogy** (extract of neem oil)	1.0-2.0% V/V	0	4	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil, Saf-T-Side, Others** (oil, insecticidal)	1-2 gal/100 gal **JMS:** 3-6 qt/100 gal (JMS)	0	4	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Stink Bugs	1A	**Sevin 80S, 4F, XLR** (carbaryl)	**80S:** 1.25-1.88lb **4F, XLR:** 1-1.5 qt	3	12	Do not apply more than a total of 6 qt or 7.5 lb per acre per season.

Table 10.7. Insecticides approved for managing insect pests of okra crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Days to Harvest	REI (hours)	Remarks[2]
	3A	***Brigade 2 EC** (bifenthrin)	2.1-6.4 fl oz	7	12	Do not apply more than 0.2 lb ai/acre per season.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	OMRI-listed.[2]
	3S	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	1	12	Do not make applications less than 7 days apart. Do not apply more than 0.3 lb ai/acre (25.8 fl oz of product) per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	**foliar:** 7-14 fl oz **soil:** 21-28 fl oz	**foliar:** 1 **soil:** 45	4	**Foliar:** Maximum allowed per acre per year: 28 fl oz. **Soil:** Maximum allowed: 28 fl oz per season with no more than 3 crop seasons per year.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
Thrips (check label for species controlled)	1B	**Malathion 5EC Malathion 8** (malathion)	1.2 pt	1	12	Maximum of 5 applications per year.
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	OMRI-listed.[2]
	4A	**Admire Pro** (imidacloprid)	**soil:** 7-14 fl oz, **foliar:** 1.3-2.2 fl oz	**soil:** 21 **foliar:** 0	12	No more than 14 oz per acre per crop for soil application or 6.7 fl oz if used as a foliar spray.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	1	4	Do not apply more than 29 oz per acre per crop. OMRI-listed.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	0	4	Can be used in organic production. OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2 -4 qt	0	4	Apply before pests reach damaging levels.
	--	**BotaniGard 22 WP, ES** (*Beauveria bassiana*)	**WP:** 0.5-2 **ES**: 0.5-2 qt/100 gal	0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	--	**SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil, Saf-T-Side, Others** (oil, insecticidal)	1-2 gal/100 gal **JMS:** 3-6 qt/100 gal (JMS)	0	4	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Whitefly	1B	**Malathion 5EC Malathion 8** (malathion)	1.2 pt	1	12	Maximum of 5 applications per year. Must be tankmixed with a pyrethroid for effective control.
	3A	***Brigade 2 EC** (bifenthrin)	2.1-6.4 fl oz	7	12	Do not apply more than 0.2 lb ai/acre per season. Best results if tank mixed with malathion
	3A	**Pyganic 5.0** (pyrethrins)	4.5-18 oz	0	12	OMRI-listed.[2]
	4A	**Admire Pro** (imidacloprid)	**soil:** 7-14 fl oz, **foliar:** 1.3-2.2 fl oz	**soil:** 21 **foliar:** 0	12	No more than 14 oz per acre per crop for soil application or 6.7 fl oz if used as a foliar spray.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz	7	12	Do not make more than 4 applications per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	**foliar:** 7-14 fl oz **soil:** 21-28 fl oz	**foliar:** 1 **soil:** 45	4	**Foliar:** Maximum allowed per acre per year: 28 fl oz. **Soil:** Maximum allowed: 28 fl oz per season with no more than 3 crop seasons per year.
	7C	**Knack IGR** (pyriproxyfen)	8-10 fl oz	7	12	Immatures only. Apply when nymphs first appear. Do not apply more than twice per growing season.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	1	12	Do not apply more than 36 fl oz per acre per season. Do not apply more than twice for whiteflies and thrips.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	1	12	Immatures only. Make no more than 2 applications per crop cycle.

Table 10.7. Insecticides approved for managing insect pests of okra crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect or mite pest	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate (Product/acre)	Days to Harvest	REI (hours)	Remarks[2]
	23	**Movento** (spirotetramat)	4-5 fl oz	1	24	Do not apply more than 10 fl oz per acre per season.
	28	**Exirel** (cyantraniliprole)	7.0-20.5 fl oz	1	12	Do not apply a total of more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per crop, either as foliar or soil applications.
	28	**Verimark** (cyantraniliprole)	5-10 fl oz	1	4	Apply at planting or through drip chemigation, but do not make more than 1 drip chemigation application per crop if an at planting application was made. Do not apply more than a total of 0.4 lb ai per crop of cyazypyr or cyantraniliprole-containing products (such as Exirel).
	28,16	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use high rate for whiteflies and leafhoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	0	4	Antifeedant, repellant, insect growth regulator. Rate depends on pest-see label.
	un	**Grandevo** (Chromobacterium subtsugae strain PRAA4-1)	1.0-3.0 lb	0	4	OMRI-listed[2].
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	0	12	IGR and feeding repellant. OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2 -4 qt	0	4	Apply before pests reach damaging levels.
	--	**BotaniGard 22 WP, ES** (*Beauveria bassiana*)	**WP:** 0.5-2 qt/100 gal **ES**: 0.5-2	0	4	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	--	**SunSpray 98.8%; Ultra-Fine; JMS Stylet Oil, Saf-T-Side, Others** (oil, insecticidal)	1-2 gal/100 gal **JMS:** 3-6 qt/100 gal (JMS)	0	4	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Wireworm	3A	***Capture LFR** (bifenthrin)	3.4-6.8 fl oz	N/A-applied at planting	12	For mixing with liquid fertilizer to apply to soil at planting.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

* Restricted use insecticide.

Table 10.8. Insecticides approved for managing insect pests of parsley.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
Aphids	1B	**Malathion 5EC** (malathion)	1.5-2.4 pt	24	7	Do not apply more than twice per year. Highly toxic to bees. Do not apply when bees are foraging in the area.
	1B	**Malathion 8 F** (malathion)	1.5 pt	24	7	Do not apply more than twice per year. Highly toxic to bees. Do not apply when bees are foraging in the area.
	3A	***Pounce 25 WP** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	7	Do not use if other 4A insecticides have been or will be used. Toxic to bees. See note for Admire.
	4A	**Assail 30SG** (acetamiprid)	2.0-4.0 oz	12	7	Begin applications for whiteflies when first adults are noticed. Do not apply more than 5 times per season or apply more often than every 7 days.
	4A	**Belay Insecticide** (clothianidin)	3-4 fl oz	12	7	Do not apply treatments less than 10 days apart. Maximum of 12 fl oz per year, regardless of application method. Highly toxic to bees for 5 days after application. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (soil application)	12	21	Maximum of 12 fl oz per year, regardless of application method. Highly toxic to bees for 5 days after application. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz	12	7	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum = 3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz **Soil:** 9-10.5 fl oz	12	foliar - 7, soil - 21	No more than 2 applications at highest rate per acre per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-3 oz; **soil:** 5-6.0 oz	12	**foliar:** 7; **soil:** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A, 28	**Voliam Flexi** (thiamethoxam, chlorantraniliprole)	4.0-7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4C	**Closer SC** (sulfoxaflor)	1.5-5.75 fl oz	12	3	Do not make more than 2 consecutive applications or more than 4 total applications per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	1	Minimum interval between applications=7 days. Maximum allowed per crop season=28 fl oz. Maximum crops per year=3.
	9B	**Fulfill** (pymetrozine)	2.75 oz	12	7	Apply when aphids first appear, before populations build to damaging levels. Two applications (maximum allowed) may be needed to control persistent aphid populations.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai per acre per crop, including other products containing cyazypyr or cyantraniliprole. Do not apply while bees are foraging in the area. See label.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	3	Do not apply more than 10 fl oz per acre per crop.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A-applied at planting	Do not apply more than 0.4 lb ai per acre per crop, including other products containing cyazypyr or cyantraniliprole (such as Exirel).
	--	**Aza-Direct** (azadirachtin)	1-2 pts, to 3.5 pts if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.

Table 10.8. Insecticides approved for managing insect pests of parsley. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	_	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed.
	--	**M-Pede 49% EC** (oil, insecticidal)	1-2% V/V	12	0	OMRI-listed.
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed.
	--	**Trilogy** (extract of neem oil)	1.0-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Flea beetles	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR; 4F:** 0.5-2.0 qt	12	14	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum of 12.8 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	7	Do not use if other 4A insecticides have been or will be used. Toxic to bees. See note for Admire.
	4A	**Belay Insecticide** (clothianidin)	3-4 fl oz	12	7	Do not apply treatments less than 10 days apart. Maximum of 12 fl oz per year, regardless of application method. Highly toxic to bees for 5 days after application. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (soil application)	12	21	Maximum of 12 fl oz per year, regardless of application method. Highly toxic to bees for 5 days after application. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz	12	7	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum = 3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz **Soil:** 9-10.5 fl oz	12	**foliar** - 7, **soil** - 21	No more than 2 applications at highest rate per acre per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-3 oz; **soil:** 5-6.0 oz	12	**foliar:** 7; **soil:** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A, 28	**Voliam Flexi** (thiamethoxam, chlorantraniliprole)	4.0-7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
Caterpillars (includes beet armyworm, cabbage looper, celery leaf-tier, corn earworm, cutworms, fall armyworm)	1A	***Larvin 3.2** (thiodicarb)	16-30 fl oz	48	14	Do not exceed 60 fl oz per acre per season. Do not apply when bees are foraging in the area.
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR; 4F:** 0.5-2.0 qt	12	14	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum of 12.8 fl oz per acre per season.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 2 lb ai/acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	***Pounce 25 WP** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.

Table 10.8. Insecticides approved for managing insect pests of parsley. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4A, 28	**Voliam Flexi** (thiamethoxam, chlorantraniliprole)	4.0-7.0 oz	12	7	Do not apply more than 14 oz per acre per growing season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Apply when larvae are small for best control. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. See label for rates for specific pests. Can be used for organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	4-10 fl oz	4	1	Do not apply more than 64 fl oz per acre per season.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	12	3	Do not apply more than 24 ounces of product per acre per crop.
	28	**Belt SC** (flubendiamide)	1.5 fl oz	12	1	Do not apply more than 4.5 fl oz/acre per season.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	4	1	May be applied by drip chemigation, in addition to foliar and various soil application methods.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai per acre per crop, including other products containing cyazypyr or cyantraniliprole. Do not apply while bees are foraging in the area. See label.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A-applied at planting	Do not apply more than 0.4 lb ai per acre per crop, including other products containing cyazypyr or cyantraniliprole (such as Exirel).
	28, 16	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	12	7	No more than 3 applications per season or 38 fl oz per acre per season.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, to 3.5 pts if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	_	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	Can be used in organic production. OMRI-listed.
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed.

Table 10.8. Insecticides approved for managing insect pests of parsley. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
Fire ants	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum of 12.8 fl oz per acre per season.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-3 oz; **soil:** 5-6.0 oz	12	**foliar:** 7; **soil:** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
Leafhoppers	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR; 4F:** 0.5-2.0 qt	12	14	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 2 lb ai/acre per season.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-3.2 fl oz	12	0	Maximum of 12.8 fl oz per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
	3A	***Pounce 25 WP** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.
	4A	**Actara** (thiamethoxam)	1.5-5.5 oz	12	7	Do not use if other 4A insecticides have been or will be used. Toxic to bees. See note for Admire.
	4A	**Admire Pro** (imidacloprid)	**soil:** 4.4-10.5 fl oz, **foliar:** 1.3 fl oz	12	**soil:** 21, **foliar:** 7	Limited to 10.5 fl oz per acre per season for soil application or 6.5 fl oz for foliar applications. Toxic to bees. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay Insecticide** (clothianidin)	3-4 fl oz	12	7	Do not apply treatments less than 10 days apart. Maximum of 12 fl oz per year, regardless of application method. Highly toxic to bees for 5 days after application. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (soil application)	12	21	Maximum of 12 fl oz per year, regardless of application method. Highly toxic to bees for 5 days after application. Do not allow drift to blooming weeds or nearby crops in bloom.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz	12	7	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A, 28	**Durivo** (thiamethoxam, chlorantraniliprole)	10-13 oz	12	30	May be applied by one of several soil application methods. One application per season.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum = 3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**foliar:** 2-5.25 fl oz **soil:** 9-10.5 fl oz	12	**foliar:** 7; **soil:** 21	No more than 2 applications at highest rate per acre per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-3 oz; **soil:** 5-6.0 oz	12	**foliar:** 7; **soil:** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	1	Minimum interval between applications=7 days. Maximum allowed per crop season=28 fl oz. Maximum crops per year=3.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	12	7	Do not make more than 2 applications per crop cycle. IGR targets immatures.
	28, 16	**Vetica** (flubendiamide and buprofezin)	12.0-17.0 fl oz	12	7	No more than 3 applications per season or 38 fl oz per acre per season.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, to 3.5 pts if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed.

Table 10.8. Insecticides approved for managing insect pests of parsley. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
Leafminers	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	12	1	Do not apply more than 2 lb ai/acre per season.
	3A	***Pounce 25 WP** (permethrin)	3.2-12.8 oz	12	1	Do not apply more than 1.0 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Can be used in greenhouses. Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz	12	7	Do not apply more than 6.4 oz per acre per season. Do not use an adjuvant. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-3.67 oz	12	30	Maximum = 3.67 oz/acre per season. Do not use in conjunction with other 4A insecticides.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**foliar:** 2-5.25 fl oz **soil:** 9-10.5 fl oz	12	**foliar:** 7; **soil:** 21	No more than 2 applications at highest rate per acre per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-3 oz; **soil:** 5-6.0 oz	12	**foliar:** 7; **soil:** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	5	**Entrust SC** (spinosad)	1.5-10.0 fl oz	4	1	Use no more than 29 oz per acre per crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Maximum of 6 applications, no more than 2 consecutive applications before rotating to another MOA.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	7	No more than 2 sequential applications. Must be used with an adjuvant (but not binder sticker types). Not for use on leafy vegetables grown for transplant.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	12	7	Do not apply more than 28.8 oz/A per season.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	No more than 5 applications per crop.
	28	**Coragen** (rynaxypyr)	3.5-7.5 fl oz	4	1	May be applied by drip chemigation, in addition to foliar and various soil application methods.
	28	**Exirel** (cyazypyr)	7.0-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai per acre per crop, including other products containing cyazypyr or cyantraniliprole. Do not apply while bees are foraging in the area. See label.
	28	**Verimark** (cyazypyr)	5.0-13.5 fl oz	4	N/A-applied at planting	Do not apply more than 0.4 lb ai per acre per crop, including other products containing cyazypyr or cyantraniliprole (such as Exirel).
	--	**Aza-Direct** (azadirachtin)	1-2 pts, to 3.5 pts if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellent, insect growth regulator.
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	IGR and feeding repellant. OMRI-listed.
	--	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2.0-4.0 qt	4	0	Apply before pests reach damaging levels.
Twospotted spider mite	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	7	No more than 2 sequential applications. Must be used with an adjuvant (but not binder sticker types). Not for use on leafy vegetables grown for transplant.
Plant bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR; 4F:** 0.5-2.0 qt	12	14	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	0	Do not apply more than 8.4 oz/acre per season. Begin applications before pests reach damaging levels.
Planthoppers	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	12	7	Do not make more than 2 applications per crop cycle. IGR targets immatures.

Table 10.8. Insecticides approved for managing insect pests of parsley. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
Stink bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb **XLR; 4F:** 0.5-2.0 qt	12	14	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Do not make applications less than 7 days apart.
	4A	**Scorpion 35 SL insecticide** (dinotefuran)	**Foliar:** 2-5.25 fl oz **Soil:** 9-10.5 fl oz	12	foliar - 7, soil - 21	No more than 2 applications at highest rate per acre per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-3 oz; **soil:** 5-6.0 oz	12	**foliar:** 7; **soil:** 21	Use only one application method (soil or foliar, not both). Do not apply more than 6 oz/acre (foliar) or 12 oz/acre (soil) per season. Highly toxic to bees. Do not allow drift to weeds or nearby crops in bloom.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, to 3.5 pts if needed	4	0	Antifeedant, repellent, insect growth regulator. OMRI-listed.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

* Restricted use insecticide.

Table 10.9. Celery fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
Alternaria **Botrytis**	7	Endura (boscalid)	9 oz	18 oz	0	0.5	Alternate with non-FRAC code 7 fungicide.
Sclerotinia	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with non-FRAC code 7 fungicide.
Bacterial blight	M1	(copper compounds) **Many labels available:** Badge SC, Badge X2, Basic Copper 53, COCS WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, Champion++, COC DF, COC WP, Copper Count N, Cuprofix Ultra, Cuproxat, Cuerva, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Stretch, Tenn-Cop 5E, Top Cop w/ Sulfur	-	-	1	Varies by product from 4 hr to 2 day	
	25	Agri-mycin 17 Bac-Master Firewall 17 WP (streptomycin)	200 ppm			0.5	See label for details. For transplant production.
Early blight (Cercospora)	M2	(sulfur) **Many labels available:** Cosavet, Crusade DF, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABLES**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.

Table 10.9. Celery fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABLES**		7	0.5	
	M5 & 33	Catamaran (chlorothalonil + phosphite)	4 pt	60 pt	7	0.5	
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action
	11	Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Evito 480SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Flint (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	Do not exceed 2 sequential and 6 total appl. of Quadris Opti. or rotate with non QoI fungicides.
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with another FRAC group 11 fungicide.
Late blight (Septoria)	M2	(sulfur) **Many labels available:** Cosavet, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABLES**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABLES**		7	0.5	
	M5/33	Catamaran (chlorothalonil + phosphite)	4 pt	60 pt	7	0.5	
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with another FRAC group 11 fungicide.
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propi-Star EC, Propimax EC, Shar-Shield PPZ, Tilt 3.6E, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.

Table 10.9. Celery fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action
	11	Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Evito 480SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Flint (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	Do not exceed 2 sequential and 6 total appl. of Quadris Opti. or rotate with non QoI fungicides.
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Pink rot (Sclerotinia)	14	Botran 75W (dichloran)	2 lb	5.33 lb	7	0.5	Direct spray to base of plant.
Powdery mildew	M2	(sulfur) **Many labels available:** Cosavet, Crusade DF, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABLES**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
Pythium	33	Aliette WDG	5 lb	20 lb		0.5	
		Legion 80WDG	5 lb	20 lb		0.5	
		Linebacker WDG (fosetyl-Al)	5 lb	20 lb		0.5	
Pythium seedling blight	4	Apron XL LS (mefenoxam)	0.64 fl. oz./ 100 lb seed			2	Seed treatment only.
	4	Metastar 2E AG (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
Pythium seedling diseases	4	Ridomil Gold EC (mefenoxam)	2 pt			2	Apply at seeding in a 7-12" band on soil over seed furrow.
	4	Ridomil Gold GR (mefenoxam)	40 lb			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.

Table 10.9. Celery fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	4	Ultra Flourish (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Stalk rot (Rhizoctonia)	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABLES**		7	0.5	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Propi-Star EC, Propimax EC, Shar-Shield PPZ, Tilt 3.6E	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action
	11	Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Evito 480SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Flint (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	22.2 pt	7	0.5	Do not exceed 2 sequential and 6 total appl. of Quadris Opti. or rotate with non Qol fungicides.
Various	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11.0 fl oz	33 fl oz	1	0.5	Alternate with fungicides of dissimilar modes of action
	11	Cabrio EG (pyraclostrobin)	16oz	64 oz	0	0.5	Do not exceed 1 sequential appl. of Qol fungicides. See label for soil appl.
	11	Quadris, Satori, Willowood Azoxy (azoxystrobin)	15.4 fl oz or 0.8 fl oz/ 1000 row ft	2.88 qt	0	4 hr	Do not exceed 1 sequential appl. of Qol fungicides. See label for soil appl.
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt		0	4 hr	See label for details.

Table 10.9. Celery fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.
	4 & 11	Uniform SC (mefenoxam + azoxystrobin)	0.34 fl oz/ 1000' of row	1 appl.		0	Soil incorporated.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 10.10. Okra fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Anthracnose	M1	Champion++	1.75 lb	17.5 lb	0	48 hr	
		Kentan DF	1.5 lb		0	2	
		Kocide 2000	3 lb	15 lb	0	2	
		Kocide 3000	1.75 lb	17.5 lb	0	2	
		Nu-Cop 50DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	OMRI product
	M1	Mastercop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
	M5	Bravo Ultrex	1.4 lb	10.9 lb	3	0.5	
		Bravo Weather Stik	1.5 pt	12 pt	3	0.5	
		Chloronil 720	1.5 pt	12 pt	3	0.5	
		Echo 720	1.5 pt	12 pt	3	0.5	
		Equus 720 SST (chlorothalonil)	1.5 pt	12 pt	3	0.5	Do not apply at < 7-day intervals.
	M5 & 27	Ariston (chlorothalonil + cymoxanil)	2.44 pt	18.1 pt	3		
	3	Topguard (flutriafol)	14 fl oz	56 fl oz	0	12 hr	
	3 & 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Do not apply more than 2 sequential applications
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0		Only suppression; make no more than 2 sequeential applications
	11	Equation	15.5 fl oz	61.5 fl oz	0	4 hr	Adjuvant may be added.
		Equation SC	15.5 fl oz	61.5 fl oz	0	4 hr	Adjuvant may be added.
		Quadris	15.5 fl oz	61.5 fl oz	0	4 hr	
		Satori Fungicide	15.5 fl oz	61.5 fl oz	0	4 hr	Do not apply more than 1 application
		Willowood Azoxy 2SC (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	

Table 10.10. Okra fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Make no more than 2 consecutive applications
	33	K-Phite 7LP AG (phosphorous acid)	see label		0	4 hr	Do not apply at intervals less than 3 days.
Bacterial leaf spot	M1	Champion++	1.75 lb	17.5 lb	0	48 hr	
		Kentan DF	1.5 lb		0	2	
		Kocide 2000	3 lb	15 lb	0	2	
		Kocide 3000	1.75 lb	17.5 lb	0	2	
		Nu-Cop 50 DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	OMRI product
	M1	Mastercop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
Cercospora leaf spot	3	Monsoon	6 fl oz	24 fl oz	3	2	Group 3 = DMI funicide
		Onset 3.6L	6 fl oz	24 fl oz	7	0.5	
		Orius 3.6F	6 fl oz	24 fl oz	3	0.5	
		Tebu-Crop 3.6F	6 fl oz	24 fl oz	3	0.5	
		TebuStar 3.6L	6 fl oz	24 fl oz	3	0.5	
		Tebucon 3.6F	6 fl oz	24 fl oz	3	0.5	
		Topguard (tebuconazole)	14 fl oz	56 fl oz	0	0.5	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Do not make 2 consecutive applications
	M5	Bravo Ultrex	1.4 lb	10.9 lb	3	0.5	
		Bravo Weather Stik	1.5 pt	12 pt	3	0.5	
		Chloronil 720	1.5 pt	12 pt	3	0.5	
		Echo 720	1.5 pt	9.0 lb a.i.	3	0.5	
		Equus 720 SST (chlorothalonil)	1.5 pt	12 pt	3	0.5	Do not apply at < 7-day intervals.
	M2 & 3	Unicorn DF (sulfur; tebuconazole)	3.75 lb	15 lb	14	0.5	Do not mix with other DMI fungicides (Group 3)
	M5 & 27	Ariston (chlorothalonil; cymoxanil)	2.44 pt	18.1 pt	3	0.5	
Leaf spot	M1	Champion++	1.75 lb	17.5 lb	0	48 hr	
		Kentan DF	1.5 lb		0	2	
		Kocide 2000	3 lb	15 lb	0	2	
		Kocide 3000	1.75 lb	17.5 lb	0	2	
		Nu-Cop 50DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	OMRI product
	M1	Mastercop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	
	M2	Cosavet DF	10 lb	-	-	1	OMRI product
		Microthiol-Disperss	10 lb	-	-	1	May cause leaf burn if applied during high temperatures
		Thiolux (sulfur)	10 lb			1	Apply at 14-day intervals
Pod spot	M1	Champion++	1.75 lb	17.5 lb	0	48 hr	
		Kentan DF	1.5 lb		0	2	
		Kocide 2000	3 lb	15 lb	0	2	
		Kocide 3000	1.75 lb	17.5 lb	0	2	
		Nu-Cop 50DF (copper hydroxide)	2.1 lb	10.5 lb	1	2	OMRI product
	M1	Mastercop (copper sulfate pentahydrate)	1.5 pt	9 pt	0	2	

Table 10.10. Okra fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Powdery mildew	M1	Champion++	1.75 lb	17.5 lb	0	48 hr	
		Kentan DF	1.5 lb		0	2	
		Kocide 2000	3 lb	15 lb	0	2	
		Kocide 3000	1.75 lb	17.5 lb	0	2	
		Nu-Cop 50DF	2.1 lb	10.5 lb	1	2	OMRI product
		(copper hydroxide)					
	M1	Mastercop	1.5 pt	9 pt	0	2	
		(copper sulfate pentahydrate)					
	M2	Cosavet DF	10 lb	-	-	1	May cause leaf burn if applied during high temperatures
		Micro Sulf	10 lb			1	
		Microthiol-Disperss	10 lb	-	-	1	
		Suffa	0.5 gal			1	
		Thiolux	10 lb			1	
		(sulfur)					
	M5	Bravo Ultrex	1.4 lb	10.9 lb	3	0.5	
		Bravo Weather Stik	1.5 pt	12 pt	3	0.5	
		Chloronil 720	1.5 pt	12 pt	3	0.5	
		Echo 720	1.5 pt	9.0 lb a.i.	3	0.5	
		Equus 720 SST (chlorothalonil)	1.5 pt	12 pt	3	0.5	Do not apply at < 7-day intervals.
	P5	Regalia (extract of Reynoutria sachalinensis)	see label		0	4 hr	
	U8	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	
	3	Rally (myclobutanil)	5.0 oz	1.25 lb	0	1	Do not exceed 4 applications per season.
	3	Sonoma 40WSP	5 oz	20 oz	0	1	Do not make more than 4 applications per season.
		(myclobutanil)					
	3	Topguard	14 fl oz	56 fl oz	0	12 hr	
		(flutriafol)					
	7	Fontelis	24 fl oz	72 fl oz	0		
		(penthiopyrad)					
	11	Equation	15.5 fl oz	61.5 fl oz	0	4 hr	Adjuvant may be added.
		Equation SC	15.5 fl oz	61.5 fl oz	0	4 hr	Adjuvant may be added.
		Quadris	15.5 fl oz	61.5 fl oz	0	4 hr	
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	See label for details.
		Satori Fungicide	15.5 fl oz	61.5 fl oz	0	4 hr	Do not apply more than 1 application
		Willowood Azoxy 2SC	15.5 fl oz	61.5 fl oz	0	4 hr	
		(azoxystrobin)					
	33	Fosphite Fungicide (potassium phosphite)	3 qt		0	4 hr	Do not apply at intervals less than 3 days.
		Rampart	3 qt		0	4 hr	
		K-Phite 7LP AG (phosphorous acid)	see label		0	4 hr	
	3 & 9	Inspire Super (difenoconazole + cyprodinil)	20 fl oz	80 fl oz	7	0.5	Do not apply more than 2 sequential applications
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Do not make 2 consecutive applications
	9 & 12	Switch 62.5WG (cyprodinil; fludioxonil)	14 oz	56 oz	0	0.5	After 2 applications, alternate wit another fungicide wit a different mode of action for 2 applications.

Table 10.10. Okra fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Phytophthora damping-off	4	Acquire	0.75 fl oz/ 100 lb seed			1	
		Allegiance FL	0.75 fl oz/ 100 lb seed	-	-	1	Seed treatment; Do not use with other seed treatment products without previous experience.
		Allegiance LS	1.2 fl oz/ 100 lb seed			1	
		Metastar ST Seed Trestment	0.75 fl oz/ 100 lb seed			1	
		Serbing 318 FS	0.75 fl oz/ 100 lb seed			1	
		Serbing 480 FS	0.50 fl oz/ 100 lb seed			1	
		(metalaxyl)					
	4	Apron XL (mefenoxam)	0.64 fl oz/ 100 lb seed			2	Seed treatment only.
	4	Orondis Gold B (mefanoxam)	2.0 pt	2.0 pt	7	2	Do not make more than 1 soil application per crop.
	21	Ranman (cyazofamid)	2.75 fl oz	16.75 fl oz	7	0.5	Do not exceed 6 applications per season. Rotate with dissimilar modes of action.
	33	Alude	2 qt			4 hr	Foliar spray
		Fosphite Fungicide	See label		0	4 hr	Do not apply at intervals less than 3 days.
		Rampart (potassium phosphite)	See label		0	4 hr	
	40	Orondis Ultra B (mandipropamid)	8 fl oz	32 fl oz	1	0.5	Do not exceed 4 applications. Do not make more than 2 sequential applications. Do not exceed more than 33% of total foliar applications.
	U15	Orondis Gold A (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	2	4 hr	Intended for use with Orondis Gold B (mefenoxam). See label for details. Do not exceed 4 applications. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
	U15	Orondis Ultra A (oxathiapripolin)	4.8 fl oz	19.2 fl oz	0	4 hr	Intended for use with Orondis Ultra B (mandipropamid). See label for details. Do not exceed 4 applications. Do not use soil and foliar appl with oxathiapripolin during same season. Check plant back restrictions.
	U15	Orondis Opti A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz	0	4 hr	Intended for use with Orondis Opti B (chlorothalonil). See label for details. Do not exceed 4 applications. Check plant back restrictions.

Table 10.10. Okra fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Pythium damping-off	4	Acquire	0.75 fl oz/ 100 lb seed			1	
		Allegiance FL	0.75 fl oz/ 100 lb seed	-	-	1	Seed treatment; Do not use with other seed treatment products without previous experience.
		Allegiance LS	1.2 fl oz/ 100 lb seed			1	
		Metastar ST Seed Trestment	0.75 fl oz/ 100 lb seed			1	
		Serbing 318 FS	0.75 fl oz/ 100 lb seed			1	
		Serbing 480 FS	0.50 fl oz/ 100 lb seed			1	
		(metalaxyl)					
	4	Apron XL (mefenoxam)	0.64 fl oz/ 100 lb seed			2	Seed treatment only.
	33	Alude	2 qt			4 hr	Foliar spray
		Fosphite Fungicide	see label		0	4 hr	Do not apply at intervals less than 3 days.
		Fungi-Phite	See label			4 hr	
		Rampart (potassium phosphite)	See label		0	4 hr	
Rhizoctonia seedling rot	11	Quadris Satori Fungicide (azoxystrobin)	0.8 fl oz/ 1000 row feet	61.5 fl oz	0	4 hr	
	33	Fosphite Fungicide	see label		0	4 hr	Do not apply at intervals less than 3 days.
		Fungi-Phite	See label			4 hr	
		Rampart (potassium phosphite)	See label		0	4 hr	

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 10.10. Parsley fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Alternaria	3	(propiconazole) **Many brands available:** Bumper41.8EC, Propi-star, Tilt, Topaz	4 fl oz	16 fl oz	14	0.5	Do not apply more than 2 sequential and 4 total applications
	3	Procure 480SC (triflumizole)	8 fl oz	18 fl oz	0	0.5	Repeat applications at 14 day intervals.
	7	Fontelis 1.67SC (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
Bacterial blight	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, COCS WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, COC DF, COC WP, Copper Count N, Cuerva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Stretch	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 day	
Basal rot & Botrytis	12	Cannonball WP (fludioxonil)	7 oz	28 oz	0	0.5	
Cercospora	3	Bumper 41.8EC (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not apply more than 2 sequential appl. Without alternating to different mode of action
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
Damping-off	33	Aliette WDG	5 lb	35 lb		0.5	
		Legion 80WDG	5 lb	35 lb		0.5	
		Linebacker WDG (fosetyl-Al)	5 lb	35 lb		0.5	
Downy mildew	21	Ranman SC (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Alternate with fungicides with dissimilar modes of action.
	33	(mono- and di-potassium salts of phosphorous acid Many brands available: Alude, Fosphite, Fungi-phite, K-phite, Phiticide, Phostrol, Rampart, Reveille	3 qt		0	0.5	See label for details.
	40	Forum (dimethomorph)	6 fl oz	18 fl oz	0	0.5	See label for details.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	Do not exceed 2 sequential applications. See label for soil applications.
	40 + 45	Zampro (mandipropamid)	14 fl oz	42 fl oz	1	4 hr	Do not exceed 2 sequential applications.
	43	Presidio (fluopicolide)	3-4 fl oz	12 fl oz	2	0.5	Must be tank-mixed with a fungicide of different mode of action. Do not exceed two sequential applications. See label for soil applications.
Powdery mildew	M2	(sulfur) **Many brands available:** Sulfur 90W, Super Six, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.

Table 10.10. Parsley fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	3	Bumper 41.8EC (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not apply more than 2 sequential appl. Without alternating to different mode of action
	3	Tilt 3.6E (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not exceed 2 sequential and 4 total applications.
	3	Procure 480SC (triflumizole)	8 fl oz	18 fl oz	0	0.5	Repeat applications at 14 day intervals.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	11 fl oz	33 fl oz	1	0.5	Alternate with fungicides with dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
Pythium damping-off; Pythium seedling blight; Pythium seedling diseases	4	(metalaxyl) Various brands available: Acquire, Allegiance, Sebring 2.65ST	0.75 fl oz/ 100 lb seed			2	Seed treatment only.
	4	Apron XL LS (mefenoxam)	0.64 fl. oz./ 100 lb seed			2	Seed treatment only.
	4	Ridomil Gold EC (mefenoxam)	2 pt			2	Apply at seeding in a 7-12" band on soil over seed furrow.
	4	Ridomil Gold GR (mefenoxam)	40 lb			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4	Ultra Flourish	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Septoria	3	Tilt 3.6E (propiconazole)	4 fl oz	16 fl oz	14	0.5	Do not exceed 2 sequential and 4 total applications.
	7	Fontelis 1.67SC (penthiopyrad) (pyraclostrobin & fluxapyroxad) (penthiopyrad) (pyraclostrobin & fluxapyroxad)	24 fl oz	72 fl oz	3	0.5	
	11	Cabrio EG (pyraclostrobin)	16oz	64 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of QoI fungicides.
	11	(azoxystrobin) **Various brands available:** Azoxystrobin, Equation, Quadris, Satori, Willowood	15.4 fl oz or 0.8 fl oz/ 1000 row ft	92.3 fl oz	0	4 hr	Do not exceed 1 sequential and 4 total appl. of QoI fungicides. See label for soil appl.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.
	4 & 11	Uniform SC (mefenoxam + azoxystrobin)	0.34 fl oz/ 1000 ft of row	1 appl.		0	Soil incorporated.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 11. Onion, Leek, and Chive Production in Florida

Peter J. Dittmar, Eugene J. McAvoy, Monica Ozores-Hampton, Richard N. Raid, Hugh A. Smith, Susan E. Webb, and Lincoln Zotarelli

Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Onion - *Allium cepa,* Alliaceae (Amaryillidaceae)
Leek - *Allium ampeloprasum*
Chive - *Allium schoenoprasum*
Bunching onion - *Allium fistulosum*

Table 11.1. Planting information for onion and allies.

Planting dates	Seeded	Transplanted
North Florida	Mid Sept - mid Nov	Nov - Jan
Central Florida	Oct	Dec - Jan
South Florida	Oct	Dec - Jan
Planting information		
Distance between rows (in)	14 - 18	14 - 18
Distance between plants (in)	3 - 4	4 - 6
Seeding depth (in)	0.25 - 0.5	-
Seed per acre (lb)	3 - 4	1
Days to maturity	100 - 130	100 - 1302
Plant populations (acre)	149,343	112,123

Cultivars

Table 11.2. Onion and leek cultivars.

Onion		
Amelia (H[1])	Granex 33 (H)	Sweet Caroline (H)
Caramelo (H)	Prowler (H)	Sweet Deal (H)
Dawn (H)	Pumba (H)	Sweet Harvest (H)
Don Victor (H)	Red Hunter	Sweet Success (H)
Frontier (H)	Ringo (H)	WI-3115 (H)
	Sweet Agent (H)	
Bunching Onion		
Perfecto Blanco	Tokyo Long White	White Portugal
Leeks		
King Richard	Tivi	Verina
Lancelot	Jolant	Tornado
Chives		
Staro		

[1] H=hybrid

Table 11.3. Herbicides approved for managing weeds in onion, garlic and other bulb crops.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
			*** PREEMERGENCE ***	
Bensulide 5.0 - 6.0	(Prefar) 4 E 5 - 6 qt.	8	Dry bulb vegetables: onion, garlic, shallot	Annual broadleaf and grass control. Incorporate or irrigate 1 to 2 in. deep within 36 hr. of application. Consult label for rotational restricitons.
Bromoxynil 0.25 - 0.38	(Buctril) 2 EC 1.0 - 1.5 pt. (Buctril) 4 EC 0.5 - 0.75 pt.	6	Onion (dry bulb)	Broadleaf weeds. Preemergence is restricted to muck soils containing greater than 10% organic matter. Apply at least 3 to 4 days prior to emergence. Weeds should not exceed the 4-leaf stage, 2 in. in height or 1 in. in diameter.
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Onion, garlic, leek, chive, shallot	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
DCPA 4.5 - 6.0	(Dacthal) W-75 6 - 8 lb. (Dacthal) 6 F 6 - 8 lb.	3	Onion (dry bulb, green), leek, shallot	Annual grasses and certain broadleaf control. Apply at seeding or planting. Maximum rate of 10.5 lb. a.i./A per season.
Flumioxazin up to 0.06	(Chateau) 51 WDG up to 2 fl. oz.	14	Garlic	Broadleaf control. Apply to transplanted onions between the 2- and 6- leaf stage. Apply to direct seeded onions between the 3- and 6- leaf stage.
Glyphosate	(various formulations) consult label	9	Onion, garlic, leek, chive, shallot	Control of emerged broadleaf and grass weeds. Consult individual labels for restrictions.

Table 11.3. Herbicides approved for managing weeds in onion, garlic and other bulb crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Crops	Weeds controlled / remarks
Oxyfluorfen 2	(Goal 2XL) 2 EC 2.0 pt. (GoalTender) 4 EC 1.0 pt.	14	Onion (dry bulb), garlic (dry bulb)	Certain broadleaf weeds. Transplanted only. Apply within 2 days of transplanting. Necrotic lesions, twisting or stunting of plants can occur if applications are made during cool, wet weather or prior to the full development of the true leaves.
Paraquat 0.5 - 1.0	(Gramoxone) 2 SL 2 - 4 pt.	22	Onion (dry bulb)	Controls emerged weeds. Apply prior, during, or after planting, but before crop emergence. Only 2 applications a season. Use a non-ionic surfactant.
Paraquat 0.63 - 1.0	(Gramoxone) 2 SL 2.5 - 4.0 pt. (Firestorm) 3 SL 1.7 - 2.7 pt.	22	Onion (seeded), garlic	Emerged broadleaf and grass weeds. Apply as a preplant burndown. A maximum of 1 lb. a.i./A per season.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Onion, garlic, leek, chive, shallot	Emerged broadleaf and grass weeds. Apply before emergence of crop. Product is a contact, nonselective, foliar applied herbicide. There is no residual activity.
Pendimethalin mineral 0.5 - 0.75 muck 1.0 - 2.0	(Prowl) 3.3 EC mineral 1.2 - 1.8 pt. muck 2.4 - 4.8 pt. (Prowl H20) 3.8 mineral 1.0 - 1.5 pt. muck 2.0 - 4.0 pt.	3	Onion (dry bulb), shallot (dry bulb), garlic	Mineral soils: Apply when crop has 2 to 9 true leaves. Muck soils: May be applied as sequential application: preemergence through loop stage, early postemergence (2 to 6 true leaf stage), late postemergence (6 to 9 true leaf stage). Do not exceed 5.9 lb. a.i./A in a growing season. PHI 45 days.
Pyraflufen 0.001 - 0.003	(ET Herbicide/Defoliant) 0.5 - 2.0 fl. oz.	14	Bulb vegetables	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.
			***** POSTEMERGENCE *****	
Bromoxynil 0.25 - 0.38	(Buctril) 2 EC 1.0 - 1.5 pt. (Buctril) 4 EC 0.5 - 1.5 pt.	6	Onion (Dry bulb)	Broadleaf weeds. Soil and onion leaves should be dry before application. Waxy coating on leaves reduces chances for injury. Varieties vary in sensitivity and use on a trial basis.
Bromoxynil 0.38 - 0.5	(Buctril) 2 EC 1.5 - 2.0 pt.	6	Garlic	Broadleaf weeds. Apply after emergence but before 12 in. tall. Weeds are most susceptible up to the 4-leaf stage or 2 in. height or 1 in. wide. PHI 112 days.
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Onion (dry bulb), garlic, leek, chive, shallot	Emerged broadleaf control. Post-direct hooded application to row middles for burndown of emerged weeds. Use crop oil concentrate or nonionic surfactant at recommended rates. PHI 0 days.
Clethodim 0.09 - 0.25 0.07 - 0.25	(Arrow, Select) 2 EC 6 - 16 fl. oz. (Select Max) 1 EC 9 - 32 fl. oz.	1	Onion (dry bulb), garlic, shallot (dry bulb)	Annual and perennial grass control. Some labels include green onion. Consult label for use of a crop oil concentrate or nonionic surfactant. PHI 45 days.
Clethodim 0.09 - 0.13	(Arrow, Select) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 12 - 16 fl. oz.	1	Chive, leek	Emerged annual and perennial grasses. Consult labels rate of COC or NIS. Do not apply more than 0.5 lb. a.i./A per season. Select Max is not registered in leek. PHI 14 days.
DCPA 4.5 - 6.0	(Dacthal) W-75 6 - 8 lb. (Dacthal) 6 F 6 - 8 pt.	3	Onion (dry bulb, green), leek, shallot	Annual grasses and certain broadleaf control. Apply at layby up to 14 weeks after planting. If weeds have emerged then cultivate or hand weed. Maximum rate of 10.5 lb. a.i./A per season.
Dimethanamid-p up to 1.0	(Outlook) 6 EC up to 21 fl. oz.	15	Onion (dry bulb), garlic, leek, shallot (dry bulb, green)	Broadleaf and grass weeds. Apply after the 2 true-leaf stage. Apply as a single application or split application. Split application of 10 - 14 fl. oz. followed by 7 to 10 fl. oz./A with 14 days between applications. Do not exceed 21 fl. oz./A per growing season. PHI 30 days.
Fluazifop 0.188	(Fusilade DX) 12 fl. oz.	1	Onion (dry bulb), garlic	Annual and perennial grass weeds. Do not apply more than 48 fl. oz./A per season. Include a COC or NIS. PHI 45 days.
Oxyfluorfen 0.5	(Goal 2 XL) 2 EC 0.5 pt. direct seeded (GoalTender) 4 EC 0.25 pt. direct seeded	14	Onion (dry bulb), garlic (dry bulb)	Certain broadleaf weeds. Direct seeded only. Apply after the crop has 2 true leaves. Multiple treatments can be applied and do not exceed 0.5 lb. a.i./A. Necrotic lesions, twisting or stunting of plants can occur if applications are made during cool, wet weather or prior to development of true leaves. PHI 60 days.

Table 11.3. Herbicides approved for managing weeds in onion, garlic and other bulb crops. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.				
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Crops**	**Weeds controlled / remarks**
Sethoxydim 0.19 - 0.28	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Onion (dry bulb, green), garlic, leek, shallot	Grass weeds. Include a surfactant. Do not apply more than 4.5 pt./A per season. PHI 30 days.
Treflan 0.35 - 0.5	(Treflan) 4 EC 0.75 - 1.0 pt. (Treflan TR-10) 3.75 - 5.0 lb.	3	Onion (dry bulb)	Broadleaf and grass weeds. Apply at layby to the soil surface between onion rows. Remove weeds that are preent. Do not apply in muck soils. PHI 60 days.

Table 11.4. Inseticides registered for managing insect pests of garlic and leeks.

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.						
Pest	**MOA Code[1]**	**Trade Name Active Ingredient**	**Rate Product/acre**	**REI hours**	**Days to Harvest**	**Notes**
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt; **8F:** 1-1.56 pt	leeks, shallots, garlic: 24	3	**Leeks, shallots, garlic.** Three applications per year for garlic, two for all others.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Leek, garlic, shallot**
	--	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V	12	0	OMRI-listed.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	--	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Beet Armyworm	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5 pt; **SP:** 0.5 lb	48	7	**Garlic only.**
	28	**Coragen** (chlorantraniliprole)	3.5-5.0 fl oz	4	1	No more than 4 foliar applications or 15.4 fl oz of product per acre per crop. For entire Bulb Vegetable Group.
Caterpillars (includes cutworms and armyworms)	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Dry bulb and garlic only**. **Label is registered only for garlic.** Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Garlic.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz—garlic	12	1	**Garlic**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots.** OMRI-listed.

Table 11.4. Inseticides registered for managing insect pests of garlic and leeks. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Use with an adjuvant.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	1.0-2.0 lb	4	0	Apply when larvae are small for best control.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. For organic production.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	4-12 fl oz	4	1	
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Leek, garlic, and shallot**
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
Fire ants	7A	**Extinguish** ((S)-methoprene)	1-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	12	1	**Dry bulb only**.
Flea beetles	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Garlic (Crop Groups 3-07A and 3-07B)**
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots.** OMRI-listed.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
Leafminers	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Garlic only**. **Label is registered only for garlic.** Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Garlic.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, garlic.**
	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Garlic (Crop Groups 3-07A and 3-07B)**

Table 11.4. Inseticides registered for managing insect pests of garlic and leeks. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Use with an adjuvant.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	30	Must be used with a non-ionic activator type wetting, spreading and/or penetrating adjuvant., not a binder sticker type adjuvant. Maximum of 10.25 fl oz per acre per season.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Maximum of 6 applications per crop.
	28	**Exirel** (cyazypyr)	13.5-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per season. Toxic to bees. Do not allow drift to blooming crops or weeds.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
Onion maggot	1B	***Diazinon AG500,** ***Diazinon 50W** (diazinon)	**AG500:** 2-4 qt; **50W:** 4-8 lb	72	preplant	Do not make more than one soil application per year. **For leeks, garlic, and shallots.**
	1B	**Lorsban 75WG;** ***Advanced** (chlorpyrifos)	**75WG:** 1.33 lb; **Advanced:** depends on row spacing	24	60	**Dry bulb only**. One application per year.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt; **8F:** 1-1.56 pt	leeks, shallots, garlic: 24	3	**Leeks, shallots, and garlic.** Three applications per year for garlic, two for all others.
	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Garlic only**. **Label is registered only for garlic.** Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Garlic.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Garlic**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
Plant bugs	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Garlic.** Maximum of 0.77 pt per acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.
	--	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V	12	0	OMRI-listed.
Stink bugs	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Garlic only**. **Label is registered only for garlic.** Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Garlic.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Garlic**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (garlic)**. Do not apply more than 15.36 fl oz per acre per season.

Table 11.4. Inseticides registered for managing insect pests of garlic and leeks. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Garlic (Crop Groups 3-07A and 3-07B)**
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips (check label for species controlled)	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt; **SP:** 0.5-1.0 lb	48	7	
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt; **8F:** 1-1.56 pt	leeks, shallots, garlic: 24	3	**Leeks, shallots, and garlic.** Three applications per year for garlic, two for all others.
	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Garlic only**. **Label is registered only for garlic.** Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Garlic.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Leeks, shallots, and garlic.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Bulb onions and garlic**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (garlic).** Do not apply more than 15.36 fl oz per acre per season.
	4A	**Admire Pro** (imidacloprid)	14.0 fl oz	12	21	Apply no more than 14 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	5.0-8.0 oz	12	7	No more than 4 applications or 32 oz of product per acre per season.
	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Garlic (Crop Groups 3-07A and 3-07B)**
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For leeks, garlic, and shallots.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Use with an adjuvant.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	30	Must be used with a non-ionic activator type wetting, spreading and/or penetrating adjuvant., not a binder sticker type adjuvant. Maximum of 10.25 fl oz per acre per season.
	7C	**Knack IGR** (pyriproxyfen)	8 fl oz	12	3	Maximum of 2 applications, at least 14 days apart. No activity against adult insects.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Leek, garlic, and shallot**
	--	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V	12	0	OMRI-listed.
	--	**Requiem EC** (extract of *Chenopodium ambrosioides*)	1.5-3.0 qt	4	0	Begin as soon as thrips are seen.
	--	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Wireworms	1B	***Diazinon AG500,** ***Diazinon 50W** (diazinon)	**AG500:** 2-4 qt; **50W:** 4-8 lb	72	preplant	Do not make more than one soil application per year. **For leeks, garlic, and shallots.**

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 11.5. Inseticides registered for managing insect pests of onions.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
Aphids	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt; **8F:** 1-1.56 pt	onions: 12	3	**Onions, bulb and green.** Two applications per year.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions**. Do not apply more than 15.36 fl oz per acre per season.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Onion (bulb and green), and shallot**
	--	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V	12	0	OMRI-listed.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	--	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Beet armyworm, black cutworm, variegated cutworm	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt;**SP:** 0.5-1.0 lb	48	7	**Dry bulb, green onions, only**. Add a wetting agent to improve coverage.
	28	**Coragen** (chlorantraniliprole)	3.5-5.0 fl oz	4	1	**Beet armyworm only.** No more than 4 foliar applications or 15.4 fl oz of product per acre per crop.
Caterpillars (includes cutworms and armyworms)	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Dry bulb and garlic only**. Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Bulb onions**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (onions), not green onions**. Do not apply more than 15.36 fl oz per acre per season.
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For onions, bulb and green.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Use with an adjuvant.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	1.0-2.0 lb	4	0	Apply when larvae are small for best control.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. For organic production.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. OMRI-listed.

Table 11.5. Inseticides registered for managing insect pests of onions. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	4-12 fl oz	4	1	**Green onion subgroup only.** Do not apply more than 64 fl oz per acre per year.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
Fire ants	7A	**Extinguish** ((S)-methoprene)	1-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	12	1	**Dry bulb only**.
Flea beetles	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Bulb and green onions (Crop Groups 3-07A and 3-07B)**
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For onions, bulb and green.** OMRI-listed.
Leafminers	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Dry bulb only**. Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz —garlic	12	1	**Bulb onions**
	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Bulb and green onions (Crop Groups 3-07A and 3-07B)**
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For onions, bulb and green.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Use with an adjuvant.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	30	Must be used with a non-ionic activator type wetting, spreading and/or penetrating adjuvant., not a binder sticker type adjuvant. Maximum of 10.25 fl oz per acre per season.
	17	**Trigard** (cyromazine)	2.66 oz	12	7	Maximum of 6 applications per crop.
	28	**Exirel** (cyazypyr)	13.5-20.5 fl oz	12	1	Do not apply more than 0.4 lb ai per acre of cyazypyr or cyantraniliprole-containing products per season. Toxic to bees. Do not allow drift to blooming crops or weeds.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
Onion maggot	1B	***Diazinon AG500, *Diazinon 50W** (diazinon)	**AG500:** 2-4 qt,**50W:** 4-8 lb	72	preplant	Do not make more than one soil application per year. **For onions, bulb and green.**

Table 11.5. Inseticides registered for managing insect pests of onions. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	1B	**Lorsban 75WG; *Advanced** (chlorpyrifos)	**75WG:** 1.33 lb; **Advanced:** depends on row spacing	24	60	**Dry bulb only**. One application per year.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt; **8F:** 1-1.56 pt	onions: 12, leeks, shallots, garlic: 24	3	**Onions, bulb and green.** Three applications per year for garlic, two for all others.
	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Dry bulb only**. Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Bulb onions**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions**. Do not apply more than 15.36 fl oz per acre per season.
	--	**Neemix 4.5 EC** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
Plant bugs	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (onions and garlic), not green onions**. Do not apply more than 15.36 fl oz per acre per season.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed.
Stink bugs	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Dry bulb only**. Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Bulb onions**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (onions), not green onions**. Do not apply more than 15.36 fl oz per acre per season.
	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Bulb and green onions (Crop Groups 3-07A and 3-07B)**
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips (check label for species controlled)	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt; **8F:** 1-1.56 pt	onions: 12, leeks, shallots, garlic: 24	3	**Onions, bulb and green.** Three applications per year for garlic, two for all others.
	3A	***Ambush 25W** (permethrin)	6.4-19.2 oz	12	1	**Dry bulb**. Maximum of 2 lb ai/acre per season.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	0.77-1.54 fl oz	24	14	**Bulb onions.** Maximum of 0.77 pt per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	7	Do not apply more than 21.5 oz per acre per season. **Onions, bulb and green.**

Table 11.5. Inseticides registered for managing insect pests of onions. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	3A	***Pounce 25 WP** (permethrin)	6.4-19.2 oz—onions 6.4-12.8 oz—garlic	12	1	**Bulb onions**
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	14	**For bulb crops only (onions), not green onions**. Do not apply more than 15.36 fl oz per acre per season.
	4A	**Admire Pro** (imidacloprid)	14.0 fl oz	12	21	Apply no more than 14 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	5.0-8.0 oz	12	7	No more than 4 applications or 32 oz of product per acre per season.
	4A	**Scorpion 35SL** (dinotefuran)	foliar: 3.5-7.0 fl oz, soil: 8.75-10.5 fl oz	12	foliar: 1, soil: N/A	**Bulb and green onions (Crop Groups 3-07A and 3-07B)**
	5	**Entrust SC** (spinosad)	3-8 fl oz	4	1	No more than 5 applications per year (29 fl oz product). **For onions, bulb and green.** OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	4	1	Use with an adjuvant.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	30	Must be used with a non-ionic activator type wetting, spreading and/or penetrating adjuvant., not a binder sticker type adjuvant. Maximum of 10.25 fl oz per acre per season.
	7C	**Knack IGR** (pyriproxyfen)	8 fl oz	12	3	Maximum of 2 applications, at least 14 days apart. No activity against adult insects. **Onion (dry bulb only).**
	--	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	--	**M-Pede 49% EC** Soap, insecticidal	1-2% V/V	12	0	OMRI-listed.
	--	**Requiem EC** (extract of *Chenopodium ambrosioides*)	1.5-3.0 qt	4	0	Begin as soon as thrips are seen.
	--	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Wireworms	1B	***Diazinon AG500, *Diazinon 50W** (diazinon)	**AG500:** 2-4 qt,**50W:** 4-8 lb	72	preplant	Do not make more than one soil application per year. **For onions, bulb and green.**

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Bacterial blight (*Xanthomonas axonopodis* pv. *allii*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Champ DP, Champ F2 FL, Champ WG, Cuprofix Ultra 40D, Cueva,Cuproxat, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Kop-hydroxide, Master Cop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	SEE INDIVIDUAL LABEL		0	Varies by product from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	2.25 lbs	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
(Suppression only)	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz.	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting. Supression only
(Suppression only)	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	See label
Black mold (*Aspergillus niger*)	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last application
Botrytis leaf blight (*Botrytis squamosa*)	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	SEE INDIVIDUAL LABEL		7	1	Do not apply to exposed bulbs
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate Zn	SEE INDIVIDUAL LABEL		7 (dry bulb); 14 (green)	1	
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	2.25 lbs	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	SEE INDIVIDUAL LABEL		7	1	
(Suppression only)	3	(propiconazole) **Many brands available:** Amtide proiconazole 41.8% EC, Bumper 41.8 EC, Bumper ES, Fitness, Propicure, Propimax EC, Propistar EC, Shar-Shield PPZ, Tide Propiconazole EC, Tilt	SEE INDIVIDUAL LABEL		See label	0.5	
	14	Botran 5F (DCNA dicloran)	2 to 3 1/5 lbs	See label	14	See label	See label
	4 & M5	Ridomil Gold Bravo SC, (mefenoxam + chlorothalonil)	See label		7 (dry bulb); 14/21 (green)	2	
	7	Endura (boscalid)	6.8 oz	41 oz	7	0.5	Alternate applications with a different fungicide group.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	See label

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	9	Vangard WG (cyprodinil)	10 oz	28 oz	7	0.5	Do not make more than 2 consecutive applications.
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	Do not make more than 2 consecutive applications.
	11	Quadris, (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
(Suppression only)	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 applications/crop.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl.oz	See label	14 (green); 7 (dry bulb)	0.5	Do not make more than 2 applications before alternate with a different fungicide group
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO or silicon adjuvant.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non- QoI (Group 11) mode of action
	11 & 3	Quilt Xcel (azoxystrobin + propiconazole)	21 fl oz (dry); 26 fl oz (green)	56 fl oz	14 (dry bulb); 0 (green)	0.5	Make only 1 appl. before alternating to a non-group 11 fungicide
	11 & 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl/ crop.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl.
	29	Omega 500F (fluazinam)	1 pt	6 pt	7	2	
Botrytis neck rot (*Botrytis allii*)	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	SEE INDIVIDUAL LABEL		7	1	Do not apply to exposed bulbs
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate Zn	SEE INDIVIDUAL LABEL		7 (dry bulb); 14 (green)	1	
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	SEE INDIVIDUAL LABEL		7	1	
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	14	Botran 5F (DCNA dicloran)	3.5 lbs	See label	14	See label	
(Suppression only)	9	Vangard WG (cyprodinil)	10 oz	28 oz	7	0.5	Do not make more than 2 consecutive applications.

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	Do not make more than 2 consecutive applications.
(Suppression only)	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO or silicon adjuvant.
	11 & 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 applications/ crop
(Suppression only)	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl.
	29	Omega 500F (fluazinam)	1 pt	6 pt	7	2	
Cercospora leaf spot (*Cercospora duddiae*)	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non- QoI (Group 11) mode of action
Cladosporium leaf blotch (*Cladosporium allii*)	11	Quadris, (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO or silicon adjuvant.
	11 & 3	Quilt Xcel (azoxystrobin + propiconazole)	21 fl oz (dry); 26 fl oz (green)	56 fl oz	14 (dry bulb); 0 (green)	0.5	Make only 1 appl. before alternating to a non-group 11 fungicide
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non- QoI (Group 11) mode of faction
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl.oz	See label	14 (green); 7 (dry bulb)	0.5	Do not make more than 2 applications before alternate with a different fungicide group
Damping-off	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	SEE INDIVIDUAL LABEL		7	1	Do not apply to exposed bulbs
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	SEE INDIVIDUAL LABEL		7	1	
	12	Cannonball WP (fludioxonil)	7 oz	32 oz	7	0.5	
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lbs seed				Seed treatment only.

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
Downy mildew (*Peronospora destructor*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	SEE INIDIVIDUAL LABEL		0	Varies from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn
(Suppression only)	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate Zn	SEE INDIVIDUAL LABEL		7 (dry bulb); 14 (green)	1	
	M1 & M2	Top cop with sulfur (basic copper sulfate + sulfur)	2-3 qts	See label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	SEE INDIVIDUAL LABEL		7	1	Do not apply to exposed bulbs
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	2.25 lbs	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	4 & M1	Ridomil Gold/Copper (mefenoxam + copper hydroxide)	2 lbs		7 (green); 10 (dry bulb)	2	Maximum 0.4 lbs/A a.i. of metalaxyl or mefenoxam
	4 & M3	Ridomil Gold MZ WG (mefenoxam + mancozeb)	2.5 lbs		7 (dry bulb)	2	
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	See label		7 (dry bulb); 14/21 (green)	2	
	11	Quadris, (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 fl oz	7	0.5	Alternate applications with a different fungicide group.
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 appl/crop.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO or silicon adjuvant.
	11 & 3	Quilt Xcel (azoxystrobin + propiconazole)	21 fl oz (dry); 26 fl oz (green)	56 fl oz	14 (dry bulb); 0 (green)	0.5	Make only 1 appl. before alternating to a non-group 11 fungicide
(Suppression only)	11 & 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl/ crop
(Suppression only)	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz.	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting.

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	
	29	Omega 500F (fluazinam)	1 pt	6 pt	7	2	
	33	Aliette WDG, Linebacker WDG (fosetyl-Al)	3 lb	7 appl.	See label	See label	Do not tank mix with copper fungicides, adjuvants or foliar fertilizers
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart, Reveille	3 qt		0	4 hr	See label for details.
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	Must be applied in a tank mix with another fungicide active against downy mildew. Do not make more than 2 sequential applications.
	40	Revus (mandipropamid)	8 fl oz	32 fl oz (dry); 24 fl oz (green)	7	4 hr	Make no more than 2 consecutive appl. before switching to a non-group 40 fungicide. A silicon-based adjuvant must be added at recommended rates
	43	Presidio (fluopicolide)	4 fl oz.		2	0.5	Do not make more than 4 applications of Presidio per season.
	21	Actigard 50WG (Acibenzolar-s-methyl)	1 oz.	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting. Supression only
	40 & 45	Zampro (dimethomorph + ametoctradin)	14 fl oz	42 fl oz	0	0.5	See label
	U15	Orondis Opti A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz	0	4 hr	Intended for use with Orondis Opti B (chlorothalonil). See label for details. Do not exceed 4 applications. Check plant back restrictions.
	U15	Orondis Ultra A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz	0	4 hr	Intended for use with Orondis Ultra B (mandipropamid). See label for details. Do not exceed 4 applications. Check plant back restrictions.
Iris Yellow Spot (*Iris yellow spot virus*) (Suppression only)	21	Actigard 50WG (acibenzolar-S-methyl)	1 oz.	4 oz	7	0.5	Do not apply to plants that are stressed or prior or within 5 days transplanting. Supression only.
Powdery mildew	M2	(sulfur) **Many brands available:** Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Yellow Jacket Wettable Sulfur	SEE INDIVIDUAL LABEL		0	1	Do not use during hot weather or within 4 weeks of an oil application.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl.oz	See label	14 (green); 7 (dry bulb)	0.5	Do not make more than 2 applications before alternate with a different fungicide group

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non- QoI (Group 11) mode for action
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 appl/crop.
Purple blotch (*Alternaria porri*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Cuproxat, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Kop-hydroxide, Nordox, Nordox 75WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	SEE INIDIVIDUAL LABEL		0	Varies from 4 hr to 2 days.	Frequent use of copper fungicides may cause foliar burn
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	SEE INDIVIDUAL LABEL		7	1	Do not apply to exposed bulbs
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Chlorothalonil 720 EC, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Initiate Zn	SEE INDIVIDUAL LABEL		7 (dry bulb); 14 (green)	1	
	M1 & M2	Top cop with sulfur (basic copper sulfate + sulfur)	3 qts	See label	0	1	Do not use during hot weather or within 4 weeks of an oil application.
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	2.25 lbs	160 lb (per crop)	7	2	Do not apply to exposed bulbs.
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	SEE INDIVIDUAL LABEL		7	1	
	3	(propiconazole) **Many brands available:** Amtide proiconazole 41.8% EC, Bumper 41.8 EC, Bumper ES, Fitness,Propimax EC, Propistar EC, Tide Propionazole EC, Tilt, Shar-Shield PPZ	SEE INDIVIDUAL LABEL		See label	0.5	
	3	(tebuconazole) **Many brands available:** Monsoon, Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	SEE INDIVIDUAL LABEL		7	0.5	
	4 & M5	Ridomil Gold Bravo SC, (mefenoxam + chlorothalonil)	See label		7 (dry bulb); 14/21 (green)	2	
	7	Endura (boscalid)	6.8 oz	41 oz	7	0.5	Alternate applications with a different fungicide group.
	7	Fontelis	24 fl oz	72 fl oz	3	0.5	See label

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
		(penthiopyrad)					
	9	Vangard WG (cyprodinil)	10 oz	28 oz	7	0.5	Do not make more than 2 consecutive applications.
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	7	0.5	Do not make more than 2 consecutive applications.
	11	Quadris, (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11	Reason 500SC (fenamidone)	5.5 fl oz	22 fl oz	7	0.5	Alternate applications with a different fungicide group.
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 applications/crop.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl.oz	See label	14 (green); 7 (dry bulb)	0.5	Do not make more than 2 applications before alternate with a different fungicide group
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	See label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO or silicon adjuvant.
	11 & 3	Azoxy Teb (azoxystrobin & tebuconazole)	12.9 fl oz	51.7 fl oz	7	0.5	See label for details. Check plant back restrictions.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non- QoI (Group 11) mode for action
	11 & 3	Quilt Xcel (azoxystrobin + propiconazole)	21 fl oz (dry); 26 fl oz (green)	56 fl oz	14 (dry bulb); 0 (green)	0.5	Make only 1 appl. before alternating to a non-group 11 fungicide
	11 & 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl/ crop.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl.
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	84 oz	3	0.5	
	29	Omega 500 F (fluazinam)	1 pt	6 pt	7	2	
(Suppression only)	33	Aliette WDG, Linebacker WDG (fosetyl-Al)	3 lb	7 appl.	See label	See label	Do not tank mix with copper fungicides, adjuvants or foliar fertilizers
Pythium Damping-off	4	MetaStar 2E AG (metalaxyl)	4 pts	see label	-	2	Apply preplant or to soil surface at planting
	4	Allegiance Acquire Sebring 2.65 ST Sebring 318 FS Sebring 480 FS (metalaxyl)	SEE INDIVIDUAL LABEL				
	4	Apron XL, Ridomil Gold EC, Ridomil Gold SL, Ultra flourish (mefenoxam)	SEE INDIVIDUAL LABEL		N/A	2	

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	11 & 4	Uniform (Azoxystrobin; Mefenoxam)	See label				
Rhizoctonia Damping off	11	Dynasty (azoxystrobin)	0.38 fl oz/ 100 lb seed	See label	See label	4 hr	Seed treatment only.
	11	Quadris (azoxystrobin)					
	11 & 4	Uniform (azoxystrobin + mefenoxam)	See label				
Rust (*Puccinia allii*)	3	(tebuconazole) **Many brands available:** Monsoon, Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	SEE INDIVIDUAL LABEL		7	0.5	
	11	Quadris, (azoxystrobin)	See label	92.3 fl oz	See label	4 hr	Alternate applications with a different fungicide group.
	11	Cabrio EG (pyraclostrobin)	12 oz	72 oz	7	0.5	Alternate applications with a different fungicide group. Make no more than 5 appl/crop.
	11 & 3	Quilt Xcel (azoxystrobin + propiconazole)	21 fl oz (dry); 26 fl oz (green)	56 fl oz	14 (dry bulb); 0 (green)	0.5	Make only 1 appl. before alternating to a non-group 11 fungicide.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl.oz	See label	14 (green); 7 (dry bulb)	0.5	Do not make more than 2 applications before alternate with a different fungicide group.
Seedling blight	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	SEE INDIVIDUAL LABEL		7	1	Do not apply to exposed bulbs
	12	Maxim 4FS Spirato 480 FS (fludioxonil)	0.16 fl oz/100 lbs seed	-	-	0.5	
	11	Dynasty (azoxystrobin)	0.38 fl oz/100 lb seed	See label	See label	4 hr	
	14	Botran 5F (DCNA dicloran)	3.5 lbs	See label	14	See label	
Stemphylium Blight (*Stemphylium vesicarium*)	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG, Meteor, Nevado 4F, Rovral 4 Flowable	**SEE INDIVIDUAL LABEL**		7	1	
	7	Fontelis (Penthiopyrad)	24 fl oz	72 fl oz	3	0.5	
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl.oz	See label	14 (green); 7 (dry bulb)	0.5	Do not make more than 2 applications before alternate with a different fungicide group
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	42 fl oz	7	0.5	Make no more than 1 application before alternating to another fungicide with a non- QoI (Group 11) mode for action
	11 & 7	Pristine (pyraclostrobin + boscalid)	18.5 oz	111 oz	7	0.5	Do not make more than 2 consecutive applications. No more than 6 appl/ crop.

Table 11.6. Onion fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group [1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks [2]
			Applic.	Season	Harvest	Reentry	
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl.
White rot (*Sclerotium cepivorum*)	1	(thiophanate-methyl) **Many brands available:** Incognito 4.5 F, NuFarm T-Methyl 4.5 T, NuFarm T-Methyl 70 WSB, Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin M 70 WP, Topsin M 70 WDG, Topsin M WSB	SEE INDIVIDUAL LABEL			3	
	3	(tebuconazole) **Many brands available:** Onset 3.6L, Orius 3.6 F, Tebu-Crop 3.6F, Tebustar 3.6 L, Tebuzol 3.6F, Toledo	SEE INDIVIDUAL LABEL		7	0.5	
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	3.7 pt	see label	14	0.5	Alternate applications with different fungicide groups. Make no more than 3 applications/crop. Do not tank mix with COC, MSO or silicon adjuvant.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl.
	12	Cannonball WP (fludioxonil)	7 oz	32 oz	7	0.5	
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/100 lbs seed	-	-	0.5	
	14	Botran 5F (DCNA dicloran)	3.5 lbs	See label	14	0.5	

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 12. Pepper Production

Monica Ozores-Hampton, Nathan S. Boyd, Eugene J. McAvoy, Hugh A. Smith, and Gary E. Vallad

Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Bell pepper - *Capsicum annuum,* Solanaceae.

Habanero and Bird's-eye pepper - *Capsicum chinense.*

Table 12.1. Planting information for pepper.

Planting dates	Traditional	Bird's Eye
North Florida	July-Aug /Feb-Mar	Aug; Feb - Mar
Central Florida	Aug-Sept/Jan-Mar	Aug - Sept; Jan - Mar
South Florida	Aug-Feb	Aug - Feb
Planting information		
Distance between rows (in)	36 – 48 60 – 72	36 – 48
Number of rows/bed	1 – 2	1
Distance between rows/bed	15 - 18	10 – 24
Distance between plants (in)	9 - 15	0.5 – 0.75
Seed per acre in transplant (lb)	0.25 - 0.5	0.25 – 0.5
Days to maturity from transplant	65 - 75	
Plant population (acre)	14,520 – 19,400	17,500

Cultivars

For more information on pepper varieties use the link below
http://edis.ifas.ufl.edu/pdffiles/IN/IN75700.pdf

1. SWEET BELL

Aristotle. Green to red blocky bell with great yield potential. Extra-large, thick walled. Very vigorous plant that produces dark green, anthocyaninless fruit. R to Xcv 1-3, PVY, Tobamo Po (R).

Blitz. Early-maturing, extra-large blocky green-to-red bell with great yield potential at first harvest. Fruit are high quality with thick walls and a uniformly blocky shape. HR: TMV: 0 / Xcv: 0-5, 7-9 and IR: TEV.

Crusader. Plant erect with good cover. Extra-large fruit that are firm at mature red stage. R to Xcv 1-3, PVY, S, PeMo, TM.

Gridiron. Early to mid-maturing, extra-large blocky dark green-to-red bell with impressive yield potential. The fruit are smooth, glossy and high quality, with thick walls and a uniform blocky shape. HR: TMV: 0 / Xcv: 0-5, 7-9 and IR: TEV.

HM 2641. Tall erect vigorous plant with good leaf coverage suited for warm weather production. Glossy dark green large to extra-large sized fruit over an extended production period R to, Xcv 1-4 and TM.

Hunter. Early maturity. Medium size plant produces smooth, four-lobed, blocky dark green glossy fruit. Produces a large percentage of extra-large fruit. R to Xcv 1-5, TE, TM.

PS 9927141. Early, green to red blocky bell pepper with large, dark-green, smooth fruit. It produces a large robust plant with a continuous fruit set. Xcv 1-5, Tm P0 (HR).

PS 9928302. High resistance to bacterial spot races 1-5 (X5R®) and combines a large robust plant with large, dark green to firm red fruits. In trials, 8302 has been very adaptable with good size, shape, uniformity and color. It is anthocyaninless. Xcv 1-5, Tm Po (HR).

PS 99544288. Early maturity with high fruit yield. Dark green fruit mature to red. R to Xcv 1-6, 10.

PS 09979325. Main-season hybrid that develops a mid-sized plant that produces green maturing to red fruit targeted to the south east US. The plants produce a high, concentrated set of firm, dark green, smooth, blocky fruit 74 days after transplant. The hybrid is resistant to Tobamo Po and bacterial leaf spot races 0 to 10 (X10R™).

Revolution. Cold tolerance, concentrated early set, firm, uniform, extra-large green to red fruits. R to Xcv 1-3 and 5 and IR to CM and Pc.

Seedway 48. Medium plant size with large to jumbo, uniform dark green fruit. R to Xcv 1-10.

Tom Cat. Mid-season. Medium plant size and a concentrated set that yields a high percentage of large size fruit. Blocky dark green color that turns a deep red upon maturity. R to Xcv 1-5, TE, and ToM.

Touchdown. Strong prolific plant with continuous setting ability and excellent cover. This variety has high yield potential of large to extra-large blocky fruit that mature from green to red. HR: TMV: 0 and Xcv: 0-5, 7-9.

Vanguard. Medium plant with good foliage. Fruit are dark green, blocky, 4-lobed, extra-large with thick firm walls. Early maturity with concentrated harvest. R to Xcv 1-5, PepMo and ToM.

2. MINI SWEET

Boris. Smooth straight fruit with thick flesh. Fruit set high within the plant. R to TSW.

Natasha. Early variety with long fruit. R to Xcv 1-3.

Orange You Sweet, Right On Red, and Yes To Yellow. Hungarian cheese types, very early maturing, has a mid to strong plant vigor, with continuous setting ability. The fruit are flat round in shape and smooth with mid thick walls well suited for stuffing and pickling. See website for further details.

Sopron. Early to mid-season for fresh or processing. R to Xcv 1-3.

Yellow Sparkler. Sweet snacking pepper type, that turns from green to bright, rich yellow. Fruit have a great sweet flavor. HR: TMV: 0

Yummy Yellow, Yummy Orange, Yummy Red, Red Sweetie, Yellow Sweetie, Orange Sweetie. Brightly colored sweet mini bell types.

3. CUBANELLE

Aruba. Early-maturing, erect plant, 3-4 lobed, elongated fruit, matures from a pale lime green to a bright red.

Grenada. Early maturing from pale green to red with very smooth and attractive fruit. HR: Xcv: 0-3, 7, 8.

4. HOT ANCHO POBLANO

Ardo. Ancho poblano type, plant produces high yields of 6 inches long by 3 inches wide fruit, turn from green to red when mature. R to Xcv 1-3, PVY, PMV, Tobamo Po.

San Ardo. Early variety with 6"x3" uniform dark green fruit. Mildly hot firm flesh. R to tobamo.

5. HOT CAYENNE

Cheyenne. Cayenne type with early maturity on a medium sized plant. Produces long (8-9 inch), medium-high pungent fruit with great flavor and aroma.

Mesilla. Long hot type produces very long (23-28 by 3.8 cm) fruit that can be used green or red. Pods grow pendant from a large plant, maturing at mid-season. R to Tobamo Po and PVY, and IR to TEV.

Iberia. Long hot type similar to Mesilla but longer and slightly hotter. R to TMV.

6. HOT JALAPENO

Capsico. Large, vigorous plants with very heavy sets of extra-large fruit. Extra-large with mild checking. Very pungent. HR: PVY: 0.1.2 / Xcv: 0-3, 7, 8.

Centella. Excellent plant cover. Large, dark green glossy fruit. R to Xcv 1-3, TM:0, PVY:0, PepMo.

Compadre. Medium to late fruiting. Vigorous plant with good tolerance to extreme temperatures. Continous picking. Uniform, smooth, large fruit. No purpling. R to PVY, TM and Xcv 2,5.

El Jefe. Large plant type jalapeño. Large to extra-large, very dark green, glossy fruit. Minimal cracking and purpling. HR: PVY: 0.1.2 / Xcv: 0-3, 7, 8 and IR: TEV

Ixtapa. Extra-large thick walled fruit. R 1-3, PVY.

Jalafuego. Extremely pungent. Large vigorous plant. Extra-large, smooth, very dark green fruit. HR: PVY: 0.1.2 / Xcv: 0-3, 7, 8

Lexus. Concentrated early season fruit set. Glossy dark green fruit. HR to Xcv 1-3.

Magno. Vigorous plants. Mostly jumbo and extra-large, smooth, very dark green fruit. HR: PVY: 0.1.2 / Xcv: 0-3, 7, 8

Sayula. Vigorous plant and with prolific set. Bullet shaped and maturing from green to red. Well suited for both fresh market and processing. R to Xcv 1-3.

Telica. Mid-season fruiting, smooth large dark green fruit with blunt ends. R to cracking and purpling, and Xcv 1-3, PVY and TM.

Tormenta. Vigorous plant. Large, thick wall, dark green fruit does not purple and resists cracking. R to Xcv 1-3.

7. OTHER HOT PEPPERS

Balada. Finger hot Asian type pepper, fruit maturing from green to red, fruit slightly curved, tapers to point, highly pungent.

Camino Real. Serrano type, medium maturity, large green fruit size. R to PVY and IR to TEV.

Charger. Anaheim type with smooth, flat thick walled fruit that is mildly hot. IR to TSWV.

Chichen Itza. Habanero type with medium-large fruit that tapers to a point and matures from green to orange.

Chile G76. Anaheim type, medium maturity, large to extra large fruit sizes, early concentrated yield, 500-600 units in the Scoville's scale. R to TMV.

Devil Serrano. Early, large, dark green glossy fruit. Semi-indeterminate bush. HR to TMV, PVY. IR to TEV.

Habanero. Habanero type, ready for harvest 90-100 days from transplant, extremely pungent, both fresh and processing markets**.** The wrinkled fruit taper to a point and measure approximately 5 by 2.5 cm. The thin flesh is light-green to orange-pink at full maturity.

Inferno. This Hungarian hot wax hybrid produces high yields of uniform fruit. The thick-walled pods are pendant, large, smooth and tapered, matures from yellow to red, well-suited for fresh market and pickling.

Rio de Oro. Very large Santa Fe type with wide shoulders. Matures from golden yellow to red.

Rio Tesoro. Hybrid yellow Caribe pepper. 3.5"x2" fruit.

8. BIRD'S-EYE PEPPER – STRAIN 3

Table 12.2. Herbicides approved for managing weeds in peppers.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
			***** PREPLANT / PREEMERGENCE *****
Bensulide **5.0 - 6.0**	(Prefar) 4 E 5 - 6 qt.	8	Broadleaves and grasses. Incorporate mechanically 1 - 2 in. deep or with irrigation 2 - 4 in. deep.
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a pre-plant burndown for emerged broadleaf weeds upto 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pre-transplant interval.
Clomazone **0.25 to 1**	(Command) 3ME 0.67 to 2.67 pt.	15	Annual broadleaves and grasses.
Flumioxazin **up to 0.128**	(Chateau) 51 WDG up to 4 oz.	14	Annual broadleaves and grasses. Apply to row middles of raised plastic mulched beds that are at least 4 in. higher than the treated row middles and with a 24 in. bed width. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank mix with a burn down herbicide to control emerged weeds. 0 day pre-transplant interval
Fomesafen **0.25 - 0.38**	(Reflex) 2 EC 1.0 - 1.5 pt.	14	Broadleaves and yellow/purple nutsedge. Suppression of some annual and perennial grasses. Label is a 24(C) local indemnified label and a waiver of liability must be signed for use. Transplanted crop only. May be applied to bareground production 7 days before transplanting or to a formed bed but prior to laying plastic. Use shields or hooded sprayers if applying to row middles and prevent contact with plastic mulch. 7 and 0 day pre-transplant interval on bare ground and plastic mulch, respectively. 60 day PHI.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses and nutsedge. Apply as a preplant burndown. Allow 3 days between application and planting. Consult label for individual product directions.
Halosulfuron **0.024 - 0.05**	(Sandea, Profine) 75 DF 0.5 - 1.0 oz.	2	Broadleaves and yellow/purple nutsedge suppression. Apply to row middles only. Do not exceed 2 oz./A per 12 month period. 30 day PHI.
Lactofen **0.25 - 0.5**	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaves. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the row middles only with a shielded or hooded sprayer. Cobra contacting green foliage or fruit can cause excessive injury. Drift of Cobra treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. 30 day PHI.
S-**metolachlor** **0.64 - 0.95**	(Dual Magnum) 7.62 EC 0.67 - 1.0 pt.	15	Annual broadleaves, grasses and suppression of yellow/purple nutsedge. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to the finished bed immediately before laying the plastic. Do not exceed 1.68 pt. of Dual Magnum/A per crop cycle. 60 day PHI.
Napropamide **1.0 - 2.0**	(Devrinol DF XT) 50 DF 2 - 4 lb.	15	Annual broadleaves. Apply to bed tops after forming beds but before plastic application. Rainfall or overhead irrigate to 1 in. within 24 hr. of application. For row middle treatments, do not apply between bloom and harvest and do not exceed 2 lb. a.i./A per crop cycle.
Oxyfluorfen **0.25 - 0.5**	(Goal 2 XL) 2 EC 1 - 2 pt. (GoalTender) 4 E 0.5 - 1.0 pt.	14	Broadleaves. Apply as a preemergence broadcast to preformed beds or banded treatment. 30 day pre-transplant interval. Mulch may be applied any time during the 30-day interval.
Paraquat **0.5 - 1.0**	(Gramoxone) 2 SL 2.0 - 4.0 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Surfactant recommended.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds
Pendimethalin **0.48 - 0.72**	(Prowl H20) 3.8 1.0 - 1.5 pt.	3	Annual broadleaves and grasses. May be applied to row middles or under the plastic. Do not exceed 3.0 pt./A per year. 70 day PHI.
Pyraflufen **0.001 - 0.003**	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaves less than 4 in. tall or rosttes less than 3 in. diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
Trifluralin **0.5 - 0.75**	(Treflan, Trifluralin) 4 EC 1.0 - 1.5 pt. (Treflan) 10 G 5.0 - 7.5 lb.	3	Annual broadleaves and grasses. Incorporate 4 in. or less within 8 hr. of application. Results in Florida are erratic on soils with low organic matter and clay contents. Note label precautions against planting noncrops within 5 months. Do not apply after transplanting. 60 day PHI.

Table 12.2. Herbicides approved for managing weeds in peppers. (continued)

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
Labels change frequently. Be sure to read a current product label before applying any chemical.			
			***** POSTEMERGENCE / POSTTRANSPLANT *****
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaves. Apply as hooded application to row middles only. May be tank mixed with other herbicides. Do not exceed 6.1 fl. oz. per cropping season. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0 day PHI.
Clethodim **0.09 - 0.13** **0.07 - 0.13**	(Arrow, Select) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. 20 day PHI.
Diquat **0.5**	(Reglone Dessiccant) 1 qt.	22	Broadleaves and grasses. Apply to row middles only. Maximum of 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. 30 day PHI.
Halosulfuron **0.024 - 0.05**	(Sandea, Profine) 75 DF 0.5 - 1.0 oz.	2	Broadleaves and yellow/purple nutsedge. Apply to row middles only. Do not exceed 2 oz./A per 12 month period. Nonionic surfactant recommended. 30 day PHI.
Imazosulfuron **0.19 - 0.30**	(League) 75 DF 4.0 - 6.4 oz.	2	Broadleaves and yellow/purple nutsedge suppression. Pepper must be well established and 10 in. tall. Direct sprays to base of stem and avoid contact with leaves or fruit. Do not exceed 6.4 oz./A per crop season. Observe crop rotation restrictions. Nonionic surfactant recommended. 21 day PHI.
***S*-metolachlor** **0.95**	(Dual Magnum) 7.62 EC 1.0 pt.	15	Annual broadleaves, grasses and yellow/purple nutsedge. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Direct spray solution to row middles only with minimal contact to plants and plastic. Do not exceed 1.68 pt. Dual Magnum/A per crop. 60 day PHI.
Paraquat **0.5**	(Gramoxone) 2 SL 2 pt. (Firestorm) 3 SL 1.3 pt.	22	Emerged broadleaves and grasses. Direct spray over emerged weeds 1 to 6 in. tall in the row middles between mulched beds. Use low pressure and shields to control drift. Do not apply more than 3 times per season. Nonionic surfactant recommended.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Direct spray to row middles. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
Pendimethalin **0.48 - 0.72**	(Prowl H20) 3.8 1.0 - 1.5 pt.	3	Broadleaves and grasses. May be applied post transplant to row middles if previously untreated. Do not exceed 3.0 pt/A per year. 70 day PHI.
Sethoxydim **0.19 - 0.28**	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Actively growing grasses. A total of 4.5 pt./A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 20 day PHI.
			***** POSTHARVEST *****
Diquat **0.5**	(Reglone Dessiccant) 2.0 pt.	22	Minimum of 35 gal./A. Thorough coverage is required. Nonionic surfactant recommended.

Table 12.3. Insecticides approved for managing insect pests of peppers.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
Aphids (including aphid transmitted viruses, green peach aphid, potato aphid)	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3.0 pt; SP: 0.25-1.0 lb	No more than 15 pt LV or 5 lb SP/acre crop	3	48	No more than 10 applications per crop.
	1A	***Vydate L** (oxamyl)	**foliar:** 2-4 pt	Do not apply more than 24 pt per acre per season.	7	48	(1) Does not control western flower thrips.
	1B	**Acephate 90 WDG** (acephate)	0.28-1.11 lb	Do not apply more than 2.22 lb/ A per crop cycle	7	24	
	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 6 pints per acre per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures is over 90F.
	1B	**Dimethoate 4EC** (dimethoate)	0.5-0.67 pt	Maximum total rate per year is 1 lb ai/A.	0 for mechanical harvesting	48	Highly toxic to bees.
	1B	**Malathion 8F** (malathion)	1.5 pt	Maximum 3 pints per acre per year.	3	12	Maximum of 2 applications per year.
	1B	**Orthene 97** (acephate)	0.25-1.00 lb—bell peppers; 0.5 lb—non-bell peppers	Do not apply more than 2 lb ai per acre per season or 1 lb ai per acre per season for non-bell peppers.	7	24	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Toxic to bees.
	4A	**Admire Pro** (imidacloprid)	7-14.0 fl oz	Maximum allowed on pepper is 14.0 fl. oz/A (0.5 lb ai/A).	21	12	Most effective if applied to soil at transplanting.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/10,000 plants		21 (soil)	12	**Planthouse:** 1 application to transplants. See label.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16 oz. of Assail 30 SG per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Begin applications for whitefly when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Assail 70 WP** (acetamiprid)	0.8-1.7 oz.	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. See label for rotational restrictions.
		Platinum 75 SG (thiamethoxam)	1.66-3.67	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	4A	**Provado 1.6F** (imidacloprid)	3.8- 6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been treated with imidacloprid or thiamethoxam.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz. Soil: 5-6 oz.	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	foliar: 1; soil: 21	12	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A Durivo per growing season.	30	12	Several methods of soil application- see label.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/ acre per crop.	0	12	Do not make more than two applications.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	Do not apply more than 8.4 oz/ acre per season.	0	12	Begin applications before pests reach damaging levels.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	soil at-planting or transplant tray treatment: 5-13.5 fl. oz.; drip chemigation or soil injection: 5-10 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qts		0	4	Begin before pest reach damaging levels.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed.
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
Beetles (including beetle larvae, blister beetle, Colorado potato beetle, cucumber beetle, flea beetle)	1A	**Carbaryl 4L** (carbaryl)	1/2 to 2 quarts	Do not apply more than 8 quarts per crop per year.	3	12	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 6 pints per acre per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures is over 90F.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 1.6 lb ai/acre per season.	3	12	Bell peppers only.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	Do not apply more than 0.35 lb ai per acre per season, or treat more than 7 times at high rate.	7	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4-12.8 oz	Do not apply more than 0.8 lb ai per acre per season.	3	12	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Toxic to bees.
	4A	**Admire Pro** (imidacloprid)	7-14.0 fl oz	Maximum allowed on pepper is 14.0 fl. oz/A (0.5 lb ai/A).	21	12	Most effective if applied to soil at transplanting.
	4A	**Assail 70 WP** (acetamiprid)	0.8-1.7 oz.	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. See label for rotational restrictions.
	4A	**Provado 1.6F** (imidacloprid)	3.8- 6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been treated with imidacloprid or thiamethoxam.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz. Soil: 5-6 oz.	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	foliar: 1; soil: 21	12	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A Durivo per growing season.	30	12	Several methods of soil application- see label.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	28	**Coragen** (chlorantraniliprole)	3.5-7.5 fl oz.	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray. Make no more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	soil at-planting or transplant tray treatment: 5-13.5 fl. oz.; drip chemigation or soil injection: 5-10 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	un	**Surround** (kaolin)	12.50 lbs		0	4	
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
Caterpillars (including cabbage looper, corn earworm, foilage feeding caterpillar, garden webworm loopers, hornworms, salt march caterpillars, tobacco budworm, tomato fruitworm, tomato pinworm), includes subcategory Armyworm (beet armyworm, fall armyworm, southern armyworm)	1A	**Carbaryl 4L** (carbaryl)	1/2 to 2 quarts	Do not apply more than 8 quarts per crop per year.	3	12	
	1A	***Lannate LV, *SP** (methomyl)	**LV:** 0.75-3.0 pt; SP: 0.25-1.0 lb	No more than 15 pt LV or 5 lb SP/acre crop	3	48	No more than 10 applications per crop.
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	1B	**Acephate 90 WDG** (acephate)	0.28-1.11 lb	Do not apply more than 2.22 lb/A per crop cycle	7	24	
	1B	**Lorsban 75WG** (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop maximum.	7	24	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications.
	1B	**Orthene 97** (acephate)	0.25-1.00 lb—bell peppers; 0.5 lb—non-bell peppers	Do not apply more than 2 lb ai per acre per season or 1 lb ai per acre per season for non-bell peppers.	7	24	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 1.6 lb ai/acre per season.	3	12	Bell peppers only.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	Do not apply more than 0.35 lb ai per acre per season, or treat more than 7 times at high rate.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	7	12	(1) 1st and 2nd instars only
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Maximum of 4 applications (0.8 lb ai/acre) per season.	3	24	
	3A	***Pounce 25 W** (permethrin)	6.4-12.8 oz	Do not apply more than 0.8 lb ai per acre per season.	3	12	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A Durivo per growing season.	30	12	Several methods of soil application- see label.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	No more than 28.8 oz/acre per season.	7	12	
	11	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-1.25 lb		0	4	Use higher rates for armyworms. OMRI-listed.
	11	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb		0	4	Treat when larvae are young. Thorough coverage is essential. OMRI listed.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb		0	4	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed[2].
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		0	4	Use high rate for armyworms. Treat when larvae are young.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb		0	4	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	11B	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	15	***Dimilin 25 W, *2 L** (diflubenzuron)	4-8 oz	Apply no more than 24 oz per acre per season	7	12	Up to 5 applications per season. IGR - effects not seen for 5-7 days.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	18	**Confirm 2F** (tebufenozide)	6-16 fl oz	Do not apply more than 1.0 lb ai per acre per season.	7	4	
	18	**Intrepid 2F** (methoxyfenozide)	4-16 fl oz	Do not apply more than 64 fl oz per acre per season.	1	4	
	22	**Avaunt** (indoxacarb)	2.5-3.5 oz	Do not use more than 14 ounces of product per acre per crop.	3	12	Minimum spray interval is 5 days.
	28	**Belt SC** (flubendiamide)	1.5 fl oz	Do not apply more than 4.5 fl oz per acre per season.	1	12	
	28	**Coragen** (chlorantraniliprole)	3.5-7.5 fl oz.	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray. Make no more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	soil at-planting or transplant tray treatment: 5-13.5 fl. oz.; drip chemigation or soil injection: 5-10 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Do not apply more than 38 fl oz/A per season.	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use 14 to 17 fl oz per acre to control whiteflies, leafhoppers, and planthoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**MBI-203 EP** (*Chromobacterium subtsugae*)	4.0-12.0 quarts		0	4	OMRI listed. Can be used in the greenhouse.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	–	**Grandevo (***Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb		0	4	Can be used in organic production. OMRI-listed.
Fire ants	7A	**Extinguish** (S-Methoprene)	1.0-1.5 lb		0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb		1	12	Apply when ants are actively foraging.
Grasshoppers	1B	**Acephate 90 WDG** (acephate)	0.28-1.11 lb	Do not apply more than 2.22 lb/A per crop cycle	7	24	
	1B	**Orthene 97** (acephate)	0.25-1.00 lb—bell peppers; 0.5 lb—non-bell peppers	Do not apply more than 2 lb ai per acre per season or 1 lb ai per acre per season for non-bell peppers.	7	24	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz. Soil: 5-6 oz.	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	foliar: 1; soil: 21	12	Use only one application method (soil or foliar). No more than 3 applications per season.
	un	**Surround** (kaolin)	12.50 lbs		0	4	
Lace bugs	1A	**Carbaryl 4L** (carbaryl)	1/2 to 2 quarts	Do not apply more than 8 quarts per crop per year.	3	12	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
Leafhoppers	1A	**Carbaryl 4L** (carbaryl)	1/2 to 2 quarts	Do not apply more than 8 quarts per crop per year.	3	12	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	7	12	(1) 1st and 2nd instars only
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Admire Pro** (imidacloprid)	7-14.0 fl oz	Maximum allowed on pepper is 14.0 fl. oz/A (0.5 lb ai/A).	21	12	Most effective if applied to soil at transplanting.
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. See label for rotational restrictions.
	4A	**Provado 1.6F** (imidacloprid)	3.8- 6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been treated with imidacloprid or thiamethoxam.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A Durivo per growing season.	30	12	Several methods of soil application- see label.
	16	**Courier SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Do not apply more than 38 fl oz/A per season.	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use 14 to 17 fl oz per acre to control whiteflies, leafhoppers, and planthoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	un	**Surround** (kaolin)	12.50 lbs		0	4	
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed.
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.
Liriomyza leafminers (includes leafminer larvae)	1A	***Vydate L** (oxamyl)	**foliar:** 2-4 pt	Do not apply more than 24 pt per acre per season.	7	48	(1) Does not control western flower thrips.
	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 6 pints per acre per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures is over 90F.
	1B	**Dimethoate 4EC** (dimethoate)	0.5-0.67 pt	Maximum total rate per year is 1 lb ai/A.	0 for mechanical harvesting	48	Highly toxic to bees.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 1.6 lb ai/acre per season.	3	12	Bell peppers only.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	7	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4-12.8 oz	Do not apply more than 0.8 lb ai per acre per season.	3	12	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz./A (0.056 lb ai/A) of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	17	**Trigard** (cyromazine)	2.66 oz	Do not apply more than 15.96 oz./A per season.	0	12	No more than 6 applications per crop.
	28	**Coragen** (chlorantraniliprole)	3.5-7.5 fl oz.	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting as well as a foliar spray. See label. For hornworms, can use as little as 2.0 fl oz/acre when applied as a foliar spray. Make no more than 4 applications per crop.
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	soil at-planting or transplant tray treatment: 5-13.5 fl. oz.; drip chemigation or soil injection: 5-10 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qts		0	4	Begin before pest reach damaging levels.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.
Mealybugs	16	**Courier SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
Mites (including broad mites, carmine spider mite, tomato russett mite, two spotted spider mite)	1B	***Dibrom 8EC** (naled)	1 pt	Do not apply more than 6 pints per acre per season.	1	48	Apply no more than 1 pt/acre in Florida. Do not apply when temperatures is over 90F.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Maximum of 4 applications (0.8 lb ai/acre) per season.	3	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz./A (0.056 lb ai/A) of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.
	10B	**Zeal Miticide** (etoxazole)	2-3 oz	Do not make more than one application per season.	7	12	Do not use with an adjuvant or surfactant.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Allow a minimum of 21 days between treatments. Do not make more than two applications per year. Do not use an adjuvant.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than two applications per season.
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	7	12	No more than 3 applications.
	un	**Acramite-50WS** (bifenazate)	0.75-1.0 lb	One application allowed per season.	3	12	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**MET52 EC** (*Metarhizium anispoliae* Strain F52)	drench: 40-80 fl. oz/100 gal.; foliar: 0.5 pt-2 qt/A		0	4	

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed.
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.
Plant bugs (includes Tarnished plant bug)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	Do not apply more than 8.4 oz/ acre per season.	0	12	Begin applications before pests reach damaging levels.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed.
Planthoppers	16	**Courier SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
Psyllids	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
Stinkbugs (including brown stinkbug, green stinkbug, southern green stinkbug)	1A	**Carbaryl 4L** (carbaryl)	1/2 to 2 quarts	Do not apply more than 8 quarts per crop per year.	3	12	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	7	12	
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 fl oz	Maximum of 4 applications (0.8 lb ai/acre) per season.	3	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Toxic to bees.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz. Soil: 5-6 oz.	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	foliar: 1; soil: 21	12	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips: check label for species controlled (includes eastern flower thrips, foliar feeding thrips, chilli thrips, melon thrips, western flower thrips)	1A	**Carbaryl 4L** (carbaryl)	1/2 to 2 quarts	Do not apply more than 8 quarts per crop per year.	3	12	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; XLR, 4F: 0.5-2.0 qt	Do not apply a total or more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times. Do not apply to crops or weeds in bloom.
	1A	***Vydate L** (oxamyl)	**foliar:** 2-4 pt	Do not apply more than 24 pt per acre per season.	7	48	(1) Does not control western flower thrips.
	1B	**Lorsban 75WG** (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop maximum.	7	24	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	7	12	(1) 1st and 2nd instars only
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Admire Pro** (imidacloprid)	7-14.0 fl oz	Maximum allowed on pepper is 14.0 fl. oz/A (0.5 lb ai/A).	21	12	Most effective if applied to soil at transplanting.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16 oz. of Assail 30 SG per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Begin applications for whitefly when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Assail 70 WP** (acetamiprid)	0.8-1.7 oz.	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. See label for rotational restrictions.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz. Soil: 5-6 oz.	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	foliar: 1; soil: 21	12	Use only one application method (soil or foliar). No more than 3 applications per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A Durivo per growing season.	30	12	Several methods of soil application- see label.
	5	**Entrust SC** (spinosad)	1.5-10 fl oz	Do not use more than 29 oz per acre per crop.	1	4	Do not apply to seedlings grown for transplant. OMRI-listed.
	5	**Radiant SC** (spinetoram)	5-10 fl oz	Maximum of 34 fl oz per acre per season.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.7-3.5 fl oz	Do not apply more than 10.25 fl. oz./A (0.056 lb ai/A) of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.	7	12	Do not make more than 2 sequential applications. Must be used with a non-ionic activator type wetting, spreading, or penetrating adjuvant.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	soil at-planting or transplant tray treatment: 5-13.5 fl. oz.; drip chemigation or soil injection: 5-10 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**MET52 EC** (*Metarhizium anispoliae* Strain F52)	drench: 40-80 fl. oz/100 gal.; foliar: 0.5 pt-2 qt/A		0	4	
		Platinum 75 SG (thiamethoxam)	1.66-3.67	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qts		0	4	Begin before pest reach damaging levels.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	un	**Surround** (kaolin)	12.50 lbs		0	4	
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed.
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.
Weevils (including pepper weevil, vegetable weevil)	1A	***Vydate L** (oxamyl)	**foliar:** 2-4 pt	Do not apply more than 24 pt per acre per season.	7	48	
	1B	**Lorsban 75WG** (chlorpyrifos) [24(c) label] SLN FL-040005	1.33 lb	10.64 lb per crop maximum.	7	24	Do not apply within 10 days of transplanting or to plants under severe heat or drought stress. Do not make more than 8 applications.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Ambush 25W** (permethrin)	6.4-12.8 oz	Do not apply more than 1.6 lb ai/acre per season.	3	12	Bell peppers only.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	Do not apply more than 0.35 lb ai per acre per season, or treat more than 7 times at high rate.	7	12	
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	7	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	***Pounce 25 W** (permethrin)	6.4-12.8 oz	Do not apply more than 0.8 lb ai per acre per season.	3	12	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16 oz. of Assail 30 SG per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Begin applications for whitefly when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Assail 70 WP** (acetamiprid)	0.8-1.7 oz.	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Provado 1.6F** (imidacloprid)	3.8- 6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been treated with imidacloprid or thiamethoxam.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	15	***Dimilin 25 W, *2 L** (diflubenzuron)	4-8 oz	Apply no more than 24 oz per acre per season	7	12	Up to 5 applications per season. IGR - effects not seen for 5-7 days.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
Whiteflies (adults, immatures)	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz.	Do not apply more than 43.26 fl. oz./A per season.	7	12	
	3	***Karate with Zeon** (lambdacyhalothrin)	0.96-1.60 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3 & 6	***Gladiator** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	Do not apply more than 0.2 lb active ingredient per acre per season.	7	12	Do not make applications less than 7 days apart.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 0.36 lb ai/acre per season.	5	24	
	3A & 4A	***Endigo ZC** (lambdacyhalothrin & thiamethoxam)	4.0-4.5 fl. oz.	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Maximum of 11 oz/acre per season.	0	12	Toxic to bees.
	4A	**Admire Pro** (imidacloprid)	7-14.0 fl oz	Maximum allowed on pepper is 14.0 fl. oz/A (0.5 lb ai/A).	21	12	Most effective if applied to soil at transplanting.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz/ 10,000 plants		21 (soil)	12	**Planthouse:** 1 application to transplants. See label.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	Do not exceed a total of 16 oz. of Assail 30 SG per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Begin applications for whitefly when first adults are noticed. Do not apply more than 4 times per season or apply more often than every 7 days.
	4A	**Assail 70 WP** (acetamiprid)	0.8-1.7 oz.	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	
	4A	**Belay 50 WDG** (clothianidin)	1.6-3.2 oz	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8 -6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	Do not release irrigation water from the treated area.
	4A	**Platinum** (thiamethoxam)	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. See label for rotational restrictions.
		Platinum 75 SG (thiamethoxam)	1.66-3.67	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A	**Provado 1.6F** (imidacloprid)	3.8- 6.2 oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been treated with imidacloprid or thiamethoxam.
	4A	**Scorpion 35SL** (dinotefuran)	**Foliar:** 2-7 fl oz **Soil:** 9-10.5 fl oz	Do not apply more than 10.5 fl oz per acre per season as foliar sprays or more than 21 fl oz to soil.	foliar - 1, soil - 21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Use only one application method
	4A	**Venom Insecticide** (dinotefuran)	foliar: 1-4 oz. Soil: 5-6 oz.	No more than 6 oz (foliar) or 12 oz (soil) per acre per season.	foliar: 1; soil: 21	12	Use only one application method (soil or foliar). No more than 3 applications per season.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4-7 oz	Do not exceed 14 oz per acre per season, or 0.172 lb ai of thiamethoxam-containing products or 0.2 lb ai of chlorantraniliprole-containing products per acre per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A Durivo per growing season.	30	12	Several methods of soil application- see label.
	7C	**Knack IGR** (pyriproxyfen)	8-10 fl oz	Do not exceed 20 fl. oz./A per season.	1	12	Immatures only. Apply when nymphs first appear. Do not make more than 2 applications per growing season.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/ acre per crop.	0	12	Do not make more than two applications.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Do not use with an adjuvant.
	16	**Courier SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Immatures only. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.

Table 12.3. Insecticides approved for managing insect pests of peppers. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code [1]	Trade Name (Active Ingredient) *Restricted	Rate	Rate per season	Days to Harvest	REI (hours)	Remarks
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than two applications per season.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz per acre per season.	1	24	
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	Maximum amount per crop: 25.5 fl oz/acre.	7	12	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	7-20.5	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	
	28	**Verimark** (cyantraniliprole)	soil at-planting or transplant tray treatment: 5-13.5 fl. oz.; drip chemigation or soil injection: 5-10 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Do not apply more than 38 fl oz/A per season.	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Use 14 to 17 fl oz per acre to control whiteflies, leafhoppers, and planthoppers.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator. See label for rates for specific pests.
	un	**MET52 EC** (*Metarhizium anispoliae* Strain F52)	drench: 40-80 fl. oz / 100 gal.; foliar: 0.5 pt-2 qt/A		0	4	
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz		0	12	IGR and feeding repellant. OMRI-listed.
	un	**Requiem 25EC** (extract of *Chenopodium ambrosioides*)	2-4 qts		0	4	Begin before pest reach damaging levels.
	un	**Suffoil-X** (petroleum oil)	1-2 gal per 100 gal. water			4	OMRI listed
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed.
	--	**Ultra-Fine Oil, JMS Stylet-Oil, Saf-T-Side, others** (oil, insecticidal)	3-6 qt/100 gal (JMS); 1-2 gal/100 gal		0	4	Stylet Oil helps manage aphid-borne viruses but does not kill aphids. Organic Stylet-Oil and Saf-T-Side are OMRI- listed.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.2 April 2012. Number codes (1 through 28) are used to distinguish the main insectide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Anthracnose	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	3 lbs	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	SEE INDIVIDUAL LABELS		3	1	
(suppression)	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For Disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
(suppression)	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 appl. of Cabrio or other group 11 fungicides/season.
	11	Heritage (azoxystrobin)	8 oz	2 lbs	0	4 hr	Limit is 4 appl/season. No more than 2 sequential appl. Before alternating with a fungicide from a different FRAC group.
(suppression)	11	Flint 50 WGD (trifloxystrobin)	4 oz	16 oz	3	0.5	Maximum of 4 appl/season & alternate with a fungicide from a different FRAC group.
	11	Quadris 2.08 FL Equation Satori (azoxystrobin)	15.4 fl oz	61.5 fl oz	0	4 hr	Limit is 6 appl/crop & alternate with a fungicide from a different FRAC group.

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 apps per season; no more than 2 sequential apps; use of a spreading or penetrating type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1 year plant back restriction for certain off label crops.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	11 & 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank mix with contact fungicides. Tank mix or rotate with a fungicide from a different FRAC group.
(suppression)	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	Limit is 5 apps. on 10-14 day interval. Alternate with a fungicide from a different FRAC group.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	2.44 pt	18.1 pt	3	0.5	
Bacterial spot	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hrs to 2 days	For best possible chemical control of bacterial spot, tank-mix copper with a mancozeb fungicide.
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	3 lbs	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	*Bacterial spot control only when tank mixed with a copper fungicide. Use of 1 lb of mancozeb/A per app. is sufficient.
(suppression)	11 & 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank mix with contact fungicides. Tank mix or rotate with a fungicide from a different FRAC group. Tank mix with copper fungicides for suppression of Phytophthora blight, bacterial spot, and bacterial soft rot
(suppression)	13	Quintec (quinoxyfen)	6 fl oz	24 fl oz	3	0.5	**Supplemental Section 2(ee) label:** Must be alternated with another product effective against bacterial spot. If multiple applications are made, at least one application must be a tank mix with another product effective against bacterial spot.
	25	Agri-mycin 17 Ag Streptomycin Firewall (streptomycin sulfate)	200 ppm	-	-	0.5	For use on transplants only. Initiate when seedling is in 2-leaf stage. Apply at 4-5 day intervals until transplanting.

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	21	Actigard* (acibenzolar-S-methyl)	0.75 oz	6 oz	14	0.5	*Labelled for chili pepper only. Begin applications within one week of transplanting or emergence. Make up to 8 weekly, sequential applications.
Bacterial soft rot (suppression)	11 & 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank mix with contact fungicides. Tank mix or rotate with a fungicide from a different FRAC group.
Botrytis or Gray mold	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		3	1	
(suppression)	7	Endura (boscalid)	3.5 oz	21 oz	0	0.5	Limit is 6 apps per season at lower rate with no more than 2 sequential apps before alternating with another effective fungicide from another FRAC group.
(suppression)	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For Disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	9 & 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Limit is 56 oz per year; after 2 apps of Switch alternate with another effective fungicide from a different FRAC group.
(suppression)	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 apps. of Cabrio or other group 11 fungicides/season.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	Limit is 5 apps. on 10-14 day interval. Alternate with a fungicide from a different FRAC group.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	2.44 pt	18.1 pt	3	0.5	

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Frogeye leaf spot, Cercospora leaf spot (Cercospora spp.)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	For best possible chemical control of bacterial spot, a copper fungicide should be tank-mixed with a mancozeb fungicide.
	M1 & M3	Mankocide (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	SEE INDIVIDUAL LABELS		7	1	
	M5	(chlorothalonil) Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		3	1	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 apps per season; no more than 2 sequential apps; use of a spreading or penetrating type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1 year plant back restriction for certain off label crops.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	2.44 pt	18.1 pt	3	0.5	
Gray leaf spot (*Stemphyllium* spp.)	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	11	Flint 50 WGD (trifloxystrobin)	4 oz	16 oz	3	0.5	Maximum of 4 appl/ season & alternate with a fungicide from a different FRAC group
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 apps per season; no more than 2 sequential apps; use of a spreading or penetrating type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1 year plant back restriction for certain off label crops.

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Powdery mildew	M2	(sulfur) **Many brands available:** Cosavet DF, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Tiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Follow label closely, it may cause phytotoxicity.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		3	1	
	3	Indar 75WSP (fenbuconazole)	4 oz	16 oz	7	0.5	No more than 2 sequential appl. before alternating with a fungicide from a different FRAC group. A 35 to 210 day plantback interval exists for non-labeled crops.
	3	Rally Sonoma 40WSP (myclobutanil)	5 oz	20 oz	0	1	No more than 4 applications per season on a 10 – 14 day treatment interval. Should be alternated or tank mixed with a fungicide from a different FRAC group.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For Disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	9 & 12	Switch (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Limit is 56 oz per year; after 2 apps of Switch alternate with another effective fungicide from a different FRAC group.
	11	Heritage (azoxystrobin)	8 oz	2 lbs	0	4 hr	Limit is 4 appl/season. No more than 2 sequential apps. before alternating with a fungicide from a different FRAC group.
	11	Flint 50 WGD (trifloxystrobin)	4 oz	16 oz	3	0.5	Maximum of 4 appl/ season & alternate with a fungicide from a different FRAC group
	11	Quadris 2.08 FL Equation Satori	15.5 fl oz	61.5 fl oz	0	4 hr	Limit is 6 appl/crop & alternate with a fungicide from a different FRAC group.

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
		(azoxystrobin)					
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	0	0.5	Only 4 apps per season; no more than 2 sequential apps; use of a spreading or penetrating type adjuvant may enhance efficacy. Not labeled for transplants. Up to a 1 year plant back restriction for certain off label crops.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	13	Quintec (quinoxyfen)	6 fl oz	24 fl oz	3	0.5	Will not control latent or established infections. Must alternate or tank mix with an effective fungicide from a different FRAC group.
	19	Ph-D WDG (polyoxin D zinc salt)	6.2 oz	31.0 oz	0	4 hr	Limit is 5 apps. on 10-14 day interval. Alternate with a fungicide from a different FRAC group.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	2.44 pt	18.1 pt	3	0.5	
	U8	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	3 apps per season; no more than 2 sequential apps. Do not mix with horticultural oils.
Phytophthora blight, Phytophthora root rot, Phytophthora crown rot (*Phytophthora* spp.)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
(suppression)	M1 & M3	Mankocide (copper hydroxide + mancozeb)	3 lb	39 lb	7	2	
	M3	(mancozeb) **Many brands available:** Dithane F45, Dithane M45, Koverall, Manzate MAX, Manzate Pro-Stik, Penncozeb 75DF, Roper DF	**SEE INDIVIDUAL LABELS**		7	1	
	4	Orondis Gold B Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt 1 pt 2 pt	3 pt 3 pt 6 pt	28 7 7	0 2* 2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4 & M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2.5 lb	10 lb	7	2	Use Ridomil Gold EC on soil preplant or at planting. Make up to 2 additional appl. Use 1 pt/A and apply at a 30 day interval.
(suppression)	11	Reason 500 SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Ground application only. Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details.
(suppression)	11 & 27	Tanos (famoxadone + cymoxanil)	10 oz	72 oz	3	0.5	Tank mix with contact fungicides. Tank mix or rotate with a fungicide from a different FRAC group.

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0	0.5	Limit is 6 apps. per crop. Must be rotated with an effective fungicide from a different FRAC group. See label for application instructions, including the recommended use of specific surfactants.
	28	Previcur Flex or Promess (propamocarb hydrochloride)	**SEE INDIVIDUAL LABELS**		5	0.5	GREENHOUSE APPLICATION: 6 apps./crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
			1.2 pt	6 pt	5	0.5	FIELD APPLICATION: Apply prior to infection when conditions are favorable for disease.
	29	Omega (fluazinam)	1.5 pt	9 pt	30	0.5	May be applied at transplanting. Begin foliar applications 7 days after transplant.
	33	Aliette 80 WDG (fosetyl-al)	5 lbs	20lbs	14	0.5	See label for warnings concerning the use of copper compounds.
	40	Forum (dimethomorph)	6 oz	30 oz	0	0.5	Apply with another fungicide from a different FRAC group.
	40	Orondis Ultra B Revus	8 fl oz 8 fl oz	32 fl oz 32 fl oz	1 1	4 hr 4 hr	No more than 2 sequential appl.; Alternate with another effective fungicide; See label.
(suppression)		Micora (mandipropamid)	8 fl oz/ 5,000 sq ft	16 fl oz/ 5,000 sq ft	n.a.	4 hr	Micora is only labeled for transplant and retail sale to consumers.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	4 apps per season; no more than 2 sequential apps. 10 day spray interval; Tank mix with another labeled non-FRAC code 43 fungicide; 18 month rotation with off label crops.
	45 & 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. Limit of 3 applications per season.
	U15	Orondis Gold 200 (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	0	4 hr	Soil applications cannot be combined or followed by foliar applications of Orondis Opti A or Orondis Ultra A. 4 apps per season; no more than 2 sequential apps. 7 day minimum app. interval; Applications should not exceed more than 33% of the total soil fungicide apps. See label for soil application instructions.
	U15	Orondis Opti A Orondis Ultra A (oxathiapiprolin)	4.8 fl oz 4.8 fl oz	19.2 fl oz 19.2 fl oz	0 0	4 hr 4 hr	Do not combine foliar apps of Orondis with soil apps of Orondis for disease control. 6 apps per season; no more than 2 sequential apps. 5 day minimum app. interval; Applications should not exceed more than 33% of the total foliar fungicide apps. See Orondis Ultra A label for greenhouse use.
Pythium damping-off, Pythium root rot, or Pythium seedling blights (*Pythium* spp.)	4	Allegiance-FL Acquire (metalaxyl)	0.75 fl oz/100 lbs seed	-	-	-	Seed treatment only

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	4	Apron XL (mefanoxam)	0.64 fl oz/100 lbs seed	-	-	-	Seed treatment only
	4	Orondis Gold B Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt 1 pt 2 pt	3 pt 3 pt 6 pt	28 7 7	0 2* 2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4 & M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2.5 lb	10 lb	7	2	Use Ridomil Gold EC on soil preplant or at planting. Make up to 2 additional appl. Use 1 pt/A and apply at a 30 day interval.
(suppression)	12	Maxim 4 FS (fludioxonil)	0.16 fl oz/ 100 lbs seed	-	-	-	Seed treatment only
	28	Previcur Flex or Promess (propamocarb hydrochloride)	1.2 pt	6 pt	5	0.5	Apply prior to infection when conditions are favorable for disease. See label for greenhouse applications.
	U15	Orondis Gold 200 (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	0		Soil applications cannot be combined or followed by foliar applications of Orondis Opti A or Orondis Ultra A. 4 apps per season; no more than 2 sequential apps. 7 day minimum app. interval; Applications should not exceed more than 33% of the total soil fungicide apps. See label for soil application instructions.
Rhizoctonia solani	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 appl. of Cabrio or other group 11 fungicides/season.
	11	Quadris 2.08 FL Equation Satori (azoxystrobin)	15.5 fl oz	61.5 fl oz	0	4 hr	Limit is 6 apps/crop & alternate with a fungicide from a different FRAC group.
			0.8 fl oz/ 1,000 row feet		0	4 hr	Soil application through drip irrigation
	14	Par-Flo 4F (PCNB)	12 fl oz/100 gal.	2 apps	Soil drench	0.5	Limited to only container-grown plants in nurseries or greenhouse.
Southern blight (*Sclerotium rolfsii*)	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential apps. before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse useage.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 appl. of Cabrio or other group 11 fungicides/season.
	11	Aftershock Evito 480 SC (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Limit is 4 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	14	Blocker 4F Terraclor 75 WP (PCNB)	**SEE INDIVIDUAL LABELS**		Soil treatment at planting	0.5	See label for application type and restrictions.

Table 12.4. Pepper fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
White mold (*Sclerotinia sclerotiorum*) (suppression)	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	11	Cabrio 2.08 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	No more than 6 apps. of Cabrio or other group 11 fungicide/season.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants. White mold suppression only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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UF IFAS Extension
UNIVERSITY of FLORIDA

Chapter 13. Potato Production

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Botany and Planting

Potato – *Solanum tuberosum*, Solanaceae.

Table 13.1. Planting information for potato.

Planting dates	
North Florida	Jan-Feb
Central Florida	Nov-Feb
South Florida	Oct-Jan
Planting information	
Distance between rows (inch)	36 - 42
Distance between plants (inch)	7 - 10
Planting depth (inch)	3 - 4
Average seed piece size (oz)	2.5 - 3.0
Average seed per planted acre (lb)	2000 - 3000
Days from planting to tuber maturity	85 - 110

Cultivars

1. CHIPPING TYPES

Atlantic. With high yield potential, high specific gravity and uniform tuber size and shape, Atlantic is the standard variety for chipping from the field or from very short-term storage. The cultivar is tolerant to scab and Verticillium wilt; resistant to pinkeye; and highly resistant to Race A of golden nematode, virus X and tuber net necrosis. Tubers are susceptible to internal heat necrosis, particularly in sandy soils in warm, dry seasons. Hollow heart in the larger diameter tubers (> 3 in) can be serious in some growing areas when growing conditions over the season fluctuate.

Elkton. Elkton is a medium to medium-late maturing potato variety with netted-skinned, round-oblong tubers, and white-flesh. Chip color processed directly from the field. Elkton is resistant to internal heat necrosis and moderately resistant to common scab, early blight, and Verticillium wilt; intermediate to moderately susceptible to late blight; moderately susceptible to powdery scab; and, susceptible to potato virus Y and potato virus S.

Harley Blackwell. Harley Blackwell is a round, white-fleshed, tan, netted-skin variety, resistant to internal heat necrosis, for chipping directly from the field in the mid-Atlantic states. Harley Blackwell is resistant to Race A of golden nematode, Verticillium wilt, and late blight. It is moderately susceptible to early blight with intermediate resistance to common scab and some tolerance to powdery scab.

2. FRESH MARKET/TABLE TYPES

Red LaSoda. Red LaSoda is an early to medium season, red-skinned variety that is primarily grown in the southeastern U.S. It is harvested in the winter months as a fresh market variety. Red LaSoda has a high yield potential of tubers with a pink to red color. Tubers size early. Tuber eye depth and off-shape tubers are limitations. The cultivar is susceptible to early and late blights, scab, corky ringspot, and bacterial wilt. Red LaSoda is the top planted red-skinned potato variety in Florida.

LaRouge. LaRouge is a early to medium maturing, red-skinned variety that has a high tuber yield potential with tubers sizing early. Primary growing areas are in the southeastern U.S. The variety is grown for the fresh market and is generally not stored. LaRouge has good scab resistance but is susceptible to early and late blights, corky ringspot, and bacterial wilt. The deep eyes and irregular tuber shape are the major limitations. When harvested in southern states the relatively high yield, bright color, and good boiling qualities make it popular for markets in the late winter.

LaChipper. LaChipper is an early to midseason variety with moderate to high tuber yield and moderate specific gravity. It is the top planted fresh market white-skinned variety in Florida. Tubers are more elongated than round, somewhat flattened. Skin is smooth and white with medium to deep, cream colored eyes that are fairly evenly distributed. Tuber flesh is very white. LaChipper possesses some resistance to late blight. It is moderately susceptible to common scab. Exposure to air pollution can result in defoliation and reduction in tuber yield. Deep eyes and irregular shape are disadvantages on the tablestock market.

Yukon Gold. Yukon Gold has early-medium maturity, moderate yields, moderate specific gravity and relatively attractive tuber type. Tubers slightly oval, may be somewhat flattened with yellow-white skin and light yellow tuber flesh. Its shallow, pink eyes distinguish Yukon Gold from other yellow-skinned, yellow-fleshed cultivars. Yukon Gold is resistant to mild mosaic, moderately resistant to leafroll virus and susceptible to virus Y, common scab and air pollution. In some growing areas, hollow heart and internal heat necrosis may be a problem. Yukon Gold retains the yellow flesh color when baked, boiled or french-fried.

Goldrush. Goldrush is a medium maturing russet cultivar grown primarily for the fresh market. Russet-skinned tubers are oblong to long and average approximately 6-10 tubers per plant. Eyes are very shallow and well distributed; under some conditions they may show a reddish blush. Tuber flesh is very white and tuber dormancy is medium in duration. Goldrush has been observed to have moderate resistance to Verticillium wilt, good resistance to scab, moderate resistance to blackspot and some resistance to silver scurf. It is considered susceptible to most common potato viruses and other potato diseases, such as early blight, late blight, soft rot and Fusarium dry rot.

Marcy. Marcy is a white-flesh and white-skinned fresh market potato variety with an oval slightly flattened shape. Marcy tubers have an attractive oval shape, shallow eyes, and highly textured skin. Marcy is resistant to brown rot, common scab and race Ro1 of the golden cyst nematode. The variety is susceptible to PVX and PVY, hollow heat, Corky ring spot, and internal heat necrosis. Marcy has a specific gravity slightly lower than Atlantic, which is not a limitation for the tablestock market.

Table 13.2. Herbicides approved for managing weeds in potato.

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
			*** PREPLANT / PREEMERGENCE ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Dimethenamid-p 0.56 - 0.84	(Outlook) 6 L 12 - 18 fl. oz.	15	Apply after planting or drag-off. Consult label for exact rates based on soil texture. In cold wet conditions, delayed crop emergence or stunting may occur. PHI 40 days.
EPTC 1	(Eptam) 20 G 15 lb.	8	Broadleaf and grass weeds and nutsedge. Apply preplant or after drag-off. Incorporate mechanically or with irrigation 2-4 in. deep. Do not apply the emulsifiable formulation preemergence in winter and early spring potatoes.
Flumioxazin 0.05	(Chateau) 51 WDG 1.5 oz.	14	Annual broadleaf weeds. Apply after hilling with a minimum of 2 in. of soil covering the vegetative portion of the potato plant. Should be tank mixed with other herbicides, especially for grass control.
Fomesafen 0.25	(Reflex, Ringside) 2 EC 1.0 pt.	14	Annual broadleaf and grass weeds. Effectiveness reduced if later cultural practices expose untreated soil. Can be applied after drag off and before crop emergence. Variety tolerance may vary, test on a small sample before application to the entire field. PHI 7 days.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Imazosulfuron 0.19-0.3	(League) 75 WG 4-6.4 oz.	2	Broadleaf and grass weeds. Limit of 2 applications per year and no more than 6.4 oz./A per year.
Linuron 0.75 - 1.25	(Lorox DF) 50 DF 1.5 - 2.5 lb. (Linex) 4 L 1 - 1.6 pt.	7	Apply after final drag-off. If weeds are present include a NIS. Best results are obtained in moist fields at application followed by rain or irrigation with 2 wk.
Metribuzin 0.25 - 1.0	(Tricor DF) 75 DF 0.3 - 1.3 lb.	5	Annual broadleaf weeds. Apply after drag-off but before crop emergence. Do not incorporate. Use lower rates on sandy soil.
Metribuzin + *S*-metolachlor	(Boundry) 6.5 EC 1.5 - 2.0 pt.	5 + 15	Broadleaf and grass weeds. Apply before potato emergence. This includes drag-off. Do not incorporate.
Paraquat 0.25 - 0.5	(Gramoxone) 2 SL 1.0 - 2.0 pt. (Firestorm) 3 SL 0.7 - 1.3 pt.	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Apply up to ground cracking before potatoes have emerged. Use a nonionic surfactant.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pendimethalin 0.75	(Prowl H20) 3.8 1.5 pt.	3	Annual broadleaf and grass weeds. Apply after planting but before potatoes and weeds emerge or after drag-off. Incorporate with rainfall or mechanically into the top 1-2 in. of soil within 7 days. Do not use on peat or muck soils.
Pyraflufen 0.001 - 0.003	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
Rimsulfuron 0.016 - 0.023	(Matrix) 25 DF 1.0 - 1.5 oz.	2	Apply immediately after drag-off. Rainfall or sprinkler irrigation 0.3-1.0 in. required with 5 days after application. Do not exceed 2.0 oz./A per year.
***S*-metolachlor 0.95 - 1.9**	(Dual Magnum) 7.62 EC 1.0 - 2.0 pt.	15	Annual broadleaf and grass weeds. Apply after drag-off before crop and weed emergence. If cool, wet soil conditions occur after application, a delay in maturity and/or reduced yield may occur. PHI 60 days.
Trifluralin 0.5	(Trust, Treflan TR-10) 10 G 5 lb. (Trifluralin, Treflan) 4 L 1 pt.	3	Broadleaf and grass weeds. Apply after dragoff or prior to crop emergence. Incorporate the herbicide into the soil profile. If applied after plant emergence do not allow soil contact with the emerged plants.
			*** POSTEMERGENCE ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use a COC or NIS at recommended rates. May be tank mixed with other herbicides. Do not exceed 6.1 fl. oz. per cropping season. PHI 7 days.

Table 13.2. Herbicides approved for managing weeds in potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
Clethodim **0.09 - 0.25** **0.07 - 0.25**	(Arrow, Select) 2 EC 6 - 16 fl. oz. (Select Max) 1 EC 9 - 32 fl. oz.	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days.
Imazosulfuron **0.19-0.3**	(League) 75 WG 4-6.4 oz.	2	Broadleaf and grass weeds. Limit of 2 applications per year and no more than 6.4 oz./A per year. PHI 45 days.
EPTC **3** **3.1 - 7.9**	(Eptam) 20 G 15 lb. (Eptam) 7 E 3.5 to 9 pt.	8	Annual broadleaf, grass weeds and nutsedge. Apply at layby to a clean cultivated soil. Incorporate mechanically or with irrigation. Apply Eptam 7 E after true leaves have formed and apply as a layby treatment. Do not exceed 12.25 lb. a.i. perseason. PHI 45 days.
Metribuzin **0.23 - 0.5**	(Tricor) 75 DF 0.3 - 0.6 lb.	5	Broadleaf and grass weeds. Do not apply to early smooth skinned, red skinned, and other specified varieties on the label. Do not exceeded 1.3 lb. of product /A. PHI 60 days.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
Rimsulfuron **0.016 - 0.023**	(Matrix) 25 DF 1.0 - 1.5 oz.	2	Apply immediately after drag-off. Rainfall or sprinkler irrigation 0.3-1.0 in. required within 5 days after application. Apply as a sequential treatment 14 to 28 days after the first application. Do not exceed 2.0 oz./A per year.
Sethoxydim **0.28 - 0.47**	(Poast) 1.5 EC 1.5 - 2.5 pt.	1	Control growing grass weeds. A total of 5.0 pt./A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grass under stress. PHI 30 days.

Table 13.3. Insecticides approved for managing insect pests of potato.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Aphids	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1B	**Dimethoate 4 EC** (dimethoate)	0.5-1.0 pt	48	0 if mechanically harvested, 14 otherwise	Highly toxic to bees. Do not apply more than 2 pts per acre per year.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt **8F:** 1-1.5 pt	12	0	Maximum of two applications per year.
	3A	***Ambush 25W** (permethrin)	3.2-12.8 oz	12	14	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
	3A	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	4A	**Admire Pro** (imidacloprid)	5.7-8.7 fl oz as soil treatment or as seed piece treatment: 3.5-7.0 fl oz/100 lb seed **foliar:** 1.3 fl oz	12	at planting, see label for options; **foliar:** 7	Do not apply more than, 0.31 lb ai per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar:** Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Do not make more than 4 applications per season. Do not exceed a total of 0.3 lb ai (16 oz of product) per acre per season.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (in-furrow or side dress application); 2-3 fl oz (foliar)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress and seed-piece applications. Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for five days after application.
	4A, 3A	**Leverage** (imidacloprid + cylfluthrin)	3-3.75 fl oz		7	Leverage should not be used in fields treated with Admire Pro or other 4A products. There have been reports of low levels of resistance to imidacloprid. To minimize selection for resistance, do not use foliar applications of any IRAC MOA class 4A insecticides if any of these compounds were applied to the crop as soil or seed piece treatments. Utilize crop roatation and insecticide rotation to minimize Colorado potato beetle resistance.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Scorpion 35SL** (dinotefuran)	**foliar:** 2-2.75 fl oz **soil:** 11.5-13.25 fl oz	12	**foliar -** 7**soil** - see label	Apply as foliar or soil application, but not both. Maxiumum per acre per season for foliar use: 8 fl oz. Maxiumum when applied to soil=13.25 fl. oz. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-1.5 oz **soil:** 6.5-7.5 oz	12	**foliar -** 7 **soil** - at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.
	9B	**Fulfill** (pymetrozine)	2.75-5.5 oz	12	14	Apply when aphids first appear. Do not exceed 11.0 oz per acre per season.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	7	Begin applications before pest populations reach damaging levels. Do not apply more than 8.4 oz/acre per season.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Insect growth regulator and anti-feedant. OMRI-listed[2].
	un	**Requiem EC** (extract of *Chenopodium ambrosioides*)	2-3 qt	4	0	Treat when threshold reached.
	un	**Trilogy** (extract of neem oil)	1.0%-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed[2].

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Caterpillars; armyworm, webworms, cutworms, cabbage looper, corn earworm	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1A	**Sevin XLR, 4F; 80 S** (carbaryl)	**XLR, 4F:** 0.5-2.0 qt**80S:** 0.63-2.5 lb	12	7	Do not apply more than a total of 6 qt (**4F, XLR**) or 7.5 lb (**80S**).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	5	**Entrust SC** (spinosad)	3-10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed.
	5	**Radiant SC** (spinetoram)	4.5-8 fl oz	4	7	No more than 4 applications per year.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. For organic production.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	12	7	Do not apply more than 24 oz/acre per crop.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
	28	**Verimark** (cyazypyr)	6.75-13.5 fl oz	4	N/A-applied at planting	Do not apply more than 13.5 fl oz per acre at planting. pH of application solution must be between 4 and 6.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Insect growth regulator and anti-feedant. OMRI-listed[2].
	--	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
European corn borer	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	4.5-8 fl oz	4	7	No more than 4 applications per year.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	12	7	Do not apply more than 24 oz/acre per crop.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
Beetles: blister beetle, flea beetle, Colorado potato beetle, cucumber beetle, whitefringed beetle)	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1A	**Sevin XLR, 4F; 80 S** (carbaryl)	**XLR, 4F:** 0.5-2.0 qt**80S:** 0.63-2.5 lb	12	7	Do not apply more than a total of 6 qt (**4F, XLR**) or 7.5 lb (**80S**).
	1B	**Imidan 70 W** (phosmet)	1.3 lb	5 days	7	Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.
	1B	***Thimet 20 G** (phorate)	See label - varies with soil type and time of application.	48	90	One application per season.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	3A	***Ambush 25W** (permethrin)	3.2-12.8 oz	12	14	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	3A	***Brigade 2 EC** (bifenthrin)	9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil); 2.1-6.4 oz (foliar)	12	21	No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season.
	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	5.7-8.7 fl oz as soil treatment or as seed piece treatment: 3.5-7.0 fl oz/100 lb seed **foliar:** 1.3 fl oz	12	at planting, see label for options; **foliar:** 7	Do not apply more than, 0.31 lb ai per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar:** Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Do not make more than 4 applications per season. Do not exceed a total of 0.3 lb ai (16 oz of product) per acre per season.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (in-furrow or side dress application); 2-3 fl oz (foliar)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress and seed-piece applications. Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for five days after application.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Scorpion 35SL** (dinotefuran)	**foliar:** 2-2.75 fl oz **soil:** 11.5-13.25 fl oz	12	**foliar -** 7**soil** - see label	Apply as foliar or soil application, but not both. Maxiumum per acre per season for foliar use: 8 fl oz. Maxiumum when applied to soil=13.25 fl. oz. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-1.5 oz **soil:** 6.5-7.5 oz	12	**foliar -** 7 **soil** - at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A, 28	**Voliam Flexi** (thiamethoxam, chlorantraniliprole)	4 oz	12	14	No more than two applications.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	5	**Entrust SC** (spinosad)	3-10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	4.5-8 fl oz	4	7	No more than 4 applications per year.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	17	**Trigard** (cyromazine)	2.66-5.32 oz	12	7	Most effective for control of 1st and 2nd instar larvae. Does not control adult CPB. Use lower rate for leafminers. Maximum per acre per season: 1.0 lb.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	12	7	Do not apply more than 24 oz/acre per crop.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
	28	**Verimark** (cyazypyr)	6.75-13.5 fl oz	4	N/A-applied at planting	Do not apply more than 13.5 fl oz per acre at planting. pH of application solution must be between 4 and 6.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**Kryocide** (cryolite)	10-12 lb	12	0	Application to exposed tubers may result in excess residues.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed[2].
Fireants	6	**Clinch** (abamectin)	1 lb	12	0	Apply when ants are actively foraging. Apply after dew or rainfall has dried for maximum effectiveness. Do not apply if rainfall is anticipated within 4-6 hours. No more than 4 applications per year.
	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Leafhopper	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	1A	**Sevin XLR, 4F; 80 S** (carbaryl)	**XLR, 4F:** 0.5-2.0 qt**80S:** 0.63-2.5 lb	12	7	Do not apply more than a total of 6 qt (**4F, XLR**) or 7.5 lb (**80S**).
	1B	**Dimethoate 4 EC** (dimethoate)	0.5-1.0 pt	48	0 if mechanically harvested, 14 otherwise	Highly toxic to bees. Do not apply more than 2 pts per acre per year.
	1B	**Imidan 70 W** (phosmet)	1.3 lb	5 days	7	Use only on potatoes to be harvested by machine. Do not apply where bees are foraging.
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt**8F:** 1-1.5 pt	12	0	Maximum of two applications per year.
	1B	***Thimet 20 G** (phorate)	See label - varies with soil type and time of application.	48	90	One application per season.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
	3A	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Admire Pro** (imidacloprid)	5.7-8.7 fl oz as soil treatment or as seed piece treatment: 3.5-7.0 fl oz/100 lb seed **foliar:** 1.3 fl oz	12	at planting, see label for options; **foliar:** 7	Do not apply more than, 0.31 lb ai per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar:** Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Scorpion 35SL** (dinotefuran)	**foliar:** 2-2.75 fl oz **soil:** 11.5-13.25 fl oz	12	**foliar - 7soil** - see label	Apply as foliar or soil application, but not both. Maxiumum per acre per season for foliar use: 8 fl oz. Maxiumum when applied to soil=13.25 fl. oz. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-1.5 oz **soil:** 6.5-7.5 oz	12	**foliar -** 7 **soil** - at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4A, 28	**Voliam Flexi** (thiamethoxam, chlorantraniliprole)	4 oz	12	14	No more than two applications.
	4C	**Transform WG** (sulfoxaflor)	0.75-2.25 oz	24	7	Do make more than 2 consecutive or 4 total applications per crop.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Leafminer	3A	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	5	**Entrust SC** (spinosad)	3-10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	4.5-8 fl oz	4	7	No more than 4 applications per year.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	14	No more than 2 sequential applications. Must be applied with non-ionic activator type wetting, spreading, or penetrating adjuvant. See label for resistance management.
	17	**Trigard** (cyromazine)	2.66-5.32 oz	12	7	Most effective for control of 1st and 2nd instar larvae. Does not control adult CPB. Use lower rate for leafminers. Maximum per acre per season: 1.0 lb.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	--	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Mites	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	14	No more than 2 sequential applications. Must be applied with non-ionic activator type wetting, spreading, or penetrating adjuvant. See label for resistance management.
	23	**Oberon 2SC** (spiromesifen)	8-16 fl oz	12	7	Maximum amount per crop: 32.0 fl oz/acre. Maximum applications: 2.
	un	**Trilogy** (extract of neem oil)	1.0%-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Leaf-footed bug, plant bug, stink bug, mealybugs, false cinch bugs	1A	**Sevin XLR, 4F; 80 S** (carbaryl)	**XLR, 4F:** 0.5-2.0 qt**80S:** 0.63-2.5 lb	12	7	Do not apply more than a total of 6 qt (4F, XLR) or 7.5 lb (80S).
	1B	**Malathion 5EC, 8F** (malathion)	**5EC:** 1.5-2.5 pt**8F:** 1-1.5 pt	12	0	Maximum of two applications per year.
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
	3A	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.
	3A	***Mustang** (zeta-cypermethrin)		12	1	A maximum of 0.3 lb ai/acre per season may be applied.
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Only exposed insects can be controlled. Do not apply more than 7.68 fl oz of product per acre per season.
	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	7	Begin applications before pest populations reach damaging levels. Do not apply more than 8.4 oz/acre per season.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed[2].
Potato tuberworm	1A	***Lannate LV; *SP** (methomyl)	**LV:** 1.5-3.0 pt **SP:** 0.5-1.0 lb	48	6	Do not make more than 10 applications per crop or apply more than 15 pt (LV) or 5 lb (SP) per acre per crop.
	3A	***Ambush 25W** (permethrin)	3.2-12.8 oz	12	14	Do not apply more than 1.6 lb active ingredient per season (102.4 oz).
	3A	***Asana XL (0.66 EC)** (esfenvalerate)	2.9-9.6 fl oz	12	7	Do not apply more than 0.35 lb ai/acre per season (7 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Allow at least 5 days between applications. A maximum of 16.8 fl oz may be applied per acre per season.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	3A	***Pounce 25 WP** (permethrin)	6.4-12.8 oz	12	14	Do not apply more than 0.8 lb ai/acre per season.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	14	Do not apply more than 15.4 fl oz per acre per crop per season. Foliar or overhead sprinkler irrigation systems only.
Thrips (check label for species controlled)	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18.0 fl oz	12	0	Harmful to bees. Degrades rapidly in sunlight. Good coverage essential. OMRI-listed[2].
	5	**Entrust SC** (spinosad)	3-10 fl oz	4	7	Do not apply to consecutive generations of Colorado potato beetle. Do not apply more 21 fl oz per acre per season or more than 4 times/crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	4.5-8 fl oz	4	7	No more than 4 applications per year.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Trilogy** (extract of neem oil)	1.0%-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V	12	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed2.
Whiteflies	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use following soil application of other Group 4A insecticides. Maximum 6 oz/acre per season.
	4A	**Admire Pro** (imidacloprid)	5.7-8.7 fl oz as soil treatment or as seed piece treatment: 3.5-7.0 fl oz/100 lb seed **foliar:** 1.3 fl oz	12	at planting, see label for options; **foliar:** 7	Do not apply more than, 0.31 lb ai per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar:** Maximum for foliar applications per year: 5.6 fl oz.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Do not make more than 4 applications per season. Do not exceed a total of 0.3 lb ai (16 oz of product) per acre per season.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (in-furrow or side dress application); 2-3 fl oz (foliar)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress and seed-piece applications. Do not apply during bloom or allow to drift to flowering plants. Toxic to bees for five days after application.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year.
	4A	**Venom Insecticide** (dinotefuran)	**foliar:** 1-1.5 oz **soil:** 6.5-7.5 oz	12	**foliar -** 7 **soil** - at planting	Do not apply more than 4.5 oz per acre per season to foliage. One soil application, either preplant, preemergence, or at ground crack. Do not use with other Group 4A insecticides. Do not apply where bees are foraging. Toxic to bees for 38 hours after application.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum amount per year=28 fl oz/acre.

Table 13.3. Insecticides approved for managing insect pests of potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	9B	**Fulfill** (pymetrozine)	2.75-5.5 oz	12	14	Apply when whiteflies first appear. Do not exceed 11.0 oz per acre per season.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Does not affect adult insects.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	23	**Oberon 2SC** (spiromesifen)	8-16 fl oz	12	7	Maximum amount per crop: 32.0 fl oz/acre. Maximum applications: 2.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Insect growth regulator and anti-feedant. OMRI-listed[2].
	un	**Trilogy** (extract of neem oil)	1.0%-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
	--	**Sun Spray 98.8%, JMS Stylet-Oil, others** (oil, insecticidal)	3-6 qt/100 gal (JMS)	4	0	See label for tank mix cautions. Organic Stylet-Oil is OMRI-listed[2].
Wireworm	1B	***Mocap 15 G, *EC** (ethoprop)	See labels	48	preplant or at planting	Use broadcast application for moderate to heavy infestations of wireworms.
	1B	***Thimet 20 G** (phorate)	See label - varies with soil type and time of application.	48	90	One application per season.
	4A	**Admire Pro** (imidacloprid)	5.7-8.7 fl oz as soil treatment or as seed piece treatment: 3.5-7.0 fl oz/100 lb seed **foliar:** 1.3 fl oz	12	at planting, see label for options; **foliar:** 7	Do not apply more than, 0.31 lb ai per acre per season. Seed piece rate is based on seeding rate of 2000 lb/acre. **Foliar:** Maximum for foliar applications per year: 5.6 fl oz.
	2B	***Regent 4SC** (fipronil)	3.2 fl oz	0	90	Many plant-back restrictions. One in-furrow application at time of planting only. Must be incorporated and covered with soil.
	3	**Capture LFR** (bifenthrin)	25.5 fl oz			In furrow at planting
	3A	***Brigade 2 EC** (bifenthrin)	9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil)	12	21	Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	4A	**Belay Insecticide** (clothianidin)	9-12 fl oz (in-furrow or side dress application)	12	Foliar: 14, or at planting or sidedress or spray at ground crack over row at hilling	See label for in-furrow, side dress and seed-piece applications.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	applied at planting or at plant emergence	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. One soil application per year. **For wireworms: seed-piece only.**

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Botrytis gray mold	M3	(mancozeb) **Many brands available:** Dithane M45, Dithane DF Rainshield, Dithane F45 Rainshield, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 80WP, Penncozeb 75DF	**SEE INDIVIDUAL LABELS**		3	1	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo ZN, Bravo Weather Stik 6L, Chloronil 720, Chlorothalonil 720SC, Echo 90DF, Echo 720, Echo ZN, Equus DF, Equus 500 ZN, Equus 720SST, Initiate 720, Initate ZN	**SEE INDIVIDUAL LABELS**		7	0.5	
(supression)	M3 & M5	Elixir (mancozeb + chlorothalonil)	**2 lb**	**18 lb**	7	24 hr	
	3	Quash (metconazole)	2.5 oz	7.5 oz	1	12 hr	Follow resistance management recommendations on label
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications
	7	Endura 70WP (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 4 apps at low rate or 2 apps at high rate
	7	Luna Privilege (fluopyram)	See label for ground or aerial application rates	See label for ground or aerial application rates	7	12 hr	Do not make more than 2 sequential applications
(suppression)	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	43.6	7	0.5	Do not make more than 2 sequential applications
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24	7	0.5	Do not make more than 2 sequential applications
	9	Scala SC (pyrimethanil)	7 fl. oz	35 fl. oz	7	0.5	Use only in a tank mix with labeled fungicide for early blight
(suppression)	11 & 4	Quadris Ridomil Gold (azoxystrobin + mefenoxam)	0.82 fl oz./1000 ft. of row	See label		0	Apply at planting
Early blight ***(Alternaria solani)***	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, COC DF, COC WP, COCS WDG, Champ DP Dry Prill, Champ 2 FL, Champ WG, Champion WP, Cuprofix Ultra 40 Disperss, Copper-Count-N, Cuprofix MZ Disperss, Copper sulfate crystals, Copper-Z 4/4, , Cueva, Kentan DF, Kocide 2000, Kocide DF, Kocide 3000, Nordox 75WG, Nu Cop 50WP, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB, Quimag Copper Sulfate Crystal	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 & M3	ManKocide 61.1DF (copper hydroxide + mancozeb)	5 lb	74.66 lb	3	2	
	M3	(mancozeb) **Many brands available:** Dithane M45, Dithane DF Rainshield, Dithane F45 Rainshield, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 80WP, Penncozeb 75DF	**SEE INDIVIDUAL LABELS**		3	1	Limit is 11.2 lb of active ingredient per a crop.

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M3	Polyram 80DF (metiram)	2 lb	14 lb	3	1	Limit is 7 appl./season
	M3 & M5	Elixir (mancozeb; chlorothalonil)	**2 lb**	**18 lb**	7	24 hr	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo ZN, Bravo Weather Stik 6L, Chloronil 720, Chlorothalonil 720SC, Echo 90DF, Echo 720, Echo ZN, Equus DF, Equus 500 ZN, Equus 720SST, Initiate 720, Initate ZN	**SEE INDIVIDUAL LABELS**		7	0.5	Read label for application directions
	2	Enclosure 4 Iprodione 4L Nevado 4F Rovral 4F (iprodione)	2 pt	8 pt	14	1	Limit is 4 appl./crop. See individual label for additional information.
	3	Quash (metconazole)	2.5 oz	7.5 oz	1	12 hr	Follow resistance management recommendations on label
	4 & M3	Ridomil Gold MZ (mancozeb + mefenoxam)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak)
	4 & M5	Ridomil Gold Bravo SC (chlorothalonil + mefenoxam)	2.5 pt	See label	14	2	Limit is 4 appl./crop. Also labeled for storage rots (Pink Rot and Leak)
	7	Endura 70WP (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 4 apps at low rate or 2 apps at high rate
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications
	7	Luna Privilege (fluopyram)	See label for ground or aerial application rates	See label for ground or aerial application rates	7	12 hr	Do not make more than 2 sequential applications
	7 & 9	Luna Tranquility (fluopyram; pyrimethanil)	11.2 fl oz	43.6	7	0.5	Do not make more than 2 sequential applications
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24	7	0.5	Do not make more than 2 sequential applications
	9	Scala SC (pyrimethanil)	7 fl. oz	35 fl. oz	7	0.5	Use only in a tank mix with labeled fungicide for early blight
	11	Evito 480SC Aftershock (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	Limit is 6 application per crop and alternate with non-group 11 chemistry
	11	Gem 500SC (trifoxystrobin)	3.8 fl oz	23 fl. oz	7	0.5	Limit is 6 application per crop and alternate with non-group 11 chemistry
	11	Headline 2.09F (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
	11	Reason 500SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate with non-group 11 chemistry between applications
	11	Quadris, Aframe, Azoxystar, Equation, Satoria, Willowood Azoxy (azoxystrobin)	See individual labels				Alternate with non-group 11 chemistry between applications. See label for soilborne disease applications
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	See label	14	0.5	Alternate with non-group 11 chemistry between applications
	11 & M3	Cabrio plus (pyraclostrobin + metiram)	2.9 lb	17.4 lb	3	1	Do not make more than two sequential applications

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & M3	Quadris Top (azoxystrobin & difenoconazole)	14 fl oz.	55.3 fl oz	14	0.5	Do not make more than 2 consecutive applications before switching to another effective fungicide with a different mode of action
	19	Ph-D (polyoxin D zinc salt)	6.2 oz	31 oz	0	0	Limit is 5 appl./season. Use in alternation with fungicides that have different modes of action.
	22 & M3	Gavel 75DF (mancozeb + zoxamide)	2.0 lb	12 lb	3	2	This product contains 66.7% mancozeb so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products.
	22 & M5	Zing! (zoxamide + chlorothalonil)	34 fl oz/A	1.52 lb zoxamide and 8.8 lb chlorothalonil	7	12 hr	Do not make more than 2 consecutive applications before switching to another effective fungicide with a different mode of action
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	48 oz	14	0.5	Do not make consecutive applications. Rotate to material with different mode of action
	27&M5	Ariston (cymoxanil + chlorothalonil)	2 pt	17.5 pt cymoxanil and 11.25 lb a.i. chlorothalonil	14	12 hr	
	28	Previcur Flex (propamocarb hydrochloride)	1.2 pt	6.0 pt	14	0.5	Use with a tank mix. See label for seed piece treatment
	30	Agri-tin (triphenyltin hydroxide)	3.75 oz	11.5	7	2	
	30	Super-Tin 80WP (triphenyltin hydroxide)	6 fl oz	18	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide
	30	Super-Tin 80WP (triphenyltin hydroxide)	3.75 oz	11.25 oz	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl. oz	28 fl oz.	14	0.5	Do not make more than 2 consecutive applications
Fusarium tuber rot	M3	(mancozeb) **Many brands available:** Dithane M45, Dithane DF Rainshield, Dithane F45 Rainshield, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 80WP, Penncozeb 75DF	SEE INDIVIDUAL LABELS		3	1	See label for seed piece treatment.
	1	Mertect 340-F (thiabendazole)	0.42 fl oz per 2,000 lb of tuber			0.5	
	M3 & 25	Nubark Macozeb AS (mancozeb & streptomycin)	1 lb/ 100 seed pieces			1	Seed treatment
	27, M3 & 1	Evolve (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/ 100 lb cut seed-pieces			1	Potato seed piece treatment

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Late blight (*Phytophthora infestans*)	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, COC DF, COC WP, COCS WDG, Champ DP Dry Prill, Champ 2 FL, Champ WG, Champion WP, Cuprofix Ultra 40 Disperss, Copper-Count-N, Cuprofix MZ Disperss, Copper sulfate crystals, Copper-Z 4/4, , Cueva, Kentan DF, Kocide 2000, Kocide DF, Kocide 3000, Nordox 75WG, Nu Cop 50WP, Nu-Cop 3L, Nu-Cop 50DF, Nu-Cop HB, Quimag Copper Sulfate Crystal	**SEE INDIVIDUAL LABELS**		Varies by product from 0 to 1 day	Varies by product from 4 hr to 2 days	
	M1 & M3	ManKocide 61.1DF (copper hydroxide + mancozeb)	5 lb	74.66 lb	3	2	
	M3	(mancozeb) **Many brands available:** Dithane M45, Dithane DF Rainshield, Dithane F45 Rainshield, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 80WP, Penncozeb 75DF	SEE INDIVIDUAL LABELS		3	1	Limit is 11.2 lb of active ingredient per a crop.
	M3	Polyram 80DF (metiram)	2 lb	14 lb	3	1	Limit is 7 appl./season
	M3 & M5	Elixir (mancozeb; chlorothalonil)	**2 lb**	**18 lb**	7	24 hr	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo ZN, Bravo Weather Stik 6L, Chloronil 720, Chlorothalonil 720SC, Echo 90DF, Echo 720, Echo ZN, Equus DF, Equus 500 ZN, Equus 720SST, Initiate 720, Initate ZN	**SEE INDIVIDUAL LABELS**		7	0.5	Read label for application directions
	4 & M1	Ridomil Gold Copper 64.8W (mefenoxam + copper hydroxide)	**SEE INDIVIDUAL LABELS**		14	2	Limit is 3 appl./crop of this product & other Ridomil products Add protectant fungicide, see label. Also for storage rots (Pythium leak Pink Rot)
	4 & M3	Ridomil Gold MZ (mancozeb + mefenoxam)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak)
	4 & M5	Ridomil Gold Bravo SC (chlorothalonil + mefenoxam)	2.5 pt	See label	14	2	Limit is 4 appl./crop. Also labeled for storage rots (Pink Rot and Leak)
	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24	7	0.5	Do not make more than 2 sequential applications
	11	Evito 480SC Aftershock (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	0.5	Limit is 6 application per crop and alternate with non-group 11 chemistry
	11	Gem 500SC (trifoxystrobin)	3.8 fl oz	23 fl. oz	7	0.5	Limit is 6 application per crop and alternate with non-group 11 chemistry
	11	Headline 2.09F (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
	11	Reason 500SC (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate with non-group 11 chemistry between applications

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	Quadris, Aframe, Azoxystar, Equation, Satoria, Willowood Azoxy (azoxystrobin)	See individual labels				Alternate with non-group 11 chemistry between applications. See label for soilborne disease applications
	11 & M3	Cabrio plus (pyraclostrobin & metiram)	2.9 lb	17.4 lb	3	1	Do not make more than two sequential applications
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	See label	14	0.5	Alternate with non-group 11 chemistry between applications
	21	Ranman (cyazofamid)	2.75 fl oz	27.5 fl oz	7	0.5	
	22 & M3	Gavel 75DF (mancozeb + zoxamide)	2.0 lb	12 lb	3	2	This product contains 66.7% mancozeb so do not exceed maximum allowed for mancozeb considering this and other mancozeb-containing products.
	22 & M5	Zing! (zoxamide + chlorothalonil)	34 fl oz/A	1.52 lb zoxamide and 8.8 lb chlorothalonil	7	12 hr	Do not make more than 2 consecutive applications before switching to another effective fungicide with a different mode of action
	27	Curzate 60DF (cymoxanil)	3.2 oz	22.4 oz	14	0.5	Limit is 7 apps/year. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides such as mancozeb or chlorothalonil. Also labeled for seed treatment
	27&M5	Ariston (cymoxanil + chlorothalonil)	2 pt	17.5 pt cymoxanil and 11.25 lb a.i. chlorothalonil	14	12 hr	
	27 & 11	Tanos (cymoxanil + famoxadone)	8 oz	48 oz	14	0.5	Do not make consecutive applications. Rotate to material with different mode of action
	27, M3 & 1	Evolve (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/100 lb cut seed-pieces			1	Potato seed piece treatment
	28	Previcur Flex (propamocarb hydrochloride)	1.2 pt	6.0 pt	14	0.5	Use with a tank mix. See label for seed piece treatment
	29	Omega 500F (fluazinam)	5.5 fl oz	3.5 pt	14	2	Rate is higher for white mold.
	30	Agri-tin (triphenyltin hydroxide)	3.75 oz	11.5	7	2	
	30	Super-Tin 80WP (triphenyltin hydroxide)	6 fl oz	18	7	2	For use with closed tractor cabs only. Super Tin should be tank-mixed with another fungicide
	40	Forum (dimethomorph)	6 oz	30 oz	4	0.5	Tank mix with another chemistry. Do not make more than two sequential applications before alternating to a non-group 40 fungicide
	40	Revus (mandipropamid)	8 fl. oz	32 fl oz	14	4 hr	Do not make more than 2 consecutive applications
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl. oz	28 fl oz	14	0.5	Do not make more than 2 consecutive applications
(suppression)	43	Presido (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Must be tank mixed

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	45 & 40	Zampro (ametoctradin + dimethomorph)	14 fl oz.	42	4	12 hr	Do not make more than 2 consecutive applications
	U15 & M5	Orondis Opti A and B (A= oxathiapiprolin + B=chlorothalonil)	1.5 fl oz oxathiapiprolin + 1.5 pt chlorothalonil	27.2 fl oz oxathiapiprolin per year and 12 pt of chlorothalonil per season			See individual labels; Follow resistance management recommendations on label
	U15 & 40	Orondis Ultra A and B (A= oxathiapirolin + B=mandipropamid)	1.64 fl oz oxathiapiprolin + 8 fl oz mandid-propamid	27.2 fl oz oxathiapiprolin per year and 32 fl oz mandi-propamid per year			See individual labels; Follow resistance management recommendations on label
Pythium, Pink Rot, and Phytophthora seed decays	4	Ridomil Gold SL Ultra Flourish (mefenoxam)	SEE INDIVIDUAL LABELS			2	At planting
	4	MetaStar 2E AG (metalaxyl)	8 pt			2	See label for banding applications; for use at planting
	4 & M1	Ridomil Gold Copper 64.8W (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	Limit is 3 appl./crop of this product & other Ridomil products Add protectant fungicide, see label. Also for storage rots (Pythium leak, Pink Rot)
	4 & M3	Ridomil Gold MZ (mancozeb + mefenoxam)	2.5 lb	See label	3	2	Also labeled for storage rots (Pink Rot and Leak)
	4 & M5	Ridomil Gold Bravo SC (chlorothalonil + mefenoxam)	2.5 pt	See label	14	2	Limit is 4 appl./crop. Also labeled for storage rots (Pink Rot and Leak)
	14	Botran 75W (DCNA cicloran)	6 lb	10 lb	20	0.5	Subsequent applications are made at 2 lb/A
	14	Terraclor F (PCNB)	10.4 fl oz / 1000 linear ft	15 pt	45	0.5	At planting or see label for white mold
	21	Ranman (cyazofamid)	2.75 fl oz	27.5 fl oz	7	0.5	Alternate with non-group 11 chemistry between applications
	27	Curzate 60DF (cymoxanil)	3.2 oz	22.4 oz	14	0.5	Limit is 7 apps/year. Use in combination with a protectant fungicide. It is best to alternate Curzate with other fungicides such as mancozeb or chlorothalonil. Also labeled for seed treatment
Rhizoctonia, Black Scurf & Stem Canker (*Rhizoctonia solani*)	M3	(mancozeb) **Many brands available:** Dithane M45, Dithane DF Rainshield, Dithane F45 Rainshield, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 80WP, Penncozeb 75DF	**SEE INDIVIDUAL LABELS**		3	1	See label for seed piece treatment.
	7	Moncut 70DF (flutolanil)	1.1 lb			0.5	In-furrow use only
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications
	7 & 3	Emesto Silver (penflufen; prothioconazole)	0.31 fl oz/100 lb seed pieces	0.93 fl oz		12 hr	See label for seed treatment details
	7 & M3	Moncoat MZ (flutolanil & mancozeb)	1.0 lb/100 lb seed			1	Seed treatment

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 & 11	Elatus (azoyxstrobin + benzovindiflupry)	5 oz/1000 linear feet		14		In-furrow use only
	11	Dynasty (azoxystrobin)	0.38 fl oz/100 lb seed			4 hr	Seed treatment
	11	Headline (pyraclostrobin)	0.8 fl oz/ 1000 linear ft			0.5	In-furrow use only
	12	Maxim, Spirato (fludioxonil)	0.8 fl oz/100 lb seed			0.5	Seed treatment
	12 + M3	Maxim MZ (fludioxonil + mancozeb)	0.5 lb/100 lb seed			1	Seed treatment
	14	Terraclor 75WP (PCNB)	6.66 lb	20 lb in one season		0.5	At planting
	14	Terraclor F (PCNB)	10.4 fl oz 1000 linear ft	15 pt	45	0.5	At planting or see label for white mold
	27, M3 & 1	Evolve (cymoxanil + mancozeb + thiophanate-methyl)	0.75 lb/100 lb cut seed-pieces			1	Potato seed piece treatment
Soft rot	25	Agri-Mycin 17 Ag Streptomycin Firewall (streptomycin)	100 ppm			0.5	Seed treatment. Check individual labels for specific rates and instructions
Soilborne pathogens	M2	(mancozeb) **Many brands available:** Dithane M45, Dithane DF Rainshield, Dithane F45 Rainshield, Mancozeb Flowable, Manzate Pro-Stick, Nubark Mancozeb, Penncozeb 4FL, Penncozeb 80WP, Penncozeb 75DF	**SEE INDIVIDUAL LABELS**		3	1	See label for seed piece treatment.
	11	Dynasty (azoxystrobin)	3.75 fl oz/100 lb seed			4 hr	For suppression of black scurf and stem canker and seed-borne black dot and for protection against silver scurf
	12	Maxim 4FS; Spirato (fludioxonil)	0.16 oz/100 lb seed			0.5	Seed treatment. Must be made using specific equipment.
	12	Maxim Potato Seed Protectant Maxim PSP (fludioxonil)	0.5 lb/100 lb seed			0.5	Seed treatment
	12 & M3	Maxim MZ (fludioxonil + mancozeb)	0.5 lb/100 lb seed			1	Seed treatment
White mold (***Sclerotinia sclerotiorum***)	1	Cercoban Topsin M WSB T-Methyl Thiophanate Methyl Incognito 4.5F (thiophanate-methyl)	**SEE INDIVIDUAL LABELS**		21	2	

Table 13.4. Potato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	2	Enclosure 4 Iprodione 4L Nevado 4F Rovral 4F (iprodione)	2 pt	8 pt	14	1	Limit is 4 appl./crop. See individual label for additional information.
	3	Quash (metconazole)	4.0 oz	7.5 oz	1	12 hr	Follow resistance management recommendations on label
(suppression)	7	Endura 70WP (boscalid)	10 oz	20 oz	10	0.5	Do not make more than 4 apps at low rate or 2 apps at high rate
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	0.5	Do not make more than 2 sequential applications
	7	Luna Privilege (fluopyram)	See label for ground or aerial application rates	See label for ground or aerial application rates	7	12 hr	Do not make more than 2 sequential applications
(suppression)	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	43.6	7	0.5	Do not make more than 2 sequential applications
(suppression)	7 & 11	Priaxor (fluxapyroxad + pyraclostrobin)	8 fl oz	24	7	0.5	Do not make more than 2 sequential applications
	11	Headline 2.09F (pyraclostrobin)	12 fl oz	72 fl oz	3	0.5	Alternate with non-group 11 chemistry between applications.
(suppression)	11 & M3	Cabrio plus (pyraclostrobin & metiram)	2.9 lb	17.4 lb	3	1	Do not make more than two sequential applications

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 13.5. Chemical desiccants for potato production.

Active Ingredient	Trade name	Product / A	PHI[1]	Relative Desc. Rate[2]
Carfentrazone	Aim	3.2 - 5.8 fl. oz.	7 days	Fast
Diquat	Reglone	1.0 - 2.0 pt.	7 days	Fast
Glufosinate	Rely 280, Reckon 280 SL	21 fl. oz.	9 days	Slow
Pelargonic acid	Scythe	7 - 10% v/v	1 day	Fast
Pyraflufen	ET Herbicide/Defoliant	2.75 - 5.5 fl.oz.	14 days	Slow

[1] PHI = Preharvest Interval is the minimum time between application and harvest. It is not necessarily the time required to achieve tuber maturity and good skin-set.

[2] Relative dessication rate for each herbicide

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Chapter 14. Root Crop Production in Florida

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I. Beet, Carrot, Radish, and Sweetpotato Botany and Planting

Beet - *Beta vulgaris,* Chenopodiaceae
Carrot - *Daucus carota,* Apiaceae (Umbelliferae)
Radish – *Raphanus sativus,* Brassicaceae (Cruciferae)
Sweetpotato – *Ipomoea batatas,* Convolvulaceae

Table 14.1. Planting information for beet, carrot, radish and sweetpotato.

	Beet	Carrot	Radish	Sweetpotato
Planting Dates				
North Florida	Aug - Feb	Aug-Mar	Sept – Mar	Mar – June
Central Florida	Sept – Feb	Aug-Mar	Sept – Mar	Feb – June
South Florida	Oct - Jan	Sept-Mar	Oct – Mar	Dec – Sept (orange flesh type) Year round (boniato/batatas type)
Planting Information				
Distance between rows (in)	12 - 30	10 - 12	6	36 – 48
Distance between plants (in)	2 - 4	1 - 3	1	10 – 12
Seeding depth (in)	0.5 - 1.0	0.25	0.25	3 – 4
Seed per acre (lb)	10 - 15	2 - 4	10 – 20	9,000 – 15,000
Days to maturity from seed	50 - 70	70 - 120	20 – 30	85 - 130
Plant population (acre)	261,360	630,000	1 million+	9,000 – 15,000

Cultivars

Table 14.2. Common cultivars of beet, carrot, and sweetpotato.

Beet	Carrot	Radish	Sweetpotato
Asgrow Wonder	Apache	Escala F1	Beauregard
Bulls Blood (tops)	Choctaw	Fuego[1]	Covington
Golden Beets (yellow)	Navajo	Red castle	Evangeline
Green Top	Top Notch	Red Satin F1	Hernandez
Pacemaker III		Red Silk[2]	Picadito (Boniato)
Red Ace		Rudi	

[1] Resistant to yellows; Tolerant to black root and rhizoctonia scurf
[2] Resistant to pithing; Intermediate resistance to black root, yellows, clubroots, rhizoctonia scurf.

II. Tropical Root Crops

Tropical root crops are planted primarily for their edible roots, corms or cormels. In this regard, tropical root crops require a longer period of time to mature than many other vegetable crops. Some root crops take as long as 14 months to reach maturity. Some people also eat the edible leaves of both cassava and taro. In the case of both these crops, plants grown for edible leaves can be grown it cooler locations than would otherwise be possible. For pest control products, these crops are included in root and tuber vegetables.

Botany and Planting

Table 14.3. Planting information for cassava, taro and malanga.

Planting dates	Cassava	Taro	Malanga
Miami-Dade County	Year-round (mainly February to April)	Year-round	Year-round
Planting information			
Distance between rows (in)	48	52	52
Distance between plants (ft)	2	1	1
Planting depth (in)	3 - 4	4 - 6	4 - 6
Propagules needed per acre	5,445	2,420-3,630	2,420-3,630
Minimum propagule size	10-12" stick or micro-propagules	2 oz	2 oz
Bedded	No	Yes	Yes
Months to harvest from planting	8-12	6-10	9-14
Plant populations (acre)	5,445	10,052	10,052

Cultivars

Cassava – known the world over by a variety of names including manioc, yuca, mandioca, balinghoy, kamoteng, kahoy (Philippines), mogo (Africa), tapioca-root (India) and manioc root in its native of South America. Though the exact origins of cassava are unknown, it was likely domesticated between 7,000 and 9,000 years ago in the Amazon. This root crop is grown throughout tropics and has become an important dietary stable in many parts of the world.

Varieties are often separated based of their cyanogenic glucoside (HCN) content into either low HCN, a.k.a. "sweet," or high HCN, a.k.a. "bitter," types. The term "bitter" comes from a bitter flavor that is commonly believed to accompany the HCN. Though no named varieties are currently known in southern Florida, 'Senorita' was locally popular in the 1980s and attempts were made to introduce the CIAT variety 'Mantiqueira' at that same time because it produced acceptable yields even with high levels of rootknot nematode infestation. The range of local genotypes covers a few unnamed clones that have been imported from various Caribbean basin countries. Federal regulations prohibit further importation of cuttings or botanical seed.

Root development may occur as early as 28 days after planting though it may take about six weeks before fibrous roots begin to thicken rapidly with starch granules. There does not appear to be any specific trigger to root thickening but the number of roots that will eventually thicken is determined early in the life of the crop with little change in the number of thickened roots after three months. A soil fertility analysis is conducted as a routine practice to ensure an adequate amount of potassium is maintained in the soil to improve root development for improved yield. The amount of nitrogen available to the crop is often limited because excessive nitrogen increases vegetative growth rather than the root development.

For people who are able to find cuttings, follow the technique developed by scientists at the International Institute for Tropical Agriculture (IITA) in Ibadan, Nigeria where one makes 2-node cuttings or ministakes that can provide a 5-fold increase in the production of propagules from each parent cassava plant. According to IITA, "[t]hese ministakes are easily moved and protected in plastic sacks until they can be grown on and hardened in individual plastic bags or nursery beds before being planted in the field."

It takes 8-12 months for cassava roots to reach maturity. Plants are often cut back two weeks prior to harvest resulting in increased tuber size and yields about 10% higher.

Preferences for specific varieties of cassava used for edible leaves may exist among consumers, though the ability to satisfy these requests is very limited given the very small number of varieties currently grown in the U.S.

Taro – 'Malanga Isleña,' produces one large white-fleshed central corm; a few unnamed Polynesian types are grown for the Asian market. The name taro is generally used to refer to *Colocasia esculenta*, one of several major root crops in the Araceae (Aroid) family.

There are several important crops throughout the tropical regions of the world related to taro and grown in certain Florida locations. These include the giant swamp taro, the giant taro, and cocoyam. Each of these Aroids has several other common names depending on the region of the world.

Information about taro in Florida is limited due to a small acreage. However taro can be cultivated under both wetland and dryland conditions with with the latter reffered to as 'dasheens' in Florida. Most will mature in 6 to 10 months with corms being dug up with modified potato harvesters in commercial production. The corms are washed of soil, sorted by size, and packed. The recommended cold room temperature for prolonged storage is 45-50 ^{o}F with a relative humidity of 85.

Tannia – is widely grown and used in the tropics and has been grown on a limited commercial sale since 1963 in south Florida where it typically planted in the spring since the crop requires 9 to 10 months to reach maturity and can be injured by frosts. Tannia can be propagated by several methods: (1) plant the top (head), (2) plant the whole main tuber, (3) plant pieces of the main tuber, or (4) plant individual secondary tubers. Propagative materials should be set 3 to 5 inches below the surface. 'South Dade White,' producies white-fleshed cormels; 'Malanga Amarilla,' produces a yellow-fleshed edible corm; and 'Vinola,' produces purple-fleshed cormels.

Tropical sweetpotato – 'Picadito' is the main variety grown in Miami-Dade County. It has deeply lobed leaves and wine colored skin.

It is illegal to import sweetpotatoes into the U.S. and there is no program to produce disease-free planting material of 'Picadito' in Florida. Other sweetpotato growing states have developed red-skinned, white-fleshed sweetpotatoes which may grow well in Florida and which may be available from those plant breeders or through certified slip producers.

Table 14.4. Herbicides approved for managing weeds in beet.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			*** **PREEMERGENCE** ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various fromulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burn down. Consult labels for individual product directions.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burn down treatment. Scythe is a contact and nonresidual herbicide and can be tank mixed residual preemergence herbicides to lengthen control.
Pyraflufen 0.001 - 0.003	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf weeds and grass weeds. Apply as a preplant burndown treatment.
			*** **POSTEMERGENCE** ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rates. May be tank mixed with other herbicides. Do not exceed 6.1 fl. oz. per cropping season. PHI 0 days.
Clethodim 0.09 - 0.13 0.07 - .25	(Select, Arrow) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat application 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Consult the label for nessary surfactant. PHI 30 days.
Pelargonic acid	(Sythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
***S*-metolachlor**	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
Sethoxydim 0.28 - 0.47	(Poast) 1.5 EC 1.5 - 2.5 pt.	1	Emerged grass weeds. A maximum of 5 pt./A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 60 days.

Table 14.5. Herbicides approved for managing weeds in carrot.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			*** **PREEMERGENCE** ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burn down. Consult label for individual product directions.
Linuron 0.5 - 1.0	(Lorox DF) 50 DF 1 - 2 lb.	7	A single application after planting and before crop emergence. Plant seed at least 0.5 in. deep. Preemergence and postemergence application should not exceed 4 lb./A per season.
Paraquat 0.5 - 1.0	(Gramoxone) 2 SL 2.0 - 4.0 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.	22	Emerged broadleaf and grass weeds. Apply as a preplant burn down treatment. Apply before crop emergence. Use a nonionic surfactant.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burn down treatment. Scythe is a contact and nonresidual herbicide and can be tank mixed with a residual preemergence herbicide to lengthen time of control
Pendimethalin 0.95	(Prowl H20) 3.8 2.0 pt.	3	Broadleaf and grass control. Apply within 2 days of planting before the emergence of the crop. PHI 60 days.

Table 14.5. Herbicides approved for managing weeds in carrot. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
Prometryn **1.0 - 2.0**	(Caparol) 4 L 2 - 4 pt.	5	Most annual broadleaf and grass weeds. Do not exceed one application. Consult label for rotiational crop restrictions.
Pyraflufen **0.001 - 0.003**	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.
Trifluralin **0.5**	(Treflan, Trifluralin) 4 EC 1 pt. (Treflan TR-10) 5 lb.	3	Annual broadleaf and grass weeds. Do not apply to muck soils. Mineral soils with 2 - 5% organic material, apply 0.75 lb. a.i./A. Incorporate 4 inches or less with 8 hr. of application. PHI 60 days.
			***** POSTEMERGENCE *****
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use crop oil concentrate or nonionic surfactant at recommended rate. May be tank mixed with other herbicides. Do not exceed 6.1 fl. oz. per cropping season. PHI 0 days.
Clethodim **0.09 - 0.13** **0.07 - 0.13**	(Select, Arrow) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Perennial and annual grass weeds. In fields with heavy grass pressure or larger grass weeds, use higher rates or repeat applications 14 days apart. Use a crop oil concentrate at 1% v/v in the finished spray volume. Nonionic surfactant with Select Max. PHI 30 days.
Fluazifop **0.188**	(Fusilade DX) 2 EC 12 fl. oz.	1	Actively growing grass weeds. Maximum is 48 fl. oz./A. per growing season. Withhold field flooding 45 to 60 days following application. In Palm Beach and Hendry counties a 60 day interval must be observed for flooding. PHI 45 days.
Linuron **0.5 - 1.0**	(Lorox DF) 50 DF 1 - 2 lb.	7	Apply after carrots are 3 inches tall. Repeat applications may be made but do not exceed 4 lb./A. Can be applied following Stoddard Sovent provided that the applications are at least one day apart. Do not tank mix with Stoddard Solvent.
Metribuzin **0.25**	(Metribuzin, Metri, Tricor) 75 DF 0.3 lb. (Metri, Tricor) 4 F 0.5 pt.	5	Broadleaf and grass control. Total amount applied in a season should not exceed 0.5 lb. a.i./A. Apply after carrots have 5 - 6 true leaves and weeds are less than 1 in. in height. If needed, a second application may be made after an interval of at least 3 wk. PHI 60 days.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contract, nonselective, foliar applied herbicidee with no residual control. May be tank mixed with several soil residual compounds.
Prometryn **1.0 - 2.0**	(Caparol) 4 L 2 - 4 pt.	5	Most annual broadleaf and grass weeds. Apply up to 6 leaf stage of carrot. One application of 4 pt./A or two application of 2 pt./A. For POST control of weeds, include NIS or COC. Consult label for rotational crop restrictions. PHI 30 days.
***S*-metolachlor**	(Dual Magnum) 7.62 EC	15	Grass and broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
Sethoxydim **0.28 - 0.38**	(Poast) 1.5 EC 1.5 - 2.0 pt.	1	Emerged grass weeds. A maximum of 5 pt./A applied in one season. Include a crop oil concentrate. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days

Table 14.6. Herbicides approved for managing weeds in radish.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			*** PREPLANT / PREEMERGENCE ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown before planting.
Pyraflufen 0.001 - 0.003	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
Trifluralin 0.5 - 0.75	(Treflan HFP, Trifluralin, Trilin) 4 EC 1.0 - 1.5 pt. (Treflan) 4 L 1.0 - 1.5 pt.	3	Annual broadleaf and grass weeds. Incorporate or irrigate 4 in. within 8 hrs. Results in Florida are erratic on soils with low organic matter and clay contents.
***S*-metolachlor**	(Dual Magnum) 7.62 EC	15	Grass, broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
			*** POSTEMERGENCE ***
Clethodim 0.09 - 0.13 0.07 - 0.13	(Select, Arrow) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Emerged annual and perennial grass weeds. For repeat application, minimum of 14 days between applications. Do not exceed 0.25 lb. a.i./ha. PHI 15 days
Sethoxydim 0.47	(Poast) 1.5 EC 2.5 pt.	1	Emerged grass weeds. Do not exceed 3.0 pt./A. per season. Include a crop oil concentrate. Head lettuce and radicchio PHI 30 days. Leaf lettuce and endive PHI 15 day.

Table 14.7. Herbicides approved for managing weeds in sweetpotato.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			*** PRETRANSPLANT ***
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Clomazone 0.49 - 0.75	(Command) 3 ME 1.3 - 2.0 pt.	13	Annual broadleaf and grass weeds. Use lower rates on coarse soils. Apply within 5 days of transplanting.
DCPA 4.5 - 6.0	(Dacthal) W-75 6 - 8 lb. (Dacthal) 6 F 6 - 8 pt.	3	Annual broadleaf and grass weeds. Apply immediately after transplanting. May be applied as a layby later in the season for preemergence control.
Flumioxazin 0.096	(Valor) 51 WDG 3 oz.	14	Annual broadleaf weeds. Do not use transplants that were harvested 2 days before application. Severe injury occurs if applied after transplanting. Apply 2-5 days before transplant and minimize soil disturbance after application.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Consult label for individual product directions.
Napropamide 1.0 - 2.0	(Devrinol DF XT) 50 DF 2.0 - 4.0 lb.	15	Annual broadleaf and grass weeds. Apply immediately after transplanting. If rainfall does not occur within 24 hr. after application then incorporate or irrigate 2-4 in. deep.

Table 14.7. Herbicides approved for managing weeds in sweetpotato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pyraflufen **0.001 - 0.003**	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment.
		***	**POSTTRANSPLANT** ***
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply as hooded application to row middles only. Use of COC or NIS at recommended rates. Contact with the leaves will cause injury. PHI 0 days.
Clethodim **0.09 - 0.25** **0.07 - 0.25**	(Arrow, Select) 2 EC 6 - 16 fl. oz. (Select Max) 1 EC 9 - 32 fl. oz.	1	Perennial and annual grass weeds. Use higher rates under heavy grass pressure or larger grass weeds. Do not apply more than 0.5 lb. a.i./A. Consult the label for required adjuvant. PHI 30 days.
Fluazifop **0.1 - 0.25**	(Fusilade DX) 2 EC 6 - 16 fl. oz.	1	Perennial and annual grass weeds. Include a NIS or COC in the spray solution. PHI 55 days.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a hooded application to row middles only. Contact with the leaves will cause injury.
***S*-metolachlor**	(Dual Magnum) 7.62 EC	15	Grass, broadleaf weeds and nutsedge. Label is a Third-Party Registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product.
Sethoxydim **0.19 - 0.47**	(Poast) 1.5 EC 1.0 - 2.5 pt.	1	Controls growing grass weeds. A total of 5.0 pt./A applied in one season. Include a COC. Unsatisfactory results may occur if applied to grasses under stress. PHI 30 days.

Table 14.8. Insecticides registered for use on insects attacking carrots and garden beets.

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
Aphids	1B	**Malathion 5EC** (malathion)	1.5-2.0 pt	beets: 12; carrots:24	7	Maximum number of applications is 3 for beets and 2 for carrots.
	1B	**Malathion 8F** (malathion)	1.25 pt	12	7	**Beets only.** Maximum number of applications is 3.
	3A	***Brigade 2EC** (bifenthrin)	5.12-6.4 fl oz	12	21 – carrots, 1 – beets	Do not apply more than 0.5 lb ai/acre per season for carrots or 0.4 lb ai/acre per season for beets. Apply no more than once every seven days
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
	3A	**Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide)	1-12 fl oz	12	0	
	4A	**Actara** (thiamethoxam)	1.5-4.0 oz	12	7	Do not exceed 8 oz product/acre/season.
	4A	**Admire Pro** (imidacloprid)	4.4-10.5 fl oz-soil; 1.2 fl oz-foliar	12	21-soil; 5-foliar	Limited to one soil application. If applied as a foliar spray, use no more than 3.7 fl oz per acre per season. Leaves may be used for food.
	4A	**Platinum, 75SG** (thiamethoxam)	5.0-12.0 fl oz; **75SG:** 1.7-4.0 oz	12	at planting	Do not exceed 12 oz Platinum or 4.0 oz Platinum 75SG per acre per season.
	4C	**Transform WG** (sulfoxaflor)	0.75-2.75 oz	24	7	Do not make more than 2 consecutive applications or apply more than 8.5 oz per acre per year.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Maximum allowed per year: 28 fl oz. Minimum interval between applications: 10 days. Foliar application only.

Table 14.8. Insecticides registered for use on insects attacking carrots and garden beets. (continued)

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	3	Do not apply more than 3 times at high rate.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**BotaniGard 22 WP, ES** (Beauveria bassiana)	**WP:** 0.5-2 lb/100 gal; **ES:** 0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Greens and roots**. OMRI-listed
	--	**M-Pede** (potassium salts of fatty acids)	1-2% V/V	12	0	OMRI-listed.
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Acts as IGR and feeding repellent. OMRI-listed.
	--	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Beetles (includes blister beetles, cucumber beetles, flea beetles)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	7	Highly toxic to bees. Repeat applications, as needed up to 6 times, at least 7 days apart.
	1B	**Malathion 8F** (malathion)	1.25 pt	12	7	**Beets only.** Maximum number of applications is 3.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Brigade 2EC** (bifenthrin)	5.12-6.4 fl oz	12	21 – carrots, 1 – beets	Do not apply more than 0.5 lb ai/acre per season for carrots or 0.4 lb ai/acre per season for beets. Apply no more than once every seven days
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
	3A	**Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide)	1-12 fl oz	12	0	
	4A	**Actara** (thiamethoxam)	1.5-4.0 oz	12	7	Do not exceed 8 oz product/acre/season.
	4A	**Admire Pro** (imidacloprid)	4.4-10.5 fl oz-soil; 1.2 fl oz-foliar	12	21-soil; 5-foliar	Limited to one soil application. If applied as a foliar spray, use no more than 3.7 fl oz per acre per season. Leaves may be used for food.
	4A	**Platinum, 75SG** (thiamethoxam)	5.0-12.0 fl oz; **75SG:** 1.7-4.0 oz	12	at planting	Do not exceed 12 oz Platinum or 4.0 oz Platinum 75SG per acre per season.
	5	**Entrust SC** (spinosad)	roots: 3-6 fl oz, beet greens: 1.5-10 fl oz	4	3	Do not apply more than a total of 21 fl oz/acre per crop (29 for beet greens) or apply more than 4 times. OMRI-listed.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
Caterpillars (includes beet armyworm, celery leaf-tier, corn earworm, cutworms, fall armyworm, loopers)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	7	Highly toxic to bees. Repeat applications, as needed up to 6 times, at least 7 days apart.
	1B	***Diazinon AG500, *50W** (diazinon)	**AG500:** 1-4 qt; **50W:**2-8 lb	72	preplant	Do not make more than one application per year.
	1B	**Malathion 8F** (malathion)	1.25 pt	12	7	**Beets only.** Maximum number of applications is 3.
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Brigade 2EC** (bifenthrin)	5.12-6.4 fl oz	12	21 – carrots, 1 – beets	Do not apply more than 0.5 lb ai/acre per season for carrots or 0.4 lb ai/acre per season for beets. Apply no more than once every seven days

Table 14.8. Insecticides registered for use on insects attacking carrots and garden beets. (continued)

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
	3A	**Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide)	1-12 fl oz	12	0	
	5	**Entrust SC** (spinosad)	roots: 3-6 fl oz, beet greens: 1.5-10 fl oz	4	3	Do not apply more than a total of 21 fl oz/acre per crop (29 for beet greens) or apply more than 4 times. OMRI-listed.
	5	**Radiant SC** (spinetoram)	leaves, 5-10 oz; roots, 6-8 fl oz	4	3	Maximum of 4 applications per year. If roots will be harvested, lower rate must be used.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Apply when larvae are small for best control. Leaves and roots. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young.
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used for organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	18	**Intrepid 2F** (methoxyfenozide)	4-16 for leaves, 8-16 fl oz for roots	4	leaves: 1; roots: 14	Do not apply more than 64 fl oz per acre per season.
	22	**Avaunt** (indoxacarb)	3.5-6.0 oz	12	7	Do not use adjuvants. Do not apply more than 24 oz per acre per crop. **Beets only.**
	28	**Coragen** (chlorantraniliprole)	3.5-5.0 fl oz	4	1	Do not apply more than 15.4 fl oz product per acre per year. Make no more than 4 applications.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Greens and roots**. OMRI-listed
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Acts as IGR and feeding repellent. OMRI-listed.
Fire ants	3A	***Brigade 2EC** (bifenthrin)	5.12-6.4 fl oz	12	21 – carrots, 1 – beets	Do not apply more than 0.5 lb ai/acre per season for carrots or 0.4 lb ai/acre per season for beets. Apply no more than once every seven days
	3A	**Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide)	1-12 fl oz	12	0	
	7A	**Extinguish Fire Ant Bait** ((S)-methoprene)	1.0-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks.
Grasshoppers	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
Leafhoppers	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	7	Highly toxic to bees. Repeat applications, as needed up to 6 times, at least 7 days apart.

Table 14.8. Insecticides registered for use on insects attacking carrots and garden beets. (continued)

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	1B	**Malathion 5EC** (malathion)	1.5-2.0 pt	beets: 12; carrots:24	7	Maximum number of applications is 3 for beets and 2 for carrots.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	7	Do not apply more than 0.5 lb ai/acre per season. **Carrots only.**
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
	3A	**Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide)	1-12 fl oz	12	0	
	4A	**Actara** (thiamethoxam)	1.5-4.0 oz	12	7	Do not exceed 8 oz product/acre/season.
	4A	**Admire Pro** (imidacloprid)	4.4-10.5 fl oz-soil; 1.2 fl oz-foliar	12	21-soil; 5-foliar	Limited to one soil application. If applied as a foliar spray, use no more than 3.7 fl oz per acre per season. Leaves may be used for food.
	4A	**Platinum, 75SG** (thiamethoxam)	5.0-12.0 fl oz; **75SG:** 1.7-4.0 oz	12	at planting	Do not exceed 12 oz Platinum or 4.0 oz Platinum 75SG per acre per season.
	4C	**Transform WG** (sulfoxaflor)	0.75-2.75 oz	24	7	Do not make more than 2 consecutive applications or apply more than 8.5 oz per acre per year.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Maximum allowed per year: 28 fl oz. Minimum interval between applications: 10 days. Foliar application only.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	**Greens and roots**. OMRI-listed
Leafminers	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
	5	**Entrust SC** (spinosad)	roots: 3-6 fl oz, beet greens: 1.5-10 fl oz	4	3	Do not apply more than a total of 21 fl oz/acre per crop (29 for beet greens) or apply more than 4 times. OMRI-listed.
	5	**Radiant SC** (spinetoram)	leaves, 5-10 oz; roots, 6-8 fl oz	4	3	Maximum of 4 applications per year. If roots will be harvested, lower rate must be used.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	--	**M-Pede** (potassium salts of fatty acids)	1-2% V/V	12	0	OMRI-listed.
	--	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Acts as IGR and feeding repellent. OMRI-listed.
Mole crickets and wireworms	1B	***Diazinon AG500, *50W** (diazinon)	**AG500:** 1-4 qt; **50W:**2-8 lb	72	preplant	Do not make more than one application per year.
Plant bugs	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	3	Do not apply more than 3 times at high rate.
Stink bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	7	Highly toxic to bees. Repeat applications, as needed up to 6 times, at least 7 days apart.
	3A	**Pyganic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Tarnished plant bug	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 lb; **XLR, 4F:** 0.5-2 qt	12	7	Highly toxic to bees. Repeat applications, as needed up to 6 times, at least 7 days apart.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
Weevils	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	7	Do not apply more than 0.5 lb ai/acre per season. **Carrots only.**

Table 14.8. Insecticides registered for use on insects attacking carrots and garden beets. (continued)

Pest	MOA Code[1]	Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Notes
	3A	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	12	0	Do not exceed 14 fl oz/acre per season. **Carrots only.**
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	--	**Aza-Direct** (azadirachtin)	1-2 pts, (max 3.5 pts)	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	--	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. -- = --known, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the --iversity of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 14.9. Insecticides approved for use on insects attacking radishes.

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes
Actara (thiamethoxam)	1.5-4.0 oz	12	7	aphids, flea beetles, leafhoppers, whiteflies	4A	Do not exceed 4 oz per acre per season. Use higher rate for whiteflies.
Admire Pro (imidacloprid)	soil: 4.4-10.5 fl oz; foliar: 1.2 fl oz	12	soil: 21: foliar: 7	aphids, flea beetles, leafhoppers, thrips (foliage feeding), whiteflies	4A	Limited to one soil application or one foliar application.
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11A	Apply when larvae are small for best control. OMRI-listed[2].
***Asana XL (0.66 EC)** (esfenvalerate)	5.8-9.6 fl oz	12	7	armyworms, beetles	3A	Do not apply more than 0.1 lb active ingredient (19.2 oz of product) per acre per season.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 , if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, mites, stink bugs, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
Azatin XL (azadirachtin)	5-21 fl oz	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator.
***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	12	0	cutworms, flea beetles, potato leafhopper	3A	Do not consume tops. Maximum amount per acre per crop = 14.0 fl oz.
Beleaf 50 SG (flonicamid)	2.0-2.8 oz	12	3	aphids, plant bugs	9C	Do not apply more than 3 times at high rate.
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11A	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. Can be used in organic production.
BotaniGard ES (*Beauveria bassiana*)	0.5-2 qt 100/gal	4	0	aphids, thrips, whiteflies	--	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
***Brigade 2EC** (bifenthrin)	5.12-6.4 fl oz	12	21	aphids, beet armyworm, corn earworm, cutworms fall armyworm, fire ants, flea beetles, loopers, southern armyworm, spider mites, whiteflies	3A	Do not apply more than 0.5 lb ai/acre per season.
Coragen (chlorantraniliprole)	3.5-5.0 fl oz	4	1	beet armyworm	28	Do not make more than 4 applications per acre per crop or a maximum of 15.4 fl oz per acre per year.
Crymax WDG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11A	Use high rate for armyworms. Treat when larvae are young. Not for organic production.

Table 14.9. Insecticides approved for use on insects attacking radishes. (continued)

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11A	Use higher rates for armyworms. OMRI-listed[2].
***Diazinon AG-500,** ***50 W** (diazinon)	**preplant -** **AG500:** 1-4 qt **50W:** 2-8 lb	72	preplant	cutworms, mole crickets, wireworms	1B	No more than one application per year.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11A	Treat when larvae are young. Good coverage is essential. Can be used in organic production.
Entrust SC (spinosad)	3-6 fl oz	4	3	armyworms, dipteran leafminers, flea beetle, loopers, thrips	5	3 applications per year. No more than 18 fl oz per acre per crop. OMRI-listed[2].
Extinguish ((S)-methoprene)	1-1.5 lb	4	0	fire ants	7A	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grandevo (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	aphids, armyworms, cabbage looper potato leafhopper, psyllids, whiteflies	–	OMRI-listed[2]
Intrepid 2F (methoxyfenozide)	4-16 fl oz for leaves, 8-16 for roots	4	leaves: 1, roots: 14	armyworms, cabbageworm, loopers, saltmarsh caterpillar, webworms	18	Do not apply more than 64 fl oz per acre/season.
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11A	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
***Lannate SP** (methomyl) ***LV**	0.5 lb 1.5 pt	48	3	beet armyworm	1A	SLN [24(c)] label for Florida.
Lorsban 15G, ***Advanced** (chlorpyrifos)	**15G:** 3.3 oz per 1000 ft of row **Advanced:** 5.5 pt	24	7 30	At planting: root maggot preplant application of Lorsban Advanced: billbugs, cutworms, grubs, symphylans, wireworms	1B	One application per season. See Advanced label for more application methods.
Malathion 5 EC (malathion)	1.5 pts	12	7	aphids	1B	Maximum applications = 3.
M-Pede 49% EC Soap, insecticidal	1-2% V/V	12	0	aphids, leafhoppers, mites, thrips, whiteflies	--	OMRI-listed[2].
***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	cabbage looper, cucumber beetles, cutworms, flea beetles, grasshoppers, leafhoppers, tarnished plant bug, vegetable weevil, whitefringed beetle (adult), yellowstriped armyworm; aids in control of aphids and beet armyworm	3A	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, beetles, caterpillars, leafhoppers, leafminers, whiteflies	un	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
Platinum 75SG (thiamethoxam)	1.7-2.17 oz	12	at planting	aphids, flea beetles, leafhoppers, whiteflies	4A	Do not exceed 2.17 oz per acre per crop.
Pyganic Crop Protection EC 5.0 (pyrethrins)	4.5-18 fl oz	12	0	aphids, beetles, caterpillars, crickets, grasshoppers, leafhoppers, leafminers, mites, stink bugs, thrips, whiteflies	3A	Pyrethrins degrade rapidly in sunlight, but still may be harmful to bees. OMRI-listed[3]
Radiant SC (spinetoram)	leaves, 5-10 oz; roots, 6-8 fl oz	4	3	armyworms, dipterous leafminers, loopers, thrips	5	Maximum of 3 applications per year. If harvesting roots, lower rate and less product per season must be used.
Sevin 80S; XLR; 4F (carbaryl)	**80S:** 0.63-2.5 lb **XLR, 4F:** 0.5 -2.0 qt	12	7	armyworms, aster leafhopper, corn earworm, fall armyworm, flea beetle, leafhoppers, stink bugs, tarnished plant bug	1A	Do not apply more than a total of 7.5 lb or 6 qt per acre per crop.

Table 14.9. Insecticides approved for use on insects attacking radishes. (continued)

Trade Name Active Ingredient	Rate Product/acre	REI hours	Days to Harvest	Insects	MOA Code[1]	Notes
Sivanto 200 SL (flupyradifurone)	**7-14 fl oz**	4	7	aphids, leafhoppers, whiteflies	4D	Maximum amount per year=28 fl oz per acre.
Sun Spray 98.8%, others Oil, insecticidal	1-2 gal/100 gal	4	0	aphids, leafhoppers, leafminers, mites, thrips, whiteflies	--	
Transform WG (sulfoxaflor)	0.75-2.75 oz	24	7	aphids, leafhoppers, silverleaf or sweetpotato whitefly	4C	Do not make more than 2 consecutive or 4 total applications per crop (or 8.5 oz per acre per year).
Trilogy (extract of neem oil)	1.0-2.0% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	un	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	caterpillars	11A	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 14.10. Insecticides approved for managing insect pests of sweet potato.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
Aphids	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A, 28	***Besiege** (lambda-cyhalothrin and chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season. Supplemental label.
	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use after Platinum.
	4A	**Admire Pro** (imidacloprid)	**soil:** 4.4-10.5 fl oz **foliar:** 1.2 fl oz	12	**soil:** 125 **foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Whiteflies not on label for sweet potatoes but are for other crops on label. No more than 4 applications per season.
	4A	**Belay Insecticide** (clothianidin)	in-furrow or side dress: 9-12 fl oz, foliar: 2-3 fl oz	12	foliar: 14	In-furrow or side-dress application, including chemigation up to 50% ground cover. Do not apply more than 12 fl oz per acre per year.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	Applied at planting	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. Highly toxic to bees. Do not allow to drift to blooming weeds or crops.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum allowed per acre per year=28 fl oz.
	9B	**Fulfill** (pymetrozine)	2.75-5.5 oz	12	14	Allow a minimum of 7 days between applications. Do not exceed 11 oz/acre per season.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	7	Do not apply more than 8.4 oz per acre per season.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.

Table 14.10. Insecticides approved for managing insect pests of sweet potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	28	**Verimark** (cyantraniliprole)	6.75-13.5 fl oz	4	at planting	pH of application solution should be between 4 and 6.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
	–	**M-Pede 49% EC** (soap, insecticidal)	1-2 % V/V	12	0	OMRI-listed[2].
Beetles (including Cucumber beetle, Japanese beetle, Tortoise beetle, flea beetle, whitefringed beetle)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 1.25-2.5 lb **XLR, 4F:** 1-2 qt	12	7	Do not apply more than 10 lb (80S) per acre per crop or 8 qt (4F, XLR). See label for preplant dip treatment.
	1B	**Imidan 70 W** (phosmet)	1.3 lb	4 days for seedbed treatment, 5 days for foliar	7	No more than 5 applications per season. Do not apply through irrigation system. Crop must be mechanically harvested.
	1B	**Lorsban 15G, 75WG, *Advanced** (chlorpyrifos)	See labels for rates	24	preplant broadcast treatment, 125 days before harvest	See label. Must be incorporated into soil. Only one application per season.
	1B	***Mocap 15 G, *EC** (ethoprop)	See labels	48	preplant, see labels	Two to three weeks before planting.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season.
	3A	***Brigade 2 EC** (bifenthrin)	9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil); 2.1-6.4 oz (foliar)	12	21	No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season.
	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use after Platinum.
	3A, 28	***Besiege** (lambda-cyhalothrin and chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season. Supplemental label.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Admire Pro** (imidacloprid)	**soil:** 4.4-10.5 fl oz **foliar:** 1.2 fl oz	12	**soil:** 125 **foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season. Flea beetles only
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Whiteflies not on label for sweet potatoes but are for other crops on label. No more than 4 applications per season.

Table 14.10. Insecticides approved for managing insect pests of sweet potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	4A	**Belay Insecticide** (clothianidin)	in-furrow or side dress: 9-12 fl oz, foliar: 2-3 fl oz	12	foliar: 14	In-furrow or side-dress application, including chemigation up to 50% ground cover. Do not apply more than 12 fl oz per acre per year. Flea beetles only
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	Applied at planting	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. Highly toxic to bees. Do not allow to drift to blooming weeds or crops. Flea beetles only
	4A	**Scorpion 35 SL** (dinotefuran)	2.0-2.75 fl oz: foliar, 11.5-13.25 fl oz: soil	12	foliar: 7, soil: apply preplant, preemergence, or at ground crack	Do not apply more than 8 fl oz per acre per season as foliar sprays, or more than 13.25 fl oz as a soil application. Highly toxic to bees for 38 hours after application. Do not apply to crops in bloom or allow to drift to weeds or other crops in bloom. Flea beetles only
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4 oz	12	14	Do not exceed a total of 8 oz of product per acre per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
Caterpillars (including armyworm, looper, corn earworm, hornworm, webworms, saltmarsh caterpillar)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 1.25-2.5 lb **XLR, 4F:** 1-2 qt	12	7	Do not apply more than 10 lb (80S) per acre per crop or 8 qt (4F, XLR). See label for preplant dip treatment.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season.
	3A	***Brigade 2 EC** (bifenthrin)	9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil); 2.1-6.4 oz (foliar)	12	21	No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season.
	3A, 28	***Besiege** (lambda-cyhalothrin and chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season. Supplemental label.
	5	**Entrust SC** (spinosad)	4.5-10 fl oz	4	7	Do not make applications less than 7 days apart or apply more than 4 times per crop. Do not apply more than 21 fl oz/acre per crop. OMRI-listed[2]
	5	**Radiant SC** (spinetoram)	6-8 fl oz	4	7	Do not make more than 4 applications per year.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in organic production.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Catepillars only. Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Limited to two applications for whiteflies (12-oz rate).
	18	**Intrepid 2F** (methoxyfenozide)	6-10 fl oz	4	7	Do not apply more than 64 fl oz of product per acre per year or apply more often than every 14 days.
	22	**Avaunt** (indoxacarb)	2.5-6.0 oz	12	7	Do not apply more than 24 oz/acre per crop.
	28	**Coragen** (chlorantraniliprole)	3.5-5.0 fl oz	4	1	Foliar only. No more than 4 applications per crop. Do not make more than 2 successive applications in a 30-day period. Do not apply more than 15.4 fl oz per acre per crop.

Table 14.10. Insecticides approved for managing insect pests of sweet potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	28	**Verimark** (cyantraniliprole)	6.75-13.5 fl oz	4	at planting	pH of application solution should be between 4 and 6.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
Fire ants	1B	***Mocap 15 G, *EC** (ethoprop)	See labels	48	preplant, see labels	Two to three weeks before planting.
	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks.
	7D	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb	12	1	Do not exceed a total of 0.109 lb pyriproxyfen per acre (all formulations, i.e., Knack IGR). Ant Bait contains 0.5% ai, or 0.10 lb at 2-lb rate.
Leafhoppers	1B	**Malathion 5 EC** (malathion)	**5EC:** 1.5-2.5 pt **8F:** 1-1.5 pt	12	**5EC:** 0 **8F:** 3	Maximum of two applications per year.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season.
	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A, 28	***Besiege** (lambda-cyhalothrin and chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season. Supplemental label.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Admire Pro** (imidacloprid)	**soil:** 4.4-10.5 fl oz **foliar:** 1.2 fl oz	12	**soil:** 125 **foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Whiteflies not on label for sweet potatoes but are for other crops on label. No more than 4 applications per season.
	4A	**Platinum 75SG** (thiamethoxam)	1.66-2.67 oz	12	Applied at planting	To manage resistance, avoid using other Group 4A insecticides in conjunction with Platinum. Highly toxic to bees. Do not allow to drift to blooming weeds or crops.
	4A	**Scorpion 35 SL** (dinotefuran)	2.0-2.75 fl oz: foliar, 11.5-13.25 fl oz: soil	12	foliar: 7, soil: apply preplant, preemergence, or at ground crack	Do not apply more than 8 fl oz per acre per season as foliar sprays, or more than 13.25 fl oz as a soil application. Highly toxic to bees for 38 hours after application. Do not apply to crops in bloom or allow to drift to weeds or other crops in bloom.
	4A, 28	**Voliam Flexi** (thiamethoxam and chlorantraniliprole)	4 oz	12	14	Do not exceed a total of 8 oz of product per acre per season.
	4C	**Transform WG** (sulfoxaflor)	0.75-2.25 oz	24	7	Do not make more than 2 consecutive or 4 total applications per year.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum allowed per acre per year=28 fl oz.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].

Table 14.10. Insecticides approved for managing insect pests of sweet potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
***Liriomyza* Leafminers**	1B	**Malathion 5 EC** (malathion)	**5EC:** 1.5-2.5 pt **8F:** 1-1.5 pt	12	**5EC:** 0 **8F:** 3	Maximum of two applications per year.
	4A	**Actara** (thiamethoxam)	1.5-3.0 oz	12	14	Toxic to bees. Do not use after Platinum.
	5	**Entrust SC** (spinosad)	4.5-10 fl oz	4	7	Do not make applications less than 7 days apart or apply more than 4 times per crop. Do not apply more than 21 fl oz/acre per crop. OMRI-listed[2].
	5	**Radiant SC** (spinetoram)	6-8 fl oz	4	7	Do not make more than 4 applications per year.
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	14	Must be used with a non-ionic activator type wetting, spreading and/or penetrating adjuvant., not a binder sticker type adjuvant.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Limited to two applications for whiteflies (12-oz rate).
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
	--	**Oil, insecticidal**	1-2 gal/100 gal	12	Up to day of harvest	
Mites	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	12	14	Must be used with a non-ionic activator type wetting, spreading and/or penetrating adjuvant., not a binder sticker type adjuvant.
	23	**Oberon 2SC** (spiromesifen)	8-16 fl oz	12	7	Maximum amount per crop: 32 oz/acre. No more than 2 applications.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**Oil, insecticidal**	1-2 gal/100 gal	12	Up to day of harvest	
Stinkbugs, plant bugs	3A	***Mustang** (zeta-cypermethrin)	1.4-4.3 oz	12	1	A maximum of 0.3 lb ai/acre per season may be applied. Leaves cannot be used for food or feed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season.
	3A, 28	***Besiege** (lambda-cyhalothrin and chlorantraniliprole)	5-9 oz	24	14	Do not apply more than 27.0 fl. oz of product per acre per season. Supplemental label.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	9C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	12	7	Do not apply more than 8.4 oz per acre per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
Thrips (check label for species controlled)	5	**Entrust SC** (spinosad)	4.5-10 fl oz	4	7	Do not make applications less than 7 days apart or apply more than 4 times per crop. Do not apply more than 21 fl oz/acre per crop. OMRI-listed[2]
	5	**Radiant SC** (spinetoram)	6-8 fl oz	4	7	Do not make more than 4 applications per year.

Table 14.10. Insecticides approved for managing insect pests of sweet potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insects	MOA Code[1]	Trade Name Active Ingredient *Restricted	Rate Product/acre	REI hours	Days to Harvest	Notes[2]
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
Sweetpotato weevil	1B	**Imidan 70 W** (phosmet)	1.3 lb	4 days for seedbed treatment, 5 days for foliar	7	No more than 5 applications per season. Do not apply through irrigation system. Crop must be mechanically harvested.
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	No more than 16.8 fl oz/acre per season. Adults only
	4A	**Belay Insecticide (clothianidin)**	9-12 fl oz			In furrow or side dressing
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
Whitefly	1B	**Malathion 5 EC** (malathion)	**5EC:** 1.5-2.5 pt **8F:** 1-1.5 pt	12	**5EC:** 0 **8F:** 3	Maximum of two applications per year. Tank mix with pyrethroid for best control
	~~3A~~	***Brigade 2 EC** (bifenthrin)	~~9.6-19.2 oz at-plant (soil); 3.2-9.6 oz at lay-by (soil)~~; 2.1-6.4 oz (foliar)	12	21	Foliar only. No more than 2 foliar applications, at least 21 days apart. Do not apply more than 0.5 lb active ingredient per acre per season, including soil applications.Tanksmix with Malathion for best control.
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	24	7	Do not apply more than 7.68 fl oz of product per acre per season. Tanksmix with Malathion for best control.
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin, thiamethoxam)	3.5-4.5 fl oz	24	14	Do not exceed a total of 10 fl oz of product per acre per growing season. Do not use with other Group 4A insecticides.
	4A	**Admire Pro** (imidacloprid)	**soil:** 4.4-10.5 fl oz **foliar:** 1.2 fl oz	12	**soil:** 125 **foliar:** 7	One application to soil per season. If using as a foliar spray, no more than 3.7 fl oz per acre per season.
	4A	**Assail 30SG** (acetamiprid)	1.5-4.0 oz	12	7	Whiteflies not on label for sweet potatoes but are for other crops on label. No more than 4 applications per season.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	4	7	Minimum interval between applications=7 days. Maximum allowed per acre per year=28 fl oz.
	15	**Rimon 0.83 EC** (novaluron)	6-12 fl oz	12	14	Do not apply more than 24 oz per acre per season. Limited to two applications for whiteflies (12-oz rate).
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	24	7	Maximum of 10 fl oz/acre per season.
	23	**Oberon 2SC** (spiromesifen)	8-16 fl oz	12	7	Maximum amount per crop: 32 oz/acre. No more than 2 applications.
	un	**Aza-Direct** (azadirachtin)	1-2 pt, up to 3.5 pt, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed[2].
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	Does not kill adult insects. IGR and feeding repellant. OMRI-listed[2].
	un	**Trilogy** (extract of neem oil)	0.5-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed[2].

Table 14.10. Insecticides approved for managing insect pests of sweet potato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical. Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.						
Insects	**MOA Code[1]**	**Trade Name Active Ingredient *Restricted**	**Rate Product/acre**	**REI hours**	**Days to Harvest**	**Notes[2]**
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed[2].
	--	**Oil, insecticidal**	1-2 gal/100 gal	12	Up to day of harvest	

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 14.11. Beet fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
Pertinent Diseases or Pathogens	**Fungicide Group[1]**	**Chemical (active ingredients)**	**Max. Rate/Acre**		**Min. Days to**		**Remarks[2]**
			Applic.	**Season**	**Harvest**	**Reentry**	
Alternaria **Powdery mildew**	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	19	OSO (polyoxin D zinc salts)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	7	Fontelis SC (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	7 & 11	Merivon SC (fluxapyroxad & pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
Cercospora	M1	(copper compounds) **Many brands available:** Badge SC, Badge X2, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, COC DF, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABLES**		1	Varies by product from 4 hr to 2 days	
	M2	(sulfur) **Many brands available:** Crusade DF, Kumulus DF, Micro Sulf, Microthiol Disperss, Sulfur 90W, Top Cop w/ Sulfur, Wettable Sulfur	**SEE INDIVIDUAL LABLES**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	Bumper 41.8EC (propiconazole)	4.0 fl oz	16.0 fl oz	7	0.5	Do not apply more than 4 appl/season.

Table 14.11. Beet fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	3	(tebuconazole) **Many brands available:** Folicur 3.6F, Monsoon 3.6F, Onset 3.6L, Orius 3,6F, Tebusha 3.6L, Toledo 3.6F, Tebuzol 3.6F, Tebustar 3.6L (tebuconazole)	7.2 fl oz	28.8 fl oz	7	0.5	Do not apply more than 4 appl/season.
	3	Tilt 3.6E (propiconazole)	4.0 fl oz	16.0 fl oz	7	0.5	Do not apply more than 4 appl/season.
	7	Fontelis SC (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	7 & 11	Merivon SC (fluxapyroxad & pyraclostrobin)	5.5 fl oz	16.5 fl oz	7	0.5	Apply no more than 2 sequential applications without alternating to dissimilar chemistry.
	11	Cabrio EG (pyraclostrobin)	16 oz	48 oz	0	0.5	Limit is 3 appl./crop & alternate chemistry.
	11	Flint (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Quadris (azoxystrobin)	15.4 fl oz	3.75 qt	0	4 hr	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	2	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Damping-off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lbs of seed			1	Seed treatment only.
	M3	Signet	5.0 oz/100 lb of seed			1	Seed treatment only.
Downy mildew	33	(mono- and di-potassium salts of phosphorous acids) **Many brands available:** Confine Xtra, Fosphite, Fungi-phite, K-phite, Oxiphos, Rampart	3 qt		0	4 hr	See label for details.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	7	0.5	Do not exceed more than 2 sequential applications.
Pythium seedling blight	4	(metalaxyl) Various brands available: Acquire, Alliegiance FL, Dyna-shield, Metalaxyl 318 FS	0.75 fl oz/ 100 lb seed			0.5	Seed treatment only.
	4	Apron XL LS (mefenoxam)	0.64 fl oz/ 100 lb seed			2	Seed treatment only.
	4	Metastar 2E AG (metalaxyl)	8 pt			1	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	Sebring 2.65 ST (metalaxyl)	0.7 fl oz/ 100 lb seed			1	Seed treatment only.
Pythium seedling diseases	4	Ridomil Gold EC (mefenoxam)	2 pt			2	Apply at seeding in a 7-12" band on soil over seed furrow.
	4	Ridomil Gold GR (mefenoxam)	40 lb			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.

Table 14.11. Beet fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
Pertinent Diseases or Pathogens	**Fungicide Group[1]**	**Chemical (active ingredients)**	**Max. Rate/Acre**		**Min. Days to**		**Remarks[2]**
			Applic.	**Season**	**Harvest**	**Reentry**	
	4	Ultra Flourish (mefenoxam)	4 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.
	4 & 11	Uniform SC (mefenoxam + azoxystrobin)	0.34 fl oz/ 1000' of row	1 appl.		0	Soil incorporated.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 14.12. Carrot fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical. Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.							
Pertinent Diseases or Pathogens	**Fungicide Group[1]**	**Chemical (active ingredients)**	**Max. Rate/Acre**		**Min. Days to**		**Remarks[2]**
			Applic.	**Season**	**Harvest**	**Reentry**	
Alternaria blight	M1	(copper compounds) **Many labels available:** Badge SC, Badge X2, Basic Copper 53, COCS WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, COC DF, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat,Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Stretch, Tenn-Cop 5E, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABLES**		1	Varies by product from 4 hr to 2 day	
	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN (chlorothalonil)	**SEE INDIVIDUAL LABLES**		7	0.5	
	M5/33	Catamaran (Chlorothalonil/phosphite)	4 pt	50 pt	0	0.5	
	2	(iprodione) **Many labels available:** Iprodione 4L AG, Enclosure 4F, Meteor, Nevado 4F, Rovral 4F	2 pt	8 pt	0	1	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Fitness, Propicure, Propimax, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt 3.6E, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.
	4 & M5	Ridomil Gold Bravo WP (mefenoxam + chlorothalonil)	2 lb		7	2	

Table 14.12. Carrot fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt		7	2	
	7	Endura (boscalid)	4.5 oz	22.5 oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7	Fontelis (pentiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of Amistar or other QoI fungicides. See label for soil appl.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	Do not exceed 2 sequential and 6 total appl. of Quadris Opti. or rotate with non QoI fungicides.
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
Botrytis rot **Sclerotinia white mold**	1	Mertect 340F (thiabendazole)	41 fl oz/ 100 gal water			0.5	
Black crown rot	2	(iprodione) **Many labels available:** Iprodione 4L AG, Enclosure 4F, Nevado 4F, Rovral 4F	2 pt	8 pt	0	1	
Cavity spot	4	Metastar 2E AG (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	Ridomil Gold EC (mefenoxam)	2 pt			2	Apply at seeding in a 7-12" band on soil over seed furrow.
	4	Ridomil Gold SL (mefenoxam)	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
	4 & M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	8 lb	7	2	
	4 & M5	Ridomil Gold Bravo WP (mefenoxam + chlorothalonil)	2 lb		7	2	
	4 & M5	Ridomil Gold Bravo SC (mefenoxam + chlorothalonil)	2.5 pt		7	2	
	11	Reason (fenamidone)	8.2 fl oz	24.6 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	21	Ranman (cyazofamid)	6 fl oz	30 fl oz	14	0.5	Alternate with fungicides of dissimilar chemistry.
	M5	(chlorothalonil) **Many labels available:** Bravo Ultrex, Bravo Weather Stik, Bravo ZN, Chloronil 720, Chlorothalonil 720SC, Echo 720, Echo 90DF, Echo ZN, Equus 720SST, Equus DF, Initiate 720, Initiate ZN	**SEE INDIVIDUAL LABLES**		7	0.5	

Table 14.12. Carrot fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Cercospora leaf spot	M1	(copper compounds) **Many labels available:** Badge SC, Badge X2, Basic Copper 53, COCS WDG, Champ DP, Champ WG, Champ Formula 2, Champ WP, COC DF, COC WP, Copper Count N, Cueva, Cuprofix Ultra, Cuproxat, Kentan DF, Kocide DF, Kocide 2000, Kocide 3000, Kocide 4.5 LF, Kop-hydroxide, Mastercop, Nordox 75 WG, NuCop 50WP, NuCop 3L, NuCop HB, NuCop DF, Stretch, Tenn-Cop 5E, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABLES**		1	Varies by product from 4 hr to 2 day	
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Propimax, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt 3.6E, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.
	4 & M5	Ridomil Gold Bravo WP (mefenoxam + chlorothalonil)	2 lb		7	2	
	4 & M5	Ridomil Gold Bravo SC (mefenoxam/chlorothalonil)	2.5 pt		7	2	
	7	Fontelis (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of Amistar or other QoI fungicides. See label for soil appl.
Damping Off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lbs of seed			1	Seed treatment only.
Powdery mildew	M2	(sulfur compounds) **Many brands available:** Crusade DF, Dusting Sulfur – IAP, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 90W, Super-Six, Top Cop w/ Sulfur, Yellow Jacket Wettable Sulfur	-	-	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	3	(propiconazole) **Many labels available:** Amtide Propiconazole, Bumper 41.8EC, Propimax, Propi-Star EC, Shar-Shield PPZ, Tilt 3.6E	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.
	7	Fontelis (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	Do not exceed 2 sequential and 6 total appl. of Quadris Opti. or rotate with non QoI fungicides.
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	33 & M2	Sanction (potassium phosphate and sulfur)	6 pt			2	
Pythium	21	Ranman (cyazofamid)	6 fl oz	30 fl oz	14	0.5	Alternate with fungicides of dissimilar chemistry.
Pythium damping-off	4	Acquire, Sebring 2.65ST	0.7 fl oz/			1	Seed treatment only.

Table 14.12. Carrot fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
		(metalaxyl)	100 lbs of seed				
Pythium seedling blight	4	Apron XL LS (mefenoxam)	0.64 fl. oz./ 100 lb seed			2	Seed treatment only.
	4	Metastar 2E AG (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	Ridomil Gold EC (mefenoxam)	2 pt			2	Apply at seeding in a 7-12" band on soil over seed furrow.
	4	Ridomil Gold SL (mefenoxam)	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Various (see label)	7 & 11	Pristine (boscalid + pyraclostrobin)	10.5 oz	63 oz	0	0.5	Limit is 6 appl/crop and alternate chemistry.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action
	11	Amistar 80DF (azoxystrobin)	5 oz or 0.25 oz/ 1000 row ft	20 oz	0	4 hr	Do not exceed 1 sequential and 4 total appl. of Amistar or other QoI fungicides. See label for soil appl.
	11	Flint (trifloxystrobin)	3 oz	12 oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Gem 500SC (trifloxystrobin)	2.9 fl oz	11.6 fl oz	7	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11	Heritage (azoxystrobin)	10.5 oz	4 lb	0	4 hr	Do not apply more than 3 sequential applications without altenating to a fungicide of dissimilar mode of action.
	11	Quadris, Satori, Willowood Azoxy (azoxystrobin)	15.4 fl oz or 0.8 fl oz/ 1000 row ft	3.75 qt	0	4 hr	Do not exceed 1 sequential and 4 total appl. of QoI fungicides. See label for soil appl.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	2.4 pt	14.4 pt	0	0.5	Do not exceed 2 sequential and 6 total appl. of Quadris Opti. or rotate with non QoI fungicides.
	11 & 3	Quadris Top (azoxystobin + difenconazole)	14 fl ozq	56 fl oz	7	0.5	Do not exceed 1 sequential and 4 total appl. Quadris Top
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	55 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14 day	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	19	OSO 5%SC (polyoxin D zinc salt)	13 fl oz	84 fl oz	0	4 hr	See label for details.
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Alude, Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Phostrol, Prophyt, Rampart	3 qt		0	4 hr	See label for details.
	29	Omega (fluazinam)	1 pt	4 pt	7 day	0.5	For southern blight, apply 45 days prior to harvest
Various seedling diseases	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.

Table 14.13. Radish fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Alternaria leaf spot	7	Fontelis (pentiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of QoI fungicides.
	11	(Azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	
	11	Flint (Trifloxystrobin)	3.0 oz	12.0 oz	7	0.5	Do not apply sequentially with any fungicide belonging to Group 11.
Cercospora leaf spot	7	Fontelis (pentiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin + fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of QoI fungicides.
	11	(Azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of QoI fungicides.
	11	Flint (Trifloxystrobin)	3.0 oz	12.0 oz	7	0.5	Do not apply sequentially with any fungicide belonging to Group 11.
Damping Off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lbs of seed			1	Seed treatment only.
Downy mildew	4 & M1	Ridomil Gold Copper (mefenoxam + copper hydroxide)	2 lb	8 lb	7	2	
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Oxiphos, Rampart	3 qt		0	4 hr	See label for details.
	43	Presidio (fluopicolide)	4 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar chemistry.
Powdery mildew	M2	(sulfur compounds) **Many brands available:** Crusade DF, Micro Sulf, Microthiol Disperss, Sulfur 90W, Top Cop w/ Sulfur	-	-	1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
	7	Fontelis (penthiopyrad)	30 fl oz	61 fl oz	0	0.5	Alternate with non-FRAC code 7 fungicide. See label for directions.
	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action
	9 & 12	Switch 62.5WDG (cyprodinil + fludioxonil)	14 oz	56 oz	7	0.5	
	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of QoI fungicides. See label for soil appl.

Table 14.13. Radish fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	(Azoxystrobin) **Various brands available:** Equation SC, Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of Qol fungicides. See label for soil appl.
	11	Flint (Trifloxystrobin)	3.0 oz	12.0 oz	7	0.5	Do not apply sequentially with any fungicide belonging to Group 11.
Pythium	21	Presidio (fluopicolide)	4 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar chemistry.
Pythium damping-off	4	Acquire, Sebring 2.65ST (metalaxyl)	0.7 fl oz/ 100 lbs of seed			1	Seed treatment only.
	4 & 11	Uniform (mefenoxam & azoxystrobin)	0.34 fl oz/ 1000 linear fet			0	Make one application per season at time of planting
Pythium seedling blight	4	Apron XL LS (mefenoxam)	0.64 fl. oz./ 100 lb seed			2	Seed treatment only.
	4	Metastar 2E AG (metalaxyl)	8 pt			2	Apply as a broadcast soil application and incorporate into top 2 inches. See label for directions.
	4	Ridomil Gold EC (mefenoxam)	2 pt			2	Apply at seeding in a 7-12" band on soil over seed furrow.
	4	Ridomil Gold SL (mefenoxam)	2 pt			2	See label for specifics regarding preplant incorporated applications and surface applications at the time of planting.
Pythium seedling diseases	4	Ultra Flourish (mefenoxam)	4 pt		7	2	See label for details.
White rust	11	Cabrio EG (pyraclostrobin)	12 oz	48 oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of Qol fungicides. See label for soil appl.
	11	(Azoxystrobin) **Various brands available:** Quadris, Satori, Willowood Azoxy	15.4 fl oz	62 fl oz	0	0.5	Do not exceed 1 sequential and 4 total appl. of Qol fungicides. See label for soil appl.
Various (see label)	7 & 11	Merivon SC (pyraclostrobin & fluxapyroxad)	5.5 fl oz	16.5 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action
	11	Quadris, Satori, Willowood Azoxy (azoxystrobin)	15.4 fl oz or 0.8 fl oz/ 1000 row ft	3.75 qt	0	4 hr	Do not exceed 1 sequential and 4 total appl. of Qol fungicides. See label for soil appl.
	33	(mono- and di-potassium salts of phosphorous acid) **Many brands available:** Confine Extra, Fosiphite, Fungi-phite, K-Phite, Oxiphos, Phiticide, Oxiphos, Rampart	3 qt		0	4 hr	See label for details.
Various seedling diseases	4 & 11	Uniform (mefenoxam + azoxystrobin)	0.34 fl oz/ 1000 linear fet			0	Make one application per season at time of planting
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb of seed			0.5	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 14.14. Sweetpotato fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Septoria leaf spot	M2	Micro Sulf (sulfur)	5 lb/treated acre		0	1	Do not use within 2 weeks of an oil spray treatment
	11 & 3	Quadris TOP (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	12 hr	Make no more than 2 consecutive applications; Adding adjuvant may enhance the efficacy
Powdery mildew	M2	Microthiol Disperss (sulfur)	10 lb			1	Do not use within 2 weeks of an oil spray treatment
	3	Quash (metconazole)	4 oz	16 oz	1	12 hr	Do not make more than 2 sequential applications
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	12 hr	Alternate with another labeled fungicide for 2 applications after 2 applications of Switch WG
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	12 hr	May be used with adjuvants; other crops cannot be planted until 120 days after the last application of Vertisan.
	11 & 3	Quadris TOP (azoxystrobin; difenoconazole)	14 fl oz	55.3 fl oz	14	12 hr	Make no more than 2 consecutive applications; Adding adjuvant may enhance the efficacy
Black rot	1	Mertect 340-F (thiabendazole)	107 fl oz/ 100 gal water			12 hr	Dip seed roots for 1-2 min
	1	Thiabendazole 4L ST (thiabendazole)	107 fl oz/ 100 gal water			12 hr	Dip seed roots for 1-2 min and plant immediately
Scurf	14	Botran 5F (DCNA dicloran)	Seed dip -0.6 qt/7.5 gal water; Plant bed soray - 5.73 oz/1000 linear ft bed (42 in)	3.2 qt		12 hr	Do not plant tomatoes as a follow-up crop.
	1	Mertect 340-F (thiabendazole)	107 fl oz/ 100 gal water			12 hr	Dip seed roots for 1-2 min and plant immediately
	1	Thiabendazole 4L ST (thiabendazole)	107 fl oz/ 100 gal water			12 hr	Dip seed roots for 1-2 min and plant immediately
Pythium damping-off	4	Acquire (metalaxyl)	1.5 fl oz/ 100 lb. seed			1	Seed treatment
	4	Allegiance FL (metalaxyl)	0.75 fl oz/ 100 lb. seed			1	Seed treatment
	4	Apron XL (mefenoxam)	0.64 fl. oz./ 100 lb seed			2	See label
	4	Dyna-Shield Metalaxyl 318 FS (metalaxyl)	0.75 fl oz/ 100 lb. seed			1	Seed treatment
	4	Sebring 318 FS (metalaxyl)	0.75 fl oz/ 100 lb. seed			1	Seed treatment
	11 & 4	Uniform Fungicide (azoxystrobin + mefenoxam)	0.34 fl oz/ 1000 ft row			0	Apply as an in-furrow sprayMake only one application per crop season
Pythium	4	Ridomil Gold EC or SL (mefenoxam)	2 pt/ treated acre			2	Apply in water or liquid fertilizer & incorporate into top 2 inches of soil.
Phytophthora	4	MetaStar 2E (metalaxyl)	See label		1	2	See label.
	4	Metalaxyl 2E AG (metalaxyl)	8 pt			2	May apply as preplant incorporated or as a soil surface spray after planting.
Sclerotinia white mold	7	Endura (boscalid)	10 oz	20 oz	10	12 hr	See label.
Early blight	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	7	12 hr	See label.
	11	Aftershock (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	12 hr	See label

Table 14.14. Sweetpotato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	Evito 480 SC (fluoxastrobin)	3.8 fl oz	22.8 fl oz	7	12 hr	
	11	Reason 500 SC (fenamidone)	8.2 fl oz	16.4 fl oz	14	12 hr	
	3	Quash (metconazole)	4.0 oz	16 oz	1	12 hr	
	7	Endura (boscalid)	10 oz	20 oz	10	12 hr	
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	12 hr	
Botrytis	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	7	12 hr	See label.
	3	Quash (metconazole)	4.0 oz	16 oz	1	12 hr	
	7	Vertisan (penthiopyrad)	24 fl oz	72 fl oz	7	12 hr	
Alternaria leaf blight	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz	7	12 hr	Alternate with another labeled fungicide for 2 applications after 2 applications of Switch WG
	11	Reason 500SC (fenamidone)	8.2 fl oz	16.4 fl oz	14	12 hr	Do not make more than 1 application before alternating with a different mode of action.
	11 & 3	Quadris TOP (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	12 hr	Make no more than 2 consecutive applications; Adding adjuvant may enhance the efficacy
White rust (*Albugo spp.*)	11	Cabrio EG (pyraclostrobin)	16 oz	48 oz	0	12 hr	Alternate with other labeled fungicides after each application
	11	Quadris (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	Do not make more than 1 application before alternating with a different mode of action.
	11	Reason 500SC (fenamidone)	8.2 fl oz	16.4 fl oz	14	0	Do not make more than 1 application before alternating with a different mode of action.
Rust	11	Quadris (azoxystrobin)	6-15.5 fl oz	123 fl oz	14	4 hr	Do not make more than 1 application before alternating with a different mode of action.
	11	Aframe (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	
	11	Azoxystar (azoxystrobin)	20 fl oz	123 fl oz	14	4 hr	
	11	Equation (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	36 days plant back interval
	11	Equation SC (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	36 days plant back interval
	11	Headline (pyraclostrobin)	12 fl oz	72 fl oz	3	12 hr	
	11	Headline SC (pyraclostrobin)	12 fl oz	72 fl oz	3	12 hr	
	11 & 3	Quadris TOP (azoxystrobin + difenoconazole)	14 fl oz	55.3 fl oz	14	12 hr	Make no more than 2 consecutive applications; Adding adjuvant may enhance the efficacy
	11	Satori Fungicide (azoxystrobin)	20 fl oz	123 fl oz	14	4 hr	36 days plant back interval
	11	Willowwood Azoxy 2SC (azoxystrobin)	15.5 fl oz	123 fl oz	14	4 hr	

Table 14.14. Sweetpotato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Rhizopus rot	14	Botran 5F (DCNA dicloran)	0.6 qt in 100 gal water for post-harvest or for root dip 5-10 seconds			12 hr	
	12	Scholar SC (fludioxonil)	32 fl oz/100 gal water for post-harvest dip; 16 fl oz / 200,000 lb sweet potatoes for spray application				Do not make more than one post-harvest application.
Pink rot	11	Equation SC (azoxystrobin)	0.6 fl oz/ton tubers			4 hr	Post-harvest use in-line aqueous application method; do not use on seed pieces.
	21	Ranman 400SC Fungicide (cyazofamid)	At planting - 0.42 fl oz/1000 linear ft; Lay-by/Hilling - 2.75 fl oz/A	27.5 fl oz	7	12 hr	
	21	Ranman Fungicide (cyazofamid)	At planting - 0.42 fl oz/1000 linear ft; Lay-by/Hilling - 2.75 fl oz/A	27.5 fl oz	7	12 hr	
Various soil-borne diseases	11	Quadris (azoxystrobin)	Various, See label	Various, See label	See label	4 hr	See label.
Seed decay, damping-off, seedling blight caused by soil pathogens	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lb seed		0	12 hr	Not effective against *Pythium* spp.; Tank mix with others for *Pythium* control

[1] FRAC code (fungicide group): Number (1 through 45) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 15. Strawberry Production

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Botany and Planting

Strawberry - *Fragaria x ananassa,* Rosaceae.

Table 15.1. Planting information for strawberries.

Planting dates	
North Florida	Sept 15 - Oct 15
Central Florida	Sept 25 - Oct 25
South Florida	Oct 1 - Dec 1
Planting information (2-row beds)	
Distance between beds (in)	48 - 60
Distance between plants (in)	12-16
Distance between rows (in)	12 - 14
Days to first ripe fruit	30 - 60
Plant populations (acre)	16,000-22,000

Cultivars

1. MAIN CULTIVARS

Strawberry Festival. Released in 2000. Medium-size, uniform broad-conic fruit that fit well in a 1lb plastic container; deep red external color and medium to dark red internal color; moderately acidic but balanced flavor; very firm with excellent shipping quality; flexible skin that is extremely resistant to rain damage. Moderately vigorous plant; long fruit stems allow efficient picking. Resistant to Phytophthora root rot (caused by *Phytophthora cactorum*); moderately resistant to anthracnose fruit rot (caused by *Colletotrichum acutatum*) and Botrytis fruit rot (caused by *Botrytis cinerea*; susceptible to angular leaf spot (caused by *Xanthamonas* spp.) and Colletotrichum crown rot (caused by *Colletotrichum gloeosporoides*). 'Strawberry Festival' produces ample runners in the nursery and is a robust plant that is not prone to damage during handling; due to its susceptibility to Colletotrichum crown rot, care should be taken to control this disease in the nursery by using disease-free foundation stock.

Florida Radiance. Released in 2008. The most widely grown cultivar in central Florida. Large, uniform, conic fruit with glossy appearance; glossy-red external color and medium red internal color; moderately acidic but balanced flavor; moderately firm with good shipping quality; flexible skin that is moderately resistant to rain damage. Low to medium plant vigor with very open canopy; very long fruit stems giving excellent picking efficiency. Moderately resistant to anthracnose fruit rot and Colletotrichum crown rot; moderately susceptible to angular leaf spot, with symptoms particularly noticeable on the calyx; susceptible to Botrytis fruit rot; highly susceptible to Phytophthora root rot. Metalaxyl, the active ingredient in Ridomil Gold®, is highly effective against Phytophthora and should be injected through the drip tape as soon as plants are established. Two applications may be needed to treat an infected crop. Products containing potassium phosphite or potassium salts of phosphorus acid and the related aluminum derivatives are alternatives that should generally be applied as foliar sprays, although some are also labeled for drip application. 'Florida Radiance' produces many runners in the nursery but must be handled very carefully since the petioles and root system are not robust and are prone to damage; it is recommended that water and nitrogen applications in the nursery be reduced at the end of the season to allow the plants to "harden off"; due to the susceptibility of this cultivar to Phytophthora root rot, poorly-drained areas of the nursery should be avoided.

Winterstar™ 'FL 05-107'. Released in 2011. Medium-large size, uniform, conic to broad-conic fruit with glossy appearance; bright-red external color that does not become overly dark at the end of the season and medium to light red internal color; low-acid flavor gives enhanced sweetness perception; firm with firmness slightly less than 'Strawberry Festival'; moderately susceptible to rain damage. Moderately vigorous plant that is also compact allowing higher density plantings; medium-long fruit stems. High early yield comparable to 'Florida Radiance'. Fruit size is more variable than for 'Florida Radiance', and later planting dates in central Florida (Oct 8-15) are recommended to reduce size fluctuation. Moderately resistant to anthracnose fruit rot; moderately susceptible to angular leaf spot; susceptible to Botrytis fruit rot and Phytophthora root rot; take precautions against Phytophthora as recommended for 'Florida Radiance'.

Sweet Sensation® 'Florida127'. Released in 2013. Very large fruit size, moderately uniform conic to broad-conic fruit, bright-red with lighter color than other cultivars. During cool weather, a longer interval between harvests compared to other cultivars may be necessary to allow optimum color development. Exceptional flavor throughout season; moderately susceptible to rain damage. Plant is vigorous, which may be an advantage in north Florida but in central Florida may require reduced nutrient applications early in the season to maintain a small plant size. In central Florida, early and total yields are slightly higher than for 'Florida Radiance' due to a more robust plant. Recommended planting dates in central Florida are Oct 5-15. Resistant to anthracnose fruit rot and Colletotrichum crown rot; moderately susceptible to angular leaf spot; susceptible to Botrytis fruit rot and powdery mildew (caused by *Podosphaera aphanis*); highly susceptible to Phytophthora root rot; take precautions against Phytophthora as recommended for 'Florida Radiance'.

2. MINOR CULTIVARS

Sweet Charlie. Released in 1992, 'Sweet Charlie' was grown on a large commercial scale at one time. Due to its soft fruit it did not remain a commercial cultivar, but its low-acid flavor and high early yields make it a local favorite for U-pick operations.

Florida Elyana. Released in 2008, 'Florida Elyana' has extremely large and firm fruit with high sugar content. Its compact plant can be spaced tightly. This cultivar is also very resistant to Colletotrichum root rot, anthracnose fruit rot, and Botrytis fruit rot. This cultivar is susceptible to rain damage and is recommended for production under protective structures such as greenhouses or high tunnels.

Table 15.2 Herbicides approved for managing weeds in strawberry.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			***** PRETRANSPLANT *****
Acifluorfen up to 0.375	(Ultra Blazer) 1.5 pt.	14	Broadleaves. May be applied under the plastic mulch or with a shielded or hooded spray directed to row middles. 60 day PHI.
Carfentrazone up to 0.031	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2.0 EC up to 2 fl. oz.	14	Broadleaves. Apply as a pre-plant burndown for emerged broadleaves upto 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pre-transplant interval.
Flumioxazin 0.1	(Chateau) 51 WDG 3 oz.	14	Broadleaves. May be applied under the plastic mulch or with a shielded or hooded spray directed to row middles before weed emergence. 30 day pre-transplant interval If applied under the plastic mulch. Do not apply after fruit set.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves and grasses. Apply as a preplant burndown. Consult label for individual product directions.
Napropamide 4	(Devrinol) 2 EC 8 qt. (Devrinol DF XT) 50 DF 4-8 lb.	15	Annual broadleaves and grasses. Apply under the plastic and in the row middles. Mechanically incorporated in the row middle to a 1-2 in. depth within 24 hrs of application. When applid under plastic, incorporate mechanically or with irrigation. Do not apply between bloom and harvest.
Oxyfluorfen 0.25 - 0.5	(Galigan H_2O, GoalTender) 4 EC 0.5 - 1.0 pt. (Galigan, Goal 2XL) 2 EC 1 - 2 pt.	14	Broadleaves. Apply pre-transplant just prior to installation of plastic mulch. 30 day pre-transplant interval. Mulch may be applied any time during the 30-day interval.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Apply as a preplant burndown treatment or post transplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar applied herbicide with no residual control.
Pendimethalin 0.72	(Prowl H_20) 3.8 1.5 pt.	3	Broadleaves and grasses in the row middles. Do not apply under the plastic. In systems that use irrigation at planting, delay application until after irrigation regime. 35 day PHI.
Terbacil 0.2	(Sinbar WDG) 80 WDG 4 oz.	3	Broadleaves, grasses and some sedges. One application per crop of 4 oz./A after bedding but prior to transplanting. Rainfall or irrigation required. Do not apply to soils with less than 0.5% organic matter. 110 day PHI.
			***** POSTTRANSPLANT *****
Acifluorfen up to 0.375	(Ultra Blazer) 1.5 pt.	14	Broadleaves. Apply directed to the row middles with a shielded or hooded sprayer. Do not allow to contact strawberry plants. 60 day PHI.
Clopyralid 0.125 - 0.25	(Stinger) 3 EC 0.33 - 0.66 pt.	4	Broadleaves. Do not exceed 2/3 pt./A per year. Do not include a surfactant. 7 day PHI.
Clethodim 0.09 - 0.13 0.07 - 0.13	(Arrow, Select) 2 EC 6 - 8 fl. oz. (Select Max) 1 EC 9 - 16 fl. oz.	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. 4 day PHI.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves and grasses. Apply directed to the row middles. Injury has been observed from translocation from daughter plants in the row middle to the mother plants. 14 day PHI. Spot treatment has 7 day PHI.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Apply as a preplant burndown treatment or post transplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar applied herbicide with no residual control.
Paraquat 0.5	(Gramoxone) 2 SL 2 pt. (Firestorm) 3 SL 1.3 pt.	22	Emerged broadleaves and grasses. Apply as a directed spray to row middles only. Do not allow spray to contact plants. Do not apply more than 3 times per season. Nonionic surfactant recommended. 21 day PHI.
Sethoxydim 0.28 - 0.47	(Poast) 1.5 EC 1.5 - 2.5 pt.	1	Emerged grasses. A maximum of 2.5 pt./A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 7 day PHI.
			***** POSTHARVEST *****
Paraquat 0.49	(Gramoxone) 2 SL 1.95 pt.	22	Broadcast spray over the top of the plants after the last harvest. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption. Nonionic surfactant recommended.

Table 15.3. Insecticides approved for managing insect pests of strawberry.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
Ants	7A	**Extinguish fire ant bait** (S - methoprene)	See label		4	0	
	7D	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lbs		12	1	
Aphids	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	un	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lbs		4	0	
	un	**M-Pede** (potassium salts of fatty acids)	See label		12	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	un	**Neemix 4.5% EC** (azadirachtin)	4-16 fl oz		12	0	
	un	**PFR-97 20%WDG** (*Isaria fumosoroseus* Apopka strain 97)	1-2 lbs		4	0	
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons		4	0	OMRI approved.
	1B	**Diazinon 50W, AG600 WBC**	**50W:** 1-2 lbs; **AG600 WBC:** 12.75-25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	
	1B	**Dibrom 8-E*** (Naled)	1 pint	Do not apply more than 5 pints per season.	48	1	
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A + 6	**Athena** (bifenthrin & avermectin B1)	7.0-17.0 fl oz	Do not apply more 68 fl oz. in a growing season after transplanting.	12	3	Make 2 applications 7-10 days apart. If further applications are needed wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	**Azera** (azadirachtin & pyrethrins)	See label		4	0	
	3A	***Brigade WSB** (bifenthrin)	6.4-32.0 oz	Do not apply more than 80 oz./A per season.	12	0	
	3A + 4A	***Brigadier** (bifenthrin & imidacloprid)	5.1-6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.
	3A	**Evergreen EC 60-6** (pyrethrins & piperonyl butoxide)	2-16 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	
	4A	**Actara** (thiamethoxam)	1.5-4.0 oz	Do not exceed a total of 12 oz/ Acre (0.188 lb ai/A) of actara or 0.188 lb ai of thiamethoxam containing products per acre per growing season.	12	3	Minimum interval between applications is 10 days. Do not use Actara in nurseries, greenhouses, plant propagation houses, or on any plants grown for use as transplants. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	4A	**Admire Pro** (imidacloprid)	soil - 10.5-14 fl oz foliar - 1.3 fl oz	Do not apply more than 14.0 fl oz /A for soil and 3.9 fl oz/A for foliar applications per season.	12	soil - 14 foliar - 5	Soil applications may be made as chemigation, as a plant hole treatment or as a band spray over-the-row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7-4.01 oz	Do not exceed 4.01 oz./A per growing season.	12	50	
	4A + 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	2-5 oz	Do not exceed 15.0 oz/A per growing season.	12	3	Application restrictions exist for this product because of the risk to bees and othe insect pollinators. Follow application restrictions found in the directions for use to protect pollinators.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	Maximum allowed per year is 28.0 fl oz/A	4	0	10 day minimum interval between applications.
	9C	**Beleaf 50 SG** (flonicamid)	2.8 oz	Do not apply more than 8.4 oz./A Beleaf 50 SG per year.	12	0	Do not apply more than 3 applications per year. Allow a minimum of 7 days between applications.
Armyworms (see also caterpillars)	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	un	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lbs		4	0	
	un	**Neemix 4.5% EC** (azadirachtin)	4-16 fl oz		12	0	
	1A	**Carbaryl 4 L** (carbaryl)	1-2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies strain GC-91) *aizawai*	0.5-2.0 lbs		4	0	
	1A	**Sevin 4F, 80 Solupak** (carbaryl)	**4F:** 1-2 quarts; **80 Solupak:** 1.25-2.5 lbs	**4F:** Do not apply more than a total of 10 quarts/A per crop per year.; **80 Solupak:** Do not apply more than a total of 12.5 quarts/A per crop per year.	12	7	
	3A + 6	**Athena** (bifenthrin & avermectin B1)	7.0-17.0 fl oz	Do not apply more 68 fl oz. in a growing season after transplanting.	12	3	Make 2 applications 7-10 days apart. If further applications are needed wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	**Azera** (azadirachtin & pyrethrins)	See label		4	0	
	3A	***Brigade WSB** (bifenthrin)	6.4-32.0 oz	Do not apply more than 80 oz./A per season.	12	0	
	3A + 4A	***Brigadier** (bifenthrin & imidacloprid)	5.1-6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 - 21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank mixed with Dipel DF for armyworm control.
	3A	**Evergreen EC 60-6** (pyrethrins & piperonyl butoxide)	2-16 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A + 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	2-5 oz	Do not exceed 15.0 oz/A per growing season.	12	3	Application restrictions exist for this product because of the risk to bees and othe insect pollinators. Follow application restrictions found in the directions for use to protect pollinators.
	5	**Entrust** (spinosad)	1.25-1.5 oz	Do not apply more than 9 oz/A per crop.	4	1	OMRI approved. Do not make applications less than 5 days apart except for thrips.
	5	**Radiant SC** (spinetoram)	6-10 fl oz	Do not apply more than a total of 39 fl oz/A per year.	4	1	
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		4	0	
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lbs		4	0	
	11A	**DiPel DF** (*Bacillus thuringiensis* kurstaki)	0.5-2.0 lbs		4	0	For armyworm and cutowrm control, use the higher rate.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lbs		4	0	
	11A	**Xentari** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lbs		4	0	
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 oz./A per season.	12	1	7 day minimum interval between applications.
	16 + 28	**Vetica** (buprofezin & flubendiamide)	12.0-18.5 fl oz	Do not apply more than 37.0 fl oz/A per crop cycle.	12	3	Do not make more than 2 applications per crop cycle.
	18	**Intrepid 2F** (methoxyfenozide)	6-12 fl oz	Do not apply more than 64 fl oz/A per year.	4	3	
	28	**Belt SC** (flubendiamide)	2.0-2.4 fl oz	Do not apply more than 7.2 fl oz/A per crop season.	12	8	Do not apply more than 2.4 fl oz per 3 day interval.
	28	**Coragen** (chlorantraniliprole)	3.5-7.5 fl oz	Do not apply more than 15.4 fl oz/A per crop.	4	1	Make no more than 4 applications/ A per crop. Minimum interval between treatments is 7 days.
Beetles and weevils (including sap beetles) (see also grubs)	--	**Govern 4E*** (chlorpyrifos)	see label	Do not apply more than 2 quarts preplant/A per year or 2 quarts foliar/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year. Do not apply after berries form or when berries are present.
	un	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench:** 40-80 fl oz/100 gal; **Foliar:** 0.5 pint - 2 quarts		4	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	1B	**Lorsban 75WG** (chlorpyrifos)	1.33-2.67 lbs	Do not apply more than 2.67 lb/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year.
	3A + 6	**Athena** (bifenthrin & avermectin B1)	7.0-17.0 fl oz	Do not apply more 68 fl oz. in a growing season after transplanting.	12	3	Make 2 applications 7-10 days apart. If further applications are needed wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	**Azera** (azadirachtin & pyrethrins)	See label		4	0	
	3A	***Brigade WSB** (bifenthrin)	6.4-32.0 oz	Do not apply more than 80 oz./A per season.	12	0	
	3A + 4A	***Brigadier** (bifenthrin & imidacloprid)	5.1-6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 - 21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank mixed with Dipel DF for armyworm control.
	4A	**Admire Pro** (imidacloprid)	soil - 10.5-14 fl oz foliar - 1.3 fl oz	Do not apply more than 14.0 fl oz /A for soil and 3.9 fl oz/A for foliar applications per season.	12	soil - 14 foliar - 5	Soil applications may be made as chemigation, as a plant hole treatment or as a band spray over-the-row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 oz./A per season.	12	1	7 day minimum interval between applications.
Caterpillars (including budworms, earworms, leafrollers, leaftiers, borers, and loopers) (see also armyworms)	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	un	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lbs		4	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	un	**Neemix 4.5% EC** (azadirachtin)	4-16 fl oz		12	0	
	un	**PFR-97 20%WDG** (*Isaria fumosoroseus* Apopka strain 97)	1-2 lbs		4	0	
	1A	**Carbaryl 4 L** (carbaryl)	1-2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.
	1A	**Sevin 4F, 80 Solupak** (carbaryl)	**4F:** 1-2 quarts; **80 Solupak:** 1.25-2.5 lbs	**4F:** Do not apply more than a total of 10 quarts/A per crop per year.; **80 Solupak:** Do not apply more than a total of 12.5 quarts/A per crop per year.	12	7	
	1B	**Diazinon 50W, AG600 WBC**	**50W:** 1-2 lbs; **AG600 WBC:** 12.75-25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	1B	**Dibrom 8-E*** (naled)	1 pint	Do not apply more than 5 pints per season.	48	1	
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A	**Azera** (azadirachtin & pyrethrins)	See label		4	0	
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	5	**Entrust** (spinosad)	1.25-1.5 oz	Do not apply more than 9 oz/A per crop.	4	1	OMRI approved. Do not make applications less than 5 days apart except for thrips.
	5	**Radiant SC** (spinetoram)	6-10 fl oz	Do not apply more than a total of 39 fl oz/A per year.	4	1	
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		4	0	
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lbs		4	0	
	11A	**DiPel DF** (*Bacillus thuringiensis* kurstaki)	0.5-2.0 lbs		4	0	For armyworm and cutowrm control, use the higher rate.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lbs		4	0	
	11A	**Xentari** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lbs		4	0	
	16 + 28	**Vetica** (buprofezin & flubendiamide)	12.0-18.5 fl oz	Do not apply more than 37.0 fl oz/A per crop cycle.	12	3	Do not make more than 2 applications per crop cycle.
	28	**Belt SC** (flubendiamide)	2.0-2.4 fl oz	Do not apply more than 7.2 fl oz/A per crop season.	12	8	Do not apply more than 2.4 fl oz per 3 day interval.
Crickets and cockroaches	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	1A	**Carbaryl 4 L** (carbaryl)	1-2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.
	1B	**Diazinon 50W, AG600 WBC** (diazinon)	**50W:** 1-2 lbs; **AG600 WBC:** 12.75-25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 oz./A per season.	12	1	7 day minimum interval between applications.
Fruit fly (vinegar fly) and spotted wing drosohila	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	3A	***Brigade WSB** (bifenthrin)	6.4-32.0 oz	Do not apply more than 80 oz./A per season.	12	0	

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 - 21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank mixed with Dipel DF for armyworm control.
	3A	**Evergreen EC 60-6** (pyrethrins & piperonyl butoxide)	2-16 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A	**Actara** (thiamethoxam)	1.5-4.0 oz	Do not exceed a total of 12 oz/ Acre (0.188 lb ai/A) of actara or 0.188 lb ai of thiamethoxam containing products per acre per growing season.	12	3	Minimum interval between applications is 10 days. Do not use Actara in nurseries, greenhouses, plant propagation houses, or on any plants grown for use as transplants. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	soil - 10.5-14 fl oz foliar - 1.3 fl oz	Do not apply more than 14.0 fl oz /A for soil and 3.9 fl oz/A for foliar applications per season.	12	soil - 14 foliar - 5	Soil applications may be made as chemigation, as a plant hole treatment or as a band spray over-the-row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	5	**Entrust** (spinosad)	1.25-1.5 oz	Do not apply more than 9 oz/A per crop.	4	1	OMRI approved. Do not make applications less than 5 days apart except for thrips.
	5	**GF-120 NF Fruit Fly Bait** (spinosad)	10-20 fl oz		4	1	
Grubs (see also beetles)	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	--	**Govern 4E*** (chlorpyrifos)	see label	Do not apply more than 2 quarts preplant/A per year or 2 quarts foliar/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year. Do not apply after berries form or when berries are present.
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	1B	**Lorsban 75WG** (chlorpyrifos)	1.33-2.67 lbs	Do not apply more than 2.67 lb/A per year.	24	21	Do not make more than 1 preplant or 2 foliar applications per year.

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	4A	**Admire Pro** (imidacloprid)	soil - 10.5-14 fl oz foliar - 1.3 fl oz	Do not apply more than 14.0 fl oz /A for soil and 3.9 fl oz/A for foliar applications per season.	12	soil - 14 foliar - 5	Soil applications may be made as chemigation, as a plant hole treatment or as a band spray over-the-row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7-4.01 oz	Do not exceed 4.01 oz./A per growing season.	12	50	
Mites (including twospotted spider mite, strawberry spider mite, carmine spider mite, cyclamen mite, broad mite)	un	**Acramite 50 WS** (bifenazate)	0.75-1.0 lb	Two applications allowed per season; 21 days minimum between applications.	12	1	Acramite is not systemic in action; therefore complete coverage of both upper and lower leaf surfaces and of fruit is necessary for effective control.
	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	un	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lbs		4	0	
	un	**JMS Stylet Oil** (paraffinic oil)	3 quarts/100 gal water		4	0	OMRI approved.
	un	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench:** 40-80 fl oz/100 gal; **Foliar:** 0.5 pint - 2 quarts		4	0	
	un	**M-Pede** (potassium salts of fatty acids)	See label		12	0	
	un	**PFR-97 20%WDG** (*Isaria fumosoroseus* Apopka strain 97)	1-2 lbs		4	0	
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons		4	0	OMRI approved.
	1B	**Diazinon 50W, AG600 WBC** (diazinon)	**50W:** 1-2 lbs; **AG600 WBC:** 12.75-25.5 fl oz	Make a maximum of one foliar application per crop and one soil application per crop.	3 days	5	
	1B	**Dibrom 8-E*** (naled)	1 pint	Do not apply more than 5 pints per season.	48	1	
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A + 6	**Athena** (bifenthrin & avermectin B1)	7.0-17.0 fl oz	Do not apply more 68 fl oz. in a growing season after transplanting.	12	3	Make 2 applications 7-10 days apart. If further applications are needed wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	***Brigade WSB** (bifenthrin)	6.4-32.0 oz	Do not apply more than 80 oz./A per season.	12	0	
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 - 21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank mixed with Dipel DF for armyworm control.

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	6	**Agri-Mek 0.15 EC * , SC***(abamectin)	**0.15EC:** 16 oz; **SC:** 3.5 fl oz	**0.15EC:** Do not apply more than 64 fl oz/A (0.075 lb ai/A) of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.; **SC:** Do not apply more than 14 fl oz/A (0.075 lb ai/A) of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.	12	3	Wait at least 21 days after second application before repeating application. Agri-Mek SC must be mixed with a surfactant approved for use on strawberries. Make 2 applications 7-10 days apart when mites first appear.
	10A	**Savey 50 DF** (hexythiazox)	6 oz	Do not apply more than 6 oz/A per year.	12	3	
	10B	**Zeal** (etoxazole)	2-3 oz	Do not apply more than 3.0 oz/A per season.	12	1	Do not make more than 1 application per season.
	12B	***Vendex 50 WP** (fenbutatin oxide)	1.5-2.0 lbs	Apply no more than 4 lbs/A per season.	48	1	Make no more than 4 applications per season.
	20B	**Kanemite 15 SC** (acequinocyl)	21-31 fl oz	Do not apply more than 62 fl oz/A per season.	12	1	Allow a minimum of 21 days between treatments. Do not make more than 2 applications per year.
	21A	**Portal XLO** (fenpyroximate)	2 pints	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Allow 14 days between applications.
	23	**Oberon 2SC** (spiromesifen)	12-16 fl oz	Do not apply more than 48 fl oz/A per crop season.	12	3	Do not make more than 3 applications per crop season.
	25	**Nealta** (cyflumetofen)	13.7 fl oz	Do not apply more than 27.4 fl oz/A per season per crop.	12	1	Active against eggs, nymphs and adults. Thorough coverage is necessary.
Plant (*Lygus*) bugs	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	un	**PFR-97 20%WDG** (*Isaria fumosoroseus* Apopka strain 97)	1-2 lbs		4	0	
	1A	**Carbaryl 4 L** (carbaryl)	1-2 quarts	Do not apply more than a total of 10 quarts/A per crop per year.	12	7	Bee restriction: do not apply to target crops in bloom.
	1A	**Sevin 4F, 80 Solupak** (carbaryl)	**4F:** 1-2 quarts; **80 Solupak:** 1.25-2.5 lbs	**4F:** Do not apply more than a total of 10 quarts/A per crop per year.; **80 Solupak:** Do not apply more than a total of 12.5 quarts/A per crop per year.	12	7	
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A + 6	**Athena** (bifenthrin & avermectin B1)	7.0-17.0 fl oz	Do not apply more 68 fl oz. in a growing season after transplanting.	12	3	Make 2 applications 7-10 days apart. If further applications are needed wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	***Brigade WSB** (bifenthrin)	6.4-32.0 oz	Do not apply more than 80 oz./A per season.	12	0	
	3A + 4A	***Brigadier** (bifenthrin & imidacloprid)	5.1-6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	3A	***Danitol 2.4 EC** (fenpropathrin)	10.67 - 21.33 fl oz	Do not apply more than 42.67 fl oz/A per year.	24	2	Do not apply more than twice a year to the same planting. May be tank mixed with Dipel DF for armyworm control.
	3A	**Evergreen EC 60-6** (pyrethrins & piperonyl butoxide)	2-16 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	9C	**Beleaf 50 SG** (flonicamid)	2.8 oz	Do not apply more than 8.4 oz./A Beleaf 50 SG per year.	12	0	Do not apply more than 3 applications per year. Allow a minimum of 7 days between applications.
	15	**Rimon 0.83EC** (novaluron)	9-12 fl oz	Do not apply more than 36 oz./A per season.	12	1	7 day minimum interval between applications.
Thrips (inlcuding flower thrips, chilli thrips)	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	un	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lbs		4	0	
	un	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench:** 40-80 fl oz/100 gal; **Foliar:** 0.5 pint - 2 quarts		4	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	un	**Neemix 4.5% EC** (azadirachtin)	4-16 fl oz		12	0	
	un	**PFR-97 20%WDG** (*Isaria fumosoroseus* Apopka strain 97)	1-2 lbs		4	0	
	1B	**Dibrom 8-E*** (Naled)	1 pint	Do not apply more than 5 pints per season.	48	1	
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A	**Azera** (azadirachtin & pyrethrins)	See label		4	0	
	3A	**Evergreen EC 60-6** (pyrethrins & piperonyl butoxide)	2-16 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	5	**Entrust** (spinosad)	1.25-1.5 oz	Do not apply more than 9 oz/A per crop.	4	1	OMRI approved. Do not make applications less than 5 days apart except for thrips.
	5	**Radiant SC** (spinetoram)	6-10 fl oz	Do not apply more than a total of 39 fl oz/A per year.	4	1	

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
Whiteflies	--	**Botanigard ES** (*Beauvaria bassiana*)	0.25-1 quarts		4	0	
	un	**Aza-Direct** (azadirachtin)	See label; 1-2 pints for most pests and crop conditions		4	0	
	un	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lbs		4	0	
	un	**JMS Stylet Oil** (paraffinic oil)	3 quarts/100 gal water		4	0	OMRI approved.
	un	**MET52 EC** (*Metarhizium anisopliae* strain F52)	**Drench:** 40-80 fl oz/100 gal; **Foliar:** 0.5 pint - 2 quarts		4	0	
	un	**M-Pede** (potassium salts of fatty acids)	See label		12	0	
	un	**Mycotrol O** (*Beauveria bassiana*)	See label		4	0	
	un	**Neemix 4.5% EC** (azadirachtin)	4-16 fl oz		12	0	
	un	**PFR-97 20%WDG** (*Isaria fumosoroseus* Apopka strain 97)	1-2 lbs		4	0	
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons		4	0	OMRI approved.
	1B	**Malathion 5EC , 8F** (malathion)	**5EC:** 1.5-3.2 pints; **8F:** 1.5-2.0 pints	**8F:** Do not apply more than 8 pints/A per year	12	3	Do not make more than 4 applications per year. Minimum retreatment interval is 7 days.
	3A + 6	**Athena** (bifenthrin & avermectin B1)	7.0-17.0 fl oz	Do not apply more 68 fl oz. in a growing season after transplanting.	12	3	Make 2 applications 7-10 days apart. If further applications are needed wait 21 days after the second application before repeating sequence of two applications. Do not make more than 4 applications per growing season. Do not make more than 2 applications per season. Do not apply more than once every 7 days.
	3A	**Azera** (azadirachtin & pyrethrins)	See label		4	0	
	3A + 4A	***Brigadier** (bifenthrin & imidacloprid)	5.1-6.14 fl oz	Maximum allowed is 17.92 fl oz/A per season.	12	7	Do not make applications less than 5 days apart.
	3A	**Evergreen EC 60-6** (pyrethrins & piperonyl butoxide)	2-16 fl oz		12	0	
	3A	**PyGanic EC 5.0** (pyrethrins)	See label		12	0	
	4A	**Actara** (thiamethoxam)	1.5-4.0 oz	Do not exceed a total of 12 oz/ Acre (0.188 lb ai/A) of actara or 0.188 lb ai of thiamethoxam containing products per acre per growing season.	12	3	Minimum interval between applications is 10 days. Do not use Actara in nurseries, greenhouses, plant propagation houses, or on any plants grown for use as transplants. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.

Table 15.3. Insecticides approved for managing insect pests of strawberry. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade Name (Active Ingredient)	Rate (Product/acre)	Season	REI (hours)	Days to Harvest	Notes
	4A	**Admire Pro** (imidacloprid)	soil - 10.5-14 fl oz foliar - 1.3 fl oz	Do not apply more than 14.0 fl oz /A for soil and 3.9 fl oz/A for foliar applications per season.	12	soil - 14 foliar - 5	Soil applications may be made as chemigation, as a plant hole treatment or as a band spray over-the-row followed by overhead irrigation. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 30 SG, 70 WP** (acetamiprid)	**30 SG:** 1.9-6.9 oz; **70 WP:** 0.8-3.0 oz	**30 SG:** Do not exceed a total of 13.8 oz of Assail 30 SG/A during each growing season.; **70 WP:** Do not exceed a total of 6.0 oz Assail 70 WP/A. per growing season.	12	1	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	4A	**Platinum 75 SG** (thiamethoxam)	1.7-4.01 oz	Do not exceed 4.01 oz./A per growing season.	12	50	
	4A + 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	2-5 oz	Do not exceed 15.0 oz/A per growing season.	12	3	Application restrictions exist for this product because of the risk to bees and othe insect pollinators. Follow application restrictions found in the directions for use to protect pollinators.
	4D	**Sivanto 200 SL** (flupyradifurone)	7-14 fl oz	Maximum allowed per year is 28.0 fl oz/A	4	0	10 day minimum interval between applications.
	7D	**Esteem 0.86 EC** (pyriproxyfen)	10 fl oz	Do not exceed 20 fl oz/A per season.	12	2	Do not make more than 2 applications per growing season. Do not apply more than once every 7 days.
	16	**Courier SC** (buprofezin)	9.0-13.6 oz	Do not apply more than 27.2 fl oz/A per crop cycle.	12	3	Do not make more than 2 applications pe crop cycle. Allow at least 10 days between applications.
	16 + 28	**Vetica** (buprofezin & flubendiamide)	12.0-18.5 fl oz	Do not apply more than 37.0 fl oz/A per crop cycle.	12	3	Do not make more than 2 applications per crop cycle.
	21A	**Portal XLO** (fenpyroximate)	2 pints	Do not apply more than 4.0 pints/A per crop cycle.	12	1	Allow 14 days between applications.
	23	**Oberon 2SC** (spiromesifen)	12-16 fl oz	Do not apply more than 48 fl oz/A per crop season.	12	3	Do not make more than 3 applications per crop season.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.2 April 2012. Number codes (1 through 28) are used to distinguish the main insectide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Angular leaf spot	M1	(copper compounds) **Many brands available:** AmeriCop 40 DF, Badge SC, Basic Copper 53, Badge X2,Champ DP Dry Prill, Champ Formula 2 Flowable, Champ WG, COC DF, COC WP, C-O-C-S WDG, Copper Count-N, CS 2005 Cueva, Cuprofix Ultra 40 Disperss, Cuproxat Flowable, Kentan DF, Kocide 2000, Kocide 3000, Kocide DF, Mastercop, Nordox, Nordox 75WG, Nu Cop 3L, Nu Cop 50 DF, Nu Cop 50 WP, Nu Cop HB, Cuproxat	**SEE INDIVIDUAL LABELS**		1-2	Varies by product from 4 hr to 2 day	Frequent use of copper fungicides may cause foliar burn
	21	Actigard 50 WG (acibenzolar-s-methyl)	0.75 oz	6 oz	0	0.5	Do not apply to plants that are stressed due to drought, excessive moisture, cold weather, herbicide injury, etc.
Anthracnose fruit rot	M4	Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L (captan)	**SEE INDIVIDUAL LABELS**		1	1	Rate per treated acre. Special label for FL allows up to 24 applications per season
	M4 + 17	Captevate 68 WDG (captan + fenhexamid)	5.25 lb	21 lb	0	1	Do not make more than 2 consecutive applications
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action
	3	(propiconazole) **Many brands available:** Amtide Propiconazole EC, Bumper 41.8 EC, Fitness, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	Do not make more than 2 consecutive applications
	3 + 11	Quadris Top (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	Do not make more than 2 sequencial applications before alternating to another fungicide group and no more than 4 appl/ crop per year.
	3 + 11	Quilt Xcel (azoxystrobin + propiconazole)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications and no more than 4 appl/crop
	9 + 12	Switch 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl. See special label for instructions on dipping transplants
	11	Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo (azoxystrobin)	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential appl. and no more than 4 appl/crop year. See label for instructions on dipping transplants
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications and no more than 5 appl/crop year
	11	Flint (trifloxystrobin)	3.2 oz.	19.2 oz.	0	0.5	Do not apply more than 2 sequential applications of Flint of other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	Aftershock Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Do not make more than 2 sequential applications and no more than 4 applications per season, and a minimum interval of 14 days between applications
	11 + 7	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	0	12 hr	Do not make more than 2 sequential applications before alternating to a another non-Group 7 or non-Group 11 fungicide
	11 + 7	Pristine (pyraclostrobin + boscalid)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive appl. and no more than 5 appl/ crop
	11 + 7	Luna Sensation (tryfloxystrobin + fluopyram)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	19	Affirm WDG, Ph-D, Oso, Veranda O (polyoxin-D)	**SEE INDIVIDUAL LABELS**		0	4 hr	Use in alternation with fungicides that have different modes of action. Do not make more than 3 applications per season.
Botrytis fruit rot	M3	Thiram Granuflo, Thiram 24/7 (thiram)	**SEE INDIVIDUAL LABELS**			1	Do not rotate treated crops with other crops for which Thiram is not registered
	M4	(captan) **Many brands available:** Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L	**SEE INDIVIDUAL LABELS**		1	1	Rate per treated acre. Special label for FL allows up to 24 applications per season
	M4 + 17	Captevate 68 WDG (captan + fenhexamid)	5.25 lb	21 lb	0	1	Do not make more than 2 consecutive applications
	M12	Fracture (banda de lupinus albus doce - BLAD)	36.6 fl oz	183 fl oz	1	4 hr	Do not make more than 2 sequential applications.
	1	(thiophanate-methyl) **Many brands available:** Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB, Incognito 4.5F, Cercobin, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG , Meteor, Nevado 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	Do not make more than 1 application per season. Do not apply after first fruiting flower
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	Do not make more than 2 sequencial applications before alternating to a fungicide from a different group
	7	Kenja 400 SC (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 + 11	Luna Sensation (fluopyram + tryfloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	12 hr	Do not make more than 2 sequential applications before alternating to a another non-Group 7 or non-Group 11 fungicide
	7 + 11	Pristine (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive appl. and no more than 5 appl/crop
	9	Scala SC (pyrimethanil)	18 fl oz	54 fl oz	1	0.5	Do not make more than 2 consecutive applications. Do not use more than 2 of 6 appl. in any one season
	9 + 12	Switch 62.5 WG (cyprodinil + fludioxonil)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive appl. Do not plant crops not on the label for 30 days after last appl. See special label for instructions on dipping transplants
	17	Elevate 50 WDG (fenhexamid)	1.5 lb	6 lb	0	0.5	Do not make more than 2 consecutive applications
	19	Affirm WDG, Ph-D, Oso, Veranda O (polyoxin-D)	**SEE INDIVIDUAL LABELS**		0	4 hr	Use in alternation with fungicides that have different modes of action. Do not make more than 3 applications per season.
Botrytis (suppression only)	11	Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo (azoxystrobin)	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential appl. and no more than 4 appl/crop year. See label for instructions on dipping transplants
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications and no more than 5 appl/crop year
	11	Flint (trifloxystrobin)	3.2 oz.	19.2 oz.	0	0.5	Do not apply more than 2 sequential applications of Flint of other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season
	11	Aftershock Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Do not make more than 2 sequential applications and no more than 4 applications per season, and a minimum interval of 14 days between applications
Colletotrichum Crown rot	1	(thiophanate-methyl) **Many brands available:** Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB, Incognito 4.5F, Cercobin, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management
	7	Kenja 400 SC (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application
Leaf Scorch	1	(thiophanate-methyl) **Many brands available:** Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB, Incognito 4.5F, Cercobin, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action
Leaf spot	M4	(captan) **Many brands available:** Captan 50W, Captan 50 WP, Captan 80 WDG, Captec 4L	**SEE INDIVIDUAL LABELS**		1	1	Rate per treated acre. Special label for FL allows up to 24 applications per season
	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG , Meteor, Nevado 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	Do not make more than 1 application per season. Do not apply after first fruiting flower
	3	(propiconazole) **Many brands available:** Amtide Propiconazole EC, Bumper 41.8 EC, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	Do not make more than 2 consecutive applications
	3	Nova 40W Rally 40WSP, Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application
	3	Mettle 125 ME (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply same product within 14 days. Do not apply more than 4 applications per season.
	3 + 11	Quadris Top (azoxystrobin + difenoconazole)	14 fl oz	56 fl oz	0	0.5	Do not make more than 2 sequencial applications before alternating to another fungicide group and no more than 4 appl/crop per year.
	3 + 11	Quilt Xcel (azoxystrobin + propiconazole)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications and no more than 4 appl/crop
(supression only)	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
(supression only)	7 + 11	Luna Sensation (fluopyram + tryfloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Merivon (fluxapyroxad + pyraclostrobin)	11 fl oz	33 fl oz	0	12 hr	Do not make more than 2 sequential applications before alternating to a another non-Group 7 or non-Group 11 fungicide
	7 + 11	Pristine (boscalid + pyraclostrobin)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive appl. and no more than 5 appl/ crop
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications and no more than 5 appl/crop year
Leather rot	4	Ridomil Gold EC, Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt/trtd acre	1 ½ qt/ trtd acre	0	2	See label for use in drip irrigation
	4	Metalaxyl 2E AG, MetaStar 2E AG (metalaxyl)	2 qt	6 qt	0	2	See label for use in drip irrigation

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo (azoxystrobin)	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential appl. and no more than 4 appl/crop year. See label for instructions on dipping transplants
	33	Aliette WDG, Legion 80WDG, Linebacker WDG (fosetyl-Al)	5 lb	30 lb	12 hr	0.5	Do not tank mix with copper fungicides, adjuvants or foliar fertilizers
	33	Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite,Phorcephite, Phostrol, Rampart	**SEE INDIVIDUAL LABELS**		0	4 hr	Do not tank mix with copper fungicides
Phomopsis leaf blight	3	Mettle 125 ME (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply same product within 14 days. Do not apply more than 4 applications per season.
	3	Nova 40W Rally 40WSP, Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application
(supression only)	11	Flint (trifloxystrobin)	3.2 oz.	19.2 oz.	0	0.5	Do not apply more than 2 sequential applications of Flint of other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season
(supression only)	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + tryfloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
Phomopsis soft rot	2	(iprodione) **Many brands available:** Enclosure 4, Iprodione 4L AG , Meteor, Nevado 4F, Rovral 4 Flowable	2 pt	2 pt	N/A	1	Do not make more than 1 application per season. Do not apply after first fruiting flower
(supression only)	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + tryfloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
Phytophthora crown rot	4	Metalaxyl 2E AG, MetaStar 2E AG (metalaxyl)	2 qt	6 qt	0	2	See label for use in drip irrigation
	4	Ridomil Gold EC, Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt/trtd acre	1 ½ qt/ trtd acre	0	2	See label for use in drip irrigation
	33	Alude, Confine Extra, Fosphite, Fungi-Phite, K-Phite,Phorcephite, Phostrol, Rampart	**SEE INDIVIDUAL LABELS**		0	4 hr	Do not tank mix with copper fungicides
Powdery mildew	M2	(sulfur) **Many brands available:**	**SEE INDIVIDUAL LABELS**		1	1	Do not use during hot weather

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
		Acoidal, Cosavet DF, Crusade DF, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Rebel DF, Sulfur 90W, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur					
	M2 + 33	Sanction (potassium phosphate + sulfur)	6 pt	24 pt	N/A	1	Do not apply during hot weather. May cause injure during certain climatic conditions
	M12	Fracture (banda de lupinus albus doce - BLAD)	24.4 fl oz	122 fl oz	1	4 hr	Do not make more than 2 sequential applications.
	1	(thiophanate-methyl) **Many brands available:** Thiophanate-methyl 85 WDG, Topsin 4.5 FL, Topsin 70 WDG, Topsin M 70 WP, Topsin M WSB, Incognito 4.5F, Cercobin, Nufarm T-Methyl 4.5 F, Nufarm T-Methyl 70WSB	**SEE INDIVIDUAL LABELS**		1	1	Fungicides from different chemical groups should be used in spray program for disease resistance management
	1 + 3	Protocol (thiophanate-methyl + propiconazole)	1.33 pt	5.3 pt	1	1	Do not make more than 2 consecutive applications before rotating to another fungicide with a different mode of action
	3	(propiconazole) **Many brands available:** Amtide Propiconazole EC, Bumper 41.8 EC, Bumper ES, Orbit, Propi-Star EC, Shar-Shield PPZ, Tilt, Topaz	4 fl oz	16 fl oz	0	0.5	Do not make more than 2 consecutive applications
	3	Nova 40W Rally 40WSP, Sonoma 40 WSP (myclobutanil)	5 oz	30 oz	0	1	Do not plant rotational crops until 30 days after last application
	3	Procure 480 SC (triflumizole)	8 oz	32 oz	1	0.5	Do not plant leafy vegetables within 30 days or root vegetables within 60 days or rotational crops not on label for one year after application
	3	Mettle 125 ME (tetraconazole)	5 fl oz	20 fl oz	0	0.5	Do not apply same product within 14 days. Do not apply more than 4 applications per season.
	3 + 11	Quadris Top (difenoconazole + azoxystrobin)	14 fl oz	56 fl oz	0	0.5	Do not make more than 2 sequencial applications before alternating to another fungicide group and no more than 4 appl/crop per year.
	3 + 11	Quilt Xcel (azoxystrobin + propiconazole)	14 oz	56 oz	0	0.5	Do not make more than 2 consecutive applications and no more than 4 appl/crop
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	Do not make more than 2 sequencial applications before alternating to a fungicide from a different group
	7	Kenja 400 SC (isofetamid)	15.5 fl oz	54 fl oz	0	0.5	Do not plant other crops not registered within 30 days after last application
	7	Luna Privilege (fluopyram)	6.84 fl oz	13.7 fl oz	0	0.5	Apply through drip irrigation system preventatively. Do not make more than 2 sequencial applications before alternating to a fungicide from a different group

Table 15.4. Strawberry fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7 + 9	Luna Tranquility (fluopyram + pyrimethanil)	27 fl oz	54.7 fl oz	1	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Luna Sensation (fluopyram + tryfloxystrobin)	7.6 fl oz	27.3 fl oz	0	0.5	Do not make more than 2 sequential applications before rotating with a fungicide from a different group.
	7 + 11	Merivon (pyraclostrobin + fluxapyroxad)	11 fl oz	33 fl oz	0	12 hr	Do not make more than 2 sequential applications before alternating to a another non-Group 7 or non-Group 11 fungicide
	7 + 11	Pristine (pyraclostrobin + boscalid)	23 oz	115 oz	0	0.5	Do not make more than 2 consecutive appl. and no more than 5 appl/ crop
	11	Abound, Aframe, Azaka, Azoxy 2SC, Equation SC, Satori, Trevo (azoxystrobin)	15.4 fl oz	1.92 qt	0	4 hr	Do not make more than 2 sequential appl. and no more than 4 appl/crop year. See label for instructions on dipping transplants
	11	Cabrio EG (pyraclostrobin)	14 fl oz	70 fl oz	0	0.5	Do not make more than 2 sequential applications and no more than 5 appl/crop year
	11	Flint (trifloxystrobin)	3.2 oz.	19.2 oz.	0	0.5	Do not apply more than 2 sequential applications of Flint of other Group 11 fungicides. Do not exceed more than 6 total applications of Group 11 fungicides per season
	11	Aftershock Evito (fluoxastrobin)	5.7 fl oz	22.8 fl oz	1	0.5	Do not make more than 2 sequential applications and no more than 4 applications per season, and a minimum interval of 14 days between applications
	13	Quintec (quinoxyfen)	6 fl oz	24 fl oz	1	0.5	Do not make more than 2 consecutive applications or more than 4 applications per crop
	19	Affirm WDG, Ph-D, Oso, Veranda O (polyoxin-D)	**SEE INDIVIDUAL LABELS**		0	4 hr	Use in alternation with fungicides that have different modes of action. Do not make more than 3 applications per season.
	U6	Torino (cyflufenamid)	3.4 oz	6.8 oz	0	4 hr	Do not make more than 2 applications per year. Do not apply more than once every 14 days.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 16. Sweet Corn Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Sweet corn - *Zea mays* var. *rugosa,* Poaceae (Gramineae).

Table 16.1. Planting information for sweet corn.

Planting dates	
North Florida	Feb - Apr
Central Florida	Jan - Apr
South Florida	Oct - Mar
Planting information	
Distance between rows (in)	28 - 36
Distance between plants (in)	6 - 81
Seeding depth (in)	1.0 - 1.5
Seed per acre (lb)	6 - 15
Days to maturity from seed	64 - 90
Plant population (acre)	24,000 - 32,000

Cultivars

Table 16.2. Description of major sweet corn cultivars currently available.

Type	Genes controlling sweetness	Storage life (days)	Relative sugar content
Sugary	Full complement of sugary	1 to 3	Normal
Sugary Enhanced, also "Modified" and "EH"	Full complement of sugary (su) and half or full complement of sugary enhancer (se)	3 to 5	Slight to moderate or even high levels
Supersweet, also "Ultra", "Extra" sweet	No sugary (su); full complement of shrunken-2 (sh2)	5 to 10	High
Synergistic, also "Sweet-Gene Hybrid"	Full complement of sugary (su); and half complement of shrunken-2 (sh2)	3 to 5	Moderate
Improved Supersweet	Half complement of sugary (su); and full complement of shrunken-2 (sh2)	5 to 10	Very high
ADX	No sugary (su) or shrunken-2 (sh2) genes; full complement of ae, du, and wx genes.	5 to 10	Moderate to high

Table 16.3. Supersweet (shrunken-2) sweet corn cultivars arranged by kernel color.

Yellow		White		Bicolor	
3188MR	Hercules	3380 XT	Munition	7143	Honor XR
Accentuate	Passion	Crookham 433	Passion	Battalion	Obsesssion
Beyond Multisweet	Primetime	Glacial	Summer Sweet 1760	Big Time	Prestige
Brezza	SV1077	Devotion	SV1580	Beyond BC	Summer Sweet 2182
Crookham 382	SV1446			Crookham 423	Summer Sweet 8102 R Plus
GSS1170				EX 7143	

Table 16.4. Herbicides approved for managing weeds in sweet corn.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			***** PREEMERGENCE *****
Atrazine **Mineral** **1.0 - 2.0** **Muck** **2.0 - 3.0**	(AAtrex) 4 L Mineral 2 - 4 pt. Muck 4 - 6 pt. (Aatrex Nine-0) 90 WDG Mineral 1.1 - 2.2 lb. Muck 2.2 - 3.3 lb.	5	Germinating broadleaf and grass weeds. Apply to moist soil. Do not exceed 2.5 lb. a.i./A per calendar year. Consult labels for plant back restrictions on rotational crops.
Carfentrazone **up to 0.031**	(Aim) 1.9 EW up to 2 fl. oz. (Aim) 2 EC up to 2 fl. oz.	14	Apply as a preplant burn down for emerged broadleaf weeds. Use crop oil concentrate, methylated seed oil, or nonionic surfactant at recommended rates. Maximum rate of 0.096 lb. a.i./A per season. No pretransplant interval.
Dimethanamid-P **0.56 - 0.84**	(Outlook, Slider) 6 EC 12 - 18 fl. oz.	15	Annual broadleaf and grass weeds. After application incorporate into soil by rainfall, sprinkler irrigation, or mechanical tillage. Consult label for rate based on soil texture.
EPTC **4.0 - 6.0**	(Eradicane) 6.7 E 4.75 - 7.33 pt.	8	Annual broadleaf, grass weeds and nutsedge. Use lower rates on lighter soils (sand). Control of perennial weeds such as bermudagrass or nutsedge is increased thorough incorporation.
Flufenacet **0.49 - 0.68**	(Define DF) 60 DF 13 - 18 oz. (Define SC) 4 SC 15 - 19 fl. oz.	15	Annual broadleaf and grass weeds. Rainfall, irrigation, or light cultivation is required within 7 to 10 days of application. Consult label for rate based on soil texture.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaf and grass weeds. Apply as a preplant burndown. Tank mix with a residual herbicide to broaden spectrum of weed control. Consult label for individual product directions.
Mesotrione **0.188 - 0.24**	(Callisto) 4 L 6.0 - 7.7 fl. oz.	28	Annual broadleaf weeds. Tank mix with a preemergence grass herbicide for grass control. Do not exceed 7.7 fl. oz./A per season.
Paraquat **0.5 - 1.0**	(Gramoxone) 2 SL 2.0 - 4.0 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.	22	Emerged broadleaf and grass weeds. Apply as a preplant burndown. No more than 3 applications per year. Tank mix with a residual preemergence herbicide to broaden the spectrm of weed control.
Pendimethalin **Mineral** **0.75 - 1.0** **Muck** **1.0 - 2.0**	(Acumen, Prowl) 3.3 EC Mineral 1.8 - 2.4 pt. Muck 2.4 - 4.8 pt. (Prowl H20) 3.8 Mineral 2.0 - 3.0 pt. Muck 2.0 - 4.0 pt.	3	Broadleaf and grass weeds. Overhead irrigation or rainfall is required within 7 days of application.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v	27	Emerged broadleaf and grass weeds. Apply as a preplant burndown treatment. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with soil residual compounds.
Pyraflufen **0.001 - 0.003**	(ET Herbicide) 0.208 EC 0.5 - 2.0 fl. oz.	14	Emerged broadleaf weeds. Apply as a preplant burndown treatment.
***S*-metolachlor** **1.0 - 1.6**	(Brawl, Dual Magnum) 7.62 EC 1.0 - 1.67 pt. (Cinch, Dual II Magnum) 7.64 EC 1.0 - 1.67 pt.	15	Annual broadleaf and grass weeds. Use a lower rate on lighter soils. Weed control is increased with 0.5 to 1 in. of rainfall or irrigation. Do not exceed 3.9 pt./A per crop year depending on soil texture.
Simazine **2.0**	(Princep, Simazine) 4 L 2.0 qt. (Princep, Simazine) 90 WDG 2.2 lb.	5	Broadleaf and grass weeds. If a second application is required do no exceed 2.5 lb. a.i./A per calendar year. Simazine 4 L and Simazine 90 DF can be applied to muck soils at 2.5 lb. a.i./A. PHI 45 days.

Table 16.4. Herbicides approved for managing weeds in sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			*** **POSTEMERGENCE** ***
Atrazine **Mineral** **1.0 - 2.0** **Muck** **2.0 - 3.0**	(AAtrex) 4 L Mineral 2 - 4 pt. Muck 4 - 6 pt. (Aatrex Nine-0) 90 WDG Mineral 1.1 - 2.2 lb. Muck 2.2 - 3.3 lb.	5	Broadleaf and some grass weeds. Apply before weeds exceed 1.5 in. tall and before corn exceeds 12 in. in height. Do not exceed 2.5 lb. a.i./A per calendar year. Consult label for plant back restrictions on rotational crops.
Bentazon **0.75 - 1.0**	(Basagran) 4 L 1.5 - 2.0 pt.	6	Certain broadleaf and sedge weeds. Consult label for weeds controlled/weed size table. Do not apply more than 4 pt./A per season.
Carfentrazone **0.008 - 0.016**	(Aim) 1.9 EW 0.5 - 1.0 fl. oz (Aim) 2 EC 0.5 - 1.0 fl. oz	14	Emerged broadleaf weeds. Apply up to the 14-leaf stage of corn growth. After the V8 stage of growth, apply as a directed application. Do not apply more than 2.0 fl. oz./A per season including preplant burndown and crop application. PHI 3 days.
Halosulfuron **0.03 - 0.05**	(Sandea) 75 DF 0.6 - 1.0 oz.	2	Broadleaf and nutsedge weeds. Apply over-the-top or with drop nozzles from the spike to the layby stage of corn. A sequential application of 0.66 oz./A may be with drop nozzles to avoid application to the plant whorl. No more than 2 applications per year.
Mesotrione **0.094**	(Callisto) 4 L 3 fl. oz.	28	Broadleaf weeds. Treat up to 30 in. tall or up to the 8-leaf stage. Include a crop oil concentrate or nonionic surfactant in the spray solution. Slight leaf bleaching may occur. Do not exceed 7.7 fl. oz./A per season.
Nicosulfuron **0.03 - 0.06**	(Accent) 75 WDG 0.6 - 1.3 oz. (Accent Q) 54.5 WDG 0.9 - 1.8 oz.	2	Broadleaf and grass weeds. Sensitivity to sweet corn varieties is variable. Do not apply to 'Merit' sweet corn. Do not apply to corn that has previously been treated with 'Counter', 'Lorsban', or 'Thimet' insecticides for this may result in injury. Consult lable for acceptable insecticides. Apply broadcast to corn plants less than 12 in. tall. Apply with drop nozzles to direct spray to corn plants 12 - 18 in. tall.
Pendimethalin **Mineral** **0.75 - 1.0** **Muck** **1.0 - 2.0**	(Acumen, Prowl) 3.3 EC Mineral 1.8 - 2.4 pt. Muck 2.4 - 4.8 pt. (Prowl H20) 3.8 Mineral 2.0 - 3.0 pt. Muck 2.0 - 4.0 pt.	3	Broadleaf and grass weeds. Apply after 4 in. tall until corn is 20 to 24 in. tall or the V8 growth stage. Direct the spray to the base of the plants.
S-**metolachlor** **up to 1.9**	(Brawl, Dual Magnum) 7.62 EC up to 2.0 pt. (Cinch, Dual II Magnum) 7.64 EC up to 2.0 pt.	15	Annual broadleaf and grass weeds. Apply after crop emergence up to 40 in. in height. Direct spray to the base of the plants when plants are taller than 5 in. Use a lower rate on lighter soils. Weed control is increased with 0.5 to 1 in. of rainfall or irrigation. DO not exceed 3.9 pt./A per crop year depending on soil texture. PHI 30 days.
Tembotrione **0.08**	(Laudis) 3.5 EC 3 fl. oz.	28	Annual broadleaf and grass weeds. Crop tolerance is dependent on variety so apply to a small area if tolerance is unknown. Do not use on Merit or Shogun varieities. May be applied from corn emergence through the V7 stage of growth. Do not exceed 3 fl. oz./A per season.
Topramezone **0.02 - 0.022**	(Armezon, Impact) 2.8 0.75 - 1.0 fl. oz.	28	Broadleaf and grass weeds. Consult label for maximum size of certain weed species for control. PHI 45 days.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
Aphids	1A	***Lannate LV, *Lannate SP** (methomyl)	**LV:** 0.75-1.5 pt; **SP: 0.25-0.50 lb**	48	**LV:** 0 - ears ; **SP:** 3 - forage, 21 - stover	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1B	**Lorsban 75WG, *Advanced, 15G** (chlorpyrifos)	**75WG:** 0.33-1.33 lb; **Advanced:** 0.5-2.0 pt **15G:** 8 oz per 1000 ft of row	24	**75WG:** 21 (grain or ears); **15G:** at planting	Do not feed treated corn silage, forage, or fodder, or allow livestock to graze. Do not make more than 3 applications of any product containing chlorpyrifos per season. See label for application methods and pest-specific instructions.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	at planting: 3.4-13.6 fl oz; pre-plant, incorporated: 4-5.3 fl oz; pre-emergence: 3.4 fl oz	12	see label	See label for application methods and restrictions. For mixing with liquid fertilizer. Do not apply more than 0.2 lb active ingredient per acre per season of all bifenthrin products.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed2.
	4A	**Assail 30SG** (acetamiprid)	4.0-5.3 oz	12	none listed	Do not exceed a total of 11.2 oz of product per acre per growing season. Do not exceed 2 crop seasons per year.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	un	**Trilogy** (extract of neem oil)	1.0-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed.
	--	**Oil, insecticidal**	1-2 gal/100 gal, depending on brand	4	0	
Beetles (includes banded cucumber beetle, flea beetles, sap beetles, seed corn beetle)	1A	***Lannate LV, *Lannate SP** (methomyl)	**LV:** 0.75-1.5 pt; **SP: 0.25-0.50 lb**	48	**LV:** 0 - ears ; **SP:** 3 - forage, 21 - stover	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	**Sevin 80S; 4F; XLR** (carbaryl)	**80S:** 1.25-2.5 lb; **4F; XLR:** 1-2 qt	12	**80S:** 2 – ears ; **4F:** 14 – forage; **XLR:** 48 – fodder	Highly toxic to bees.
	1B, 3A	***Cobalt Advanced** (chlorpyrifos, lambda-cyhalothrin)	6-42 fl oz	24	21	See label for application methods and many restrictions.
	1B	***Counter 15G Lock 'n Load** (terbufos)	6.0-8.0 oz per 1000 ft of row, banded or in furrow; post emergence incorporated, 8 oz per 1000 ft of row at cultivation	48	60	(1)Early season control of light to moderate infestations. Only one application (at-planting, post-emergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	1B	***Thimet 20-G** (phorate)	See label. 4.5-6.0 oz per 1000 ft of row	48	at planting, see label	One application per season, no more than 6.5 lb/ acre per season.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	3A	***Ambush 25W** (permethrin)	6.4-16.0 oz	12	1	Do not apply more than 2.0 lb ai/acre per season. Rates above 12.8 oz are for Florida only.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Maximum number of applications: 10. Maximum amount allowed per season: 28 fl oz/acre.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	1.02-1.54 fl oz	24	1 - ears, 21-fodder	
	3A	***Force 3G Insecticide** (tefluthrin)	depends on row spacing	0	at planting or cultivation within 30 days of seeding emergence	Only one application per crop. Granules must be incorporated. (1) suppression only. (2) suppression for 28 days
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.
	4A	**Assail 30SG** (acetamiprid)	4.0-5.3 oz	12	none listed	Do not exceed a total of 11.2 oz of product per acre per growing season. Do not exceed 2 crop seasons per year.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	1	See label for timing of applications for specific pests. Do not apply more than 60 fl oz per acre per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed.
Caterpillars (includes beet armyworm, corn borer, corn earworm, cutworms, fall armyworms, webworms)	1A	***Lannate LV, *Lannate SP** (methomyl)	**LV:** 0.75-1.5 pt; **SP: 0.25-0.50 lb**	48	**LV:** 0 - ears ; **SP:** 3 - forage, 21 - stover	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	***Larvin 3.2** (thiodicarb)	20-30 fl oz	48	0	Do not allow livestock to graze treated field. Do not feed treated corn silage or fodder to livestock. See label for special instructions for cutworms.
	1A	**Sevin 80S; 4F; XLR** (carbaryl)	**80S:** 1.25-2.5 lb; **4F; XLR:** 1-2 qt	12	**80S:** 2 – ears ; **4F:** 14 – forage; **XLR:** 48 – fodder	Highly toxic to bees.
	1B, 3A	***Cobalt Advanced** (chlorpyrifos, lambda-cyhalothrin)	6-42 fl oz	24	21	See label for application methods and many restrictions.
	1B	***Counter 15G Lock 'n Load** (terbufos)	6.0-8.0 oz per 1000 ft of row, banded or in furrow; post emergence incorporated, 8 oz per 1000 ft of row at cultivation	48	60	(1)Early season control of light to moderate infestations. Only one application (at-planting, post-emergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	1B	**Lorsban 75WG, *Advanced, 15G** (chlorpyrifos)	**75WG:** 0.33-1.33 lb; **Advanced:** 0.5-2.0 pt **15G:** 8 oz per 1000 ft of row	24	**75WG:** 21 (grain or ears); **15G:** at planting	Do not feed treated corn silage, forage, or fodder, or allow livestock to graze. Do not make more than 3 applications of any product containing chlorpyrifos per season. See label for application methods and pest-specific instructions. See 24(c) SLN for Lorsban Advanced for control of beet armyworm, fall armyworm, and corn earworm larvae (7 day PHI).
	1B	***Mocap 15G** (ethoprop)	See label.	48	at planting	One application per growing season.
	3A	***Ambush 25W** (permethrin)	6.4-16.0 oz	12	1	Do not apply more than 2.0 lb ai/acre per season. Rates above 12.8 oz are for Florida only.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Maximum number of applications: 10. Maximum amount allowed per season: 28 fl oz/acre.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	at planting: 3.4-13.6 fl oz; pre-plant, incorporated: 4-5.3 fl oz; pre-emergence: 3.4 fl oz	12	see label	See label for application methods and restrictions. For mixing with liquid fertilizer. Do not apply more than 0.2 lb active ingredient per acre per season of all bifenthrin products.
	3A	***Declare Insecticide** (gamma-cyhalothrin)	1.02-1.54 fl oz	24	1 - ears, 21-fodder	(1)Use higher rates for large larvae
	3A	***Force 3G Insecticide** (tefluthrin)	depends on row spacing	0	at planting or cultivation within 30 days of seeding emergence	Only one application per crop. Granules must be incorporated.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	3A	***Pounce 1.5 G, 25 WP** (permethrin)	**1.5G:** 8 oz/1000 ft; 6.7-13.3 lb; **25WP:** 6.4-16.0 oz	12	**1.5G:** at planting, pre-emergence, 1	**1.5G:** Do not apply more than 2.0 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.
	5	**Entrust SC** (spinosad)	1.5-6.0 fl oz	4	1 day - ears; 7 day - forage	Do not apply more than 29 oz per acre per year or six applications.
	5	**Radiant SC** (spinetoram)	3-6 fl oz	4	1 - ear harvest3 - forage or fodder	No more than 6 applications per year.
	11A	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	1.0-2.0 lb	4	0	Apply when larvae are small for best control. OMRI-listed.
	11A	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed2.
	11A	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Use high rate for armyworms. Treat when larvae are young. Not for organic production.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	11A	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	Use higher rates for armyworms. OMRI-listed2.
	11A	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	Treat when larvae are young. Good coverage is essential. For organic production.
	11A	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb	4	0	Treat when larvae are young. Thorough coverage is essential. OMRI-listed2.
	11A	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	1	See label for timing of applications for specific pests. Do not apply more than 60 fl oz per acre per season.
	22	**Avaunt** (indoxacarb)	2.5-3.5 oz	12, (14 days for hand harvest-ing)	3, (35 for fodder & stover)	Whorl application (before silking) only. No more than 4 applications per season.
	28	**Belt SC** (flubendiamide)	2.0-3.0 fl oz	12	1	Do not apply more than 12 fl oz/acre per season (or four applications). Use in rotation with products with a different mode of action.
	28	**Coragen** (rynaxypyr)	3.5-5.0 fl oz	4	1	Foliar only. No more than 4 applications per crop. Do not apply more than 15.4 fl oz per acre per crop.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4-16 fl oz	12	0	OMRI-listed.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed.
	--	**Oil, insecticidal**	1-2 gal/100 gal, depending on brand	4	0	
Chinch bugs	1A	**Sevin 80S; 4F; XLR** (carbaryl)	**80S:** 1.25-2.5 lb; **4F; XLR:** 1-2 qt	12	**80S:** 2 – ears ; **4F:** 14 – forage; **XLR:** 48 – fodder	Highly toxic to bees.
	1B, 3A	***Cobalt Advanced** (chlorpyrifos, lambda-cyhalothrin)	6-42 fl oz	24	21	See label for application methods and many restrictions.
	1B	***Counter 15G Lock 'n Load** (terbufos)	6.0-8.0 oz per 1000 ft of row, banded or in furrow; post emergence incor-porated, 8 oz per 1000 ft of row at cultivation	48	60	(1)Early season control of light to moderate infestations. Only one application (at-planting, post-emergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Maximum number of applications: 10. Maximum amount allowed per season: 28 fl oz/acre.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	3A	***Force 3G Insecticide** (tefluthrin)	depends on row spacing	0	at planting or cultivation within 30 days of seeding emergence	Only one application per crop. Granules must be incorporated.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.
Corn silkfly	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Maximum number of applications: 10. Maximum amount allowed per season: 28 fl oz/acre.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	4A	**Assail 30SG** (acetamiprid)	4.0-5.3 oz	12	none listed	Do not exceed a total of 11.2 oz of product per acre per growing season. Do not exceed 2 crop seasons per year.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed.
Fire ants	3A	***Force 3G Insecticide** (tefluthrin)	depends on row spacing	0	at planting or cultivation within 30 days of seeding emergence	Only one application per crop. Granules must be incorporated. (1) suppression only. (2) suppression for 28 days
	7A	**Extinguish** ((S)-methoprene)	1-1.5 lb	4	0	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
Grasshoppers	1B, 3A	***Cobalt Advanced** (chlorpyrifos, lambda-cyhalothrin)	6-42 fl oz	24	21	See label for application methods and many restrictions.
	1B	**Lorsban 75WG, *Advanced, 15G** (chlorpyrifos)	**75WG:** 0.33-1.33 lb; **Advanced:** 0.5-2.0 pt **15G:** 8 oz per 1000 ft of row	24	**75WG:** 21 (grain or ears); **15G:** at planting	Do not feed treated corn silage, forage, or fodder, or allow livestock to graze. Do not make more than 3 applications of any product containing chlorpyrifos per season. See label for application methods and pest-specific instructions.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Maximum number of applications: 10. Maximum amount allowed per season: 28 fl oz/acre.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	15	**Rimon 0.83EC** (novaluron)	6-12 fl oz	12	1	See label for timing of applications for specific pests. Do not apply more than 60 fl oz per acre per season.
Leafhoppers	1A	**Sevin 80S; 4F; XLR** (carbaryl)	**80S:** 1.25-2.5 lb; **4F; XLR:** 1-2 qt	12	**80S:** 2 – ears ; **4F:** 14 – forage; **XLR:** 48 – fodder	Highly toxic to bees.
	3A	***Ambush 25W** (permethrin)	6.4-16.0 oz	12	1	Do not apply more than 2.0 lb ai/acre per season. Rates above 12.8 oz are for Florida only.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	12	3	Maximum of 0.3 lb ai/acre per season.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed2.
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Soil pests - corn rootworm, seed corn maggot, white grubs, wireworms	1A	***Lannate LV, *Lannate SP** (methomyl)	**LV:** 0.75-1.5 pt; **SP: 0.25-0.50 lb**	48	**LV:** 0 - ears ; **SP:** 3 - forage, 21 - stover	Certain hybrid varieties are susceptible to methomyl injury. Treat a small area to determine safety first.
	1A	**Sevin 80S; 4F; XLR** (carbaryl)	**80S:** 1.25-2.5 lb; **4F; XLR:** 1-2 qt	12	**80S:** 2 – ears ; **4F:** 14 – forage; **XLR:** 48 – fodder	Highly toxic to bees.
	1B, 3A	***Cobalt Advanced** (chlorpyrifos, lambda-cyhalothrin)	6-42 fl oz	24	21	See label for application methods and many restrictions.
	1B	***Counter 15G Lock 'n Load** (terbufos)	6.0-8.0 oz per 1000 ft of row, banded or in furrow; post emergence incorporated, 8 oz per 1000 ft of row at cultivation	48	60	(1)Early season control of light to moderate infestations. Only one application (at-planting, post-emergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	1B	**Lorsban 75WG, *Advanced, 15G** (chlorpyrifos)	**75WG:** 0.33-1.33 lb; **Advanced:** 0.5-2.0 pt **15G:** 8 oz per 1000 ft of row	24	**75WG:** 21 (grain or ears); **15G:** at planting	Do not feed treated corn silage, forage, or fodder, or allow livestock to graze. Do not make more than 3 applications of any product containing chlorpyrifos per season. See label for application methods and pest-specific instructions.
	1B	***Mocap 15G** (ethoprop)	See label.	48	at planting	One application per growing season.
	1B	***Thimet 20-G** (phorate)	See label. 4.5-6.0 oz per 1000 ft of row	48	at planting, see label	One application per season, no more than 6.5 lb/ acre per season.
	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A	***Baythroid XL** (beta-cyfluthrin)	0.8-2.8 fl oz	12	0	Maximum number of applications: 10. Maximum amount allowed per season: 28 fl oz/acre.
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.
	3A	***Capture LFR** (bifenthrin)	at planting: 3.4-13.6 fl oz; pre-plant, incorporated: 4-5.3 fl oz; pre-emergence: 3.4 fl oz	12	see label	See label for application methods and restrictions. For mixing with liquid fertilizer. Do not apply more than 0.2 lb active ingredient per acre per season of all bifenthrin products.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	3A	***Force 3G Insecticide** (tefluthrin)	depends on row spacing	0	at planting or cultivation within 30 days of seeding emergence	Only one application per crop. Granules must be incorporated. (1) suppression only. (2) suppression for 28 days
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed2.
	--	**Oil, insecticidal**	1-2 gal/100 gal, depending on brand	4	0	
Tarnished plant bug	3A	***Asana XL (0.66EC)** (esfenvalerate)	5.8-9.6 fl oz	12	1	Do not apply more than 0.5 lb ai/acre per season (10 applications at highest rate).
	3A, 28	***Besiege** (lambda-cyhalothrin, chlorantraniliprole)	6-10 fl oz	24	1	Do not exceed 31 fl oz of Besiege per acre per year.
	3A	***Brigade 2EC** (bifenthrin)	2.1-6.4 fl oz	12	1	Use of Brigade is prohibited in coastal counties. Do not apply more than 12.8 fl oz per acre per season. See label for soil application at planting. Many other brands available with same active ingredient.
	3A	***Warrior II** (lambda-cyhalothrin)	0.33 fl oz per 1000 ft of row (at plant); 1.28-1.92 fl oz (foliar)	24	1; 21 for feeding livestock or for soil applications	Use higher rates with large armyworm larvae. Many other brands with same active ingredient are available. Do not apply more than 30.72 fl oz per acre per crop.
Thrips	1B	***Counter 15G Lock 'n Load** (terbufos)	6.0-8.0 oz per 1000 ft of row, banded or in furrow; post emergence incorporated, 8 oz per 1000 ft of row at cultivation	48	60	(1)Early season control of light to moderate infestations. Only one application (at-planting, post-emergence incorporated, or cultivation time treatment) per season. Do not exceed 8.7 lb/acre. 20G formulation also available.
	3A	**PyGanic Crop Protection EC 5.0** (pyrethrins)	4.5-18 fl oz	12	0	Thorough coverage is essential. Breaks down rapidly in sunlight. OMRI-listed.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.
	un	**Trilogy** (extract of neem oil)	1.0-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.
	--	**BotaniGard ES** (*Beauveria bassiana*)	0.5-2 qt/100 gal	4	0	May be used in greenhouses. Contact dealer for recommendations if an adjuvant must be used. Not compatible in tank mix with fungicides.
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed.
	--	**Oil, insecticidal**	1-2 gal/100 gal, depending on brand	4	0	
Spider mites	1B	***Thimet 20-G** (phorate)	See label. 4.5-6.0 oz per 1000 ft of row	48	at planting, see label	One application per season, no more than 6.5 lb/ acre per season.
	23	**Oberon 2 SC** (spiromesifen)	5.7-16 fl oz	12	5 for fresh, green forage or silage; grain or stover, 30	No more than two applications or a total of 17 fl oz per acre per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed2.
	un	**Trilogy** (extract of neem oil)	1.0-2.0% V/V	4	0	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment.

Table 16.5. Insecticides approved for managing arthropod pests of sweet corn. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Pest	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	REI (hours)	Days to Harvest	Remarks
	–	**Grandevo** (*Chromobacterium subtsugae* strain PRAA4-1)	1-3 lb	4	0	OMRI-listed.
Weevils	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	Antifeedant, repellant, insect growth regulator. OMRI-listed2.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz	4	0	Antifeedant, repellant, insect growth regulator.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.3, February 2014. Number codes (1 through 28) are used to distinguish the main insecticide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 16.6. Sweet corn fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
Bacterial stalk rot	M1	(copper compounds) **Many brands available:** Badge X2, Copper Count N, Cueva, Kocide 2000, Kocide 3000, Mastercop, Nu-Cop DF, Top Cop w/ Sulfur	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days	
Powdery mildew **Rust**	M2	(sulfur) **Many brands available:** Kumulus DF, Microfine Sulfur, Sulfur 90W, Top Cop w/ Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Do not apply during periods of warm weather. Do not apply within 2 weeks of an oil spray.
Northern blight **Southern blight** **Common rust**	M3	(mancozeb) **Many brands available:** Dithane DF Rainshield, Dithane F-45 Rainshield, Dithane M45, Fortuna, Koverall, Manzate DF, Manzate Flowable, Manzate Pro-Stick, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP, Roper DF	1.5 lb	24 lb	7	1	Start applications at the first sign of disease.
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Chloronil 720, Chlorothalonil 720 SC, Echo 720, Echo 90DF, Echo ZN, Equus 500 ZN, Equus 720, Equus DF, Initiate 720, Initiate ZN	SEE INDIVIDUAL LABELS		7	0.5	
	3	(propiconazole) **Many brands available:** Amtide propiconizole 41.8, Bumper 41.8EC, Fitness, Propiconazole E-AG 41.8EC, Propi-cure 3.6F, Propimax EC, Propi-Star EC, Shar-Shield PPZ, Tide Propiconazole, Tilt 3.6EC, Topaz	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.

Table 16.6. Sweet corn fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	3	(tebuconazole) **Many brands available:** Folicur 3.6F, Monsoon 3.6F, Onset 3.6L, Orius 3.6F, Tebu-Crop, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	6 fl oz	24 fl oz	7	0.5	Restricted-entry time is 19 days.
	3	Prosaro (tebuconazole + prothioconazole)	8.2 fl oz	26 fl oz	7	0.5	See label for adjuvant information and rotational restrictions.
	3 & 33	Viathon (tebuconazole + potass. phosphite)	3.0 pt	16.5 pt	7	0.5	See label for details and rotational restrictions.
	7	Trivapro A (benzovindiflupyr)	4.0 fl oz	14.0 fl oz	7	0.5	Use in combination with a group 3 and 11 fungicide. Rotate with a non-group 7 fungicide.
	7	Vertisan (penthiopyrad)	24 fl oz	48 fl oz	0	0.5	Soil and foliar treatments.
	11	Aftershock (fluoxastrobin)	0.24 fl oz per 1000' of row in soil, 3.8 fl oz foliarly	22.8 fl oz in-furrow or 7.6 fl oz foliarly		0.5	Soil and foliar treatments.
	11	Aproach SC (picoxystrobin)	12 fl oz	36 fl oz	7	0.5	See label for details.
	11	Evito 480SC (fluoxastrobin)	3.8 fl oz	15.2 fl oz	7	0.5	Do not exceed 2 sequential and 4 total appls.
	11	Headline SC (pyraclostrobin)	12 fl oz	72 fl oz	0	0.5	Do not exceed 2 sequential and 6 total appls. of Headline or other QoI fungicides.
	11	Quadris (azoxystrobin)	15.4 fl oz or 0.8 fl oz/ 1000 row ft	2.88 qt	0	4 hr	Do not exceed 2 sequential and 4 total appl. of Quadris or other QoI fungicides. See label for soil applications.
	11	Willowood (azoxystrobin)	15.5 fl oz	62 fl oz	0	4 hr	Do not exceed 2 sequential applications
	11 & 3	Azoxy Teb (azoxystrobin & tebuconazole)	12.9 fl oz	51.7 fl oz	7	19	See label for details. Check plant back restrictions. Do not use adjuvant following V8 stage.
	11 & 3	Custodia (azoxystrobin + tebuconazole)	12.9 fl oz	51.7 fl oz	21	0.5	See label for details.
	11 & 3	Evito T (fluoxastrobin + tebuconazole)	9 fl oz	36 fl oz	7	19	Do not exceed 2 sequential and 4 total appls.
	11 & 3	Headline AMP (pyraclostrobin + metconazole)	14.4 fl oz	57.6 fl oz		0.5	Do not exceed 2 sequential and 4 total appls. of Headline AMP.
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Avaris (azoxystrobin + propiconazole)	14 fl oz	28 fl oz	14	0.5	See label for details.
	11 & 3	Stratego YLD (trifloxystrobin + prothioconazole)	5 fl oz	20 fl oz	14	0.5	Do not apply more than 2 sequential applications.
	11 & 7	Elatus (azoxystrobin & benzovindiflupyr)	7.3 fl oz	14.6 fl oz	7	0.5	Do not make more than 2 sequential applications. Do not apply within 14 days of last application of Elatus.
	11 & 7	Priaxor SC (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	See label for details.
	11, 7, 3	Trivapro (azoxystrobin & propiconazole & benzovindiflupyr)	10.5 fl oz	21.0 fl oz	7	0.5	See label for details.

Table 16.6. Sweet corn fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
Gray leaf spot	3	(tebuconazole) **Many brands available:** Folicur 3.6F, Monsoon 3.6F, Orius 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F	6 fl oz	24 fl oz	7	0.5	Restricted-entry time is 19 days.
	3 & 33	Viathon (tebuconazole + potass. phosphite)	3.0 pt	16.5 pt	7	0.5	See label for details and rotational restrictions.
	7 & 11	Priaxor SC (pyraclostrobin & fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	Alternate with a fungicide of dissimilar mode of action.
Eye Spot	3	(propiconazole) **Many brands available:** Amtide propiconizole 41.8, Bumper 41.8EC, Fitness, Propiconazole E-AG 41.8EC, Propimax EC, Tilt 3.6E	4 fl oz	16 fl oz	14	0.5	Do not exceed 4 total appls.
	7	Vertisan (penthiopyrad)	24 fl oz	48 fl oz	0	0.5	Soil and foliar treatments. See label for details.
	7 & 11	Priaxor SC (pyraclostrobin & fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	Alternate with fungicides of dissimilar modes of action.
	11	Aftershock (fluoxastrobin)	0.24 fl oz per 1000' of row in soil, 3.8 fl oz foliarly	22.8 fl oz in-furrow or 7.6 fl oz foliarly		0.5	Soil and foliar treatments. See label for details.
	11	Evito 480SC (fluoxastrobin)	3.8 fl oz	15.2 fl oz	7	0.5	Do not exceed 2 sequential and 4 total appls.
	11	Headline EC (pyraclostrobin)	12 fl oz	72 fl oz	0	0.5	Do not exceed 2 sequential and 6 total appls. of Headline or other QoI fungicides.
	11	Headline SC (pyraclostrobin)	12 fl oz	72 fl oz	0	0.5	Do not exceed 2 sequential and 6 total appls. of Headline or other QoI fungicides.
	11	Quadris (azoxystrobin)	15.4 fl oz or 0.8 fl oz/ 1000 row ft	2.88 qt	0	4 hr	Do not exceed 1 sequential and 4 total appl. of Quadris or other QoI fungicides. See label for soil applications.
	11 & 3	Evito T (fluoxastrobin + tebuconazole)	9 fl oz	36 fl oz	7	19	Do not exceed 2 sequential and 4 total appls.
	11 & 3	Headline AMP (pyraclostrobin + metconazole)	14.4 fl oz	57.6 fl oz		0.5	Do not exceed 2 sequential and 4 total appls. of Headline AMP.
	11 & 3	Quilt (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Quilt XCEL (azoxystrobin + propiconazole)	14 fl oz	56 fl oz	14	0.5	Alternate every other application with a fungicide of dissimilar mode of action.
	11 & 3	Avaris (azoxystrobin + propiconazole)	14 fl oz	28 fl oz	14	0.5	See label for details.
	11 & 3	Stratego 250EC (trifloxystrobin + propiconazole)	12 fl oz	24 fl oz	14	0.5	Do not apply more than 2 sequential applications.
	11 & 3	Stratego YLD (trifloxystrobin + propiconazole)	5 fl oz	20 fl oz	14	0.5	Do not apply more than 2 sequential applications.
	11 & 7	Priaxor SC (pyraclostrobin + fluxapyroxad)	8 fl oz	16 fl oz	7	0.5	See label for details.
Damping-off	M3	Defiant 75WP (thiram)	5.3 oz/ 100 lbs of seed			1	Seed treatment only.
	M3	Signet 480FS	5.0 oz/ 100lbs of seed			1	Seed treatment only.
Damping-off **Seedling blight**	3	Vortex (ipconazole)	0.085 fl oz/ 100 lb of seed			0.5	Seed treatment only.

Table 16.6. Sweet corn fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	4 & 3	Dividend Extreme (mefenoxam + difenoconazole)	5 fl oz/ 100 lbs of Seed			2	Seed treatment only.
	11	Dynasty (azoxystrobin)	0.153 fl oz/ 100 lbs of seed			4 hrs	Seed treatment only.
	11	Trilex (trifloxystrobin)	0.96 fl oz/ 100 lb of seed			0.5	Seed treatment only.
Pythium seedling blight **Systemic downy mildew**	4	(metalaxyl) **Various brands available:** Acquire, Acceleron, Allegiance, Sebring 2.65ST	3 fl oz/ 100 lb seed			1	Seed treatment only.
	4	Apron XL LS (mefenoxam)	2.2 fl. oz./ 100 lb seed			2	Seed treatment only.
	33	(mono- and di-potassium salts of phosphorous acid) **Various brands available:** Confine Extra, K-phite	3 qts		0	4 hr	See label for details.
Soil-borne diseases	11	Aftershock (fluoxastrobin)	0.24 fl oz per 1000' of row in soil, 3.8 fl oz foliarly	22.8 fl oz in-furrow or 7.6 fl oz foliarly		0.5	Soil and foliar treatments. See label for details.
Various seedling diseases	1, 4, 11, 12	Maxim Quatro (thiabendazole, mefenoxam, azoxystrobin, and fludioxonil)					Seed treatment only.
	4, 14, & NC	System 3 (mefenoxam + PCNB + Bacillus subtilis GB03)	3 oz/bu of seed			1	Seed treatment only.
	11	Stamina (pyraclostrobin)	1.6 fl oz/100 lbs seed				Seed treatment only.
	12	Maxim 4FS (fludioxonil)	0.16 fl oz/ 100 lbs seed			0.5	Seed treatment only.
	14	Rizolex (tolclofos-methyl)	0.3 fl oz/ 100 lbs/seed			12 hr	Seed treatment only.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 17. Tomato Production

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Information regarding crop specific fertilization and irrigation recommendations can be found in chapters 2 and 3, respectively.

Botany and Planting

Tomato - *Solanum lycopersicum*, Solanaceae

Table 17.1. Planting information for tomato.

Planting dates	
North Florida	July-Aug ; Feb-Apr
West-central Florida	Aug-Sept; Jan-Feb
South Florida	Aug-Feb
Planting information	
Distance between rows (in.)	48-72
Distance between plants (in.)	18-32
Days to maturity	70-90
Plant population per acre	3630-4356

Cultivars

For more information on tomato varieties use the link below.
https://edis.ifas.ufl.edu/hs1189

1. LARGE FRUITED AND BEEFSTAKE TYPES

Amelia. Vigorous determinate, main season, jointed hybrid. Fruit are firm and aromatic suitable for green or vine ripe. Good crack resistance. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3), root-knot nematode, gray leaf spot and Tomato spotted wilt.

Bella Rosa. Midseason maturity. Fruit are large to extra-large, deep globed shaped with firm, uniform green fruits well suited for mature green or vine-ripe production. Determinate, medium to tall vine. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), gray leaf spot, and tomato spotted wilt.

BHN 602. Early-midseason maturity. Fruit are globe shape but larger than BHN 640, and green shouldered. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3) and tomato spotted wilt.

BHN 975. Midseason maturity. "Hot set" variety. Strong bush with large, smooth fruit. Resistant: Fusarium crown and root rot, Fusarium wilt (races 1 and 2), Verticillium wilt (race 1).

Camaro. Medium plant with limited to no pruning. Extra large globe shaped fruit. Resistant: Alternaria stem canker, Fusarium wilt (races 1,2, and 3), Verticilium wilt (race 1). Intermediate resistance: gray leaf spot, Tomato yellow leaft curl.

Charger. Vigorous plant with good vine cover. Large, smooth, deep oblate fruit with excellent firmness and color. Resistant: Fusarium wilt (races 1, 2, and 3), tomato yellow leaf curl, Verticillium wilt (race 1) and Alternaria stem canker.

Crista. Midseason maturity. Large, deep globe fruit with tall robust plants. It does best with moderate pruning and high fertility. Good flavor, color and shelf-life. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3), tomato spotted wilt and root-knot nematode.

Florida 47. A late midseason, determinate, jointed hybrid. Uniform green, globe-shaped fruit. Resistant: Fusarium wilt (races 1 and 2), Verticillium wilt (race 1), Alternaria stem canker, and gray leaf spot.

Florida 91. Midseason variety. Uniform green fruit borne on jointed pedicels. Determinate plant. Good fruit setting ability under high temperatures. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), Alternaria stem canker, and gray leaf spot.

Grand Marshall. Mid-season vigorous plant with hot set and extra large to large oblate fruit. Resistant: Alternaria stem canker, Fusarium wilt (race 1 and 2). Intermediate resistance: gray leaf spot, Tomato yellow leaf curl.

HM 1823. Determinant round tomato, early maturing variety with a strong plant and large to extra-large round fruit. Verticilium wilt (race 1), Fusarium wilt (races 1 and 2), Fusarium crown and root rot and gray leaf spot.

HM 8849 CR. Early maturing variety with a strong plant and good leaf cover. Fruit extra-large, smooth and slightly flatten globe. Resistance: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), Fusarium crown and root rot and gray leaf spot.

Phoenix. Early mid-season. Fruit are large to extra-large, high quality, firm, globe-shaped and are uniformly-colored. "Hot-set" variety. Determinate, vigorous vine with good leaf cover for fruit protection. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), Alternaria stem canker and gray leaf spot.

Quincy. Full season. Fruit are large to extra-large, excellent quality, firm, deep oblate shape and uniformly colored. Very strong determinate plant. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), Alternaria stem canker, Tomato spotted wilt and gray leaf spot.

Raceway (STM9203). Main season. Mid vigorous with good vine cover, suited for light pruning. Mostly extra-large, smooth, deep oblate fruit with good firmness and color. Mature green and vine ripe. Resistance: Alternaria stem canker, Fusarium crown and root rot, Fusarium wilt (races 1 and 2), Verticillium wilt (race 1) and Intermediate resistance: Gray leaf spot.

Red Defender. Medium maturity. Vigorous vine with smooth, large deep red fruit with excellent firmness and shelf life Resistant: to Alternaria stem canker, Fusarium wilt (races 1 and 2), gray leaf spot, tomato spotted wilt and Verticillium wilt (race 1).

Red Morning. Early variety with medium plant. Large round fruit. Resistant: Fusarium wilt (races 1 and 2), Tomato mosaic virus. Intermediate resistance: Tomato spotted wilt, Verticillium wilt (race 1).

Red Rave. Main season variety with a strong plant and extra large globe shaped fruit. Good flavor suitable for vine ripe. Resistant: Fusarium wilt (races 1 and 2), Verticilium wilt (race 1).

Resolute. Mid-season variety with strong plant and extra large to large fruit. Resistant: Fusarium wilt (races 1 and 2), Verticilium wilt (race 1). Intermediate resistance: Tomato spotted wilt.

Rocky Top. Mid-season. Mostly extra-large and large firm fruit. Great eating quality and is well adapted for vine ripe production as well as high tunnel production. Resistance: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3), gray leaf spot.

RFT 6153. Main season. Fruit have good eating quality and fancy appearance in a large sturdy shipping tomato and are firm enough for vine-ripe. Large determinate plants. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), gray leaf spot,

Ridge Runner. Medium tall, determinate for the mature green market. Mid-early variety for warm conditions. Resistance: Verticillium (race1) Fusarium (races 1 and 2), Fusarium Crown and Root Rot, Tomato Yellow Leaf Curl.

Sanibel. Main season. Large, firm, smooth fruit with light green shoulder and a tight blossom end. Large determinate bush. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), root-knot nematodes, Alternaria stem canker and gray leaf spot.

Sebring. A main season, determinate, jointed hybrid with smooth, deep oblate, firm, thick walled fruit. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3) Fusarium crown rot, gray leaf spot.

Skyway. Mainseason variety with a strong plant. Extra large globe shaped fruit. Resistant: Fusarium wilt (races 1 and 2). Intermediate resistance: root-knot nematode, Tomato spotted wilt, Tomato yellow leaf curl.

Solar Fire. An early, determinate, jointed hybrid. "Hot set" variety. Fruit are large, flat-round, smooth, firm, light green shoulder and blossom scars are smooth. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3), gray leaf spot.

Soraya. Full season. Fruit are high quality, smooth and tend toward large to extra-large. Continuous set. Strong, large bush. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3), Fusarium crown rot and gray leaf spot.

SV 7631. Mid season variety with medium to strong plant with extra large to large oblate fruit. Resistant: Alternaria stem canker, Fusarium wilt (races 1 and 2), Tomato spotted wilt, Verticilium wilt (race 1). Intermediate resistance: root-knot nematode.

Tasti-Lee. It was released for the premium tomato market. A midseason, determinate, jointed hybrid with moderate heat-tolerance. Fruit are uniform green with a high lycopene content and deep red interior color due to the crimson gene. Resistant: Fusarium wilt (races 1, 2, and 3), Verticillium wilt (race 1), and gray leaf spot.

Tribute. Main season fall variety. Vigorous plant with good cover. Medium large to large, smooth, globed-shaped fruit with excellent firmness and color. Resistance: Alternaria stem canker, Fusarium wilt (races 1 and 2), Verticillium wilt (race 1), gray leaf spot, tomato spotted wilt and tomato yellow leaf curl.

Volante. Mid-season "Hot set" variety with determinate, medium to tall vine. Fruit are extra-large and large, deep globed shaped with very firm, uniform green fruits well suited for mature green or vine-ripe production. Resistant: Alternaria stem canker, Fusarium wilt (races 1 and 2), Verticillium wilt (race 1) and Intermediate resistance: Gray leaf spot and Tomato spotted wilt.

2. PLUM AND ROMA TYPES

BHN 685. Midseason. Large to extra-large, deep blocky, globe shaped fruit. Determinate, vigorous bush with no pruning recommended. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1, 2, and 3) and Tomato spotted wilt.

Marianna. Midseason. Fruit are predominately extra-large and extremely uniform in shape. Fruit wall is thick and external and internal color is very good with excellent firmness and shelf life. Determinate, small to medium sized plant with good fruit set. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), root-knot nematode, Alternaria stem canker and tolerant to gray leaf spot.

Monticello. Uniform fruit size and a unique blocky shape with an improved disease resistance package. Large firm fruit with good interior quality and small blossom end scar. Hig level of resistance to Fusarium wilt (races 1 and 2), bacterial speck, grey leaf spot, tomatoes spotted wilt virus, verticillum and root knot nematode

Picus. Main season, determinate Roma tomato that is widely adapted. Fruits are large, uniform and blocky, maturing to a deep-red color with great firmness at the red stage. Medium to large, vigorous plant that provides good fruit cover and sets well in hot temperatures. Resistant: Alternaria stem canker, Fusarium wilt (races 1 and 2), tomato spotted wilt, Verticillium wilt (race 1), Alternaria stem canker and Cladosporium leaf mold.

Sunoma. Main season. Fruit are medium-large, elongated and cylindrical. Plant maintains fruit size through multiple harvests. Determinate plant with good fruit cover. Resistant: Verticillium wilt (race 1), Fusarium wilt (races 1 and 2), bacterial speck (race 0), root-knot nematodes, tomato mosaic and gray leaf spot.

Supremo. Mid-season variety with early maturity. Determinate mid compact plant. Uniform predominately extra-large fruit. Suited for concentrated harvests for vine ripe and mature green markets. High resistance: Fusarium wilt (races 1, 2 and 3), Bacterial speck, root-knot nematode, Verticillium wilt (race 1), and Intermediate resistance: Tomato spotted wilt.

Tachi. Mid-season variety with classic saladette shape. Determinate mid compact plant. Fruit size predominately extra-large, uniform and very similar to Mariana. Wide adaptability and suited for concentrated harvests for vine ripe and mature green markets. Advantage over Mariana is its resistance to tomato spotted wilt. Resistance: Fusarium wilt (races 1 and 2), Verticillium wilt (race 1), root-knot nematodes and Alternaria stem canker.

3. CHERRY TYPES

BHN 268. Early to mid-season. Tall bush. An extra firm cherry tomato that holds, packs and ships well. Determinate, small to medium bush with high yields. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 1).

Camelia. Midseason. Deep globe, cocktail-cherry size with excellent firmness and long shelf life. Indeterminate bush. Outdoor or greenhouse production. Verticillium wilt (race 1), Fusarium wilt (race 1) and tobacco mosaic.

Sakura. Early indeterminate hybrid. Resistant: Fusarium wilt (race 1 and 2), leaf mold, Tobacco mosaic virus.

Shiren. Compact plant with high yield potential and nice cluster. Resistant: Fusarium wilt (races 1 and 2), root-knot nematodes and tomato mosaic.

Sweet Treats. Early main season with wide adaptability. Strong, vigorous, indeterminate plant. Deep pink, firm, globe shaped fruit with outstanding flavor potential. Strong against cracking. High resistance: Fusarium wilt (race 1 and 2), Leaf mold, Tobacco mosaic and Intermediate resistance: Fusarium crown and root rot and gray leaf mold.

4. GRAPE TYPES

Amai. Early main season with smooth uniform fruit, ~1-2gr more than Sweet Hearts. Uniform sizing. Dark red, firm, elongated grape-shaped fruit. High yield potential. High resistance: Fusarium wilt (race 1), Leaf mold, Tobacco mosaic and Intermediate resistance: Root-knot nematode and gray leaf mold.

BHN 784. Early-midseason determinate grape hybrid. Heat tolerant. Resistant: Fursrium wilt (race 1).

BHN 785. Midseason determinate grape hybrid with a strong set of very uniform size and shape fruit on a vigorous bush with good cover. Resistant: Fusarium wilt (race 1).

BHN 1022. Determinate "hot set" variety. Resistant: Fusarium wilt (races 1-3), Toamto spotted wilt

Brixmore. Very early. Indeterminate. Very uniform in shape and size, deep glossy red color with very high early and total yield. High brix and excellent firm flavor. Resistant: Verticillium wilt (race 1), root-knot nematodes and Tomato mosaic.

Cupid. Early. Vigorous, indeterminate bush. Oval-shaped fruit have an excellent red color and a sweet flavor. Resistant: Fusarium wilt (races 1 and 2), bacterial speck (intermediate resistance race 0), Alternaria stem canker, and gray leaf spot.

Jolly Girl. Early season. Determinate plant. Extended market life with firm, flavorful grape-shaped fruits. Average 10% brix. Resistant: Verticillium wilt (race 1), Fusarium wilt (race 2) and cracking.

Smarty. 69 days. Vigorous, indeterminate bush with short internodes. Plants are 25% shorter than Santa. Good flavor, sweet and excellent flavor.

Sweethearts. Early to mid-season. Indeterminate bush with intermediate internodes. Brilliant red, firm, elongated grape-shaped fruit. Matures between 70 and 75 days. Good flavor, crack-resistant and high brix. Resistant: Tobacco mosaic virus. Cladosporium leaf mold and Fusarium wilt (race 1).

Tami G. Early season. Indeterminate, medium tall. Small fruits with nice shape.

Table 17.2. Herbicides approved for managing weeds in tomato.

Labels change frequently. Be sure to read a current product label before applying any chemical.			
Active ingredient lb. a.i./A	**Trade name product/A**	**MOA code**	**Weeds controlled / remarks**
			***** PREPLANT / PREEMERGENCE *****
Carfentrazone up to 0.031	(Aim) 1.9 EW or (Aim) 2.0 EC up to 2 fl. oz.	14	Apply as a pre-plant burndown for emerged broadleaves up to 4 inches tall or rosettes less than 3 inches across. Good coverage is essential. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. No pre-transplant interval.
EPTC 2.6	(Eptam) 7 E 3 pt.	8	Annual broadleaves, annual grasses and suppression of yellow/purple nutsedge. Labeled for transplanted tomatoes grown on low density mulch. Do not use under high density, VIF, TIF, or metalized mulches. A 24(c) special local needs label in Florida. 14 day pre-transplant interval.
Flumioxazin up to 0.128	(Chateau) 51 WDG up to 4 oz.	14	Annual broadleaves and grasses. Apply to row middles of raised plastic mulched beds that are at least 4 in. higher than the treated row middle and 24 in. bed width. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Tank mix with a burndown herbicide to control emerged weeds. 0 day pre-transplant interval.
Fomesafen 0.25 - 0.38	(Reflex) 2 EC 1.0 - 1.5 pt.	14	Broadleaves and suppression of yellow/purple nutsedge. Suppression of some annual and perennial grasses. Label is a 24(C) local indemnified label and a waiver of liability must be signed for use. Transplanted crop only. May be applied to bareground production or to plastic mulched beds following bed formation but prior to laying plastic. Use shields or hooded sprayers if applying to row middles and prevent contact with the plastic mulch. 7 and 0 day pre-transplant interval on bare ground and plastic mulch, respectively. 70 day PHI.
Glyphosate	(various formulations) consult labels	9	Emerged broadleaves, grasses, and nutsedge. Apply as a preplant burndown. Consult label for individual product directions.
Halosulfuron 0.024 - 0.05	(Sandea, Profine) 75 DF 0.5 - 1.0 oz.	2	Broadleaf weeds and yellow/purple nutsedge. Do not exceed 2 applications of halosulfuron per 12 month period. 7 day pre-transplant interval. 30 day PHI.
Imazosulfuron 0.19-0.3	(League) 4.0-6.4 oz	2	Broadleaves and suppression of yellow/purple nutsedge. Apply pre-transplant just prior to installation of plastic mulch. 1 day pre-transplant interval. 21 day PHI.
Lactofen 0.25 - 0.5	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaves. Label is a Third-Party registration (TPR, Inc.). Use without a signed authorization and waiver of liability is a misuse of the product. Apply to row middles only with shielded or hooded sprayers. Contact with green foliage or fruit may cause excessive injury. Drift of Cobra treated soil particles onto plant can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. 30 day PHI.
***S*-metolachlor 1.0 - 1.3**	(Brawl, Dual Magnum, Medal) 7.62 EC 1.0 - 1.33 pt. if organic matter less then 3%	15	Annual broadleaves and grasses. Suppression of yellow/purple nutsedge. Apply to bed tops pre-transplant just prior to laying the plastic. May also be used in row middles. Research has shown that the 1.33 pt. may be too high in some Florida soils except in row middles. 30 day PHI. 90 day PHI if rate exceeds 1.33 pt./A.
Metribuzin 0.25 - 0.5	(Sencor DF, TriCor DF) 75 WDG 0.33 - 0.67 lb. (Sencor 4, Metri) 4 F 0.5 - 1.0 pt.	5	Small emerged weeds less than 1 in. tall. Apply preplant in transplanted tomatoes only. Incorporate to a depth of 2-4 inches. Maximum of 1.0 lb. a.i./A within a season. Avoid application for 3 days following cool, wet, or cloudy weather to reduce possible crop injury. 7 day PHI.

Table 17.2. Herbicides approved for managing weeds in tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
Napropamide **1.0 - 2.0**	(Devrinol DF-XT) 50 DF 2.0 - 4.0 lb. (Devrinol 2-XT) 2-4 quarts	15	Annual broadleaves and grasses. For direct-seed or transplanted tomatoes. Apply to well worked soil that is moist enough to permit thorough incorporation to a depth of 2 in. Incorporate same day as applied.
Oxyfluorfen **0.25 - 0.5**	(Goal 2 XL) 2 EC 1.0 - 2.0 pt. (GoalTender) 4 E	14	Broadleaves. Apply pre-transplant just prior to installation of plastic mulch. 30 day pre-transplant interval. Mulch may be applied any time during the 30-day interval.
Paraquat **0.5 - 1.0**	(Gramoxone) 2 SL 2.0 - 4.0 pt. (Firestorm) 3 SL 1.3 - 2.7 pt.	22	Emerged broadleaves and grasses. Apply as a preplant burndown treatment. Surfactant recommended.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaves and grasses. Apply as a preplant burndown treatment or post transplant with shielded or hooded sprayers. Product is a contact, nonselective, foliar applied herbicide with no residual control.
Pendimethalin **0.48 - 0.72**	(Prowl H_20) 3.8 1.0 - 1.5 pt.	3	May be applied pretransplant to bed tops just prior to laying the plastic mulch or to row middles. Do not exceed 3.0 pt./A per year. 70 day PHI.
Pyraflufen **0.001 - 0.003**	(ETX Herbicide) 0.208 EC 0.3 - 1.25 fl. oz.	14	Emerged broadleaves less than 4 in. tall or rosttes less than 3 in. diameter. Apply as a preplant burndown treatment. Nonionic surfactant or crop oil concentrate recommended.
Rimsulfuron **0.03 - 0.06**	(Matrix FNV, Matrix SG, Pruvin) 25 WDG 2.0 - 4.0 oz.	2	Annual broadleaves and grasses. Suppression of yellow nutsedge. Requires 0.5-1 in. of rainfall or irrigation within 5 days of application for activation. May be applied as a sequential treatment with a PRE and POST application not exceeding 0.06 lb. a.i./A in a single season. 45 day PHI
Tifluralin **0.5**	(Treflan, Trifluralin) 4 EC 1 pt. (Treflan, Trifluralin) 10 G 5 lb.	3	Annual broadleaves and grasses. Do not apply in Dade County. Incorporate 4 in. or less within 8 hr. of application. Results in Florida are erratic on soils with low organic matter and clay contents. Note label precautions against planting noncrop within 5 months. Do not apply after transplanting.
			***** POSTTRANSPLANT *****
Carfentrazone **up to 0.031**	(Aim) 1.9 EW or (Aim) 2.0 EC up to 2 fl. oz.	14	Emerged broadleaf weeds. Apply as a hooded application to row middles only. Good coverage is essential. May be tank mixed with other herbicides. A nonionic surfactant, methylated seed oil, or crop oil concentrate is recommended. 0 day PHI.
Clethodim **0.09 - 0.25** **0.07 - 0.25**	(Arrow, Select) 2 EC 6 - 16 fl. oz. (Select Max) 1 EC 9 - 32 fl. oz.	1	Perennial and annual grasses. Use higher rates under heavy grass pressure or larger weeds. Surfactant or crop oil concentrate recommended. Consult label. 20 day PHI.
DCPA **6.0 - 7.5**	(Dacthal) W-75 8 - 10 lb. (Dacthal) 6 F 8 - 10 pt.	3	Annual grasses and select broadleaves. Apply to weed-free soil 6-8 wk. after crop is established and growing rapidly or to moist soil in row middles after crop establishment. Note label precautions against replanting non-registered crops within 8 months.
Diquat **0.5**	(Reglone Dessiccant) 1 qt.	22	Broadleaves and grasses. Apply to row middles only. Maximum of 2 applications per season. Prevent drift to crop. Nonionic surfactant recommended. 30 day PHI.
Halosulfuron **0.024 - 0.05**	(Sandea, Profine) 75 DF 0.5 - 1.0 oz.	2	Broadleaf weeds and yellow/purple nutsedge. Apply 14 days after transplant but before first bloom. Following first bloom apply with shielded or hooded applicator. May be applied to row middles with shielded or hooded sprayer. Do not exceed 2 oz per 12 month period. Surfactant recommended. 30 day PHI.
Imazosulfuron **0.19-0.3**	(League) 4.0-6.4 oz	2	Apply post emergence 3 to 5 days after transplant through early bloom. Only apply if no pre-transplant application was made. Surfactant recommended. PHI 21 days.
Lactofen **0.25 - 0.5**	(Cobra) 2 EC 16 - 32 fl. oz.	14	Broadleaf weeds. Apply to row middles only with shielded or hooded sprayers. Contact with green foliage or fruit can cause excessive injury. Drift of Cobra treated soil particles onto plants can cause contact injury. Limit of 1 PRE and 1 POST application per growing season. Do not apply within 18 days of transplant. Surfactant recommended. PHI 30 days.
***S*-metolachlor** **1.0 - 1.3**	(Brawl, Dual Magnum, Medal) 7.62 EC 1.0 - 1.33 pt.	15	Annual broadleaf, grasses, and yellow/purple nutsedge. Apply to row middles. Label rates are 1.0-1.33 pt./A if organic matter is less than 3%. Use on a trial basis. Surfactant not recommended. 90 day PHI for rates above 1.33 pt./A. 30 day PHI for rates 1.33 pt./acre or less.

Table 17.2. Herbicides approved for managing weeds in tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.

Active ingredient lb. a.i./A	Trade name product/A	MOA code	Weeds controlled / remarks
Metribuzin **0.25 - 0.5**	(Sencor DF, TriCor DF) 75 WDG 0.33 - 0.67 lb. (Sencor 4, Metri) 4 F 0.5 - 1.0 pt.	5	Small emerged weeds. Apply after transplants or seedlings are well established. Apply in single or multiple applications with a minimum of 14 days between treatments. Maximum of 1.0 lb. a.i./A within a season. Avoid application for 3 days following cool, wet, or cloudy weather to reduce possible crop injury. 7 day PHI.
Paraquat **0.5**	(Gramoxone) 2 SL 2 pt. (Firestorm) 3 SL 1.3 pt.	22	Emerged broadleaf and grass weeds. Direct spray over emerged weeds 1-6 in. tall in row middles between mulched beds. Use low pressure and shields to control drift. Do not apply more than 3 times per season. Nonionic surfactant recommended. 30 day PHI.
Pelargonic acid	(Scythe) 4.2 EC 3 - 10% v/v		Emerged broadleaf and grass weeds. Direct spray to row middles. Product is a contact, nonselective, foliar applied herbicide with no residual control. May be tank mixed with several soil residual compounds.
Pendimethalin **0.48 - 0.72**	(Prowl H_20) 3.8 1.0 - 1.5 pt.	3	Broadleaf and grass weeds. May be applied post transplant to row middles if previously untreated. Do not exceed 3.0 pt./A per year. 70 day PHI.
Rimsulfuron **0.02 - 0.03**	(Matrix FNV, Matrix SG, Pruvin) 25 WDG 1.0 - 2.0 oz.	2	Broadleaves and grasses. May be applied as a sequential treatment with a PRE and POST application not exceeding 0.06 lb. a.i./A in a single season. Requires 0.5-1.0 in. of rainfall or irrigation within 5 days of application for activation. Nonionic surfactant or crop oil concentrate recommended. PHI 45 days.
Sethoxydim **0.19 - 0.28**	(Poast) 1.5 EC 1.0 - 1.5 pt.	1	Actively growing grasses. Do not exceed a total of 4.5 pt./A applied in one season. Unsatisfactory results may occur if applied to grasses under stress. Crop oil concentrate recommended. 20 day PHI.
Trifloxysulfuron **0.005 - 0.009**	(Envoke) 75 DG 0.1 - 0.2 oz.	2	Broadleaves and yellow/purple nutsedge. Direct spray solution to the base of transplanted tomato plants. Apply at least 14 days after transplanting and before fruit set. 45 day PHI.
			***** POSTHARVEST *****
Diquat **0.5**	(Reglone Dessiccant) 2.0 pt.	22	Minimum of 35 gal./A. Thorough coverage is required. Nonionic surfactant recommended.
Paraquat **0.62 - 0.94**	(Gramoxone) 2 SL 2.4 - 3.75 pt. (Firestorm) 3 SL 1.6 - 2.5 pt.	22	Broadcast spray over the top of the plants after the last harvest. Thorough coverage is required to ensure maximum herbicide burndown. Do not use treated crop for human or animal consumption. Nonionic surfactant recommended.

Table 17.3. Insecticides approved for managing insect pests of tomato.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
Aphids (including aphid transmitted viruses, green peach aphid, potato aphid)	1A	***Lannate LV** (methomyl)	**LV:** 1.5-3.0 pt	Do not apply more than 21 pt LV/acre/crop (15 for tomatillos) or 7 lb SP /acre/ crop (5 lb for tomatillos).	1	48	
		***Lannate SP** (methomyl)	SP: 0.5-1.0 lb		1	48	
	1A	***Vydate L** (oxamyl)	**foliar:** 2.0-4.0 pt	Do not apply more than 32 pts/A per season.	3	48	
	1B	**Dimethoate 4 EC** (dimethoate)	0.5-1.0 pt	Maximum total rate per year is 1 lb ai/A.	7	48	Minimum 6 day reapplication interval.
	1B	**Malathion 5** (malathion)	1.0-2.5 pt	10 pints	1	12	8F can be used in greenhouse.
		Malathion 8 F	1.5 pt				
	3	***Asana XL (0.66EC)** (esfenvalerate)	2.9-9.6 fl oz	Do not apply more than 0.5 lb ai per acre per season, or 10 applications at highest rate.	1	12	
	3	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	0	12	
	3	***Danitol 2.4 EC** (fenpropathrin)	7-10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	. Do not make applications less than 7 days apart.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3 & 4A	**Leverage*** 360 (beta-cyfluthrin & imidacloprid)	3.8-4.1		0	12	
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Do not exceed a total of 11.0 oz/Acre per acre per growing season.	0	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4A	**Admire Pro** (imidacloprid)	7-10.5 fl oz	Maximum allowed on tomato is 10.5 fl. oz/A.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	0.6 fl oz per 1000 plants		0 (soil)	12	Greenhouse use: 1 application to mature plants, see label for cautions.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz per 10,000 plants		21	12	Planthouse: 1 application. See label.
	4A	**Assail 70WP** (acetamiprid)	0.6-1.7 oz	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz (foliar application)	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8-6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum**	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides
	4A	**Platinum 75 SG** (thiamethoxam)	1.66-3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.	30	12	
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 fl oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting.
	4A	**Safari 20 SG** (dinotefuran)	7.0-14.0 oz		1	12	For transplant production only. Can be applied as foliar spray or soil drench.
	4A	**Scorpion** (dinotefuran)	Soil: 9-10.5 fl. oz.; foliar: 2-7 fl. oz.	Do not apply more than 21 fl. oz/A per season as a soil application. Do not apply more than 10.5 fl. oz/A per season foliarly.	1	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**foliar:**0.44-0.895 lb	Do not apply more than 1.34 lb./A per season.	1	12	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
	4A	**Venom 20 SG** (dinotefuran)	**soil:** 1.13-1.34 lb	Do not apply more than 2.68 lb/A per season.	21	12	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A per growing season.	30	12	Several methods of soil application – see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Do not exceed 14 oz/A per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	0	12	(FL-040006) 24(c) label for growing transplants also (FL-03004).
	9 C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	Do not apply more than 8.4 oz per acre per season.	0	12	Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz/acre per season.	1	24	
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
	un	**Grandevo** (*Chromobacterium subtsugae*)	1.0-3.0 lb		0	4	Thorough coverage is necessary for effective control.
	un	**Mycotrol O** (*Beauvaria bassiana* strain GHA)	0.5 quart -1 quart/100 gallons		0	4	OMRI Listed
	un	**Neemix 4.5** (azadirachtin)	4.0-16.0 fl oz		0	12	IGR, feeding repellant. OMRI-listed.
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of Chenopodium ambrosioides)	2-4 qt	Limited to 10 applications per crop cycle.	0	4	Begin applications before pests reach damaging levels.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.			4	OMRI listed.
	-	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed
	-	**Ultra Fine Oil, Saf-T-Side, others** **JMS Stylet-Oil** (oil, insecticidal)	1.0-2.0 gal/100 gal 3.0-6.0 qt/100 gal water (JMS)		0	4	Do not exceed four applications per season. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Beetles (including beetle larvae, blister beetles, Colorado potato beetle, cucumber beetle, cucumber beetle adults, flea beetles)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
	1A	***Vydate L** (oxamyl)	**foliar:** 2.0-4.0 pt	Do not apply more than 32 pts/A per season.	3	48	
	3	***Ambush 25W** (permethrin)	3.2-12.8 oz	Do not apply more than 76.8 oz/A per season.	up to day of harvest	12	**Do not use on cherry tomatoes.**

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3	***Asana XL (0.66EC)** (esfenvalerate)	2.9-9.6 fl oz	Do not apply more than 0.5 lb ai per acre per season, or 10 applications at highest rate.	1	12	
	3	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	0	12	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Do not make applications less than 7 days apart.
	3	***Pounce 25 WP** (permethrin)	3.2-12.8 oz		0	12	Do not apply to cherry or grape tomatoes (fruit less than 1 inch in diameter). Do not apply more than 0.6 lb ai per acre per season.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3 & 4A	**Leverage*** 360 (beta-cyfluthrin & imidacloprid)	3.8-4.1		0	12	
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Do not exceed a total of 11.0 oz/Acre per acre per growing season.	0	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Admire Pro** (imidacloprid)	7-10.5 fl oz	Maximum allowed on tomato is 10.5 fl. oz/A.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 70WP** (acetamiprid)	0.6-1.7 oz	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz (foliar application)	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8-6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum**	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides
		Platinum 75 SG (thiamethoxam)	1.66-3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 fl oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting.
	4A	**Scorpion** (dinotefuran)	Soil: 9-10.5 fl. oz.; foliar: 2-7 fl. oz.	Do not apply more than 21 fl. oz/A per season as a soil application. Do not apply more than 10.5 fl. oz/A per season foliarly.	1	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**foliar:**0.44-0.895 lb	Do not apply more than 1.34 lb./A per season.	1	12	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
		Venom 20 SG (dinotefuran)	**soil:** 1.13-1.34 lb	Do not apply more than 2.68 lb/A per season.	21	12	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A per growing season.	30	12	Several methods of soil application – see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Do not exceed 14 oz/A per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	5	**Entrust** (spinosad)	0.5-2.5 oz	Do not apply more than 9 oz per acre per crop.	1	4	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	No more than 28.8 oz/A per season.	7	12	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	15	**Rimon 0.83EC** (novaluron)	9.0-12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Minimum of 7 days between applications.
	17	**Trigard** (cyromazine)	2.66 oz	Do not apply more than 15.96 oz./A per season.	0	12	No more than 6 applications per crop. Does not control CPB adults. Most effective against 1st & 2nd instar larvae.
	28	**Coragen** (chlorantraniliprole/ rynaxypyr)	3.5-7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting. See label for details.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
	un	**Neemix 4.5** (azadirachtin)	4.0-16.0 fl oz		0	12	IGR, feeding repellant. OMRI-listed.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.			4	OMRI listed.
	un	**Surround WP** (kaolin)	12.5-50 lbs		0	4	OMRI listed.
	-	**Ultra Fine Oil, Saf-T-Side, others**	1.0-2.0 gal/100 gal		0	4	Do not exceed four applications per season.
		JMS Stylet-Oil (oil, insecticidal)	3.0-6.0 qt/100 gal water (JMS)				Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Caterpillars (including cabbage looper, corn earworm,foilage feeding caterpillar, garden webworm, hornworms, imported cabbageworm, loopers, saltmarsh caterpillar, tobacco budworm, tomato fruitworm); includes armyworms (beet armyworn, fall armyworm,southern armyworm, true armyworm, yellowstriped armyworm), includes cutworms (black cutworm, granulate cutworm)	1A	***Lannate SP** (methomyl)	SP: 0.5-1.0 lb		1	48	
	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
	1A	**10% Sevin Granules** (carbaryl)	20 lb		3	12	Maximum of 4 applications, not more often than once every 7 days.
	1B	***Diazinon AG500; *50 W** (diazinon)	**AG500:** 1-4 qt **50W:** 2-8 lb	Do not make more than one soil applicationper year regrardless of target pest.	preplant	48	Incorporate into soil - see label.
	3	***Ambush 25W** (permethrin)	3.2-12.8 oz	Do not apply more than 76.8 oz/A per season.	up to day of harvest	12	**Do not use on cherry tomatoes.**
	3	***Asana XL (0.66EC)** (esfenvalerate)	2.9-9.6 fl oz	Do not apply more than 0.5 lb ai per acre per season, or 10 applications at highest rate.	1	12	
	3	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	0	12	
	3	***Danitol 2.4 EC** (fenpropathrin)	7-10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Do not make applications less than 7 days apart.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3	***Pounce 25 WP** (permethrin)	3.2-12.8 oz		0	12	Do not apply to cherry or grape tomatoes (fruit less than 1 inch in diameter). Do not apply more than 0.6 lb ai per acre per season.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3 & 4A	**Leverage*** 360 (beta-cyfluthrin & imidacloprid)	3.8-4.1		0	12	
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	4A	**Platinum**	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides
		Platinum 75 SG (thiamethoxam)	1.66-3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A per growing season.	30	12	Several methods of soil application – see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Do not exceed 14 oz/A per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	5	**Entrust** (spinosad)	0.5-2.5 oz	Do not apply more than 9 oz per acre per crop.	1	4	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	**Radiant SC** (spinetoram)	5-10 fl oz.	Do not apply more than 34 fl. oz./A per calendar year.	1	4	For thrips, if additional treatment is needed after two applications, switch to an alternate mode of action (not group 5) for at least two applications.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	No more than 28.8 oz/A per season.	7	12	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	11	**Agree WG** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb		0	4	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	11	**Biobit HP** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. OMRI-listed.
	11	**Crymax WDG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb		0	4	Use high rate for armyworms. Treat when larvae are young.
	11	**Deliver** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb		0	4	Use higher rates for armyworms. OMRI-listed.
	11	**DiPel DF** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-2.0 lb		0	4	Treat when larvae are young. Good coverage is essential. Can be used for organic production.
	11	**Javelin WG** (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.5 lb		0	4	Treat when larvae are young. Thorough coverage is essential. OMRI-listed[2].
	11	**Xentari DF** (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb		0	4	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production. OMRI-listed.
	15	**Rimon 0.83EC** (novaluron)	9.0-12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Minimum of 7 days between applications.
	18	**Confirm 2F** (tebufenozide)	6-16 fl oz	Do not apply more than 64 fl. oz./A per season.	7	4	Product is a slow-acting IGR that will not kill larvae immediately.
	18	**Intrepid 2F** (methoxyfenozide)	4-16 fl oz	Do not apply more than 64 fl oz per acre per season.	1	4	Product is a slow-acting IGR that will not kill larvae immediately.
	22	**Avaunt** (indoxacarb)	2.5-3.5 oz	Do not apply more than 14 ounces of product per acre per crop. Minimum spray interval is 5 days.	3	12	
	28	**Belt SC** (flubendiamide)	1.5 fl oz	Do not apply more tha 4.5 oz per acre per crop season.	1	12	Do not apply more than 1.5 oz per acre per 3 day interval.
	28	**Coragen** (chlorantraniliprole/ rynaxypyr)	3.5-7.5 fl oz	Do not apply more than 15.4 fl oz per acre per crop.	1	4	Can be applied by drip chemigation or as a soil application at planting. See label for details.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatments is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Do not apply more than 38 fl oz/A per season.	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Same classes of active ingredients as Belt, Synapse, Coragen (all group 28), and Courier (group 16).
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
	un	**CheckMate TPW-F** (pheromone)	1.2-6.0 fl oz		0	0	For mating disruption of tomato pinworm- See label for details.
	un	**Grandevo** (*Chromobacterium subtsugae*)	1.0-3.0 lb		0	4	Thorough coverage is necessary for effective control.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	un	**MBI-203 EP** (*Chromobacterium subtsugae*)	4.0-12.0 quarts		0	4	OMRI listed. Can be used in the greenhouse.
	un	**Neemix 4.5** (azadirachtin)	4.0-16.0 fl oz		0	12	IGR, feeding repellant. OMRI-listed.
Fire Ants	7A	**Extinguish** ((S)-methoprene)	1.0-1.5 lb		0	4	Slow-acting IGR (insect growth regulator). Best applied early spring and fall where crop will be grown. Colonies will be reduced after three weeks and eliminated after 8 to 10 weeks. May be applied by ground equipment or aerially.
	7C	**Esteem Ant Bait** (pyriproxyfen)	1.5-2.0 lb		1	12	Apply when ants are actively foraging.
Grasshoppers	1A	**10% Sevin Granules** (carbaryl)	20 lb		3	12	Maximum of 4 applications, not more often than once every 7 days.
	3	***Asana XL (0.66EC)** (esfenvalerate)	2.9-9.6 fl oz	Do not apply more than 0.5 lb ai per acre per season, or 10 applications at highest rate.	1	12	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Do not make applications less than 7 days apart.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	un	**Surround WP** (kaolin)	12.5-50 lbs		0	4	OMRI listed.
Lace bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
Leafhoppers	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
	1B	**Dimethoate 4 EC** (dimethoate)	0.5-1.0 pt	Maximum total rate per year is 1 lb ai/A.	7	48	Minimum 6 day reapplication interval.
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Do not make applications less than 7 days apart.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Do not exceed a total of 11.0 oz/Acre per acre per growing season.	0	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Admire Pro** (imidacloprid)	7-10.5 fl oz	Maximum allowed on tomato is 10.5 fl. oz/A.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz (foliar application)	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8-6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum**	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides
		Platinum 75 SG (thiamethoxam)	1.66-3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 fl oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting.
	4A	**Scorpion** (dinotefuran)	Soil: 9-10.5 fl. oz.; foliar: 2-7 fl. oz.	Do not apply more than 21 fl. oz/A per season as a soil application. Do not apply more than 10.5 fl. oz/A per season foliarly.	1	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**foliar:**0.44-0.895 lb	Do not apply more than 1.34 lb./A per season.	1	12	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4A	**Venom 20 SG** (dinotefuran)	**soil:** 1.13-1.34 lb	Do not apply more than 2.68 lb/A per season.	21	12	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A per growing season.	30	12	Several methods of soil application – see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Do not exceed 14 oz/A per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	6	***Proclaim** (emamectin benzoate)	2.4-4.8 oz	No more than 28.8 oz/A per season.	7	12	Do not use in greenhouses, nurseries, plant propagation houses, or on any plants grown for use as transplants.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Do not apply more than 38 fl oz/A per season.	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Same classes of active ingredients as Belt, Synapse, Coragen (all group 28), and Courier (group 16).
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.			4	OMRI listed.
	un	**Surround WP** (kaolin)	12.5-50 lbs		0	4	OMRI listed.
	--	**M-Pede 49% EC** (Soap, insecticidal)	1-2% V/V		0	12	OMRI-listed
	--	**Ultra Fine Oil, Saf-T-Side, others** **JMS Stylet-Oil** (oil, insecticidal)	1.0-2.0 gal/100 gal 3.0-6.0 qt/100 gal water (JMS)		0	4	Do not exceed four applications per season. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Liriomyza leafminers	1A	***Vydate L** (oxamyl)	**foliar:** 2.0-4.0 pt	Do not apply more than 32 pts/A per season.	3	48	
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	4A	**Venom 20 SG** (dinotefuran)	**foliar:**0.44-0.895 lb	Do not apply more than 1.34 lb./A per season.	1	12	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
		Venom 20 SG (dinotefuran)	**soil:** 1.13-1.34 lb	Do not apply more than 2.68 lb/A per season.	21	12	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	5	**Entrust** (spinosad)	0.5-2.5 oz	Do not apply more than 9 oz per acre per crop.	1	4	OMRI-listed. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	**Radiant SC** (spinetoram)	5-10 fl oz.	Do not apply more than 34 fl. oz./A per calendar year.	1	4	
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	Do not apply more than 10.25 fl. oz./A in a growing season.	7	12	Do not make more than 2 sequential applications of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.
		***Agri-Mek 0.15 EC**	8.0-16.0 fl. oz	Do not apply more than 48 fl oz per acre per season.	7	12	Do not make more than 2 sequential applications per season.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Requiem 25EC** (extract of Chenopodium ambrosioides)	2-4 qt	Limited to 10 applications per crop cycle.	0	4	Begin applications before pests reach damaging levels.
Mites (including broad mites, two spotted spider mites, tomato russett mites, carmine spider mites)	1B	**Malathion 5** (malathion)	1.0-2.5 pt	10 pints	1	12	8F can be used in greenhouse.
		Malathion 8 F	1.5 pt				
	3	***Danitol 2.4 EC** (fenpropathrin)	7-10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	Do not apply more than 10.25 fl. oz./A in a growing season.	7	12	Do not make more than 2 sequential applications of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.
	20B	**Kanemite 15 SC** (acequinocyl)	31 fl oz	Do not apply more than 62 fl. oz/A per season.	1	12	Do not use less than 100 gal per acre. Make no more than 2 applications at least 21 days apart.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than two applications per growing season. Allow 14 days between applications.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
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Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz/acre per season.	1	24	
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	Maximum amount per crop: 25.5 fl oz/A.	1	12	No more than 3 applications.
	un	**Acramite-50WS** (bifenazate)	0.75-1.0 lb	One application allowed per season.	3	12	One application per season. Field grown only. ACRAMITE-50WS is not systemic in action; therefore complete coverage of both upper and lower leaf surfaces and of fruit is necessary for effective control.
		***Agri-Mek 0.15 EC** (abamectin)	8.0-16.0 fl. oz	Do not apply more than 48 fl oz per acre per season.	7	12	Do not make more than 2 sequential applications per season.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Grandevo** (*Chromobacterium subtsugae*)	1.0-3.0 lb		0	4	Thorough coverage is necessary for effective control.
	un	**MET52 EC** (*Metarhizium anispoliae* strain F52)	drench: 40-80 fl. oz.; foliar: 0.5 pint - 2qt		0	0	
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.			4	OMRI listed.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed
	--	**Sulfur** (many brands)				24	May burn fruit and foliage when temperature is high. Do not apply within 2 weeks of an oil spray or EC formulation.
	--	**Ultra Fine Oil, Saf-T-Side, others** **JMS Stylet-Oil** (oil, insecticidal)	1.0-2.0 gal/100 gal 3.0-6.0 qt/100 gal water (JMS)		0	4	Do not exceed four applications per season. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Mole crickets	1B	***Diazinon AG500; *50 W** (diazinon)	**AG500:** 1-4 qt **50W:** 2-8 lb	Do not make more than one soil applicationper year regrardless of target pest.	preplant	48	Incorporate into soil - see label.
Plant bugs + tarnished plant bugs	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Do not make applications less than 7 days apart.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz (foliar application)	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8-6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	9 C	**Beleaf 50 SG** (flonicamid)	2.0-2.8 oz	Do not apply more than 8.4 oz per acre per season.	0	12	Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	15	**Rimon 0.83EC** (novaluron)	9.0-12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Minimum of 7 days between applications.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed
Plant hopper	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
Psyllids	4D	**Sivanto 200 SL** (flupyradifurone)	7.0-14.0 fl. oz.	Do not apply more than 28.0 fl. oz./A per year.	1	4	Minimum interval between applications: 7 days.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz/acre per season.	1	24	
	un	**Neemix 4.5** (azadirachtin)	4.0-16.0 fl oz		0	12	IGR, feeding repellant. OMRI-listed.
Soil insects (including centipedes, crickets, earwigs, millipedes, sow bugs, springtails)	1A	**10% Sevin Granules** (carbaryl)	20 lb		3	12	Maximum of 4 applications, not more often than once every 7 days.
Stinkbugs (including brown stink bug, green stink bug)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
	3	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	0	12	
	3	***Danitol 2.4 EC** (fenpropathrin)	7-10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Not recommended for vegetable leafminer in Florida. Do not make applications less than 7 days apart.
	3 & 4A	**Leverage*** 360 (beta-cyfluthrin & imidacloprid)	3.8-4.1		0	12	
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A & 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Do not exceed a total of 11.0 oz/Acre per acre per growing season.	0	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz (foliar application)	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Scorpion** (dinotefuran)	Soil: 9-10.5 fl. oz.; foliar: 2-7 fl. oz.	Do not apply more than 21 fl. oz/A per season as a soil application. Do not apply more than 10.5 fl. oz/A per season foliarly.	1	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Do not exceed 14 oz/A per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	15	**Rimon 0.83EC** (novaluron)	9.0-12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Minimum of 7 days between applications.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Thrips: check label for species controlled (includes melon thrip, western flower thrips, Florida flower thrips, eastern flower thrips, foliar feeding thrips, chili thrips)	1A	**Sevin 80S; XLR; 4F** (carbaryl)	**80S:** 0.63-2.5 **XLR; 4F:** 0.5-2.0 A	Do not apply a total of more than 10 lb or 8 qt per acre per crop.	3	12	Do not apply more than seven times.
	3	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	0	12	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Not recommended for vegetable leafminer in Florida. Do not make applications less than 7 days apart.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3 & 4A	**Leverage*** 360 (beta-cyfluthrin & imidacloprid)	3.8-4.1		0	12	

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3 & 6	**Gladiator*** (avermectin B1 & zeta-cypermethrin)	10-19 fl. oz.	Do not apply more than 57 fl. oz./A per 12 month cropping year.	7	12	
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	4A	**Admire Pro** (imidacloprid)	7-10.5 fl oz	Maximum allowed on tomato is 10.5 fl. oz/A.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Assail 70WP** (acetamiprid)	0.6-1.7 oz	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.
	4A	**Platinum**	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides
		Platinum 75 SG (thiamethoxam)	1.66-3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A	**Scorpion** (dinotefuran)	Soil: 9-10.5 fl. oz.; foliar: 2-7 fl. oz.	Do not apply more than 21 fl. oz/A per season as a soil application. Do not apply more than 10.5 fl. oz/A per season foliarly.	1	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**foliar:**0.44-0.895 lb	Do not apply more than 1.34 lb./A per season.	1	12	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
		Venom 20 SG (dinotefuran)	**soil:** 1.13-1.34 lb	Do not apply more than 2.68 lb/A per season.	21	12	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A per growing season.	30	12	Several methods of soil application – see label.
	5	**Entrust** (spinosad)	0.5-2.5 oz	Do not apply more than 9 oz per acre per crop.	1	4	OMRI-listed2. For thrips, rotate to other class of effective insecticide after 2 applications of a Group 5 insecticide for at least 2 applications.
	5	**Radiant SC** (spinetoram)	5-10 fl oz.	Do not apply more than 34 fl. oz./A per calendar year.	1	4	For thrips, if additional treatment is needed after two applications, switch to an alternate mode of action (not group 5) for at least two applications.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	6	***Agri-Mek SC** (abamectin)	1.75-3.5 fl oz	Do not apply more than 10.25 fl. oz./A in a growing season.	7	12	Do not make more than 2 sequential applications of Agri-Mek SC or any other foliar applied abamectin-containing product in a growing season.
		***Agri-Mek 0.15 EC** (abamectin)	8.0-16.0 fl. oz	Do not apply more than 48 fl oz per acre per season.	7	12	Do not make more than 2 sequential applications per season.
	9C	**Beleaf 50 SG** (flonicamid)	4.2 oz.	Do not apply more than 8.4 oz per acre per season.	0		Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	15	**Rimon 0.83EC** (novaluron)	9.0-12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Minimum of 7 days between applications.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz/acre per season.	1	24	
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
	un	**Grandevo** (*Chromobacterium subtsugae*)	1.0-3.0 lb		0	4	Thorough coverage is necessary for effective control.
	un	**MET52 EC** (*Metarhizium anispoliae* strain F52)	drench: 40-80 fl. oz.; foliar: 0.5 pint - 2qt		0	0	
	un	**Mycotrol O** (*Beauvaria bassiana* strain GHA)	0.5 quart -1 quart/100 gallons		0	4	OMRI Listed
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of Chenopodium ambrosioides)	2-4 qt	Limited to 10 applications per crop cycle.	0	4	Begin applications before pests reach damaging levels.
	un	**Surround WP** (kaolin)	12.5-50 lbs		0	4	OMRI listed.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed
	--	**Ultra Fine Oil, Saf-T-Side, others** **JMS Stylet-Oil** (oil, insecticidal)	1.0-2.0 gal/100 gal 3.0-6.0 qt/100 gal water (JMS)		0	4	Do not exceed four applications per season. Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Weevils (vegetable weevil)	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	3A, 4A	***Endigo ZC** (lambda-cyhalothrin & thiamethoxam)	4.0-4.5 fl oz	Do not exceed a total of 19.0 fl oz per acre per season.	5	24	See label for limits on each active ingredient.
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
Whiteflies	1A	***Vydate L** (oxamyl)	**foliar:** 2.0-4.0 pt	Do not apply more than 32 pts/A per season.	3	48	
	3	***Asana XL (0.66EC)** (esfenvalerate)	2.9-9.6 fl oz	Do not apply more than 0.5 lb ai per acre per season, or 10 applications at highest rate.	1	12	Not recommended for control of vegetable leafminer in Florida.
	3	***Baythroid XL** (beta-cyfluthrin)	1.6-2.8 fl oz	Do not apply more than 16.8 fl oz per acre per season.	0	12	
	3	***Danitol 2.4 EC** (fenpropathrin)	7-10.67 fl oz	Do not exceed 42.67 fl. oz. total application /A per season.	3	24	
	3	***Hero** (bifenthrin & zeta-cypermethrin)	4.0-10.3 oz	Do not apply more than 43.26 fl. oz./A per season.	1	12	Do not make more than 4 applications per season. Do not make applications less than 10 days apart.
	3	**Karate with Zeon*** (lambdacyhalothrin)	0.96-1.92 fl. oz.	Do not apply more than 23.04 fl. oz. /A per season.	5	24	
	3	***Mustang** (zeta-cypermethrin)	2.4-4.3 oz	Do not apply more than 25.8 fl. oz./A per season.	1	12	Not recommended for vegetable leafminer in Florida. Do not make applications less than 7 days apart.
	3	**Pyganic Crop Protection EC 5.0 II** (pyrethrins)	4.5-18.0 fl oz	11.25 pints.	0	12	Pyrethrins degrade rapidly in sunlight. Thorough coverage is important. OMRI-listed. Do not apply more than 10 times per season.
	3 & 28	***Voliam Xpress** (lambda-cyhalothrin & chlorantraniliprole)	5.0-9.0 fl oz	Do not apply more than 31.0 fl oz /A per season.	5	24	
	3A	***Brigade 2EC** (bifenthrin)	2.1-5.2 fl oz	Make no more than 4 applications per season.	1	12	Do not make applications less than 10 days apart.
	3A	***Proaxis Insecticide** (gamma-cyhalothrin)	1.92-3.84 fl oz	Do not apply more than 2.88 pints per acre per season.	5	24	
	3A	***Warrior II** (lambda-cyhalothrin)	0.96-1.92 fl oz	Do not apply more than 23.04 fl. oz/A per season.	5	24	
	4A	**Actara** (thiamethoxam)	2.0-5.5 oz	Do not exceed a total of 11.0 oz/Acre per acre per growing season.	0	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators. Minimum interval between applications is 5 days.
	4A	**Admire Pro** (imidacloprid)	7-10.5 fl oz	Maximum allowed on tomato is 10.5 fl. oz/A.	21	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in directions for use to protect pollinators.
	4A	**Admire Pro** (imidacloprid)	0.6 fl oz per 1000 plants		0 (soil)	12	Greenhouse use: 1 application to mature plants, see label for cautions.
	4A	**Admire Pro** (imidacloprid)	0.44 fl oz per 10,000 plants		21	12	Planthouse: 1 application. See label.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	4A	**Assail 70WP** (acetamiprid)	0.6-1.7 oz	Do not exceed a total of 6.8 oz. Assail 70 WP per acre per growing season including any pretransplant applications of acetamiprid.	7	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting. Begin applications for whitefly when first adults are noticed. Do not make more than 4 applications per season. Do not apply more than once every 7 days.
	4A	**Belay 50 WDG** (clothianidin)	1.6-2.1 oz (foliar application)	Do not apply more than 6.4 oz per acre per season.	7	12	Do not use an adjuvant. Toxic to bees. Do not release irrigation water from the treated area.
	4A	**Belay 50 WDG** (clothianidin)	4.8-6.4 oz (soil application)	Do not apply more than 6.4 oz per acre per season.	Apply at planting	12	See label for application instructions. Do not release irrigation water from the treated area.
	4A	**Platinum**	5-11 fl oz	Do not exceed a total of 11 fl. oz. Platinum/A per growing season.	30	12	Soil application. Not for use in nurseries, plant propagation houses, greenhouses, or on plants grown for use as transplants. See label for rotational restrictions. Do not use with other neonicotinoid insecticides
		Platinum 75 SG (thiamethoxam)	1.66-3.67 oz	Do not exceed a total of 3.67 Platinum 75 SG/A per growing season.			
	4A	**Provado 1.6F** (imidacloprid)	3.8-6.2 fl oz	Maximum per crop per season 19.2 fl oz/A.	0	12	Do not apply to crop that has been already treated with imidacloprid or thiamethoxam at planting.
	4A	**Safari 20 SG** (dinotefuran)	7.0-14.0 oz		1	12	For transplant production only. Can be applied as foliar spray or soil drench.
	4A	**Scorpion** (dinotefuran)	Soil: 9-10.5 fl. oz.; foliar: 2-7 fl. oz.	Do not apply more than 21 fl. oz/A per season as a soil application. Do not apply more than 10.5 fl. oz/A per season foliarly.	1	12	Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow application restrictions found in the directions for use to protect pollinators. Do not combine soil and foliar applications. Use one method or the other.
	4A	**Venom 20 SG** (dinotefuran)	**foliar:**0.44-0.895 lb	Do not apply more than 1.34 lb./A per season.	1	12	Use only one application method (soil or foliar). Limited to three applications per season. Toxic to honeybees.
		Venom 20 SG (dinotefuran)	**soil:** 1.13-1.34 lb	Do not apply more than 2.68 lb/A per season.	21	12	Use only one application method (soil or foliar). Must have supplemental label for rates over 6.0 oz/acre.
	4A & 28	**Durivo** (thiamethoxam & chlorantraniliprole)	10-13 fl oz	Do not exceed a total of 13.0 fl. oz./A per growing season.	30	12	Several methods of soil application – see label.
	4A & 28	**Voliam Flexi** (thiamethoxam & chlorantraniliprole)	4.0-7.0 oz	Do not exceed 14 oz/A per season.	1	12	Do not use in greenhouses or on transplants. Do not use if seed has been treated with thiamethoxam or if other Group 4A insecticides will be used. Highly toxic to bees.
	7C	**Knack IGR** (pyriproxyfen)	8-10 fl oz	Do not exceed 20 fl. oz./A per season.	14	12	Immatures only. Apply when nymphs first appear. Apply when a threshold is reached of 5 nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. Make no more than two applications per season. Treat whole fields.
	9B	**Fulfill** (pymetrozine)	2.75 oz	Do not apply more than 5.5 oz/acre per crop.	0	12	(FL-040006) 24(c) label for growing transplants also (FL-03004).

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	9C	**Beleaf 50 SG** (flonicamid)	4.2 oz.	Do not apply more than 8.4 oz per acre per season.	0		Begin applications before pests reach damaging levels. Do not apply more than 2 applications per season. Allow a minimum of 7 days between applications.
	15	**Rimon 0.83EC** (novaluron)	9.0-12.0 fl oz	Do not apply more than 36 fl oz per acre per season.	1	12	Minimum of 7 days between applications.
	16	**Courier 40SC** (buprofezin)	9.0-13.6 fl oz	Do not apply more than 27.2 fl. oz./A per crop cycle.	1	12	Immatures only. Apply when a threshold is reached of 5 whitefly nymphs per 10 leaflets from the middle of the plant. Product is a slow-acting IGR that will not kill nymphs immediately. No more than 2 applications per season. Allow at least 5 days between applications.
	21A	**Portal** (fenpyroximate)	2.0 pt	Do not apply more than 4.0 pints/A per crop cycle.	1	12	Do not make more than two applications per growing season. Allow 14 days between applications.
	23	**Movento** (spirotetramat)	4.0-5.0 fl oz	Maximum of 10 fl oz/acre per season.	1	24	
	23	**Oberon 2SC** (spiromesifen)	7.0-8.5 fl oz	Maximum amount per crop: 25.5 fl oz/A.	1	12	No more than 3 applications.
	28	**Exirel** (cyantraniliprole)	7-20.5 fl. oz.	Do not apply a total of more than 0.4 lb ai/A per crop.	1	12	Application restrictions exist for this product because of risk to bees and other pollinators. Follow application restrictions found in the directions for use to protect pollinators. Minimum application interval between treatmenst is 5 days.
	28	**Verimark** (cyantraniliprole)	5-13.5 fl. oz.	Do not apply more than 0.4 lb ai/A per crop.	1	4	
	28 & 16	**Vetica** (flubendiamide & buprofezin)	12.0-17.0 fl oz	Do not apply more than 38 fl oz/A per season.	1	12	Do not apply more than 3 times per season or apply more than 38 fl oz per acre per season. Same classes of active ingredients as Belt, Synapse, Coragen (all group 28), and Courier (group 16).
	un	**Aza-Direct** (azadirachtin)	1-2 pts, up to 3.5 pts, if needed		0	4	Antifeedant, repellant, insect growth regulator. OMRI-listed.
	un	**Azatin XL** (azadirachtin)	5-21 fl oz		0	4	Antifeedant, repellant, insect growth regulator.
	un	**Grandevo** (*Chromobacterium subtsugae*)	1.0-3.0 lb		0	4	Thorough coverage is necessary for effective control.
	un	**MET52 EC** (*Metarhizium anispoliae* strain F52)	drench: 40-80 fl. oz.; foliar: 0.5 pint - 2qt		0	0	
	un	**Mycotrol O** (*Beauvaria bassiana* strain GHA)	0.5 quart -1 quart/100 gallons		0	4	OMRI Listed
	un	**Neemix 4.5** (azadirachtin)	4.0-16.0 fl oz		0	12	IGR, feeding repellant. OMRI-listed.
	un	**PFR-97** (*Isaria fumosorosea* Apopka strain 97)	1.0-2.0 lbs		0	4	Repeat applications at 3-10 days are needed to maintain control. Can be used in greenhouse for food crop transplants raised to be planted into the field. OMRI listed.
	un	**Requiem 25EC** (extract of Chenopodium ambrosioides)	2-4 qt	Limited to 10 applications per crop cycle.	0	4	Begin applications before pests reach damaging levels.

Table 17.3. Insecticides approved for managing insect pests of tomato. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.2 for biopesticide and other alternative products labeled for disease management.

Insect	MOA Code[1]	Trade name (Active Ingredient) *Restricted	Rate (Product/acre)	Rate per Season	Days to Harvest	REI (hours)	Remarks
	un	**SuffOil-X** (unsulfonated residue of petroleum oil)	1-2 gallons per 100 gallons of water.			4	OMRI listed.
	--	**M-Pede 49% EC** (soap, insecticidal)	1-2% V/V		0	12	OMRI-listed
	--	**Ultra Fine Oil, Saf-T-Side, others**	1.0-2.0 gal/100 gal		0	4	Do not exceed four applications per season.
		JMS Stylet-Oil (oil, insecticidal)	3.0-6.0 qt/100 gal water (JMS)				Organic Stylet-Oil and Saf-T-Side are OMRI-listed.
Wireworms	1B	***Diazinon AG500; *50 W** (diazinon)	**AG500:** 1-4 qt **50W:** 2-8 lb	Do not make more than one soil applicationper year regrardless of target pest.	preplant	48	Incorporate into soil - see label.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.2 April 2012. Number codes (1 through 28) are used to distinguish the main insectide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned. OMRI listed: Listed by the Organic Materials Review Institute for use in organic production.

*** Restricted use insecticide.**

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action.

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre Applic.	Max. Rate/Acre Season	Min. Days to Harvest	Min. Days to Reentry	Remarks[2]
Anthracnose	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies from 4 hr to 2 days.	Mancozeb enhances bactericidal effect of fix copper compounds.
	M3	**(mancozeb)** **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3	Ziram 76DF (ziram)	4 lb	23.7 lb	7	2	Do not use on cherry tomatoes.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	M3 & M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	**(chlorothalonil)** **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
(suppression)	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	For Disease suppression only. No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
(suppression)	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	11	Equation Heritage Quadris FL Satori (azoxystrobin)	6.2 fl oz 3.2 oz 6.2 fl oz 6.2 fl oz	37 fl oz 1.6 lb 37 fl oz 37 fl oz	0 0 0 0	4 hr 4 hr 4 hr 4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
	11	Flint Gem 500 SC (trifloxystrobin)	4 oz 3.8 floz	16 oz 16 fl oz	3 3	0.5 0.5	Limit is 5 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	1.9 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
(suppression)	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	6.2 oz 13 fl oz	31.0 oz 78 fl oz	0 0	4 hr 4 hr	Alternate with a non-FRAC code 19 fungicide.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	Limit is 4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Bacterial canker	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	Mancozeb enhances the bactericidal effect of fix copper compounds.
(suppression)	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
Bacterial spot and Bacterial speck	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	Mancozeb enhances the bactericidal effect of fix copper compounds.
	M3	**(mancozeb)** **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	Bacterial spot control only when tank mixed with a copper fungicide.
	M3 & M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
(suppression)	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	25	Agri-mycin 17 Ag Streptomycin Bac-Master (streptomycin sulfate)	200 ppm	-	-	0.5	See label for details. For transplant production only. Many isolates are resistant to streptomycin.
	P	Actigard (acibenzolar-S-methyl)	0.75 oz	4.75 oz	14	0.5	Begin applications within one week of transplanting or emergence. Make up to 8 weekly, sequential applications.
Black mold (*Alternaria* spp.)	3	Mentor (propiconazole)	8 oz /100 gal or / 50,000 lb of fruit	-	-	-	Apply as a post-harvest dip, drench, or high-volume spray for the post-harvest control of certain rots. See label for details.
	3 & 9	Chairman (propiconazole + fludioxonil)	32 floz / 100 gal or / 50,000 lb of fruit	-	-	-	Apply as a post-harvest dip, drench, or high-volume spray for the post-harvest control of certain rots. Lower rates for small diameter fruit. See label for details.
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides, see label

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	11	Heritage Quadris FL Equation Satori (azoxystrobin)	3.2 oz 6.2 fl oz 6.2 fl oz 6.2 fl oz	1.6 lb 37 fl oz 37 fl oz 37 fl oz	0 0 0 0	4 hr 4 hr 4 hr 4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 1 year plant back restriction for certain off label crops.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	1.9 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Botrytis, Gray Mold	M5	**(chlorothalonil)** Many brands available: Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	SEE INDIVIDUAL LABELS		0	0.5	Use higher rates at fruit set and lower rates before fruit set.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	3 & 9	Chairman (propiconazole + fludioxonil)	32 floz /100 gal or /50,000 lb of fruit	-	-	-	Apply as a post-harvest dip, drench, or high-volume spray for the post-harvest control of certain rots. Lower rates for small diameter fruit. See label for details.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse usage.
(*suppression*)	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse usage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide; Has a 30 day plant back with off label crops.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 appl. Alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30 day plant back with off label crops.
(suppression)	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential appl. Allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	14	Botran 75 W (dichloran)	1 lbs per 100 gal.	5.33 lb	10	0.5	Greenhouse use only. Limit is 4 applications. Seedlings or newly set transplants may be injured.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	6.2 oz 13 fl oz	31.0 oz 78 fl oz	0 0	4 hr 4 hr	Alternate with a non-FRAC code 19 fungicide.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	1.9 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
Buckeye rot **Phytophthora fruit rot** **(*Phytophthora* spp.)**	4	Orondis Gold B (mefenoxam)	1 pt	3 pt	28	0	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil.
	M1 + 4	Ridomil Gold Copper (copper hydroxide + mefenoxam)	2 lb	6 lb	14	2	Limited to 3 apps per season. Tankmix with mancozeb.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	Heritage	3.2 oz	1.6 lb	0	4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
		Quadris FL	6.2 fl oz	37 fl oz	0	4 hr	
		Equation	6.2 fl oz	37 fl oz	0	4 hr	
		Satori	6.2 fl oz	37 fl oz	0	4 hr	
		(azoxystrobin)					
	11	Cabrio 2.09 F	16 fl oz	96 fl oz	0	0.5	Only 2 sequential appl. Allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group, see label.
		(pyraclostrobin)					
	11 & M5	Quadris Opti	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
		(azoxystrobin + chlorothalonil)					
(suppression)	11 & 27	Tanos	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
		(famoxadone + cymoxanil)					
	22 & M3	Gavel 75DF	2.0 lb	16 lb	5	2	See label
		(zoaximide + mancozeb)					
	U15	Orondis Opti A	4.8 fl oz	19.2 fl oz	0	4 hr	Do not combine foliar apps of Orondis with soil apps of Orondis for disease control. 6 apps per season; no more than 2 sequential apps. 5 day minimum app. interval; Applications should not exceed more than 33% of the total foliar fungicide apps. See Orondis Ultra A label for greenhouse use.
		Orondis Ultra A	4.8 fl oz	19.2 fl oz	0	4 hr	
		(oxathiapiprolin)					
Early blight	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	Mancozeb or maneb enhances bactericidal effect of fix copper compounds. **See label for details.**
	M3	(mancozeb) **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate FL, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3	Ziram 76DF	4 lbs	23.7 lb	7	2	Do not use on cherry tomatoes.
		(ziram)					
	M3 & M1	ManKocide	5 lb	112 lb	5	2	
		(mancozeb + copper hydroxide)					
	M5	**(chlorothalonil)** **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	SEE INDIVIDUAL LABELS		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	3	Tebuzol 3.6F	8 fl oz	48 fl oz	7	0.5	Limit is 6 appl./crop. Minimum appl. interval of 7 days.
		(tebuconazole)					

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	4 & M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 appl./crop.
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse useage.
	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide ; Has a 30 day plant back with off label crops.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 apps. alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30 day plant back with off label crops.
	11	Heritage	3.2 oz	1.6 lb	0	4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
		Quadris FL	6.2 fl oz	37 fl oz	0	4 hr	
		Equation	6.2 fl oz	37 fl oz	0	4 hr	
		Satori (azoxystrobin)	6.2 fl oz	37 fl oz	0	4 hr	
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential apps. allowed. Limit is 6 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Flint	4 oz	16 oz	3	0.5	Limit is 5 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
		Gem 500 SC (trifloxystrobin)	3 floz	16 fl oz	3	0.5	
	11	Evito	5.7 fl oz	22.8 fl oz	3	0.5	Limit is 4 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
		Aftershock (fluoxastrobin)					
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group. See supplemental label for restrictions and details.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 1 year plant back restriction for certain off label crops.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	6.2 oz 13 fl oz	31.0 oz 78 fl oz	0 0	4 hr 4 hr	Alternate with a non-FRAC code 19 fungicide.
	22 & M3	Gavel 75DF Zing! (zoaximide + mancozeb)	2.0 lb 34 fl oz	16 lb 272 fl oz	5	2	
	27 & M5	Ariston (cymoxanil + chlorothalonil)	3.0 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	28	Previcur Flex (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank mix with chlorothalonil or mancozeb.
	28	Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank mix with chlorothalonil or mancozeb.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	Limit is 4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Late blight	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	
	M3	**(mancozeb)** **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3 & M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	4 & M3	Ridomil MZ 68 WP (mefenoxam + mancozeb)	2.5 lb	7.5 lb	5	2	Limit is 3 apps./crop.
	4 & M1	Ridomil Gold Copper 64.8 W (mefenoxam + copper hydroxide)	2 lb	6 lb	14	2	Limit is 3 apps./crop. Tank mix with mancozeb fungicide.
	4 & M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 apps./crop.
	11	Heritage	3.2 oz	1.6 lb	0	4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
		Quadris FL	6.2 fl oz	37 fl oz	0	4 hr	
		Equation	6.2 fl oz	37 fl oz	0	4 hr	
		Satori (azoxystrobin)	6.2 fl oz	37 fl oz	0	4 hr	
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential appl. Allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Flint	4 oz	16 oz	3	0.5	Limit is 5 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
		Gem 500 SC (trifloxystrobin)	3.8 floz	16 fl oz	3	0.5	
	11	Evito Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Limit is 4 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	19	Oso 5% SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
	21	Ranman (cyazofamid)	2.75 oz	16oz	0	0.5	Limit is 6 apps./crop.
	22 & M3	Gavel 75DF	2.0 lb	16 lb	5	2	
		Zing! (zoaximide + mancozeb)	34 fl oz	272 fl oz			
	27	Curzate 60DF (cymoxanil)	5 oz	30 oz per year	3	0.5	Must tank mix with another effective product.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	3.0 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	28	Previcur Flex (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank mix with Chlorothalonil or mancozeb.
	28	Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank mix with Chlorothalonil or mancozeb.
	33	Aliette 80 WDG (fosetyl-al)	5 lb	20lb	14	0.5	See label for warnings concerning the use of copper compounds.
	33	Alude (mono- and di-potassium salts of phosphorous acid)	1.5 qt/ acre/ 25 gal	-	-	4 hr	For transplants only.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	40	Forum (dimethomorph)	6 oz	30 oz	4	0.5	Only 2 sequential appl. See label for details
	40	Orondis Ultra B	8 fl oz	32 fl oz	1	4 hr	No more than 2 sequential appl. Rotate with another effective fungicide; See label.
		Revus (mandipropamid)	8 fl oz	32 fl oz	1	4 hr	
		Micora (mandipropamid)	8 fl oz/ 5,000 sq ft	16 fl oz/ 5,000 sq ft	n.a.	4 hr	Micora is only labeled for transplant and retail sale to consumers.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants. See label
	43	Presidio (Fluopicolide)	4 fl oz	12 fl oz/per season	2	0.5	4 apps per season; no more than 2 sequential apps. 10 day spray interval; Tank mix with another labeled non-FRAC code 43 fungicide; 18 month rotation with off label crops; see label.
	45 & 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. Limit of 3 applications per season.
	U15	Orondis Opti A	4.8 fl oz	19.2 fl oz	0	4 hr	Do not combine foliar apps of Orondis with soil apps of Orondis for disease control. 6 apps per season; no more than 2 sequential apps. 5 day minimum app. interval; Applications should not exceed more than 33% of the total foliar fungicide apps. See Orondis Ultra A label for greenhouse use.
		Orondis Ultra A (oxathiapiprolin)	4.8 fl oz	19.2 fl oz	0	4 hr	
Leaf mold	M3	**(mancozeb)** **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5		
	M5	**(chlorothalonil)** **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group.
	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	19	Oso 5% SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	22 & M3	Gavel 75DF (zoaximide + mancozeb)	2.0 lb	16 lb	5	2	
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Grey leaf spot (*Stemphyllium* spp.)	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	SEE INDIVIDUAL LABELS		1	Varies by product from 4 hr to 2 days.	Mancozeb or maneb enhances bactericidal effect of fix copper compounds.
	M3	**(mancozeb)** **Many brands available:** Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP	**SEE INDIVIDUAL LABELS**		5	1	
	M3 & M1	ManKocide (mancozeb + copper hydroxide)	5 lb	112 lb	5	2	
	M5	**(chlorothalonil)** **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	SEE INDIVIDUAL LABELS		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 & M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 apps./crop.
	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	11	Flint Gem 500 SC (trifloxystrobin)	4 oz 3.8 floz	16 oz 16 fl oz	3 3	0.5 0.5	Limit is 5 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 1 year plant back restriction for certain off label crops.
	22 & M3	Gavel 75DF (zoaximide + mancozeb)	2.0 lb	16 lb	5	2	
	27 & M5	Ariston (cymoxanil + chlorothalonil)	3.0 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Phytophthora crown rot, Phytophthora root rot (*Phytophthora* spp.)	4	Orondis Gold B Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt 1 pt 2 pt	3 pt 3 pt 6 pt	28 28 7	0* 2* 2*	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4	Metastar 2E (metalaxyl)	2 qt	6 qt	2	28	Soil applied by drip injection.
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group. *(Phytophthora capsici-* suppression only)
	14	Terramaster 4EC (etridiazole)	7 fl oz	27.4 fl oz	3	0.5	Greenhouse use only.
	21	Ranman (cyazofamid)	2.75 fl oz	16.5 fl oz	0		Apply to the base of plant at the time of transplanting. Make additional applications on a 7 to 10 day schedule if conditions are favorable for disease.
	28	Previcur Flex (propamocarb hydrochloride)	**SEE LABEL**		5	0.5	GREENHOUSE APPLICATION: 6 apps/crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.
	33	Aliette 80 WDG Linebacker WDG (fosetyl-aluminum)	5 lb	2 lb	14	0.5	See label for warnings concerning the use of copper compounds.
	33	Alude (mono- and di-potassium salts of phosphorous acid)	1.5 qt/ acre/ 25 gal	-	-	4 hr	For transplants only.
	43	Presidio (fluopicolide)	4 fl oz	12 fl oz	2	0.5	4 apps per season; no more than 2 sequential apps. 10 day spray interval; Tank mix with another labeled non-FRAC code 43 fungicide; 18 month rotation with off label crops.
	45 & 40	Zampro (ametoctradin + dimethomorph)	14 fl oz	42 fl oz	4	0.5	Addition of a spreading or penetrating adjuvant is recommended to improve performance. Limit of 3 applications per season.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	U15	Orondis Gold 200 (oxathiapiprolin)	19.2 fl oz	38.6 fl oz	0	4 hr	Soil applications cannot be combined with foliar applications of Orondis Opti A or Orondis Ultra A. 4 apps per season; no more than 2 sequential apps. 7 day minimum app. interval; Applications should not exceed more than 33% of the total soil fungicide apps. See label for soil application instructions.
	U15	Orondis Opti A Orondis Ultra A (oxathiapiprolin)	4.8 fl oz 4.8 fl oz	19.2 fl oz 19.2 fl oz	0 0	4 hr 4 hr	Do not combine foliar apps of Orondis with soil apps of Orondis for disease control. 6 apps per season; no more than 2 sequential apps. 5 day minimum app. interval; Applications should not exceed more than 33% of the total foliar fungicide apps. See Orondis Ultra A label for greenhouse use.
Powdery mildew	M2	**(sulfur)** **Many brands available:** Cosavet DF, Kumulus DF, Micro Sulf, Microfine Sulfur, Microthiol Disperss, Sulfur 6L, Sulfur 90W, Super Six, That Flowable Sulfur, Tiolux Jet, Thiosperse 80%, Wettable Sulfur, Wettable Sulfur 92, Yellow Jacket Dusting Sulfur, Yellow Jacket Wettable Sulfur	**SEE INDIVIDUAL LABELS**		1	1	Follow label closely, may cause leaf burn if applied during high temperatures.
	3	Rally 40WSP Nova 40 W Sonoma 40WSP (myclobutanil)	4 oz	1.25 lb	0	1	Note that a 30 day plant back restriction exists.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential applications before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse useage.
(suppression)	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	After 2 apps alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30 day plant back with off label crops.

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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11	Heritage Quadris FL Equation Satori (azoxystrobin)	3.2 oz 6.2 fl oz 6.2 fl oz 6.2 fl oz	1.6 lb 37 fl oz 37 fl oz 37 fl oz	0 0 0 0	4 hr 4 hr 4 hr 4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential apps. allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Flint Gem 500 SC (trifloxystrobin)	4 oz 3.8 floz	16 oz 16 fl oz	3 3	0.5 0.5	Limit is 5 apps/crop; must alternate or tank mix with a fungicide from a different FRAC group.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 1 year plant back restriction for certain off label crops.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	19	Ph-D WDG Oso 5% SC (polyoxin D zinc salt)	6.2 oz 13 fl oz	31.0 oz 78 fl oz	0 0	4 hr 4 hr	Alternate with a non-FRAC code 19 fungicide.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
	U8	Vivando (metrafenone)	15.4 fl oz	46.2 fl oz	0	0.5	3 apps per season; no more than 2 sequential apps. Do not mix with horticultural oils.
Pythium diseases (*Pythium spp.*)	4	Orondis Gold B Ridomil Gold GR Ridomil Gold SL Ultra Flourish (mefenoxam)	1 pt 20 lb 2 pt 2 pt	3 pt 40 lb 3 pt 6 pt	28 28 7 7	0* 2* 2* 2	Do not apply more than 1.5 lb mefenoxam/A per crop to the soil. *There is a reentry interval exemption if material is soil-injected or soil-incorporated.
	4	Metastar 2E (metalaxyl)	2 qt	6 qt	28	2	Soil applied by drip injection.
	14	Terramaster 4EC (etridiazole)	7 fl oz	27.4 fl oz	3	0.5	Greenhouse use only.
	21	Ranman (cyazofamid)	3 fl oz/ 100 gal	-	0	-	For greenhouse transplant production; make a single application to the seedling tray 1 week prior up to the time of transplanting. Do not use any surfactant.
	28	Previcur Flex (propamocarb hydrochloride)	**SEE INDIVIDUAL LABELS**		5	0.5	GREENHOUSE APPLICATION: 6 apps/crop cycle. Do not mix with other products. Can cause phytotoxicity if applied in intense sunlight.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

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Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	28	Previcur Flex (propamocarb hydrochloride)	1.5 pts/ treated acre	7.5 pt/ treated acre	5	0.5	(Root rots and seedling diseases) Applied to lower portion of plant and soil, or as a soil drench or drip irrigation.
	28	Promess (propamocarb hydrochloride)	1.5 pt	7.5 pt	5	0.5	Must tank mix with chlorothalonil or mancozeb.
	33	Alude (mono- and di-potassium salts of phosphorous acid)	1.5 qt/ acre/ 25 gal	-	-	4 hr	For transplants only.
Rhizoctonia root rot, Rhizoctonia fruit rot (*Rhizoctonia solani*)	M5	**(chlorothalonil)** **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	7	Fontelis (penthiopyrad)	1.0 - 1.6 fl oz/ 1000 row-ft	24 fl oz	0	0.5	Apply at-plant, pre-plant incorporated, in-furrow, as a transplant drench, or by drip irrigation.
(*suppression*)	11	Cabrio (pyraclostrobin)	16 oz	96 oz	0	0.5	Limit is 2 sequential applications before alternating to another effective fungicide from a different FRAC group.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	7	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	14	Blocker 4F Terraclor 75 WP (PCNB)	**SEE INDIVIDUAL LABELS**		Soil treatment at planting	0.5	See label for application type and restrictions
	14	Par-Flo 4F (PCNB)	12 fl oz per 100 gal.	2 app.	Soil drench	0.5	Limited to only container-grown plants in nurseries or greenhouse.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	1.9 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
Rhizopus rot	3 & 9	Chairman (propiconazole + fludioxonil)	32 floz /100 gal or /50,000 lb of fruit	-	-	-	Apply as a post-harvest dip, drench, or high-volume spray for the post-harvest control of certain rots. Lower rates for small diameter fruit. See label for details.
Septoria leaf spot	M1	**(copper compounds)** **Many brands available:** Badge SC, Badge X2, Basic Copper 50W HB, Basic Copper 53, C-O-C-S WDG, Champ DP, Champ F2 FL, Champ WG, Champion WP, C-O-C DF, C-O-C WP, Copper Count N, Cuprofix Ultra 40D, Cueva, Kentan DF, Kocide 3000, Kocide 2000, Kocide DF, Nordox, Nordox 75WG, Nu Cop 50WP, Nu Cop 3L, Nu Cop 50DF, Nu Cop HB	**SEE INDIVIDUAL LABELS**		1	Varies by product from 4 hr to 2 days.	
	M3	**(mancozeb)** **Many brands available:**	**SEE INDIVIDUAL LABELS**		5		

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
		Dithane DF, Dithane F45, Dithane M45, Koverall, Manzate, Manzate Pro-Stik, Penncozeb 4FL, Penncozeb 75DF, Penncozeb 80WP					
	M3	Ziram 76DF (ziram)	4 lbs	23.7 lb	7	2	Do not use on cherry tomatoes.
	M3 & M1	ManKocide (mancozeb + copper hydroxide)	5 lbs	112 lb	5	2	
	M5	(chlorothalonil) **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.
	4 & M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 apps./crop.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential apps. before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse useage.
	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	11	Heritage Quadris FL Equation Satori (azoxystrobin)	3.2 oz 6.2 fl oz 6.2 fl oz 6.2 fl oz	1.6 lb 37 fl oz 37 fl oz 37 fl oz	0 0 0 0	4 hr 4 hr 4 hr 4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential appl. Allowed. Limit is 6 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Flint (trifloxystrobin)	4 oz	16 oz	3	0.5	Limit is 5 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Reason 500 SC (fenamidone)	8.2 oz	24.6 lb	14	0.5	Must alternate with a fungicide from a different FRAC group.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Up to a 1 year plant back restriction for certain off label crops.
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	22 & M3	Gavel 75DF Zing! (zoaximide + mancozeb)	2.0 lb 34 fl oz	16 lb 272 fl oz	5	2	
	27 & M5	Ariston (cymoxanil + chlorothalonil)	3.0 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Sour Rot (*Geotrichum candidum*)	3	Mentor (propiconazole)	8 oz /100 gal or /50,000 lb of fruit	-	-	-	Apply as a post-harvest dip, drench, or high-volume spray for the post-harvest control of certain rots. See label for details.
	3 & 9	Chairman (propiconazole + fludioxonil)	32 floz /100 gal or /50,000 lb of fruit	-	-	-	Apply as a post-harvest dip, drench, or high-volume spray for the post-harvest control of certain rots. Lower rates for small diameter fruit. See label for details.
Southern blight	7	Fontelis (penthiopyrad)	1.0 - 1.6 fl oz/ 1000 row-ft	24 fl oz	0	0.5	Apply at-plant, pre-plant incorporated, in-furrow, as a transplant drench, or by drip irrigation.
	11	Evito Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Limit is 4 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
(*suppression*)	11	Cabrio (pyraclostrobin)	16 oz	96 oz	0	0.5	Limit is 2 sequential applications before alternating to another effective fungicide from a different FRAC group.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	14	Blocker 4F Terraclor 75 WP (PCNB)	**SEE INDIVIDUAL LABELS**		Soil treatment at planting	0.5	See label for application type and restrictions.
(suppression)	19	Oso 5% SC (polyoxin D zinc salt)	13 fl oz	78 fl oz	0	4 hr	Alternate with a non-FRAC code 19 fungicide.
Target spot	M5	**(chlorothalonil)** **Many brands available:** Bravo Ultrex, Bravo Weather Stik, Bravo Zn, Chloronil 720, Echo 720, Echo 90 DF, Echo Zn, Equus 500 Zn, Equus 720 SST, Equus DF, Initiate 720, Orondis Opti B	**SEE INDIVIDUAL LABELS**		0	0.5	Use higher rates at fruit set and lower rates before fruit set.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	4 & M5	Ridomil Gold Bravo 76.4 W (chlorothalonil + mefenoxam)	3 lb	12 lb	14	2	Limit is 4 appl./crop.
	7	Endura (boscalid)	12.5 oz	25 oz	0	0.5	Alternate with non-FRAC code 7 fungicides.
	7	Fontelis (penthiopyrad)	24 fl oz	72 fl oz	0	0.5	No more than 2 sequential apps. before switching to another effective fungicide with a different mode of action. See label for additional instructions pertaining to greenhouse useage.
	7 & 9	Luna Tranquility (fluopyram + pyrimethanil)	11.2 fl oz	54.7 fl oz	1	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. See label for additional instructions pertaining to greenhouse useage.
	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	9	Scala SC (pyrimethanil)	7 fl oz	35 fl oz	1	0.5	Use only in a tank mix with another effective non-FRAC code 9 fungicide; has a 30 day plant back with off label crops.
	9 & 3	Inspire Super (cyprodinil + difenoconazole)	20 fl oz	47 fl oz	0	0.5	Limit is 5 apps./season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 8 month plant back restriction with off label crops.
	9 & 12	Switch 62.5WG (cyprodinil + fludioxonil)	14 oz	56 oz per year	0	0.5	See 2 (ee) label. After 2 apps. alternate with non-FRAC code 9 or 12 fungicides for next 2 applications. Has a 30 day plant back with off label crops.
	11	Heritage	3.2 oz	1.6 lb	0	4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
		Quadris FL	6.2 fl oz	37 fl oz	0	4 hr	
		Equation	6.2 fl oz	37 fl oz	0	4 hr	
		Satori (azoxystrobin)	6.2 fl oz	37 fl oz	0	4 hr	
	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential appl. Allowed. Limit is 6 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11	Evito Aftershock (fluoxastrobin)	5.7 fl oz	22.8 fl oz	3	0.5	Limit is 4 appl/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
	11 & M5	Quadris Opti (azoxystrobin + chlorothalonil)	1.6 pt	8 pt	0	0.5	Must alternate with a non-FRAC code 11 fungicide; use of an adjuvant may cause phytotoxicity.
	11 & 3	Quadris Top (azoxystrobin + difenoconazole)	8 fl oz	47 fl oz	0	0.5	Limit is 4 apps per season with no more than 2 sequential apps. Must tank mix or alternate with another effective fungicide from another FRAC group. Has up to a 1 year plant back restriction for certain off label crops.

Table 17.4. Tomato fungicides ordered by disease and then FRAC group according to their mode of action. (continued)

Labels change frequently. Be sure to read a current product label before applying any chemical.
Also refer to Table 18.1 for biopesticide and other alternative products labeled for disease management.

Pertinent Diseases or Pathogens	Fungicide Group[1]	Chemical (active ingredients)	Max. Rate/Acre		Min. Days to		Remarks[2]
			Applic.	Season	Harvest	Reentry	
	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.
	11 & 27	Tanos (famoxadone + cymoxanil)	8 oz	72 oz	3	0.5	Do not alternate or tank mix with other FRAC group 11 fungicides.
	27 & M5	Ariston (cymoxanil + chlorothalonil)	3.0 pt	30.2 pt	3	0.5	Check copper manufacturer's label for specific precautions and limitations for mixing with this product.
	40 & 3	Revus Top (mandipropamid + difenoconazole)	7 fl oz	28 fl oz	1	0.5	4 apps per season; no more than 2 sequential apps. Not labeled for transplants.
Timber Rot, Sclerotinia stem rot, or White mold (*Sclerotinia sclerotiorum*) *(suppression)*	7 & 11	Luna Sensation (fluopyram + trifloxystrobin)	7.6 fl oz	27.3 fl oz	3	0.5	No more than 2 sequential applications before rotating with another effective fungicide from a different FRAC group. Limit of 5 apps per a year.
	11	Heritage Quadris FL (azoxystrobin)	3.2 oz 6.2 fl oz	1.6 lb 37 fl oz	0	4 hr	Must alternate or tank mix with a fungicide from a different FRAC group; use of an adjuvant or tank mixing with EC products may cause phytotoxicity.
(*suppression*)	11	Cabrio 2.09 F (pyraclostrobin)	16 fl oz	96 fl oz	0	0.5	Only 2 sequential apps. allowed. Limit is 6 apps/crop. Must alternate or tank mix with a fungicide from a different FRAC group.
(suppression)	11 & 7	Priaxor (pyraclostrobin + fluxapyroxad)	8 fl oz	24 fl oz	0	0.5	Limit is 3 apps per season; no more than 2 sequential apps. See label about compatibility with other formulated products and adjuvants.

[1] FRAC code (fungicide group): Number (1 through 46) and letters (U and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. U = unknown, or a mode of action that has not been classified yet and is typically associated with another number; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any chemical. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

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Chapter 18. Biopesticides and Alternative Disease and Pest Management Products

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Table 18.1. Biopesticides and other alternative products labeled for plant disease management.

Labels change frequently. Be sure to read a current product label before applying any pesticide. Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.

Product (active ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to: Harvest	Minimum Days to: Reentry	OMRI Listed	Remarks[2]
Actinovate, ActinoGrow (*Streptomyces lydicus* WYEC 108), NC	All Vegetables & Strawberries	*Alternaria* spp., Anthracnose, *Aphanomyces*, Botrytis, Charcoal Rot (*Macrophomina phaseolina*), Club root (*Plasmodiophora brassicae*), Downy Mildew, *Erwinia* spp., *Fusarium* spp., *Gaeumannomyces*, Powdery Mildew, Pseudomonas spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Sclerotinia* spp., Southern Blight, Verticillium spp., *Xanthomonas* spp.	0	1 hr	Yes	See label for specific rates and application recommendations.
Afla-guard GR (Aspergillus flavus NRRL 21882)	Sweet Corn	Aspergillus	-	4 hr	No	Do not exceed 20lb/acre per growing season. See label for specific application instructions.
AgriPhage (bacteriophage), NC	Tomato, Pepper	Bacterial spot, Bacterial speck	0	0	No	Bacterial strains must be characterized preiodically by manufacturer to correctly formulate the bacteriophage mixture.
Armicarb 100 **Eco-mate Armicarb "O"** (potassium bicarbonate), NC	All Vegetables & Strawberries	Anthracnose, Botrytis, Downy mildew, Phoma, Powdery mildew, Septoria leaf spot	0	4 hr	No	See label for specific rates and application recommendations.
Ballad Plus, (*Bacillus pumilus* strain QST 2808) NC	All Legumes & Sweet Corn	Bacterial blight, Brown spot, Cercospora leaf spot, Common Rust, Downy mildew, Northern and Southern leaf blight, Pseudomonas spp. Xanthomonas spp.	0	4 hr	No	See label for specific rates and application recommendations.
BioCover (Oil, petroleum)	All Vegetables & Strawberries	Powdery mildew, Rust	0	4 hr	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
BIO-TAM (*Trichoderma asperellum* strain ICC 012 + *Trichoderma gamsii* strain ICC 080) NC	All Vegetables & Strawberries	*Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Sclerotinia* spp., *Sclerotium rolfsii*, *Thielaviopsis basicola*, and *Verticillium* spp.	-	1 hr	Yes	See label for additional rates and recommendations for transplant production and details for specific diseases. Check label for product incompatibility with certain chemical fungicides.
Cease (*Bacillus subtilis* strain QST 713), 44	All Vegetables & Strawberries	Bacterial spot, Bacterial speck, Botrytis, Early Blight, Late Blight, Powdery mildew, Target spot, Rhizoctonia spp., Pythium spp., Fusarium spp., Verticillium spp., Phytophthora spp.	0	4 hr	Yes	For foliar applications mix with copper compounds or other effective fungicides. Compatible with soil drench and in-furrow applications. See label for specific rates and application recommendations.
Contans WG (*Coniothyrium minitans* strain CON/M/91-08)	All Vegetables & Strawberries	*Sclerotinia sclerotiorum* and *Sclerotinia minor*	0	4 hr	Yes	See label for specific rates and application recommendations.
Double Nickel 55 **Double Nickel LC** (*Bacillus amyloliquefaciencs* strain D747), 44	All Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Bacterial diseases, Botrytis, Early blight, Late blight, *Phytophthora* spp., Powdery mildew, *Pythium* spp., Rhizoctonia, Fusarium spp., Rhizoctonia, Phytophthora spp., Pythium spp.	0	4 hr	Yes	See label for additional rates and recommendations for foliar and soil application rates and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment. See label for details.

Table 18.1. Biopesticides and other alternative products labeled for plant disease management. (continued)

Labels change frequently. Be sure to read a current product label before applying any pesticide.
Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.

Product (active ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to: Harvest	Minimum Days to: Reentry	OMRI Listed	Remarks[2]
Glacial Spray Fluid (Oil, petroleum), NC	All Vegetables & Strawberries	Powdery mildew, Rust	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
JMS Stylet-Oil **Organic JMS Stylet-Oil** (paraffinic oil), NC	All Vegetables & Strawberries	Potato Virus Y, Tobacco Etch Virus, Cucumber Mosaic Virus	0	4 hr	Yes, but only for one label.	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Kaligreen (potassium bicarbonate), NC	All Vegetables & Strawberries	Powdery mildew	0	4 hr	Yes	See label for specific rates and application recommendations.
Milstop (potassium bicarbonate), NC	All Vegetables & Strawberries	Anthracnose, *Alternaria* spp., Botrytis, Downy mildew, Powdery mildew	0	1 hr	Yes	See label for specific rates and application recommendations.
Oxidate 2.0 (mono- and di-potassium salts of phosphorous acid + hydrogen peroxide), 33 + NC	All Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Bacterial diseases, Botrytis, Early blight, Late blight, *Phytophthora* spp., Powdery mildew, *Pythium* spp., Rhizoctonia, Fusarium spp., Rhizoctonia, Phytophthora spp., Pythium spp.	0	1 hr for enclosed areas; until spray dries in open field areas.	No	See label for additional rates and recommendations for transplant production and details for specific diseases. Use as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment.
OxiPhos (hydrogen peroxide), NC	All Vegetables & Strawberries	Bacterial diseases, Gummy stem blight, Late blight, *Phytophthora* spp., *Pythium* spp., Phytophthora spp., Pythium spp.	0	4 hr	No	See label for recommedations for rates, application methods, and details for specific diseases.
(potassium phosphite; mono- and di-potassium salts of phosphorous acid), 33 **Many brands available:** Alude, Appear, Confine Extra T&O, Fosphite, Fungi-Phite, Helena Prophyt, K-Phite 7LP AG, Phorcephite, Phostrol, Rampart, Reveille	All Vegetables & Strawberries	*Alternaria spp., Anthracnose, Bacterial diseases,* Downy mildew, *Fusarium* spp., Late blight, Leaf blights caused by *Cercospora* and *Septoria* spp., *Phytophthora* spp., Powdery mildew, *Pythium* spp., *Rhizoctonia* spp., Root rots	0	4 hr	No	See label for details, specific recommendations, and precautions for tank mixing with copper-based fungicides.
PlantShield HC (*Trichoderma harzianum* Rifai strain KRL-AG2), NC	All Vegetables & Strawberries	*Fusarium* spp., Rhizoctonia, *Pythium* spp.	0	4 hr	Yes	Can be applied to plant as a direct drench, furrow spray, chemigation, or in transplant starter solution. See label for details.
Procidic (Citric acid), NC	All Vegetables & Strawberries	Broad spectrum fungicide	0	0	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Purespray Green (Oil, petroleum), NC	All Vegetables & Strawberries	Powdery mildew, Rust	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions regarding use.
Regalia SC (extract of *Reynoutria sachalinensis*), P	All Vegetables & Strawberries	Bacterial canker , Bacterial speck, Bacterial spot, Botrytis, Early blight, Phytophthora spp., Powdery mildew, Target spot, Late blight	0	4 hr	Yes	Tank mix with other effective fungicides for improved disease control under heavy pressure. See label for details.
Rendition **ZeroTol 2.0** (Hydrogen peroxide + peroxyacetic acid), NC	All Vegetables & Strawberries	Broad spectrum fungicide	0	1 hr for enclosed areas; until spray dries in open field areas.	No	See label for specific rates, application recommendations, and precautions regarding use with other pesticides. Can be used as a soil drench at transplant and periodically throughout the season. Can also be used as a seed treatment.
RootShield Granular (Trichoderma harzianum Rifai strain KRL-AG2), NC	All Vegetables & Strawberries	*Fusarium* spp., Rhizoctonia, *Pythium* spp.	0	0	Yes	Granular formulation can be applied in furrow in the field, or to greenhouse planting mix. See label for details.
RootShield WP (*Trichoderma harzianum* Rifai strain KRL-AG2), NC	All Vegetables & Strawberries	*Fusarium* spp., Rhizoctonia, *Pythium* spp.	0	Until spray has dried.	Yes	Can be applied as a greenhouse soil drench, or by chemigation in field and greenhouse operations. In furrow or transplant starter solution.

Table 18.1. Biopesticides and other alternative products labeled for plant disease management. (continued)

Labels change frequently. Be sure to read a current product label before applying any pesticide.
Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.

Product (active ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to: Harvest	Minimum Days to: Reentry	OMRI Listed	Remarks[2]
Serenade ASO **Serenade Max** **Serenade Opti** **Serenade Optimum** (*Bacillus subtilis* strain QST 713), 44	All Vegetables & Strawberries	Bacterial speck, Bacterial spot, Botrytis, Early Blight, Late Blight, Powdery mildew, Target spot	0	4 hr	Yes	For foliar applications mix with copper compounds or other effective fungicides for improved disease control. See label for details.
Serenade Soil (Bacillus subtilis strain QST 713), 44	All Vegetables & Strawberries	*Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Verticillium* spp.	0	4 hr	Yes	Formulation compatible with soil drench, in-furrow, and chemigation applications. Mix with other effective fungicides for improved disease control. See label for details.
Sil-Matrix (potassium silicate), NC	All Vegetables & Strawberries	Broad spectrum fungicide	0	4 hr	No	Must be used in a rotational program with other fungicides when conditions are conducive for disease development. See label for details.
Soilgard 12G (Gliocladium virens GI-21), NC	All Vegetables & Strawberries	Fusarium root and crown rot, *Phytophthora capsici, Pythium* spp., Rhizoctonia, *Sclerotinia* spp., *Sclerotium* spp.	0	0	Yes	For best results apply to transplants or as a drench during transplanting. Subsequent applications can be made as drench, directed spray, or by chemigation. Chemical fungicides should not be mixed with or applied to soil or plant media at the same time as SoilGard 12G. See label for details.
Sonata (*Bacillus pumilus* QST 2808), NC	All Vegetables & Strawberries	Early Blight, Downy mildew, Late Blight, Powdery mildew, Rust	0	4 hr	Yes	Mix or alternate with other effective fungicides for improved disease control. See label for details.
Sporatec (oils of clove, rosemary and thyme), NC	All Vegetables & Strawberries	Bacterial spot, Botrytis, Early blight, Gray mold, Late blight, Powdery mildew	0	0	Yes	Exercise care when applying. Begin applications once disease is observed. Use of a spreader and/or penetrant adjuvant recommended for improved performance. Do not apply when temps are above 90ºF. See label for details. Ingredients are exempt from FIFRA.
Taegro ECO (*Bacillus amyloliquefaciencs* strain FZB24), NC	Cucurbits: cantaloupe, honey dew, cucumber, squash, watermelon; Leafy vegetables: lettuce, celery, spinach, radicchio, endive, arugula, mache, parsley, rhubarb, and swiss chard; Fruiting vegetables: tomato and pepper.	Foliar diseases: Downy mildew, Powdery mildew, Pseudomonas spp., Xanthomonas spp.; Soilborne diseases: *Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Sclerotinia* spp.	-	1 day	No	See label for specific instructions regarding soil injected, spray, or incorporated applications. Maximum of 12 applications per season. For best efficacy, product should be applied prior to disease or disease establishment. May be applied to greenhouse produced crops.
Tenet (*Trichoderma asperellum* ICC 012; *Trichoderma gamsii* ICC 080), NC	All Vegetables & Strawberries	*Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Sclerotium rolfsii*, *Sclerotinia* spp., *Thielaviopsis basicola*, and *Verticillium* spp.	0	1 hr	Yes	For best results apply 1 week prior to planting, with 2 or more additional applications throughout the production cycle. May be applied through fertigation systems in combination with most common fertilizers. Can be applied to fumigated soil after fumigant has dissipated. Tenet has no curative activity. See label for details regarding application and fungicide incompatibility.
Terraclean (hydrogen dioxide), NC	All Vegetables & Strawberries	Soilborne plant pathogens caused by species of *Fusarium, Phytophthora, Pythium,* and *Rhizoctonia*	0	0	No	Can be applied by flood irrigation, drip irrigation, or as a soil drench. See label for application details and instructions regarding applications with liquid fertilizer mixtures.

Table 18.1. Biopesticides and other alternative products labeled for plant disease management. (continued)

Labels change frequently. Be sure to read a current product label before applying any pesticide.
Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.

Product (active ingredient), Fungicide Group[1]	Crops	Pertinent Diseases or Pathogens	Minimum Days to: Harvest	Minimum Days to: Reentry	OMRI Listed	Remarks[2]
Trilogy (clarified hydrophobic extract of neem oil), NC	All Vegetables & Strawberries	*Alternaria* spp., Anthracnose, Botrytis, Early blight, Powdery mildew	0	4 hr	Yes	See label for specific rates, application recommendations, and precautions regarding use with other pesticides.
Vacciplant (laminarin), P	All Vegetables & Strawberries	Anthracnose, Bacterial speck, Bacterial spot, Early blight, Phytophthora blight, Powdery mildew	0	4 hr	No	Start applications preventively, when weather conditions are favorable for disease development. Repeat applications until disease conditions end. Add a labeled copper product to VacciPlant if the disease symptoms appear.

[1] FRAC code (fungicide group): Number (33 and 44) and letters (NC and P) are used to distinguish the fungicide mode of action groups. All fungicides within the same group (with same number or letter) indicate same active ingredient or similar mode of action. This information must be considered for the fungicide resistance management decisions. However, products with NC or P are considered low risk and don't require any rotation unless specifically directed on the label. NC = not classified, includes mineral oils, organic oils, potassium bicarbonate, and other materials of biological origin; P = host plant defense inducers. Source: FRAC Code List 2013; http://www.frac.info/ (FRAC = Fungicide Resistance Action Committee).

[2] Information provided in this table applies only to Florida. Be sure to read a current product label before applying any product. The use of brand names and any mention or listing of commercial products or services in the publication does not imply endorsement by the University of Florida Cooperative Extension Service nor discrimination against similar products or services not mentioned.

Table 18.2. Biopesticides and other alternative products labeled for plant pest management.

Labels change frequently. Be sure to read a current product label before applying any pesticide.
Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.

Product (active ingredient)	Rate	REI	PHI	Insects	MOA Code[1]	Notes
Agree WG (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	lepidopteran larvae (caterpillar pests)	11A	Apply when larvae are small for best control. Can be used in greenhouse. OMRI-listed.
Aza-Direct (azadirachtin)	1-2 pts, up to 3.5 pts, if needed	4	0	aphids, beetles, caterpillars, leafhoppers, leafminers, thrips, weevils, whiteflies	un	Antifeedant, repellant, insect growth regulator. OMRI-listed.
Azera (pyrethrins, azadirachtin)	1.0-3.5 qt	12	0	aphids, beetles, caterpillars, leafminers, whiteflies	3A, un	Apply when larvae are small for best control. Can be used in greenhouse. For organic production.
Biobit HP (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars (will not control large armyworms)	11A	Treat when larvae are young. Good coverage is essential. Can be used in the greenhouse. Can be used for organic production.
Botanigard ES (*Beauvaria bassiana* strain GHA)	up to 3 quarts per 100 gallons water; 0.33-1.00 fl. oz. per gallon water	4	0	whiteflies, aphids, thrips, mealybug, leafhoppers, planthoppers, plant bugs, two spotted spider mites	un	Works by contact. Spores attach to insects, germinate and penetrate insect cuticle.
Captiva (*Capsicum oleoresin* extract, garlic oil, soybean oil)	8 oz per 100 gallons water	4	0	mites, thrips, leafhoppers, whiteflies	un	
Deliver (*Bacillus thuringiensis* subspecies *kurstaki*)	0.25-1.5 lb	4	0	caterpillars	11A	Use higher rates for armyworms. OMRI-listed.
Des-X (soap, insecticidal)	2 % V/V	12	0	aphids, mites, plant bugs, whiteflies	--	OMRI-listed.
DiPel DF (*Bacillus thuringiensis* subspecies *kurstaki*)	0.5-2.0 lb	4	0	caterpillars	11A	Treat when larvae are young. See label for rates for specific pests. Good coverage is essential. OMRI-listed.
Entrust SC (spinosad)	see label for specific crops	4	See label	caterpillers, some beetles, thrips. See label for specific pests on specific crops	5	See label for resistance management and for maximum allowed amount per season. OMRI-listed.

Table 18.2. Biopesticides and other alternative products labeled for plant pest management. (continued)

Labels change frequently. Be sure to read a current product label before applying any pesticide. Refer to crop-specific tables for conventional pesticides labeled for disease and pest management.

Product (active ingredient)	Rate	REI	PHI	Insects	MOA Code[1]	Notes
Gemstar LC (*Helicoverpa zea* NPV)	4-10 fl oz	4	0	corn earworm (tomato fruitworm), tobacco budworm	–	Naturally occurring insect virus. OMRI-listed.
Grandevo (*Chromobacterium subtsugae* strain PRAA4-1)	1.0-3.0 lb	4	0	See label for specific pests for specific crops. For control of caterpillars, aphids, whiteflies and other insects.	–	Can be used in organic production. OMRI-listed
Javelin WG (*Bacillus thuringiensis* subspecies *kurstaki*)	0.12-1.50 lb	4	0	most caterpillars, but not *Spodoptera* species (armyworms)	11A	Treat when larvae are young. Thorough coverage is essential. OMRI-listed. See label for crops (most cole crops).
JMS Stylet oil (paraffinic oil)	3-6 quarts per 100 gallons water	4	0	leafhoppers, leafminers, mites, whiteflies		
MBI-203 EP bioinsecticide (*Chromobacterium subtsugae* strain PR AA4-IT)	4-12 quarts	4	0	various caterpillars, mites, plant bugs	_	OMRI listed
Met52 EC (*Metarhizium anisopliae* Strain F52)	drench: 40-80 fl. oz.; foliar: 0.5-2 quarts	0	0	thrips, whiteflies, mites	_	Composed of spores of insect pathogenic fungus *Metarhizium anisopliae* strain F52.
Met52 granular (*Metarhizium anisopliae* strain F52)		0	0	thrips pupae	1.5-3.0 lb/yd[3]	Product is incorporated into growing medium.
M-Pede 49% EC (soap, insecticidal)	1-2 % V/V	12	0	aphids, leafhoppers, mites, thrips, whiteflies	--	OMRI-listed.
Mycotrol O (*Beauveria bassiana*)	0.5-1.0 qt	4	0	aphids, thrips, whiteflies, psyllids	--	May be used in greenhouses. Not compatible in tank mix with fungicides. OMRI-listed.
Neemix 4.5 (azadirachtin)	4-16 fl oz	12	0	aphids, armyworms, cabbage looper, caterpillars, cutworms, leafminers, imported cabbageworm, whiteflies	un	IGR and feeding repellant. Greenhouse and field. OMRI-listed.
PFR-97 20% WDG (*Isaria fumosoroseus* Apopka Strain 97)	Foliar and soil: 1-2 lb	4	0	Foliar: whiteflies, aphids, thrips, spider mites, broad mites, *Liriomyza* leafminers, pysllids, plant bugs: Soil: thrips pupae, rootworms, wireworms, grubs, symphylans	–	Can be used on vegetables grown for transplant. Do not mix with fungicides or apply within 5 days of fungicide applications other than copper. Dust/mist respirator must be used for mxing and applying. For organic production.
Pyganic 5.0 (pyrethrins)		12	0	most insects	3A	Harmful to bees. Can be used in greenhouses. OMRI-listed.
Seduce Insect Bait (spinosad)	20-44 lb	4	see specific crops on label	cutworms, earwigs	5	For organic production
Trilogy (extract of neem oil)	0.5-2% V/V	4	0	aphids, mites, suppression of thrips and whiteflies	un	Apply morning or evening to reduce potential for leaf burn. Toxic to bees exposed to direct treatment. OMRI-listed.
Venerate XC (heat killed *Burkholderia* spp. strain A396 cells and spent fermentation media)	1-8 quarts per acre	4	0	control of caterpillars (see label); suppression of mealybugs, stink bugs, thrips, twospotted spider mite, whiteflies		OMRI listed.
Xentari DF (*Bacillus thuringiensis* subspecies *aizawai*)	0.5-2.0 lb	4	0	caterpillars	11A	Treat when larvae are young. Thorough coverage is essential. May be used in the greenhouse. Can be used in organic production.

[1] Mode of Action (MOA) codes for plant pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 7.2 April 2012. Number codes (1 through 28) are used to distinguish the main insectide mode of action groups, with additional letters for certain sub-groups within each main group. All insecticides within the same group (with same number) indicate same active ingredient or similar mode of action. This information must be considered for the insecticide resistance management decisions. un = unknown, or a mode of action that has not been classified yet.

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