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Vegetable Crops Department
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INTRODUCTORY REMARKS

D. N. Maynard

Welcome to the Twenty-third Annual Florida Tomato Grower's Institute.

Tomatoes continue to be Florida's most important vegetable crop and Florida continues to be the most important fresh-market tomato producing state.

The vitality of the Florida tomato industry is related to numerous factors. A generally favorable climate, available land, knowledgeable and progressive growers, and effective coordination of the industry through the Florida Tomato Committee and Florida Tomato Exchange have all contributed to the industry. In addition, new varieties and improved production and postharvest handling procedures developed by IFAS research have greatly benefitted the Florida tomato industry.

Because of the importance of tomatoes in Florida, research is conducted on virtually every aspect of production and handling by an interdisciplinary team of scientists. General areas of investigation are: 1. Variety improvement, 2. Soil and water management, 3. Stand establishment, 4. Cultural systems, 5. Pest management, 6. Harvest and postharvest handling, 7. Consumer and nutritional quality and 8. Transportation and marketing. Horticulturists constitute the core of this team with scientists from the Departments of Agricultural Engineering, Entomology and Nematology, Food and Resource Economics, Food Science and Human Nutrition, Plant Pathology and Soil Science contributing to their particular specialties.

Tomato research in Florida, in addition to being multidisciplinary, occurs at several locations; many in the heart of production areas. In addition to research and extension activities at Gainesville in several departments, other locations include the Gulf Coast, Tropical, and North Florida Research and Education Centers and the Agricultural Research and Education Centers at Ft. Pierce and Immokalee. The research program is coordinated by the Dean of Research, the Chairman of the Vegetable Crops Department, and the Center Directors.

The Cooperative Extension Service interprets and disseminates research information. A team of state Specialists and County Agents work together in bringing current research information to growers and shippers through on-site demonstrations, mass media, grower meetings, and newsletters or other publications.

The Tomato Institute is one means of reporting IFAS research and educational activities to the Florida tomato industry.

1984
FLORIDA TOMATO INSTITUTE
MARCO ISLAND, FLORIDA
THE 1983-84 TOMATO SEASON

BY
WAYNE HAWKINS
MANAGER, FLORIDA TOMATO COMMITTEE

The Organizational Meeting of the Florida Tomato Committee was held at Port St. Lucie, Florida, in September 1983. The initial regulations recommended to the Secretary of Agriculture were slightly different that those in effect for the 1982-83 season. The new regulations allowed commingling of only 5x6 and larger tomatoes, required all tomatoes shipped out of state to be in new boxes, and required the name and address of the registered handler on the box. Containers, net weight and size dimensions all remained the same.

The old saying that no two seasons are the same certainly proved to be true this season. Exceptionally heavy rains in the late summer and early fall delayed plantings in some areas. Continued wet weather compounded the problem of controlling disease in the field. Glut conditions occurred early in the fall with disastrously low prices. On December 24, 25, and 26 most areas in

Florida set all time low temperature records. District 3 was wiped out except for some young plants and Districts 1 and 2 experienced from 10 to 25 percent losses. Heavy replanting in District 3 occurred after the freeze and the harvest of this acreage coincided with the harvest of the spring crop in District 4. For all practical purposes, the season ended on June 15 with only a few people packing any tomatoes after that date.

Total harvested acres in Florida were 45,400 compared to 43,386 the previous season and 30,095 harvested in 1981-82. Districts 2 and 4 had increases of 915 and 1,209 acres, respectively. Districts 1 and 3 were down 105 and five acres, respectively, giving a net increase of 2,014 acres. There were 646 acres less of ground tomatoes and 2,660 acres more of staked tomatoes planted this season. The ratio remains about 1/3 ground and 2/3 staked. Total shipments were 45,493,783 25-lb. equivalents compared to 45,703,529 the previous season.

Total shipments were nearly 210,000 25-lb. equivalents less than the previous season even though there were 2,014 more acres planted. This is directly attributable to the results of the freeze and weather conditions that were very wet and windy at times which affected fruit set and quality. If Florida or Mexico had experienced good growing conditions producing a bumper crop, glut conditions and disastrously low prices would have occurred throughout most of the entire season.

Harvesting of the fall crop began in District 4 in mid-October with Districts 2 and 3 starting about two weeks later and District 1 starting the last week of November. Total shipments from all districts exceeded one million packages by the second week of November and continued at this level for the next nine weeks, dropping to 700,000 on the week ending January 21. Shipments ranged between 400,000 and 990,000 packages for nine weeks and then exceeded one million 25-lb. equivalents per week for the next 12 weeks with five of these weeks exceeding two million per week. Fall acreage in District 4 was up 12 percent over the previous season and shipments were up by 24 percent.

District 2 started harvesting the last week of October and continued shipping good volume through the second week of May and finished harvesting during the week ending May 26. Acreage planted for harvest was up 31 percent over the previous season but total shipments were up only 2.6 percent. This is a good illustration of the damage that occurred to the crops during the December 24-26 freeze and the cold, wet, windy weather that followed in January and February. Weekly shipments from this district exceeded 100,000 25-lb. equivalents for 22 weeks during the season and ten of these weeks had shipments that approached or exceeded 200,000 25-lb. equivalents.

District 1 started picking the last week of November and finished for all practical purposes on April 21. Weekly volume remained steady throughout this period except for four weeks in February when the real effects of the December freeze were felt. Total acreage planted for harvest was down approximately one percent but shipments were up nearly 16 percent. Again this points out how fortunate south Florida was on the nights of December 24-26 when most of the balance of the state experienced sub-freezing temperatures.

District 3 began shipping tomatoes the last week of October and total weekly shipments were approaching the normal volume when they were zapped by the December freeze. Virtually all tomatoes in this district were totally wiped out. Following a couple of weeks of salvage operations, shipments dropped to almost nothing for the next nine weeks and only reached normal shipments for three weeks during the balance of the season. The official records show harvested acres to be only five acres less than the previous season but this information is misleading. Any salvage following the freeze was counted as acres harvested with low yields. Official estimates indicate about 1,750 acres were lost as a result of the freeze. Total shipments from this area were down nearly 14 percent which again illustrates the damage that occurred during the freeze.

District 4 started harvesting in mid-April which was a little earlier than the previous season. Total acreage planted for harvest was up nearly five percent but shipments were down approximately six percent. During their 10-week spring season, shipments from District 4 totalled more than 11 million 25-lb. equivalents but 9.7 million of these were shipped in a six-week period.

Basic quality was good throughout most of their season, but cat faces, wind scarring and misshapen fruit were terrible. Packouts and resulting yields were far below normal with many packinghouses never reaching a grade of 85 percent No. 1's for any length of time. This was without a doubt the poorest quality ever shipped from this district in the spring.

The total 45,493,783 25-lb. equivalents were shipped over a 36-week period. Twenty-two of these weeks showed shipments exceeding one million packages with six of them showing more than two million. The total shipments were down 209,746 packages although the acres harvested were up by 2,014.

The total value of the crop was about 310.6 million dollars, a decrease of 34 million dollars from the previous season. The average price was $6.83 per 25-lb. equivalent for the entire season, compared to $7.54 per 25-lb. equivalent for the 1982-83 season. The short supplies in January through March helped to bolster the total season's average price. Many tomatoes were sold for prices far below the average at various times during the season.

During the 1983-84 season, there were more than 14 different commercial varieties planted. Sunny, Duke and F.T.E. No. 12 accounted for 89 percent of the total acreage. Hayslip, FloraDade and 8212 make up another eight percent. Six varieties accounted for 97 percent of the total commercial acreage. Some of the other varieties planted were Freedom, Atlantic, Mountain Pride, Castle

1035, Count, F.T.E. 20 and 21 and BHW 26. The Florida Tomato Exchange is continuing research efforts to find a new super variety for Florida and several seed companies are working toward the same objective.

The new regulations allowing commingling of only 5x6 and larger tomatoes, requiring all tomatoes shipped out of state to be in new boxes, and requiring the name and address of the registered handler on the carton went a long way toward solving the problems of theft and the shipment of cull tomatoes all over the United States. A few refinements in these regulations in the future will close the loop holes and further control these serious problems.

The first report on Mexican imports from Nogales appeared on the week ending December 17, 1983, which was about the same as the previous season. For the past four seasons, Mexico has started shipments in early December which has increased their season by several weeks. Shipments were light through December and the first two weeks of January. In the week ending January 21, imports jumped to more than 1.2 million 25 lb. equivalents and stayed well above this amount for the next 12 weeks, exceeding two million packages on two of these weeks. Imports for the next five weeks stayed above one-half million 25 lb. equivalents and did not drop below 100,000 cartons until the week ending June 2.

Total shipments from Mexico were up about 13.5 percent over the previous season. This coupled with an increase of 18 percent in 1982-83 gives them a total increase of 31.5 percent in two years. The reported acres planted in Mexico should have produced even a larger volume, but Mexico experienced some wet, cold, windy days and their quality was very poor. Even so, total mature greens imported increased by 96.8 percent from the previous season while ripes increased 6.8 percent and cherries increased 4.6 percent. Prices at Nogales, Arizona, were constantly cheaper than Florida prices which tended to depress the market, particularly in the west, for certain grades and sizes during some parts of the season. Efforts to get any help from Washington failed and Florida can only expect the situation to get worse in future years.

The Committee's activities in controlling container weights and designated diameters of tomato sizes have been profitable for the Florida Tomato Industry. It is also doubtful that Mexican producers would impose restrictions on themselves voluntarily if the Florida Tomato Marketing Order was not in effect. The need for continued use of these controls plus consideration of additional regulations on domestic shipments during periods of market glut are essential if profitable returns are to be expected by the Florida Tomato Industry.

The producers of Florida tomatoes must continue to work together to provide the ultimate consumer with a more palatable product. New varieties will be developed and the consumer must be educated in the proper methods of ripening and preparation. Increased per capita consumption of fresh Florida tomatoes could cure many of the problems of overproduction. Joint efforts of the Florida Tomato Committee and the Florida Tomato Exchange are channeled in this direction.

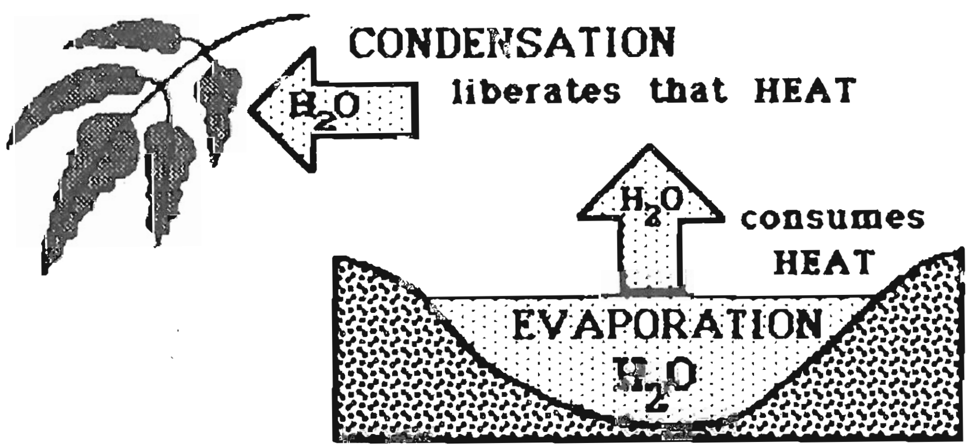
FROST PROTECTION FOR FLORIDA TOMATOES

J. DAVID MARTSOLF[1]

Brief Review of Frost Protection Mechanisms

What are the mechanisms on which the commonly used methods of frost protection depend? Both heating and wind machines capitalize on the mixing of the air layer near the ground. Typically, an inversion (temperature increases with height) is present. Bouyant plumes from heaters drive heated air upward which must be countered with equivalent air mass movement downward (subsidence) to obey a classic law of physics, i.e. conservation of mass. In the case of the wind machine this mixing is accomplished mechanically. As this mechanism became apparent, the observation that the combination of wind machines with heaters was synergistic became easier to explain. But why start with a discussion of a method that seems inappropriate for the tomato grower? Simply to make the point that once the protection mechanism becomes apparent, realistic estimates of how much protection may result from a particular practice seems more likely.

What mechanisms do irrigation practices utilize? These do not seem to be as easily visualized and certainly they do not seem to be understood as well as those we have just reviewed. The overhead sprinkling case has been studied in some detail in Florida. As a result of the advective freeze of 1962, the method has been used successfully with great respect for cooling that can take place from evaporation. A table (Gerber & Martsolf, 1965) has been reproduced thousands of times and used all over the world to make the point that as temperature goes down and/or wind speed increases, the amount of water that must reach the ice covered plant part has to increase or the protection system switches to a refrigeration system (a horrifying experience that all too many have witnessed). Several have helped to refine the model that started with Businger (1965) and Gerber & Harrison (1964), e.g. Perry, et al. (1980, 1982), with Barfield (1981) struggling with the humidity effect.



LATENT HEAT FLOW FROM FLOODED FURROW TO TOMATO LEAF

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What Frost Protection Mechanisms Seem to be at Work in Seep Irrigation?

Evaporation/Condensation

The diagram on the previous page focuses attention on a mechanism that may be quite effective in this case. The process is that of evaporation and condensation, equal and opposite mechanisms from an energy standpoint. **Evaporation** consumes a very large amount of energy, i.e. cools very effectively. **Condensation** delivers or liberates the same amount of energy where it occurs, i.e. it warms in an equally effective manner. The consumption of heat at one point in space, the transport of the resulting vapor (transparent) to another point where the heat is liberated by condensation is the most difficult heat transfer mechanism to envision. It is termed **latent heat transfer.**

You have no doubt seen evidence of latent heat transfer when observing what is often termed the "steaming" of water-filled ditches during cold weather. Evaporation is occurring at the surface of the water, facilitated by the heat that is stored in the water. In other words, water molecules are escaping into the air above the water surface somewhat like a satellite is placed in orbit. Those water molecules that acquire sufficient energy to become suspended in the atmosphere above the water surface change state and we refer to them collectively as water vapor, a clear gas, i.e. you do not see them. But what are you seeing?

As water vapor accumulates in the atmosphere by evaporation, some of the heat necessary to fuel that evaporation process comes from the air and cools it. Some of it comes from the water and cools it. As parcels of air cool, some of the water vapor reaches dew point temperature and if there is a condensation site (often called a condensation nucleus) available, vapor condenses to the liquid state and coalesces with adjacent liquid molecules to first form droplets and then drops. The vapor is transparent, but the drops become visible as fog as they coalesce. You are observing the result of the condensation process. The condensation process liberates the heat that originally drove the evaporation process. Let us trace the process backward in time. The original evaporation probably occurred at the surface of the water in the furrow and the energy that was necesary to the placement of the water molecule into orbit, i.e. into the vapor state, came from the environment of the molecule (either the liquid water or the air near the surface). This is a cooling process and when air is cooled it tends to sink, but that is not what we are seeing.

Two mechanisms work together to move the "steam" upward from the water surface. <u>One</u> is the liberated heat of the **condensation** process producing **bouyancy.** The heat of condensation warms the air around the developing droplet and makes it less dense, i.e. warmer air rises, an easily visualized process.

The <u>second mechanism</u> is much more difficult to visualize. In fact, our intuition throws us the wrong direction on the second one. How many of you can visualize damp air being heavier than dry air? I can, and I suspect that you feel that damp air -- being full of water, so to speak -- will simply sink down through dry air. But <u>not so!</u> How can you be convinced? Recall that the molecular weight of water is 18, relatively light. Air is a mixture and a bit harder to recall. Dry air has an average molecular weight of about 29. What has thrown our intuitive process off is that we imagine the water vapor as somehow being added to the dry air without replacing, molecule for molecule, the dry air molecules. In other words, we are intuitively thinking about air as if it were a towel and when the towel becomes wet it is obviously heavier. Throw away this analogy! What happens is that as heavier dry air molecules are replaced by lighter water vapor molecules, the resulting mixture, the damp air, is lighter than the dry air around it and tends to move upward relative to the drier air.

So, we have the visible fog droplets (which we naively term steam) moving upward and all that is left is to notice that they frequently disappear again, i.e. they evaporate in the drier air surrounding them. In the process they reabsorb all the heat that was liberated as they were formed. And this heat goes downstream with the air flow.

If the water vapor drifts out of the field without condensing on a radiantly cooled surface, e.g. a tomato leaf, the latent heat of condensation that it carries is lost to the field. But the process works in the grower's favor when the vapor drifts by a cooler surface (one that is at the local dew point temperature or below it) and condensation takes place, liberating the heat that was consumed during evaporation. This is a large amount of heat, 7.5 times as much heat per gallon as is liberated when an equal mass of water is fused to ice. Of course when the temperature goes below 32^{O}F and the dew freezes to frost, then the sum of the heat of condensation and the heat of fusion is liberated at the plant leaf.

TABLE OF RELATIVE VALUES

CONDENSATION	LIBERATES ABOUT	9000	BTU/GAL H_2O
EVAPORATION	CONSUMES ABOUT	9000	BTU/GAL H_2O
FUSION	LIBERATES	1200	BTU/GAL H_2O
10^{O}F CHANGE IN TEMP.	YEILDS ABOUT	83	BTU/GAL H_2O
BURNING	LIBERATES	140,000	BTU/GAL OIL

Storage of Heat in the Soil and the Water

The soil and the water in the ditches act as a bank in which energy is stored. The more water in the soil the higher its heat conductivity and heat capacity. In other words, increasing the water content of a soil greatly increases its ability to absorb heat from the sun (after the surface has dried sufficiently to reduce evaporation) and to store that heat. The seepage of water from the furrows into the exposed soil would seem to have the advantage over sprinkler irrigation at this point because the solar energy arriving at the exposed soil surface would not be consumed in evaporation but rather be conducted down into the soil as stored heat. Of course water in the ditches has a very high heat capacity, requiring one BTU to change the temperature of one pound of water one degree F (Brewer, 1973; Georg, 1979).

The point is that the more water, the higher the heat storage from the sun. The two, i.e. the water application and the sun, must work together (Fritton & Martsolf, 1981). The forecast seems essential to this mechanism. The water application must precede the frost by several sunny days to reap the maximum benefit. If the cold front is accompanied by cloudiness, one may not be able to count on full sun immediately before the freeze.

Attenuation of Radiant Loss at Night

In addition to the role that water vapor plays in the latent heat transfer mechanism described above, it also plays an important role in heat transfer by radiation. We all know that water droplets, as in a cloud, can interrupt radiant loss at night. No frosts and very few freezes develop under cloud cover because one of the most important cooling mechanisms is disrupted. While water in vapor form is not as effective as the droplets near 10 microns in diameter, it also absorbs and radiates in the infrared portion of the radiation spectrum at 10 microns in wavelength, right where we are losing heat on frost nights. So any water vapor that is added to the atmosphere over the tomato field on a cold night aids in retarding the cooling of that field and the plants growing there. The attenuation of radiant loss by water vapor is proportional to both the concentration of vapor and the thickness (depth) of the air layer effected. This introduces what has been termed the mass effect in frost protection. Neighbors reinforce each other's effort. Irrigation upwind will increase the depth of the vapor layer downwind.

Summary Statement

There is little doubt that pumping water into seep irrigation furrows decreases the possibility of frost damage to tomatoes. Condensation may be playing an important role and certainly heat storage in soil and water as well as net radiation attenuation help in the right direction. Evaporation is equal and opposite to condensation and constitutes a loss (cooling mechanism) wherever it occurs. Visualizing the mechanisms with some feel for their relative magnitude aids the producer in observing how well his methods are working and what he can expect from them in the future.

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BIOSTIMULANTS - TIMING AND RESPONSE ON TOMATOES

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Biostimulants and growth regulators applied to tomatoes have been shown to enhance plant growth, fruit size, quality and yield (1, 2, 3, 4, 5, 6, 7, 8, 9, 10). Application timing is critical and adverse responses could occur if chemicals are applied at the wrong time. Favorable results have occurred when certain biostimulants were applied during various stages of plant growth: seed, seedling, flowering, fruit-set, preharvest and harvest stages.

A. Seed.

a. Ungerminated seed for plug-mix sowing: Alpha-keto acids and humic acids derived from leonardite mixed with plug-mix media improv ed seedling growth and marketable yields (2).

b. Imbibed seed. Seed imbibition of alpha-keto acids, cytokinins + amino acids and micronutrients, humic acids and triacontanol from germination solutions for pregerminating seeds resulted in accelerated emergence and seedling growth (Bryan - unpublished).

c. Germinated seed for gel sowing. Additives of alpha-keto acids, cytokinins, cytokinins + amino acids and micronutrients, humic acids and triacontanol to gels for sowing pregerminated seeds have improved stands and accelerated seedling growth (9 and Bryan - unpublished).

B. Seedling.

Foliar applications of diaminozide, ethephon, alpha-keto acids and humic acids to young seedlings (2-4 true leaves) increased fruit size and marketable yields (2, 5). Graywall was reduced with daminozide and ethephon (5). Daminozide increased yields of large and marketable fruits when applied to 'Walter' cv. at the 4-leaf stage, 'Flora-Dade' at the 2-leaf stage and hybrid 'Duke' at the 1-leaf and the cotyledon stage. Daminozaide should not be tank mixed with copper or sprayed on plants recently sprayed with copper. Humic acids drenched or sprayed on young seedlings increased number of branches, improved internal fruit color and increased marketable and large fruit yields.

C. Flowering.

Yields were increased when alpha-keto acids were applied to seedlings up to first flowering; however, maximum responses occurred with applications to young seedlings at the 2 to 4-true leaf stage. Cy kinins sprayed or injected through drip irrigation at initial flow ing increased large and marketable fruit yields (8). Applications alpha-keto acids (with or without micronutrients), cytokinins, cy kinins with amino acids and micronutrients, humic acids and N-ace thiazolidin carboxylic acid with folic acid to plants at early flow ing increased large and marketable fruit yields.

D. Fruit-set.

Daminozide sprayed on plants with 20 or more fruit set per pl caused flower drop of unopened and open flower and increased size the remaining fruit at harvest. Daminozide is incompatible with c tain copper compounds and should not be sprayed within 7 days of c per applications. Citcop 4E was the safest copper used in conju tion with daminozide (6). Lower rates of daminozide when combi with certain surfactants were effective for flower abscission increased fruit size. Ethephon was also effective for initiat flower drop of immature and open flowers. It increased fruit s and resulted in earlier ripening (1). The most rapid increase fruit diameter occurred 0 to 4 days after ethephon application c pared to 7 to 11 days for untreated plants (1).

E. Pre-harvest.

Low rates of ethephon applied as a foliar spray 5 to 8 days before harvest, when about 5% of the fruit were breaking color, advanced and concentrated fruit maturity of market tomatoes. Ra were temperature dependent and fruit size response was inconsistent (1, 7). Fruit scuffing damage was reduced and less noticeable on fruit machine harvested after ethephon treatments.

F. Harvest.

Harvested mature green fruit dipped in or sprayed with ethephon solutions ripened more uniformly and about 10 days earlier t those treated with water (1, 10). Fruit treated with ethephon with ethylene gas after machine harvest had a much better appeara with few areas of unpigmented (lack of chromoplasts) tissues compa to untreated fruit. Induced, accelerated ripening might prev quality loss from dehydration or disease development and would a speed the flow of harvested fruit to the consumer (1, 10).

Generic and product names and sources of effective biostimula for tomatos are shown in Table 1.

Table 1. Generic and product names and manufacturers of effective biostimulants tested for tomatoes.

Generic names	Product names	Companies
alpha-keto acids	AG-50Y	Natural Earth Products, Inc.
" " " + micronutrients	Keyplex	Morse Enterprises Ltd.
cytokinins	Cytex	A. & P. Research
" + amino acids + micronutrients	Crop +	Cytozyme Labs. Inc.
daminozide	Alar	UniRoyal
ethephon	Ethrel	Amchem Products, Inc.
humic acids	Agro-lig	American Colloids Co.
" "	PGS-10	" " "
" "	Liqua-Hume	" " "
" "	Micro-Hume	" " "
N-acetttyl thiazolidin carboxylic acid + folic acid	Ergostim	Montedison, USA, Inc.
triacontanol	Triacontanol	Mich. St. Univ.

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ADVANCES IN THE IFAS TOMATO BREEDING PROGRAM

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The overall objective of the tomato breeding program is to provide reliable fruit setting, multiple disease resistant, high quality varieties and breeding lines for use by the Florida tomato industry. The approach has been to develop improved "standard" tomato inbreds or varieties which can be used by growers today, and utilized by plant breeders as crossing material to make further improvements in the future. Good inbreds are essential to efficiently incorporate desired characteristics, which are often in undesirable genetic backgrounds, into acceptable varieties or breeding lines. Today I'm going to report on the development of two "standard" tomato varieties which are being released, the progress in cherry tomato development, and give an update on our work with two disease resistances, bacterial spot and Fusarium wilt race 3.

Florida 7067, tentatively called 'Horizon,' is being released as an open-pollinated commercial tomato. It has consistently performed well in yield trials and grower trials around the state. Fla. 7067 has disease resistance, firmness, and fruit size comparable to existing cultivars grown in Florida, but the vine is smaller. It is jointless and has a concentrated, relatively early, fruit set. The smaller vine is well suited to ground culture in Dade County as well as stake culture in the fall when vine growth is greater. For spring stake culture, closer plant spacing should be tested as there might be some benefit toward increasing marketable yield. Pruning is not necessary and is probably detrimental to performance.

Florida 7065, tentatively called 'Sun Coast,' is being released as a home garden tomato. It is a very large fruited tomato with excellent fruit color and flavor. It carries an intense fruit color gene, old gold (og), which results in its deep red color. Selection has emphasized a lack of white tissue, blotchy ripening, and gray wall. It has a higher than normal sugar to acid ratio, which gives Sun Coast a sweeter taste than many other varieties. The vine is about the same size as Horizon's and it has a jointed stem. It is best suited to ground or cage culture without pruning. It should be a good tomato for roadside stand and U-Pick operations where the crop is grown only for that purpose. Sun Coast has all the standard disease resistances and firmness of varieties presently grown in Florida. It is susceptible to black shoulder and can be rough at the blossom end, which would be problems for commercial shipping.

We have had difficulty in obtaining cherry tomato lines with consistent size, reliable fruit setting, and an adequate vine from season to season, but it now appears that we are getting closer. One line being tested is Fla. 7117, which has been a consistent performer for the last 3 seasons. In a trial last spring it had greater yield than 'Red Cherry Large' and was comparable to 'Cherry Grande.' Advantages of this line are that it is jointless, open-pollinated, heat tolerant, bacterial spot tolerant and resistant to Fusarium wilt races 1 and 2 and Verticillium wilt. The vine size is comparable to Cherry Grande. It is tolerant to gray leafspot, although some spots do occur. We're trying to clean this up in some sister lines which are being evaluated this summer. Another line which looks promising is 7143 which is just entering the advanced trial stage. Several cherry lines with Fusarium race 3 resistance or bacterial spot resistance are looking pretty good and may emerge in a relatively short time.

Bacterial spot resistance is now possible because J. B. Jones and I discovered that a genetic line, Hawaii 7998, is resistant. This resulted from screening over 300 genetic accessions with reported tolerance or resistance to bacterial tomato pathogens. Hawaii 7998 is also tolerant to bacterial wilt, is heat tolerant, and has fruit size slightly larger than a cherry tomato. We are presently studying the inheritance of this resistance which will help breeders working with this material.

Much of our early breeding effort with Fusarium wilt race 3 utilized tolerance from 4 accessions from Australia. It is not known if these tolerances will be useful under Florida conditions but one of the sources, BTN 421 - a Lycopersicon pimpinellifolium accession, looks most promising. Almost 900 other accessions have been screened and after several hundred crosses and re-screens, 6 were selected for further study. Data from field and greenhouse tests with J. P. Jones have not been analyzed yet, but it appears that at least 4 of the lines have better resistance than BTN 421. Further work is needed to understand modes of inheritance, but one or more of these sources may provide the long-term genetic solution to this disease. Breeding work using these sources is underway.

FINANCIAL CONSIDERATIONS FOR TOMATO GROWERS IN THE 80'S

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An old timer from the West tells about coming to a long stretch of unimproved country road with his Model T. A sign at the side of the road, obviously put there by someone coming from the other direction, warned, "Choose your ruts carefully, you will be in them for the next 30 miles." In the 80's, similar counsel applies to agriculture because of its growing appetite for large amounts of capital and cyclical returns which often make it necessary for farmers to extend their debt commitments.

The past decade has been marked as a period of historically high levels of both inflation and interest rates. While inflation has benefitted many farmers, the combination of inflation and higher interest rates has also contributed to larger debt commitments for many farmers who now have inadequate net farm incomes to service their level of expanded debt. Thus, requiring farmers to refinance and extend debt commitments.

Paper presented at the 1984 Florida Tomato Institute, Marriott's Marco Beach Resort, Marco Island, Florida, September 6, 1984.

Financial Situation

During the last two decades farmers have watched their production expenses increase at a faster rate than gross farm income (see Figure 1.). As a result, net farm income has only realized modest increases due to technological advances (increased yields) and expanded markets. Moreover, the modest increases in net farm income have not kept pace with the needs of farmers to replace capital items such as machinery, equipment, structures, etc. (see Figure 2.). Therefore, many farmers financed these capital purchases not based on their ability to repay with net farm income, but on the increased asset values (due to inflation) as collateral. Continued low or constant net farm income has resulted in burdensome debt commitments for many farmers.

Recent farm statistics describe the seriousness of the changing debt of American agriculture. For example, total U. S. farm debt more than tripled during the last decade; almost doubled in the last five years; and has reached an estimated $220 billion as on January 1, 1984. These increases do not include operating debt that is normally borrowed and repaid annually.

The interest alone on outstanding farm real estate and non-real estate debt increased from approxiamtely $3.3 billion in 1970 to over $22 billion during 1983. Currently, interest costs account for over 15 percent of total farm expenses, while they accounted for only 7.5 percent a decade ago. The increases in the cost of capital and the prices of farm inputs coupled with the low net farm income were largely responsible for the growing farm debt during this period (see Figure 3.).

Increased farm asset values (primarily farm land) between 1970 and 1981 fueled the debt expansion fire (see Figure 4.). During this decade, farm land values increased at a faster rate than inflation. Average U. S. farm land values increased from $196 per acre to $796, or 306 percent. Farm producers used the increased asset values as collateral for extending loans, servicing new production and capital assets (land, machinery, operating), and refinancing debts.

Comparing debt-to-net income ratios illustrates the rising farm debt load. During the early 1970's the debt-to-net income ratio was about 3.5, meaning there was $3.5 of outstanding debt for each dollar of net income generated. By 1980, each dollar of net income had to carry almost eight dollars of debt. In 1983, net income improved very little and total farm debt shot up by 7.2 percent, resulting in a debt-to-net income ratio of greater than 9.

In short, farmer's debt-to-net income ratios more than doubled during the 70's, which more than offset the gains from inflation on farm asset values. The current best guess is that the debt-to-net income ratio will likely continue to increase during the mid 1980's.

Farm asset values are expected to continue upward throughout the 80's period, but the rate of increase in expected to slow, and may even decrease in some areas during the mid 80's. Also, farm income and net farm income are not expected to increase as rapidly as the debt load during the 80's. These conditions suggest a continuation of the cash flow bind that has been typical for agriculture during the recent past. Neither the timing nor the extent of the recovery is very predictable at this time, so the need is for strategies geared toward short-term survival with the flexibility to capitalize on the recovery if and when it comes.

New Farming Strategy

The new economic environment evolved from a period of rising inflation into one of reduced inflation; from relatively loose money with low interest rates to tight money with high interest rates; from fairly steady economic growth to constant or declining incomes. Regardless of how they came about, these conditions call for a reappraisal of our planning process.

This reappraisal suggests that some of the successful management strategies of the 1970's are no longer appropriate. For instance, investment strategy - during the 70's, farmers borrowed heavily, expanded rapidly, and paid their debts with cheaper inflated dollars. Today, with much lower inflation, larger debt repayments, and roughly the same or lower net incomes, those expansion-minded farmers are now in financial trouble. In short, the rules of the game have changed, so new strategies are being evaluated for the profitable management of all businesses, and farming is no exception.

After realizing the economic conditions affecting agriculture have changed and recognizing that other strategies may be safer, and perhaps more profitable, farmers are groping for ways to put workable strategies together. When their team is behind, football coaches may resort to a couple of gimmick plays, and then concentrate on trying to make their basic plays work. So it is with farming. The gimmicks have been tried, now it is back to the basics.

The basic survival strategy is to maintain low debt burdens, low cost structure, and an operation geared to maximizing efficiency (reduced unit cost) rather than production or volume. The heroic trick is how to make it work. Since no miracles are in sight, we again resort to basic management principles.

Making Decisions in the 80's

Those farmers who 1) have a thorough understanding of where they are, 2) set goals for where they want to be, and 3) have a start on figuring out how to get there (this is basic "Management by Objectives"). Reviewing these three questions may aid the producer in analyzing the current status of the farm operation, help him reassess his goals, and help choose strategies that are consistent with his objectives.

1) Where Am I?

Perhaps the best place to begin is to determine the net worth of your operation. Preparing a detailed list of owned assets, including inventories, along with what is borrowed against them, will provide the basics for a balance sheet. Of course, any lender will be interested in this, and will probably insist on seeing it, since a balance sheet is the basis for any debt restructuring. Some managers have taken the approach of "putting as much air as possible" in the values of the assets in order to borrow as much as possible. That may be necessary, of course, but it is wise also to take a hard look at what those assets are really worth, in case one of the options is to try and sell some assets. The basic importance of the balance sheet is that it gives broad credit limits within which a manager can operate.

A second step is to estimate the profitability of the different parts of the operation using an income statement. For instance, in vegetable production, which crop (tomatoes, peppers, cauliflower, etc.) has generated that largest profits during the recent past. Also, which crop or crops are likely to generate the largest profits for the coming year. Good records are, of course, the best source of information, but enterprise budgets are an acceptable substitute, and are available for many enterprises at County Extension offices.

Income statements for the total operation spell out the overall profitability of the firm, and thus show what is happening to debt repayment ability. Clearly, the more accurately these instruments reflect what has actually happened, the better basis they serve for decision making. And the more years they are kept, the more valuable they become as indicators of the financial health and progress of the business.

2) Where Do I Want to Be?

One management expert suggests a really tough question as the starting point in determining future direction: "Knowing what I know now, would I get in this business?" If the answer is no, he suggests looking for ways to get out. But that is the extreme; most people are somewhere this side of wanting to get out, and they can build on the base laid down above. From the balance sheet preparation, they know what their debt commitments are for the coming year; they know, or can estimate, what their family living expenses will be; and they have some feel for which parts of their operation are making them relatively more money. Establishing income goals is relatively simple, once the base has been laid. But income goals aren't that helpful when it comes to managing the physical side of the business. Things like planting dates, plant spacing, fertilizer rates, nematode and pest control, disease control, adequate level of irrigation and water control, etc. are vital in order to do the best job of managing the overall operation.

3) How Can I Get There From Where I Am?

The first basic question looked hardest at the financial performance of the firm; and the second concentrated on the manager and his resources, and what could be done with what was available. The biggest boulder of all looms now in the road: How to get there from here means trying to read the markets. Most everyone has a certain amount of flexibility; they can plant different crops, lease their land, let the land lay fallow, etc.. Their choice depends on what they think the markets are going to do for the commodities they can produce. No predictors are very accurate these days; most outlook projections for prices a year away have as much as a 20 percent error associated with them. For instance, using a tomato example, if the season average tomato price was expected to be $6 per carton, then prices could logically (assuming a 20 percent error) be expected to fall within a range of $4.80 to $7.20, and the results of that range might bring on a celebration or a foreclosure notice, depending on which way it went.

Faced with that sort of price uncertainty, most producers will try to do well those things that have worked best for them, and concentrate on reading the markets over time to decide when to plant, what level to produce, and how to sell. Paradoxically, the more uncertain the price outlook is, the more important it is to follow the markets closely in order to separate the little blips from any real trends that may be developing.

After satisfactorily answering these three questions, growers will be in a much better position to analyze the current situation. This additional information will also help growers identify opportunities and make sound financial decisions affecting their operation. Regardless of the changing economic conditions, these three questions when adequately answered provide the key to profitable farm production during the 80's.

Summary

The successful management strategies for the 1970's are no longer appropriate under today's new economic conditions. The rules of the game have changed and therefore new strategies must be evaluated for the profitable management of all businesses.

Today with much lower levels of inflation and higher interest rates the basic financial strategy is to maintain low debt burdens, low cost structure, and an operation geared to maximizing efficiency rather than production or volume. In addition, farmers need to recognize that most agricultural markets have shrunk, many other nations are in financial trouble, and haven't enough foreign exchange to spend on agricultural products. Those nations with currency will likely purchase essentials such as grains and cotton. In retrospect, we have developed an agriculture with considerable excess production capability if foreign markets cannot be strengthened.

Rodeo cowboys have a motto: "When the Going Gets Tough, the Tough Get Going!" Agriculture has always been a tough way to make a living, and the rewards have gone to those who hung on in the tough times and tightened up their operations.

Figure 1. U. S. Income From Farming

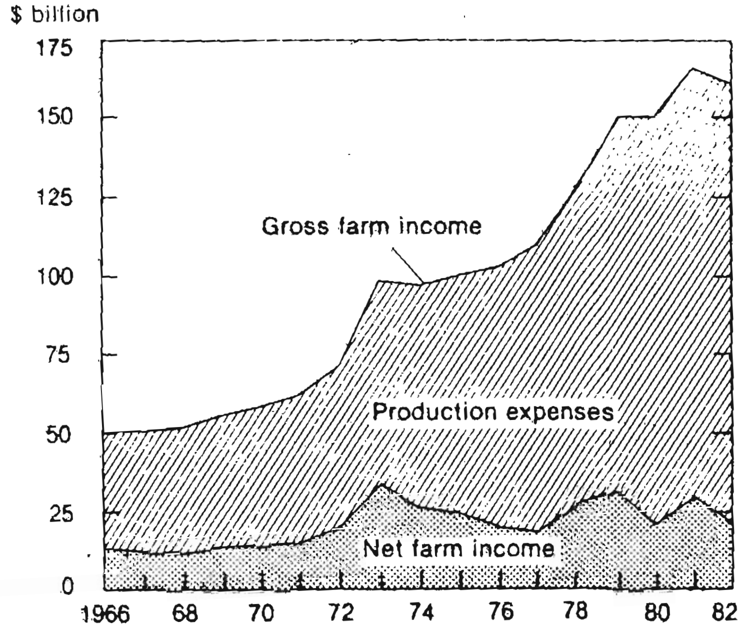


Figure 2. U. S. Net Farm Income

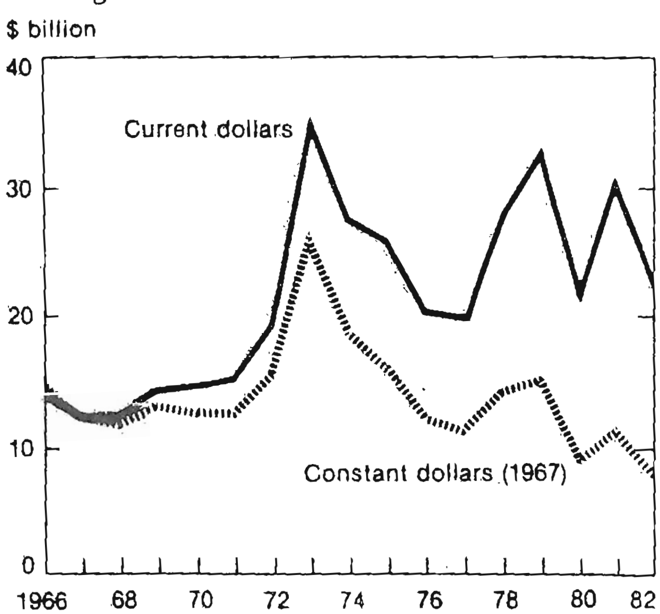
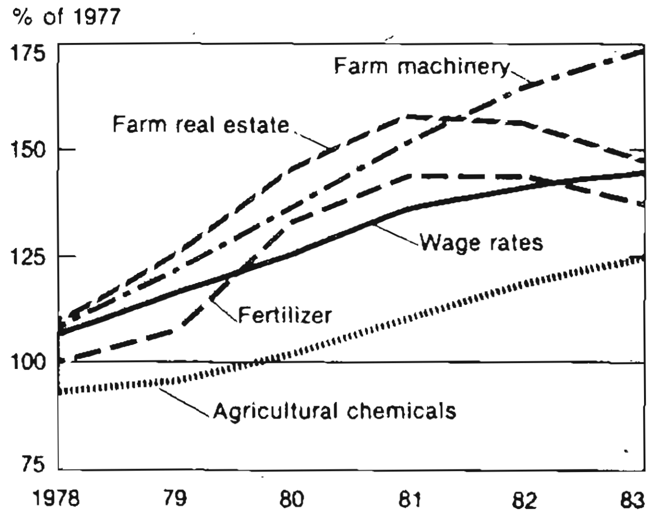
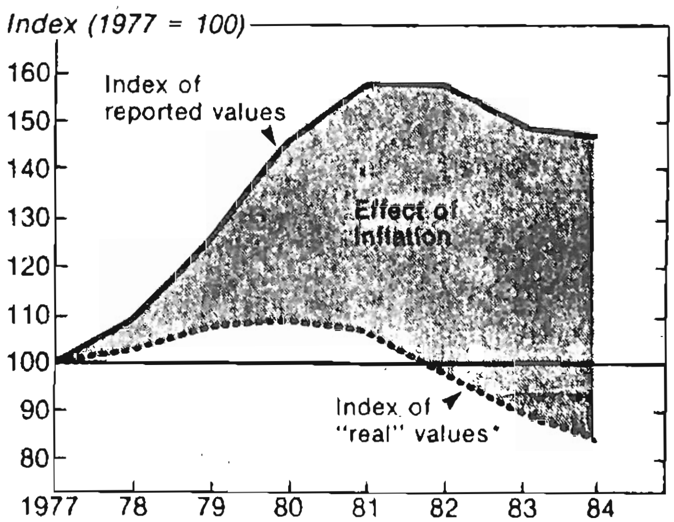


Figure 3. Prices of Selected Farm Inputs



1982 preliminary, 1983 projected. Farm machinery includes tractors and self-propelled machinery.

Figure 4. Farm Real Estate Value



*Reported values adjusted for changes in the CPI.

SPECTRUM OF ACTIVITY OF AVID® AND TRIGARD® AGAINST TOMATO INSECT PESTS

David J. Schuster

Avid® (avermectin) and Trigard® (cyromazine) are two insecticides which are effective in controlling Liriomyza leafminers on tomato as well as other horticultural crops. Typical small plot field data indicate that both materials result in fewer large leafmines and fewer leafminer puparia (resting stage between the larval and adult stages) (Tables 1 and 2). In a large plot field test, Trigard was applied either weekly or on demand (when the number of leafminer larvae equalled or exceeded 0.7/30 leaflets). Demand plots received only 2 applications while the weekly plots received 10. At the end of the crop, the numbers of living and dead leafminer larvae per 30 leaflets averaged 0 and 22 for the demand plots and 0 and 20 for the weekly plots. Leafminer damage ratings (based upon an increasing damage scale of 1 to 8) were low in both types of plots averaging 4.0 and 3.7, respectively, for the demand and weekly plots.

Detailed laboratory experiments have been conducted to determine the effects that Avid and Trigard, as well as other insecticides, have on the various life stages of leafminers. These studies showed that, over a 24 hr exposure period, neither Avid or Trigard induced significant adult leafminer mortality (Table 4). However, in later tests Avid was shown to induce significant mortality, especially to females, 24 and 48 hr after an initial 24 hr exposure to Avid-treated leaflets. Avid also was shown to reduce oviposition and feeding (stippling) (Table 4). This effect was studied further when females were either confined on nontreated or Avid-treated foliage or were given a choice of treated or nontreated foliage. In both types of tests, stippling was less on nontreated leaflets (Table 5). In the case of oviposition, this same trend was apparent although the difference between treated and nontreated foliage was not significant when females were given a choice. This would indicate a repellency for feeding but not oviposition. Further testing, however, has shown that overall oviposition is reduced when females are exposed to a treated and nontreated leaflet. This effect is not reversed when the females are exposed subsequently to two nontreated leaflets. Thus, Avid residues reduce feeding and oviposition through contact and not repellency.

In further testing, both Avid and Trigard killed 1- and 3-day old leafminer larvae (Table 6). This effect was so pronounced with Avid that larvae hatching from eggs in treated foliage were killed before completely exiting the eggs. Some were killed before penetrating the egg shell. The effect of Avid on larvae appeared to be one of direct toxicity. The effect of Trigard is that of an insect growth regulator. Larvae generally were not killed until their final molt inside treated leaflets. Larvae at this time were pear-shaped rather than the normal barrel-shaped.

Neither Avid and Trigard appeared effective against stink bugs (Table 1). This was particularly evident when considering the numbers of fruit damaged by the true bugs (leaffooted and stink bugs combined) (Table 1). In general, neither Avid nor Trigard was effective against lepidopterous larvae (caterpillars) although certain rates of each resulted in reduced numbers of some species in some seasons (Tables 1 and 2). For instance, both reduced the numbers of cabbage looper larvae in 1983 (Table 1) but only the 0.04 lb ai/100 gal rate of Avid resulted in such a reduction in 1982 (Table 2). This apparent lack of consistent caterpillar control is reflected by the numbers of fruit damaged by noctuid (armyworm, looper, fruitworm and cutworm) larvae in 1983 (Table 1). Avid reduced the number of tomato pinworm larvae in 1982 (Table 2). In addition, Avid controlled mites on tomato (Table 1) and mites and aphids on chrysanthemum (Table 3).

SUMMARY

Both Avid and Trigard are effective in controlling leafminers on tomato. Trigard is effective for leafminer control when used on demand. Both insecticides kill leafminer larvae, although the effect of Trigard is like that of an insect growth regulator. Avid kills leafminer adults and inhibits oviposition and feeding of females.

Neither Avid nor Trigard is consistently effective against noctuid caterpillars. Neither material controls stink bugs but both appear effective against leaffooted bugs. Avid is effective against mites and aphids.

TABLE 1. ARTHROPOD CONTROL ON TOMATO, GCREC-BRADENTON. SPRING 1983.

TREATMENT AND LB AI/100 GAL	LARGE LEAFMINES/ 30 LEAFLETS	NO. INSECTS/5 PLANTS: LEAFFOOTED BUGS	NO. INSECTS/5 PLANTS: STINK BUGS	NO. INSECTS/5 PLANTS: CABBAGE LOOPERS	MITE DAMAGE RATING*	NO. UNDAMAGED FRUIT	NO. DAMAGED FRUIT: NOCTUID LARVAE	NO. DAMAGED FRUIT: TRUE BUGS
AVID 0.15EC 0.01	0.3a**	0.0a	10.7ab	4.3abc	5.8a	270.3b	76.5bc	131.5abc
AVID 0.15EC 0.005	2.0a	1.7a	7.3ab	3.7abc	5.8a	180.0b	88.5bc	221.0c
AVID 0.15EC 0.0025	8.3a	0.0a	11.7ab	7.0c	6.7ab	192.5b	97.0bc	180.8bc
TRIGARD 75WP 0.125	5.8a	0.0a	21.0ab	6.0bc	6.8ab	160.8b	107.0c	192.3bc
TRIGARD 75WP 0.25	16.8ab	2.3a	17.7ab	2.0abc	7.3b	232.3b	68.8b	191.8bc
MONITOR 4EC 1.0	30.5b	0.0a	2.3a	0.3a	7.3b	560.0a	11.0a	22.5a
PYDRIN 2.4EC 0.2	60.0c	0.0a	0.7a	1.0ab	7.2b	499.5a	1.8a	59.3a
LANNATE 1.8L 1.0	60.5c	0.3a	6.0ab	4.0abc	7.8b	445.3a	6.5a	92.0ab
CHECK (WATER)	28.0b	21.3b	32.3b	10.0d	7.5b	270.3b	75.3b	132.8abc

*AVERAGE HORSFALL-BARRATT RATING WITH INCREASING VALUES REPRESENTING INCREASING PERCENTAGE OF AFFECTED FOLIAGE.

**MEANS WITHIN A COLUMN FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE P=0.05 LEVEL, DUNCAN'S MULTIPLE RANGE TEST.

TABLE 2. ARTHROPOD CONTROL ON TOMATO, AREC-IMMOKALEE. SPRING 1982.

		NO. INSECT LARVAE/5 PLANTS				
TREATMENT AND LB AI/100 GAL	PUPARIA/30 LEAFLETS	SOUTHERN ARMYWORM	CABBAGE LOOPER	TOMATO PINWORM	TOMATO FRUITWORM	GRANULATE CUTWORM
TRIGARD 0.4EC 0.5	0.0a*	16.5ab	5.8abc	0.8ab	1.9ab	0.0a
TRIGARD 0.4EC 0.25	0.0a	11.8ab	6.4abc	0.6ab	3.5b	0.6ab
AVID 0.03SL 0.04	0.0a	39.0b	1.7a	0.0a	1.7ab	0.4ab
AVID 0.03SL 0.01	0.0a	17.4ab	12.5bc	0.2a	2.8b	0.8ab
AVID 0.03SL 0.005	1.8ab	5.6a	14.9c	0.0a	1.1a	0.2ab
MONITOR 4EC 1.0	1.4ab	1.0a	0.8a	1.7ab	0.0a	0.0a
PYDRIN 2.4EC 0.1	3.1b	0.4a	3.9ab	0.2a	0.0a	0.0a
CHECK (WATER)	5.0b	19.6ab	16.5c	5.9b	2.3b	1.5b

*MEANS WITHIN A COLUMN FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE P=0.05 LEVEL, DUNCAN'S MULTIPLE RANGE TEST.

TABLE 3. ARTHROPOD CONTROL ON CHRYSANTHEMUM, GCREC-BRADENTON.* FALL 1982.

TREATMENT AND LB AI/100 GAL	NO. TWOSPOTTED SPIDER MITE	NO. STEMS WITH APHIDS
VYDATE 2L 1.0	11.8a**	0.0a
AVID 0.15EC 0.02	13.8a	0.0a
AVID 0.15EC 0.01	11.5a	1.0a
AVID 0.15EC 0.005	14.3a	0.3a
TRIGARD 75WP 0.125	22.3ab	25.5c
TRIGARD 75WP 0.25	34.3bc	45.8d
NONTREATED CHECK	44.5c	14.5b

*DATA SUPPLIED BY DR. JAMES F. PRICE.
**MEANS WITHIN A COLUMN FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE P= 0.05 LEVEL, DUNCAN'S MULTIPLE RANGE TEST.

TABLE 4. ADULT MORTALITY (n = 90) AND OVIPOSITION OF LIRIOMYZA TRIFOLII EXPOSED 24 H TO INSECTICIDE RESIDUES ON TOMATO FOLIAGE IN THE LABORATORY.

INSECTICIDE	LB AI/ 100 GAL	% MORTALITY	EGGS/ LEAFLET	STIPPLE RATING*
MONITOR 4EC	1.0	80.1a**	10.2cd	1.0c
PYDRIN 2.4EC	0.10	47.5b	9.2cd	0.6c
AMBUSH 2EC	0.10	47.4b	18.2bc	4.4b
TRIGARD 0.4EC	0.5	38.8bc	27.7ab	4.7b
AVID 0.03SL	0.01	38.3bc	0.8d	0.6c
TRIGARD 0.4EC	0.25	23.9c	20.6bc	3.9b
CHECK (WATER)	-	35.6bc	38.2a	6.7a

*THE NUMBER OF STIPPLES (FEEDING AND OVIPOSITION PUNCTURES) WERE ESTIMATED ON THE BASIS OF PERCENT LEAF AREA AFFECTED: 1 = 0-10%; 2 = 10-20%; 3 = 30-40%; ETC.
**MEANS WITHIN COLUMNS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE P = 0.05 LEVEL, DUNCAN'S NEW MULTIPLE RANGE TEST.

TABLE 5. THE NUMBERS OF EGGS DEPOSITED AND FEEDING PUNCTURES (STIPPLES) PRODUCED PER LEAFLET BY *LIRIOMYZA TRIFOLII* WHEN EXPOSED IN THE LABORATORY IN CHOICE AND NO CHOICE SITUATIONS TO RESIDUES OF AVID INSECTICIDE ON TOMATO FOLIAGE.

TREATMENT	LB AI/ 100 GAL	CHOICE		NO CHOICE* 24 H		NO CHOICE* 48 H	
		EGGS	STIPPLES	EGGS	STIPPLES	EGGS	STIPPLES
AVID 0.03SL	0.01	1.5a**	10.1a	<0.1a	1.8a	0.2a	18.1a
WATER (CHECK)	-	2.2a	48.4b	7.0b	117.2b	6.3a	103.5b

*L. TRIFOLII WERE PLACED ON TREATED FOLIAGE FOR 24 H AND THEN TRANSFERRED TO NONTREATED FOLIAGE.

**MEANS WITHIN COLUMNS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE P = 0.05 LEVEL, F TEST IN AN ANALYSIS OF VARIANCE.

TABLE 6. PERCENT MORTALITY (n) OF *LIRIOMYZA TRIFOLII* EGGS AND 1 AND 3 DAY OLD LARVAE IN TOMATO FOLIAGE DIPPED IN INSECTICIDE PREPARATIONS IN THE LABORATORY.

INSECTICIDE	LB AI/ 100 GAL	EGGS	LARVAE 1 DAY	LARVAE 3 DAYS
AVID 0.03SL	0.01	93.3(249)a*	100.0(346)a	98.1(81)a
AVID 0.03SL	0.005	89.7(237)a	100.0(140)a	99.0(127)a
MONITOR 4EC	1.0	40.2(180)b	100.0(272)a	93.0(136)ab
TRIGARD 0.4EC	0.25	10.4(282)c	100.0(218)a	89.5(114)ab
AMBUSH 2EC	0.10	7.0(360)c	57.3(158)b	52.8(134)cd
TRIGARD 0.4EC	0.5	5.2(257)c	100.0(175)a	86.0(130)ab
PYDRIN 2.4EC	0.10	4.9(220)c	35.2(161)c	29.8(129)d
CHECK (WATER)	-	2.7(282)c	34.9(149)c	11.3(91)e

*MEANS WITHIN COLUMNS FOLLOWED BY THE SAME LETTER ARE NOT SIGNIFICANTLY DIFFERENT AT THE P = 0.05 LEVEL, DUNCAN'S NEW MULTIPLE RANGE TEST.

SURVIVAL OF XANTHOMONAS CAMPESTRIS PV. VESICATORIA IN FLORIDA

J. B. Jones, K. L. Pohronezny, R. E. Stall and J. P. Jones

For the past three years an extensive program has been in progress to study the survival potential of *Xanthomonas campestris* pv. *vesicatoria* (XCV), causal agent of bacterial spot of tomato. The studies were undertaken to determine the length of time the bacterium is able to survive in crop residue from spring and fall crops, the ability of the bacterium to survive on various weed species as an epiphyte (on the surface of the plant) or as a pathogen of the weed species and the potential role of tomato volunteers in the epidemiology of bacterial spot. Studies on seed infection have also been undertaken.

In survival studies with crop residue from a fall tomato crop, XCV was detected up to 6 months after placing the crop residue in the field (Table 1). It was detected in buried tissue as well as tissue placed on the soil surface. In summer survival tests in Bradenton, the bacterium was detected 3 months after initiating the study (Table 2), whereas XCV was detected in Homestead up to 6 weeks after placing the tissue in the field.

Samples of weed spp. in several fields in the Manatee-Ruskin area were collected and assayed for populations of XCV. The bacterium was detected on 11 of 202 weed samples. Of those 11, 3 each were from *Physalis pubescens* and *Solanum americanum*.

Tomato and pepper seed were assayed for the presence of XCV. The bacterium was detected in 1 of 50 pepper seed lots, whereas XCV was not detected in any of 250 tomato seed lots.

Surveys for volunteer tomato plants were conducted in the Bradenton area and in the Homestead area. Nine fields in the Bradenton area were monitored every 4-6 weeks. The survey began in March of 1982. Volunteers were observed in 7 of the 9 fields initially. Volunteer populations persisted in those fields in which the plant beds with the plastic remained or where a cover crop of sorghum was planted. Fields that were disked periodically were free of volunteers. Volunteers were observed in one field on August 17, 1982. This field had been planted to sorghum and the volunteers were present in the field when the next tomato crop had been planted. Bacterial spot was associated with the volunteers.

In Homestead, 5 abandoned tomato fields were monitored weekly for volunteer tomato plants, starting in June 1980. In 4 fields, volunteers were found until late July and in one case were still observed on 13 August, 1980.

Survival of infected volunteers until late July or early August, coupled with our experimental results showing 2 month survival of XCV in infected debris buried in Bradenton and Homestead soils, suggests the potential for XCV to oversummer and serve as a source of inoculum for the next crop. Failure to periodically disc fields in the summer or using sorghum as a cover crop may allow substantial numbers of volunteers to survive. Thus, eliminating volunteers through cultural manipulation may reduce disease levels.

In conclusion, XCV can survive extended periods of time in crop residue buried or on the soil surface, and in tomato volunteers. Although the bacterium was isolated from weeds it does not appear to be a factor in long term survival. The role of seed as a source of XCV is questionable. It does not appear that tomato seed serves as a source of XCV, whereas pepper seed may be a source of the bacterium.

Table 1. Recovery of *Xanthomonas campestris* pv. *vesicatoria* from naturally infected crop residue buried at two depths or placed on the soil surface in the winter and spring of 1981-82 and 1982-83.

	Sampling dates, 1981-82[a]				Sampling dates, 1982-83[a]					
Treatment	Jan. 19	March 25	June 9	Sept. 20	Jan. 17	March 4	April 4	May 6	June 27	Aug. 3
Crop residue placed on the surface	4[b] (5.0)[c]	4 (5.0)	2 (0.5)	0	4 (5.0)	4 (5)	4 (1.75)	4 (2.0)	2 (1)	0
Crop residue buried 6" below soil surface	4 (3.0)	4 (2.75)	3 (0.75)	0	4 (5.0)	4 (3)	4 (2.5)	4 (2.0)	0	0
Crop residue buried 12" below soil surface	4 (2.5)	4 (2.0)	2 (0.75)	0	4 (5.0)	4 (3)	4 (2.5)	3 (2.3)	0	0
Infested soil	-	-	-	-	0	0	0	0	ND	ND

[a] 1981-82 test begun December 14, 1981; 1982-83 test begun December 15, 1982.

[b] The number of replications out of 4 where *X. campestris* pv. *vesicatoria* was isolated from crop residue.

[c] The value in parentheses represents the average severity rating for bacterial spot severity of tomato plants infiltrated with washings from crop residue where 0 = no lesions, 1 = 1 to 10, 2 = 10-50, 3 = 50-500, 4 = 500-1000, 5 = >1000.

Table 2. Recovery of Xanthomonas campestris pv. vesicatoria from naturally infected crop residue buried or placed on the soil surface at two locations in Florida in the spring and summer of 1982 and 1983.

	1982							1983							
	Homestead[a] Sampling date			Bradenton[a] Sampling date				Homestead[b] Sampling date				Bradenton[b] Sampling date			
Treatment	7/7	7/30	8/29	6/11	7/28	8/24	9/28	6/15	7/20	8/21	9/26	6/15	7/18	8/19	9/24
Crop residue placed on surface	4[c] (5)	0	0	4 (5)	3 (1)	1 (2)	0	4 (5)	4 (2.25)	0	0	4 (5)	4 (4)	0	0
Crop residue buried 6" below soil surface	4 (1)	0	0	4 (3.3)	4 (1.5)	4 (1)	0	4 (5)	4 (1)	0	0	4 (5)	4 (1.5)	0	0

[a]In 1982 Homestead study was begun June and Bradenton study was begun May 21.

[b]In 1983 Homestead study was begun June 7 and Bradenton study was begun June 8.

[c]The number of replications out of a total of 4 where X. campestris pv. vesicatoria was isolated from crop residue.

[d]The value in parentheses represents the average severity rating for bacterial spot severity of tomato plants infiltrated with washings from crop residue where 0 = no lesions, 1 = 1 to 10, 2 = 10-50, 3 = 50-500, 4 = 500-1000, 5 = greater than 1000 lesions.

Rice,Marcela L

From: Adrian Prado [adrianprado1985@gmail.com]
Sent: Friday, October 26, 2012 3:27 PM
To: Rice,Marcela L
Subject: Cuban food estimate

Hello Marcela, this is adrian prado: manager at prados cuban cafe. I have your estimate ready. Picadillo rice beans and plantains for 55 people with the plates and utensils is $385. Thats less than what we charge for this plate at the restaurant. I can also deliver it to you. Just let me know what kind of plates you want. If you have any questions please give me a call at 239-850-6531. Thats my cell phone.

Spread of the Bacterial Spot Pathogen: Summary of Some Observations in Homestead Area Tomato Fields and a Review of Pertinent Literature

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Bacterial spot, caused by Xanthomonas campestris pv vesicatoria, is often cited by Florida tomato growers as their most serious pest problem. This concern is certainly supported by recent research data which show large yield losses, reduced quality, and reduced fruit size in tomato plantings with bacterial spot, especially when epidemics begin early in crop development (7).

The distribution of diseased plants in a field can often shed light on various aspects of the epidemiology of that disease. For instance, Gitaitis et al. (1) used the distribution of corn plants with bacterial leaf blight as a clue to the source of primary inoculum for this disease and to implicate farm equipment in field spread of the pathogen.

Surveys of the distribution of bacterial spot-infected plants were made in commercial fields in Homestead during the fall seasons of 1980 and 1981. Several methods were tried, ranging from selection of sections of fields (less information) to thorough examination of all leaflets of all plants in a field (quite labor-intensive). The best approach was a compromise between these two extremes; fields were walked at a moderate pace, and records were made of all diseased plants that could readily be detected without having to bend over.

The initial discoveries of diseased plants in a field were like point sources; that is, on the first visit that any diseased plants were found, the frequency of diseased plants was one in several thousand. The locations of the point sources were not correlated with volunteers or solanaceous weeds on field borders, and no inferences have been drawn about sources of primary inoculum. However, on closer examination of some of the 1981 data, it was seen that the initial infections were often associated with low spots in the field. This suggests that micro-environmental factors may be limiting in the expression of symptoms on plants that harbor epiphytic phase populations of X. campestris pv vesicatoria.

Secondary spread of bacterial spot from the point sources was rapid. In the rainy season, large portions of many fields were diseased within 3-4 weeks. Movement of the disease down rows was more pronounced than movement across rows. This is no doubt related to the close proximity of plants in a row compared to those in adjacent beds.

While rain, espcecially wind-driven rain, is involved in X. campestris pv vesicatoria dissemination, a large mechanical component may also exist. In at least one field, the largest weekly increase in disease incidence was recorded immediately after hand-thinning operations.

It is well-known today that plant pathogenic bacteria (including X. campestris pv vesicatoria) can survive on the surface of apparently healthy hosts (3). When conditions are favorable, the bacteria can multiply and disease then appears. Water is a particularly acute commodity in the epiphytic life style of pathogenic bacteria (4). Population growth of pathogens may also take place on the surface of other plants, such as weeds, and these bacteria may represent a reservoir for infection of crop plants.

It has been a generally-held view that the primary mechanism for dispersal of bacterial pathogens is by splashing rain, especially in storms with high winds. Bacteria are carried by the relatively large, ballistic particles generated by drops of rain hitting plant surfaces. This mechanism only accounts for short-distance dispersal, say within the canopy of the same plant, to nearby plants, or to the ground.

A more recent and, in some ways revolutionary concept of bacterial dispersal relates to longer-range spread in aerosols. Aerosols are particles ranging in size from 0.5 μm to 20 μm (9). These small particles are much more buoyant than ballistic particles and can be suspended in air for some time. Aerosols can be generated by the impact of rain drops on leaves with bacterial lesions and/or epiphytic populations of pathogenic bacteria, adding bacteria to the aerosols in the air over crops (9). Wind currents may disperse these buoyant bacteria in ways we usually associate with fungal spores.

Of even greater potential importance to Florida tomato growers are the reports of several workers of aerial dispersal of bacteria over crops during dry, sunny days (2,5,6,8). There is a net upward flux of bacteria during these dry, sunny periods, providing an aerial reservoir of bacteria (including pathogens) for fairly long-range dispersal. The net upward bacterial flux is higher at higher winds speeds and at higher epiphytic bacterial populations.

During rain, the net flux of aerial bacteria is strongly downward, obviously resulting in deposition of some of the bacteria on crop plants (2,8). However, it is important to note that even on dry, sunny days, the net upward flux is an algebraic sum, with some bacteria being deposited on leaf surfaces. In fact, experiments with the bean bacterial brown spot pathogen (*Pseudomonas syringae* pv *syringae*) have show that 100-10,000 viable pathogenic bacteria could be deposited on each exposed bean leaflet every day - all in the absence of rain (2)!

Plant species closely related to the crop are usually suspected as alternate hosts for epiphytic populations of bacterial pathogens. However, it is becoming increasingly evident that bacterial pathogens can survive on the surface of many healthy, non-host plants. The bean brown spot bacterium has been found as an epiphyte on such diverse plants as oak and black locust trees, rye and corn crops, and stands of sowthistle weeds. These epiphytic bacteria on non-host plants are an endemic source of the pathogen for Wisconsin commercial bean crops (2,5). When lots containing low levels of *P. syringae* pv *syringae* - infected seed were planted, severe brown spot epidemics tended to occur in growing areas with high populations of *P. syringae* pv *syringae* on leaves of non-hosts. This suggests that the endemic epiphytic pathogen populations, and not seed, were more important quantitatively in the epidemiology of brown spot in Wisconsin.

These relatively new ideas, bacterial aerosols, aerial dispersal of bacteria, survival of plant pathogenic bacteria on surfaces of non-host plants, and the role of microenvironment in disease expression suggest fruitful areas for research in Florida tomato-growing areas. Dispersal mechanisms (especially long-range aerial dispersal) and endemic inoculum sources for *X. campestris* pv *vesicatoria* need to be studied. The jury certainly is still out on the relative quantitative contribution of endemic and seed sources to the initiation of bacterial spot epidemics in Florida tomato crops.

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SOIL FUMIGATION AND ALTERNATIVES

A. J. Overman

Migration and rotation practices to escape nematodes, soil-borne diseases, insects, and weeds are gradually being supplanted in modern tomato production by use of soil fumigation. Soil fumigants have assisted the grower in maintaining the productivity of tomato fields in the face of increasingly severe soil pest pressures. When virgin land was easily available, appropriately located, and cheaply prepared for crops, soil fumigation was rarely needed. Growers migrated from one location to another routinely.

Today new land is rare, old land is expensive, and the high cost of tomato production demands maximum marketable yield per unit of land managed.

Recently, several nematicides have been banned or restricted by the Environmental Protection Agency or removed from the market by the manufacturers because of ground water pollution problems in Florida. The broad spectrum soil fumigant methyl bromide is presently receiving EPA attention and researchers and growers must map new strategies in case the use of soil fumigants is limited in the future by regulation.

Control of soil-borne pests of tomato cannot be managed by a classic integrated pest management (IPM) system in which scouts monitor the crop for infestation levels and defer the use of pesticides until the damage threshold is attained. There is no post-plant means of controlling nematode and wilt diseases. Since a fair percentage of the cost of tomato production has been encumbered before economic damage due to these soil-borne pests is generally apparent in the field, growers must decide prior to planting whether the land will be fumigated.

Ideally, the decision should be made during harvest of the previous cro on the land. Scouting the previous mature crop for nematode damage, plant wilt, and nutsedge severity will provide the information required for decisi on fumigating the following season.

Soil fumigants labeled for use in Florida are listed by R. A. Dunn, Extension Nematologist, elsewhere in this publication.

It benefits the entire industry to use these chemicals responsibly. In order to preserve fumigant access, the proper dosage, storage and disposal should receive constant supervision in the management system. Recommendatio for soil preparation prior to treatment, and management following treatment, can lead to greater efficacy at lower rates of application. Growers should measure the benefit of soil fumigation in each crop by leaving several untreated areas scattered through the field as checks.

Alternatives to soil fumigation apply primarily for those growers who control their land year-round. Cultural practices have traditionally reduced soil pest pressures when followed assiduously. The procedures are familiar, contributive, and relatively time-consuming compared to routine soil fumigation. However, introducing procedures from the following list which are compatible with specific crop management systems may defer the need for fumigants in a tomato monoculture:

1. Destruction of crops immediately after harvest. Procrastinating only a few weeks permits disease organisms, nematodes, and weed seed to increase.

2. Fallow cultivation. Manipulation of the soil deprives pathogens of living hosts on which to thrive and decreases weed populations.

3. Maintenance of appropriate pH levels. Fusarium wilt may be suppressed at pH 6.5 and above, while Verticillium wilt is reduced in soils held at less than pH 6.5.

4. Flooding. Alternate flooding and drying reduces nematode populations but if the water source is canals and ditches, disease organisms and weed seed may be introduced by flooding.

5. Resistant tomato cultivars. Resistance to Verticillium wilt and Fusarium wilt race 1 and 2 is available; resistance to Fusarium wilt race 3 is not yet available. Root-knot nematode resistance occurs in several commercial tomato cultivars, but the resistance is temperature sensitive and often fails in Florida plantings.

6. Cover crops. Several agronomic crops suppress specific nematode species: the grasses are probably most advantageous since they seldom support the root-knot nematode which is the most severe nematode problem in Florida tomato fields.

There are two other subjects that should be mentioned here. The first is the effort to reduce the amount of methyl bromide required to fumigate the soil by containing the vapors of a lower rate longer in the soil profile by using a plastic mulch designed specifically as a vapor barrier.

The second subject which should be mentioned is solarization, the development of pasteurising heat in the soils under a clear plastic film. In some areas of the world the process is successful in reducing plant pest populations in the soil.

Under Florida conditions, a method has not yet evolved which is compatible with management, although the summer off-season is the appropriate time to solarize.

The advantage of solarization is that no chemicals are involved in soil pest control. When the method works, weeds, nematodes, and disease organisms are reduced significantly, thereby reducing or deferring the need for herbicides, soil fumigants and soil insecticides.

The disadvantages of solarization are:

1. The plastic must remain intact, in place for two months.

2. The plastic film is expensive and inconvenient to discard.

3. Broadcast application of plastic film is not effective during heavy rainfall. Pools of water on the film insulate the soil against the heating sunlight.

4. Solarizing the bed configuration over two months in the field prior to planting results in loss of nutrients during summer rains.

5. Practical application to large scale agriculture still needs to be worked out.

Some form of chemical assistance will no doubt be required on land infested with tomato pests, regardless of the care taken by growers to decrease pest pressures through cultural practices.

In summary, modern tomato production does demand maximum yields to prosper. The routine costs of production are altered little if fumigation is withheld; however, the resultant yields might be less than profitable. It behooves growers to make every effort to manage fumigants conservatively in order to preserve their availability.

THE TOMATO PROCESSING INDUSTRY IN FLORIDA

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The Florida tomato processing industry exists as an appendage to the fresh vegetable industry. There are five small canners packing primarily whole tomatoes for the consumer market. These are marginal processors who depend upon supplies of salvage ripe tomatoes from fields grown for fresh-market green tomatoes. The continued supply of these salvage tomatoes is uncertain due to anticipated changes in grower technology and the initiation of mechanical harvesting for fresh-market tomatoes. Production of whole canned tomatoes has decreased from over three million cases in 1968 to approximately one million cases in 1983.

The annual processing utilization of Florida tomatoes has decreased from approximately 68,000 tons in 1963-68 period to approximately 20,500 tons in the 1978-81 period. Average value for a 30 lb. box of ripe tomatoes for processing was $0.99 for the period 1978-81.

There is no current production of concentrated tomato products from Florida tomatoes by processors.

One company, Deltina Foods Inc., Miami, Florida, imports tomato paste from Spain, Israel, and other countries. The tomato paste is used in the manufacture of catsup, puree and sauces. Their market for these products is primarily Puerto Rico and the Caribbean areas. Some product is sold to the Florida institutional market. The importation of tomato paste is economically viable due to the high value of the U. S. dollar in the international market (2).

The Deltina processing facility is located in the trade free zone in Miami, so that the imported product which is exported is duty-free.

The Deltina company is proposing to build a processing plant in Homestead, FL to utilize ripe tomatoes left from the fresh market production. Ripe tomatoes from approximately 10,000 acres would be required to supply the proposed plant.

Product Quality

Many factors are involved in raw product quality and these affect the processed product. Some of these are flavor, color, viscosity, and solids. The flavor of Florida-grown tomatoes is good, when compared with the California processing tomatoes. The color of present Florida varieties is good (1) and should not be a limiting factor to processing. The solids content of tomatoes is very important for processing as paste, puree, or sauce. In a

1983 California tomato variety trial the mean value for 17 varieties was 5.03 percent soluble solids (3). In a recent study by Gull, et.al. (1) the mean value for 10 Florida grown varieties wa 4.25 percent soluble solids. Previous studies, which included production from the 1976, 1979, and 1981 seasons, gave a mean value for 9 Florida grown varieties of 4.41 percent soluble solids. This is a difference in soluble solids between Californi and Florida grown tomatoes of 0.62 to 0.78 percent solids, or a 14.0 to 18.3 percent higher solids level for the California tomat

Soil mosisture level has a significant effect on the tomato percent solids. Date from the California Tomatyo Grower indicate as much as 0.5 percent solids Difference between 10 days and 55 days from last irrigation to harvest (Tables 1,2)

In the production of concentrated products (paste, sauce) the soluble solids are a major cost factor. A 0.75 percent difference in raw tomato soluble solids results in an 18.5 percent cost differential in the final tomato paste (26% solids, Table 3).

A recent study of a Vegetable Processing Task Force (4) reported on the "Potential for the Expansion of the Tomato Processing Industry in Florida". Some of the conculusions from this report were:

1. The utilization of salvage tomatoes from fresh market production with no additional inputs provided the highest returns per acre of the processing production systems analyzed. Net returns of $120 per acre are projected at a yield of 6 tons per acre and a price of $60 per ton.

2. Production of processing tomatoes with high input levels resulted in a net loss at maximum anticipated yields per acre (30 tons) and maximum price per ton ($70).

3. Production of processing tomatoes with low input levels resulted in a net return of $21 per acre with maximum anticipated yields of 30 tons per acre and a price of $70 per ton.

4. The lower solids content of Florida tomatoes is an additional negative factor in the processing of concentrated tomato products.

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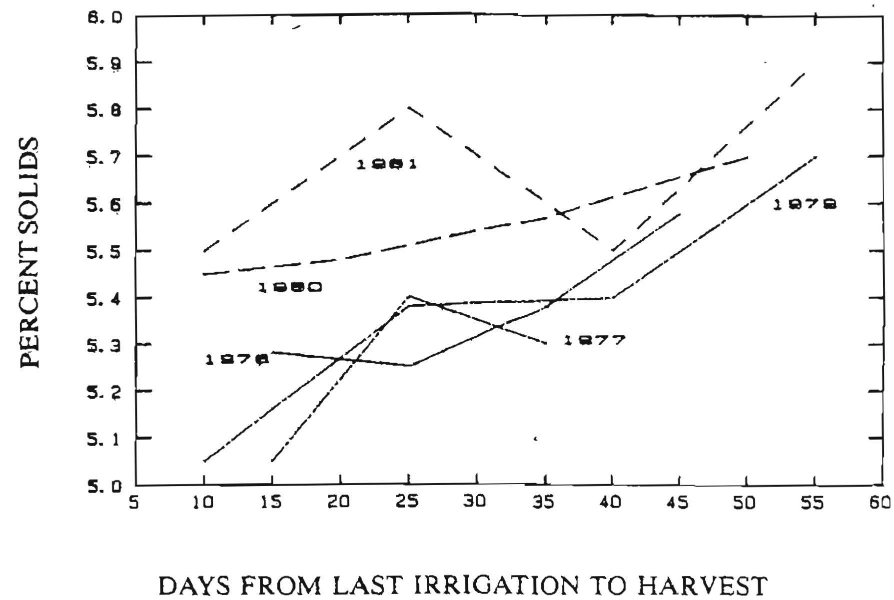
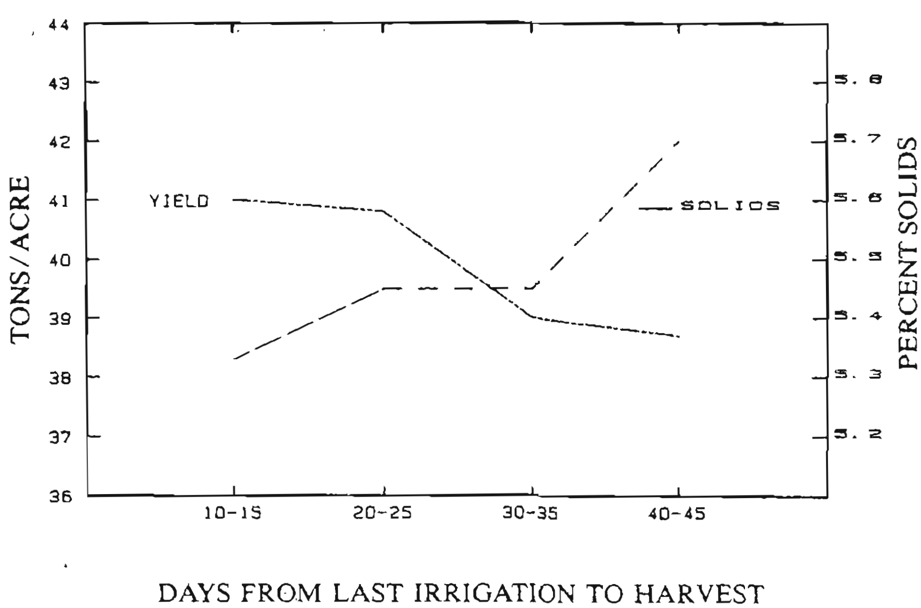
TABLE 1* IRRIGATION CUTOFF PERCENT SOLIDS



* From California Tomato Grower, March 1984

TABLE 2* YIELD AND SOLIDS IRRIGATION CUTOFF 1977 - 1981



* From California Tomato Grower, March 1984

TABLE 3

RELATIVE EVAPORATION COST AND YIELD TO PRODUCE TOMATO PASTE AT 26% SOLIDS PER TON OF TOMATOES PROCESSED WITH VARIOUS INITIAL SOLIDS CONTENT

Final Product: Tomato Concentrate at 26% Solids

Cost Factor / Initial Solids (%)	Evaporation Load (lbs. Water Removed Per Ton)	Theoretical Yield (lbs. Product per Ton)	Relative Cost Per Unit Yield (¢/lb.)*	Product (26%) Cost Per Pound (¢/lb.)**	Product (26%) Cost Plus Evaporation Cost (¢/lb.)
5.0 (California)	1,616	384	4.2	15.63	19.83
4.5 (Florida Best)	1,654	346	4.8	17.34	22.14
4.25 (Fl. Average)	1,674	326	5.1	18.40	23.50

* Based on estimated evaporation cost of $10.00 per 1,000 lbs. water removed.
** Tomato Costs $60 per ton

A year's experience with the 40 x 30 cm MUM container for Florida tomatoes.

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When the Florida tomato industry adopted a 25-lb. unit rather than a 30-lb. unit for mature-green tomatoes in January 1982, most shippers utilized a cut-down version of the 30-lb. container and retained the so-called "air" stacking pattern. This had the undesirable effect of decreasing the weight of tomatoes per pallet by 6.3% compared to the 30-lb. carton. In contrast, the 40 x 30 cm MUM container increases the weight of tomatoes per pallet and therefore, increases ripening room and truck load capacities by 4% over the old 30-lb. carton, and by 11% over the cut-down 25-lb. carton.

Several packinghouses made the conversion from the "cut-down" carton to the MUM carton during the 1983-84 shipping season. All shippers reported satisfactory results with the MUM carton both in Florida and elsewhere. In addition to the economic advantages cited above, the MUM box is reported to fill better and more evenly with less crowning resulting in reduced spillage at the fillers. Within the packinghouse more packages can be accomodated in the same conveyor space, because the MUM carton is not as long as the " cut-down" carton. Several shippers have stated a preference for the 8-high stacking pattern of the MUM box over the 9 or 10 high stacking pattern of the "cut-down" box.

The major box manufacturers reported that the change to the

MUM container was no more difficult than making any other change in containers. Manufacturers reported that one disadvantage of the MUM box is that it requires more paper (has a larger blank size) than the cut-down carton and therefore, it is more expensive to manufacture. Experiments are planned to determine if the venting pattern of the MUM carton can be changed as a cost cutting measure. The need to supply both a MUM and a "cut-down" version of the tomato carton has caused some inventory problems to the container manufacturers.

No one reported any problems with temperature management of tomatoes packed in the MUM carton. This was in good agreement with the earlier experimental results. Simple modifications of the air delivery systems within tomato ripening rooms were tested. These improve air distribution within the rooms regardless of the container used for packing the tomatoes.

An estimate of the potential economic impact of the MUM container can be computed from the 1982-83 shipping figure of 45,703,529 25lb. equivalents. To handle and ship this volume in most "cut-down" cartons would require approximately 634,771 pallets and 31,738 truckloads. To handle and ship this volume in the MUM carton would require about 571,294 pallets and 28,565 truckloads. Adoption of the MUM carton would mean a savings of 63,477 pallets and 3,173 truckloads. The 40 x 30 cm MUM carton provides a very satisfactory, practical and economical alternative to the "cut-down" carton. Voluntary adoption of the MUM containers by Florida shippers sets a high standard for all members of the produce industry.

TOMATO SECTION OF EXTENSION PLANT PATHOLOGY REPORT NO. 6
FLORIDA VEGETABLE PLANT DISEASE CHEMICAL CONTROL GUIDE

Tom Kucharek
Extension Plant Pathologist
July, 1984

Crop	Chemical	Rate/A	Minimum days to harvest	Pertinent Diseases listed on label	Pertinent Diseases not listed on the label but also controlled	Special Remarks
Tomato	Benlate	1/2-1 lb.	NTL	Gray mold Leaf mold White mold (Sclerotinia) Phoma leaf spot	Target spot Rhizoctonia fruit rot	Field & Greenhouse.
	Botran 75 W	1 lb/100 gal water	NTL	Botrytis stem canker		Seedlings or newly set transplants may be injured by drenching. Greenhouse use only.
	Bravo 500	2 1/4 - 4 1/4 pts.	NTL	Early blight Late blight Gray leaf spot Leaf mold Septoria leaf spot Gray mold Black mold Rhizoctonia fruit rot Bacterial spot (when combined with Kocide 101, Tri-basic Copper Sulfate, or CP-Basic Copper TS-53-WP)	Phoma leaf spot Target spot Rhizoctonia fruit rot Bacterial speck (when used as indicated for bacterial spot)	Do not use with Copper Count-N in concentrated spray mixtures.

Crop	Chemical	Rate/A	Minimum days to harvest	Pertinent Diseases listed on label	Pertinent Diseases not listed on the label but also controlled	Special Remarks
Tomatoes (cont'd)	Dithane FZ	Field 0.8-2.4 qts greenhouse 4.5-6.1 fl oz/5000 sq ft	5	Leaf mold Early blight Late blight Gray leaf spot Septoria leaf spot Bacterial spot (use 1.2 qts combined with copper fungicides as in Dithane M-45)	See Dithane M-45	Do not use on young plants in greenhouse to avoid injury.
	Dithane M-45	1 1/2-3 lbs.	5	Late blight Early blight Gray leaf spot Leaf mold Bacterial spot	Leaf mold Phoma leaf spot Target spot Bacterial spot & Bacterial speck (When combined with Kocide 101, Tri-basic Copper Sulfate, or CP-Basic Copper TS-53-WP)	
	Dithane M-22	1-3 lbs.	5	Early blight Late blight Septoria leaf spot Gray leaf spot Leaf mold	See Dithane M-45	Field or greenhouse. Do not use on young tender plants under glass.
	Dithane M-22 Special	1-3 lbs.	5	Early blight Late blight Gray leaf spot Septoria leaf spot Bacterial spot	See Dithane M-45	To avoid injury do not use on young plants in greenhouse.

Crop	Chemical	Rate/A	Minimum days to harvest	Pertinent Diseases listed on label	Pertinent Diseases not listed on the label but also controlled	Special Remarks
Tomatoes (cont'd)	Manzate	1 1/2-2 lbs.	5	Early blight Late blight Septoria leaf spot Gray leaf spot	See Dithane M-45	Do not use on young plants in greenhouse as injury may occur.
	Manzate D	1 1/2-2 lbs.	5	Early blight Late blight Septoria leaf spot Gray leaf spot	See Dithane M-45 &	Do not use on young plants in greenhouse as injury may occur.
	Manzate 200	1 1/2-3 lbs.	5	Early blight Late blight Gray leaf spot Gray leaf mold Bacterial spot	See Dithane M-45	
	Manzate Flowable	Field 1.2-2.4 qts. Greenhouse 4.5 - 6.1 fl oz/5000 sq ft	5	Early blight Late blight Septoria leaf spot Gray leaf spot	See Dithane M-45	Field and green-house. Do not use on young seedlings in greenhouse as injury may occur.
	Manex[1]	1.2-1.6 qts	5	Leaf mold Early blight Late blight Gray leaf spot Septoria leaf spot	Target spot Phoma leaf spot	Field or greenhouse.

[1]High rate is equivalent to 67% of Maneb a.i. in Dithane M-22 special, Dithane M-22, Manzate Flowable and Dithane FZ.

Crop	Chemical	Rate/A	Minimum days to harvest	Pertinent Diseases listed on label	Pertinent Diseases not listed on the label but also controlled	Special Remarks
Tomatoes (cont'd)	Diflolatan 4 F (Mechanically harvested tomatoes only)	2 1/2 - 5 pts.	NTL	Early blight Late blight Gray leaf spot Septoria leaf spot Fruit rot	Target spot Phoma leaf spot Leaf mold	1. For mechanically harvested tomatoes only. 2. Fruit spotting may occur when applied during high temperatures or drought stress.
	Dyrene (not for use in greenhouse)	2-5 lbs.	NTL	Botrytis Early blight Late blight Septoria leaf spot		If temperatures exceed 85°F do not use more than 1 lb. if tank mixed with a copper fungicide.
	Kocide 101	2-4 lbs.	NTL	Early blight Bacterial speck Bacterial spot	See Dithane M-45	Min days to harvest is 5 if used with a Dithane or Manzate fungicide.
	Kocide 606	2 2/3-5 1/3 pts.	NTL	Early blight Bacterial speck Bacterial spot	See Dithane M-45	Same as Kocide 101.
	Tri-basic Copper Sulfate	2-4 lbs.	NTL	Bacterial spot Bacterial canker Early blight Late blight Leaf mold Septoria Stemphyllium leaf spot	See Dithane M-45	Same as Kocide 101.

Crop	Chemical	Rate/A	Minimum days to harvest	Pertinent Diseases listed on label	Pertinent Diseases not listed on the label but also controlled	Special Remarks
Tomatoes (cont'd)	CP-Basic Copper TS-53 WP	2-4 lbs.	NTL	Same as Tri-basic Copper sulfate	See Dithane M-45	Same as Kocide 101.
	JMS Stylet Oil	3 qts.	NTL	Potato virus Y Tobacco etch virus Pepper mottle virus	Tomato yellows	Must be applied with ground rig at 400 psi using Tee Jet TX5 SS nozzles. READ LABEL
	Ridomil 2E[1] (Soil application)	2-4 pts. (Broadcast only)	PPI treatment for plant beds	Pythium damping off in plant beds Late blight Phytophthora stem canker		Not a necessary treatment for Pythium if beds are fumigated prior to seeding and recontamination of fumigated soil is avoided. Not for use in greenhouses.
	Ridomil 2E[1] (Soil application)	4-8 pts.[2] (Broadcast rate)		Pythium damping off for field	Phytophthora stem canker Late blight	Same as entry above.

[1] Do not apply more than 12 pints Ridomil 2E/season.
[2] PPI (via mechanical device) or POPI (via irrigation) broadcast or banded.

Crop	Chemical	Rate/A	Minimum days to harvest	Pertinent Diseases listed on label	Pertinent Diseases not listed on the label but also controlled	Special Remarks
Tomatoes (cont'd)	Ridomil 2E[1] (Soil application)	4 pts.[2] (Broadcast rate)		Phytophthora or Pythium fruit rots	Late blight	Same as entry above.
	Ridomil MZ-58[3] (Foliar spray)	1 1/2 - 2 lbs.	5	Late blight	Phytophthora stem canker Pythium fruit rot	Only Dithane M-45, Manzate 200, Manzate or Dithane M-22 may be tank mixed with Ridomil MZ-58. Do not apply more than 2 lbs/A of Manzate or Dithane fungicides with Ridomil MZ-58.

TOMATO NEMATICIDES FOR FLORIDA

Tomatoes can be damaged by several plant nematodes in Florida, including root-knot, reniform, sting, and stubby-root. Risk of crop losses to any of these may be reduced by crop rotation (farming "new" land), but the value of the crop practically dictates that chemical nematicides be used, even on most new land. On old vegetable land, nematicides are definitely necessary for most efficient crop production.

Most Florida tomatoes are grown on some form of the full-bed plastic mulch system, in which one of the multi-purpose fumigants is an integral part of the program. Historically, product choice has often been dictated by the classes of pests other than nematodes for which control is desired. For instance, methyl bromide is most active of the fumigant ingredients against nutsedges (*Cyperus* spp.), so has often been preferred for that reason. Some growers who felt that they had little problem with nutsedge or could control it satisfactorily by other means have used Vapam or multi-purpose fumigants based on dichloropropene, such as Vorlex. Less expensive fumigant nematicides and non-fumigant nematicides are also registered for some situations in Florida tomato production.

MULTI-PURPOSE SOIL FUMIGANTS registered for Florida tomatoes are listed in Table 1. These products can help control several classes of pests, depending on product, rate, and application procedure chosen. Rates shown here are guidelines to most common uses of the products. Consult product labels to be sure of legal uses. All of these products are more effective when covered with a plastic tarp; methyl bromide products must be covered to keep that volatile active ingredient in the ground long enough to effectively control the target pests. Since bed widths and spacing are highly variable, rates are given on a broadcast acre basis. The actual amount of chemical used per acre of field depends on the portion of the field area which is actually occupied by the beds: if beds are 30 inches wide and are spaced 60 inches apart, center-to-center, the treated area is 50% of the total field area, so 50% of the broadcast rate of product would be needed; for 36-inch beds spaced 5 feet apart, the field requires 36/60 = 60% of the broadcast rate.

The selection of multi-purpose fumigant products (Table 1) has not changed much in recent years, in contrast to less expensive fumigants. However, that situation is expected to change soon. Methyl bromide is currently under critical review by EPA; there are questions about its fate in soil and risk of contaminating ground water; recently published data raise serious questions about its potential carcinogenic properties. There is a very real chance that use of methyl bromide soil fumigants may be sharply restricted or completely suspended within 2 or 3 growing seasons. This, combined with recent restrictions on use of Telone products by their manufacturer (see below), suspension of all EDB soil fumigants, and withdrawal of D-D Soil Fumigant from the market, suggest that the entire family of halogenated hydrocarbon soil fumigants will probably soon be gone. Since Vorlex is based on Telone's active ingredients, regulatory action affecting Telone products should be expected to similarly affect Vorlex. Chloropicrin, another common component of multipurpose fumigants, belongs to the same chemical family as the dichloropropenes. The Florida tomato industry should seriously pursue alternative means of managing nematodes, with the realization that most existing alternatives which seem likely to survive are either more difficult to use effectively, less effective, or both, as they are currently used.

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Table 1. MULTI-PURPOSE SOIL FUMIGANTS FOR FLORIDA TOMATOES. Note that rates are expressed in terms of broadcast treatment; see text above for explanation of calculation of actual amounts to apply per field acre, depending on bed area and spacing.

PRODUCTS	ACTIVE INGREDIENTS	BROADCAST RATE/ACRE
Chlor-O-Pic, Picfume	chloropicrin	35-78 gal. without tarp 11-15 gal. when tarped
Dowfume MC-33, Terr-O-Gas 67, many others	methyl bromide/ chloropicrin mixtures, often in 2:1 ratio but available in many proportions	rate usually provides 180-240 lb methyl bromide/acre; use label rates
Vapam	metam-sodium	40-60 gal. when tarped 80-100 gal. with water seal
Vorlex	dichloropropene (the active ingredient of Telone II) + MITC, a tear gas similar to chloropicrin	30-50 gal.

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FUMIGANT NEMATICIDES. Within the past year, moderately-priced soil fumigants intended primarily or entirely for nematode control have essentially disappeared from peninsular Florida. Use of all ethylene dibromide (EDB) products has been suspended; D-D Soil Fumigant has been permanently withdrawn from the market by the manufacturer; Telone II has been removed from most of peninsular Florida by its manufacturer. While North Florida growers may continue to have Telone II available for their use, most of the Florida tomato industry does not presently have that option. The long-term fate of Telone-based products depends on the results of studies of its fate in soil and water and its carcinogenic potential which are now in progress.

Where tomatoes are grown in less intensive culture without use of plastic mulch and only nematode control is desired, Telone II can still provide economical, reliable nematode control where it is still available. It is relatively cheap and easy to apply with simple pump or gravity-flow regulators and is registered for use in production of most vegetables, making it economically feasible and often the only practical nematicide for small market-garden operations.

NON-FUMIGANT NEMATICIDES. Several "granular" or "contact" insecticide-nematicides have registrations which include nematode control for tomatoes in Florida. Although they are generally inferior to fumigants for control of root-knot and reniform nematodes, these products will apparently assume greater importance in Florida tomato production when (if) methyl bromide and other multi-purpose fumigants become more restricted or totally unavailable.

Foliar application of Vydate L on a regular schedule of 2-4 pts/acre in at least 100 gal. of water/acre, at 1-2 week intervals, seems to suppress nematode activity in tomatoes. This may provide a reasonable means to prevent significant nematode damage to a second crop planted on plastic-mulched beds without disturbing the beds for fumigation. Consult product labelling for specific application guidelines.

Dasanit 15G and Dasanit SC are both registered for application at planting for early-season suppression of nematodes. Consult label for details.

R. A. DUNN
August, 1984

LEGAL INSECTICIDES FOR CONTROL OF INSECTS ON TOMATOES

August 1984

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TOMATOES (REVISED 8-3-84)

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
ants	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label
aphids	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label
	aliphatic petroleum (JMS-Stylet Oil)	97.6% EC	see label.	see label
	azinphosmethyl (Guthion)	2 S (EC)	2-3 pts.	0
	demeton (Systox)	2 EC	1-1 1/2 pts./ 100 gal.	3
	diazinon	4 EC	1/2 pt.	1
	dimethoate (Cygon, Defend)	4 EC	1/2-1 pt.	7
	disulfoton (Di-Syston)	15 G	8-23.4 oz./1000 ft. row (any row space)	30
	endosulfan (Thiodan) (green aphid aphid)	3 EC	2/3 qt.	1
	lindane (Isotox-lindane)	25 WP	1 lb.	do not apply after fruits start to form
	malathion	5 EC	1 pt./100 gal.	1
	methamidophos (Monitor)	4 EC	1 1/2-2 pts.	7
	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts.	1 - 2 pts. 2 - 2+ pts.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
aphids (cont.)	methoxychlor + diazinon (Alfa-Tox)	30% liquid (EC)	2 1/2 qts.	1
	mevinphos (Phosdrin)	4 EC	1/4-1/2 pt.	1
	methyl parathion	4 EC	1-3 pts.	15
	monocrotophos (Azodrin)	5 S (EC)	7/8 pt.	21
	parathion	4 EC	1-2 pts.	10
	phosphamidon	8 EC	1/2 pt.	10
	pyrethrins + piperonyl butoxide (Pyrenone) (green peach aphid)	66% liquid (EC)	2-6 oz./100 gal.	0
	toxaphene* (green peach aphid)	8 EC	2-5 pts.	1 - 2 pts. 3 - 2+ pts.
armyworms	allethrin (Pyrellin SCS)	1% liquid EC	1-1 1/2 pts.	see label
	carbaryl (Sevin)	5 B	40 lbs.	0
	diazinon	4 EC	3/4-1 pt.	6
	fenvalerate (Pydrin) (Southern, Sugarbeet Western Yellow-Striped)	2.4 EC	5 1/3-10 2/3 ozs.	1
	methomyl (Lannate, Nudrin)	1.8 L	1-2 pts.	1
	methyl parathion	4 EC	1-3 pts.	15

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
armyworms (cont.)	parathion (up to 3rd instar)	4 EC	1-2 pts.	10
	toxaphene*	5 B	20-40 lbs.	1
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 3 - 5 pts.
	trichlorofon (Dylox, Proxol)	5 B	20 lbs.	28
(fall armyworms)	carbaryl (Sevin)	80 WP	1 1/2-2 1/2 lbs.	0
	methomyl (Lannate, Nudrin)	1.8 L	2 pts.	1
	methoxychlor (Marlate)	50 WP	2-6 lbs.	1 - 3 1/2 lbs. 7 - 3 1/2+ lbs.
	methoxychlor + diazinon (Alfa-Tox)	30% liquid (EC)	2 1/2 qts.	1
(southern armyworms)	diazinon	4 EC	3/4-1 pt.	1
	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts.	1 - 2 pts. 2 - 2+ pts.
(beet armyworms)	fenvalerate (Pydrin) (Sugarbeet armyworm)	2.4 EC	5 1/3-10 2/3 ozs.	1
	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts.	1 - 2 pts. 2 - 2+ pts.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
(yellow striped armyworms)	azinphosmethyl (Guthion)	2 S (EC)	3-6 pts.	14
	endosulfan (Thiodan)	3 EC	1 1/3 qts.	1
	fenvalerate (Pydrn) (Western Yellow Striped)	2.4 EC	5 1/3-10 2/3 ozs.	1
banded cucumber beetle	azinphosmethyl (Guthion)	2 S (EC)	1 1/2-2 pts.	0
	diazinon	4 EC	3/4-1 pt.	1
	lindane (Isotox-lindane) larvae	25 WP	1-2 lbs.	Preplant (soil)
beetles	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	See label.
blister beetle	cryolite (Kryocide)	96 WP	15-30 lbs.	wash fruit
	endosulfan (Thiodan)	3 EC	2/3 qt.	1
	methoxychlor (Marlate)	50 WP	2-7 lbs.	1 - 3 1/2 lbs. 7 - 3 1/3+ lbs.
	methoxychlor + diazinon (Alfa-Tox)	30% liquid EC	2 1/2 qts.	1
	parathion	4 EC	1-2 pts.	10
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 3 - 2+ pts.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
cabbage looper	Bacillus thruingiensis Bactospeine, Bactur, Dipel, Sok, Stan-Guard, Thuricide)	See individual labels.		0
	cryolite (Kryocide)	96 WP	15-30 lbs.	wash fruit
	endosulfan (Thiodan)	3 EC	1 qt.	1
	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts.	1 - 2 pts. 2 - 2+ pts.
	methomyl (Lannate, Nudrin)	1.8 L +	1-2 pts.+ 1/2 lb.	1 - 2 pts. 2 - 2+ pts.
	methyl parathion	4 EC	2-3 pts.	15
	monocrotophos (Azodrin)	5 S (EC)	1 5/8 pts.	21
	toxaphene*	8 EC	2 pts.	1
Colorado potato beetle	azinphosmethyl (Guthion)	2 S (EC)	1 1/2 pts.	0
	carbaryl (Sevin)	80 WP	2/3-1 1/4 lb.	0
	disulfoton (Di-Syston)	8 EC	1.2-3.5 fl. oz./ 1000 ft. row (any row spacing) or 1-3 pts./A (38" row spacing)	30

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
Colorado potato beetle (cont.)	disulfoton (Di-Syston)	15 G	8-23.4 oz./1000 ft. row (any row spacing) or 6.7-20 lbs./A (38" row spacing)	30
	endosulfan (Thiodan)	3 EC	2/3 qt.	1
	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	methoxychlor (Marlate)	50 WP	2-6 lbs.	1 - 3 1/2 lbs. 7 - 3 1/2+ lbs.
	parathion	4 EC	1-2 pts.	10
	Penncap-M	2 EC	4 pts.	15
	phosphamidon	8 EC	1/2 pt.	10
	pyrethrins + piperonyl butoxide (Pyrenone)	66% liquid (EC)	2-6 oz./100 gal.	0
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 2 - 2+ pts.
corn earworm (See also tomato fruitworms)	azinphosmethyl (Guthion)	2 S (EC)	3-6 pts.	14
crickets	carbaryl (Sevin)	5 B	40 lbs.	0
	trichlorfon (Dylox, Proxol)	5 B	20 lbs.	28

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
cutworms (cont.)	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label
	carbaryl (Sevin)	80 WP	2 1/2 lbs.	0
	carbaryl (Sevin)	5 B	40 lbs.	0
	diazinon	14 G	14-28 lbs.	preplant
	diazinon	4 EC	2-4 qts.	preplant
	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	lindane (Isotox-lindane)	25 WP	1-2 lbs.	preplant (soil)
	methomyl (Lannate) (varigated cutworm)	1.8 L	2 pts.	1
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 3 - 2+ pts.
	trichlorfon (Dylox, Proxol) (survace feeding cutworms)	5 B	20 lbs.	28
darkling ground beetles	carbaryl (Sevin)	5 B	40 lbs.	0
<u>Drosophila</u> (fruit flies)	azinphosmethyl (Guthion)	2 S (EC)	1 1/2-2 pts.	0
	diazinon	4 EC	1/2-1 1/2 pts.	1
	malathion	5 EC	2 1/2 pts.	1
	naled (Dibrom)	8 EC	1 pt.	1

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
European corn borer	azinphosmethyl (Guthion)	2 S (EC)	2-3 pts.	0
	carbaryl (Sevin)	80 WP	1 1/4-2 1/2 lbs.	0
flea beetles	azinphosmethyl (Guthion)	2 S (EC)	2-3 pts.	0
	carbaryl (Sevin)	80 WP	2/3-1 1/4 lbs.	0
	carbophenothion (Trithion) (potato flea beetle)	8 EC	1/2-1 pt.	7
	cryolite (Kryocide)	96 WP	15-30 lbs.	wash fruit
	disulfoton (Di-Syston)	8 EC	1.2-3.5 fl. oz./ 1000 ft. row (any row spacing) or 1-3 pt./A (38" row spacing)	30
	disulfoton (Di-Syston)	15 G	8-23.4 oz./1000 ft. row (any row spacing) or 6.7-20 lb./A (38" row spacing)	30
	endosulfan (Thiodan)	3 EC	2/3 qt.	1
	fenvalerate (Pydrin)	2.4 EC	5 2/3-10 2/3 ozs.	1
	methyl parathion	4 EC	1-3 pts.	10 - 1 pt. 15 - 1+ pt.
	methoxychlor (Marlate)	50 WP	2-6 lbs.	1 - 3 1/2 lbs. 7 - 3 1/2+ lbs.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
flea beetles (cont.)	methoxychlor + diazinon (Alfa-Tox)	30% liquid (EC)	2 1/2 qts.	1
	naled (Dibrom)	8 EC	1 pt.	1
	parathion	4 EC	1-2 pts.	10
	Penncap-M	2 EC	2-4 pts.	15
	phosphamidon	8 EC	1/2 pts.	10
	pyrethrins + piperonyl butoxide (Pyrenone)	66% liquid (EC)	2-6 oz./100 gal.	0
	toxaphene*	8 EC	2-3 pts.	1 - 2 pts. 3 - 2+ pts.
garden symphylans	fonofos (Dyfonate)	10 G	20 lbs.	preplant, broadcast
grasshoppers	azinphosmethyl (Guthion)	2 S (EC)	2-3 pts.	0
	carbaryl (Sevin)	5 B	40	0
	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	mevinphos (Phosdrin)	4 EC	1/2-1 pt.	1
	parathion	4 EC	1-2 pts.	10
	toxaphene*	8 EC	2.5-4 pts.	1 - 2 pts. 3 - 2+ pts.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
hornworms (tomato hornworms)	azinphosmethyl (Guthion)	2 S (EC)	3-6 pts.	14
	<u>Bacillus</u> <u>thuringiensis</u> Bactospeine, Bactur, Dipel, Stan-Guard, Sok, Thuricide)	See individual labels.		0
	carbaryl (Sevin)	80 WP	1 1/4-2 1/2 lbs.	0
	cryolite (Kryocide)	96 WP	15-30 lbs.	wash fruit
	endosulfan (Thiodan)	3 EC	2/3-1 1/3 qts.	1
	fenvalerate (Pydrin)	2.4 EC	2 2/3-5 1/3 ozs.	1
	methomyl (Lannate)	1.8 L	2-4 pts.	1 - 2 pts. 2 - 2+ pts.
	naled (Dibrom)	8 EC	1 pt.	1
	Penncap-M	2 EC	4 pts.	15
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 3 - 2+ pts.
	trichlorfon (Dylox, Proxol)	80 SP	20 oz.	21

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
lacebugs	carbaryl (Sevin)	80 WP	1 1/4-2 1/2 lbs.	0
leafhoppers	allethrin (Pyrellin SCS)	1% liquid EC	1-1 1/2 pts.	see label
	azinphosmethyl (Guthion)	2 S (EC)	2-3 pts.	0
	carbaryl (Sevin)	80 WP	2/3-1 1/4 lbs.	0
	carbophenothion (Trithion) (potato leafhopper)	8 EC	1/2-1 pt.	7
	disulfoton (DiSyston)	8 EC	1.2-3.5 fl. oz./ 1000 ft. row (any row spacing) or 1-3 pts./A (38" row spacing)	30
	disulfoton (Di-Syston)	15 G	8-23.4 oz./1000 ft. row (any row spacing) or 6.720 lbs./A (38" row spacing)	30
	dimethoate (Cygon, Defend)	4 EC	1/2-1 pt.	7
	methoxychlor (Marlate)	50 WP	2-6 lbs.	1 - 3 1/2 lbs. 7 - 3 1/2+ lbs.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
leafhoppers (cont.)	methyl parathion	4 EC	1-2 pts.	15
	mevinphos (Phosdrin)	4 EC	1/2-1 pt.	1
leafminers	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label
	azinphosmethyl (Guthion)	2 S (EC)	1 1/2-2 pts.	0
	carbophenothion (Trithion)	8 EC	1/2-1 pt.	7
	diazinon	4 EC	1/2 pt.	1
	diazinon	50 WP	1/2 lb.	1
	dimethoate (Cygon, Defend)	4 EC	1/2-1 pt.	7
	disulfoton (Di-Syston)	8 EC	1.2-3.5 fl. oz./ 1000 ft. row (any row spacing) or 1-3 pts/A (38" row spacing)	30
	disulfoton (DiSyston)	15 G	8-23.4 oz./1000 ft. row (any row spacing) or 6.7-20 lbs./A (38" row spacing)	30
	ethion	4 EC	1 pt.	2
	fenvalerate (Pydrin)	2.4 EC	10 2/3 ozs.	1

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
leafminers (cont.)	lindane (Isotox-linedane)	25 WP	1 1/2 lbs.	Do not apply after fruit starts to form.
	methamidophos (Monitor) (adults)	4 EC	1 1/2-2 pts.	7
	methoxychlor + diazinon (Alfa-Tox)	30% liquid (EC)	2 1/2 qts.	1
	monocrotophos (Azodrin)	5 S (EC)	1 5/8 pts.	21
	naled (Dibrom)	8 EC	1 pt.	1
	oxamyl (Vydate L)	2 EC	2-4 pts./100 gal.	1
	parathion	4 EC	1-2 pts.	10
	Penncap-M	2 EC	2-4 pts.	15
	phorate (Thimet)	15 G	15 oz./1000 ft. row (min. 38" spacing)	at planting
	phosphamidon	8 EC	1/2 pt.	10
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 3 - 2+ pts.
	trichlorfon (Dylox, Proxol)	80 SP	20 oz.	21
loopers	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
loopers (cont.)	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts.	1-2 pts. 2-2+ pts.
mites	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label
	carbophenothion (Trithion) (russet, tropical & two-spotted mites)	4 EC	1-2 pts.	7
	demeton (Systox)	2 EC	1-1 1/2 pts./100 gal.	3
	dicofol (Kelthane)	1.6 EC	1-2 qts.	2
	disulfoton (Di-Syston)	8 EC	1.2-3.5 fl. oz./ 1000 ft. row (any row spacing) or 1.3 pts. (38" row spacing)	30
	disulfoton (Di-Syston)	15 G	8-23.4 oz./1000 ft. row (any row spacing) or 6.7-20 lbs./A (38" row spacing)	30
	ethion (tropical, two-spotted, and tomato russet mites)	4 EC	1 pt.	2
	methyl parathion	4 EC	1-2 pts.	15
	mevinphos (Phosdrin)	4 EC	1/2 - 1 pt.	1
	naled (Dibrom)	8 EC	1 pt.	1

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
pinworm (tomato pinworm) cont.	methamidophos (Monitor) (suppression of low populations)	4 EC	1 1/2-2 pts.	7
	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts. (ground application only)	1 - 2 pts. 2 - 2+ pts.
	Penncap-M	2 EC	4 pts.	15
	toxaphene*	8 EC	2-5 pts.	1 - 2 pts. 3 - 2+ pts.
plant bugs	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label
	carbaryl (Sevin)	80 WP	1 1/4-2 1/2 lbs.	0
	methyl parathion	4 EC	2 pts.	15
	parathion	4 EC	1-2 pts.	10
potato flea beetle	carbophenothion (Trithion)	8 EC	1/2-1 pt.	7
potato psyllid	carbophenothion (Trithion)	4 EC	1-2 pts.	7
	endosulfan (Thiodan)	3 D	33 lbs.	1
	methyl parathion	4 EC	1-3 pts.	15
	parathion	4 EC	1-2 pts.	10
salt marsh caterpillar	trichlorfon (Dylox, Proxol)	5 B	20 lbs.	28

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
sowbug	carbaryl (Sevin)	5 B	40 lbs.	0
stinkbugs	azinphosmethyl (Guthion) (green stinkbugs)	2 S (EC)	1 1/2-2 pts.	0
	carbaryl (Sevin)	80 WP	1 1/4-2 1/2 lbs.	0
	endosulfan (Thiodan)	3 EC	1-1 1/3 qts.	1
	parathion	4 EC	1-2 pts.	10
	phosphamidon	8 EC	1/2 pt.	10
	pyrethrins + piperonyl butoxide (Pyrenone)	66% liquid (EC)	2-6 oz./100 gal.	0
thrips	azinphosmethyl (Guthion)	2 S (EC)	2-3 pts.	0
	lindane (Isotox-lindane)	25 WP	1 lb.	Do not apply after fruit starts to form.
	parathion	4 EC	1-2 qts.	10
	toxaphene*	8 EC	3 pts.	1 - 2 pts. 3 - 2+ pts.

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
tomato fruitworm (same specifics as corn earworm and fruitworm)	azinphosmethyl (Guthion)	2 S (EC)	3-6 pts.	14
	carbaryl (Sevin)	80 WP	1 1/4-2 1/2 lbs.	0
	cryolite (Kryocide)	96 WP	15-30 lbs.	wash fruit
	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	methamidophos (Monitor)	4 EC	1 1/2-2 pts.	7
	methomyl (Lannate, Nudrin)	1.8 L	2-4 pts.	1 - 2 pts. 2 - 2+ pts.
	methoxychlor + diazinon (Alfa-Tox)	30% liquid (EC)	2 1/2 qts.	1
	monocrotophos (Azodrin)	5 EC	1 5/8 pts.	21
	naled (Dibrom)	8 EC	1 pt.	1
	Penncap-M	2 EC	4 pts.	15
	toxaphene*	8 EC	2-5 pts.	3 - 5 pts. 5 - 5 pts.
tuberworm	azinphosmethyl (Guthion)	2 S (EC)	2 1/4-3 pts.	0
weevils	allethrin (Pyrellin SCS)	1% liquid (EC)	1-1 1/2 pts.	see label.
whitefly	azinphosmethyl (Guthion)	2 S (EC)	1 1/2-2 pts.	0
	endosulfan (Thiodan)	3 EC	2/3 qt./100 gal.	1

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
whitefly (cont.)	fenvalerate (Pydrin)	2.4 EC	5 1/3-10 2/3 ozs.	1
	parathion	4 EC	1-2 pts.	10
	phosphamidon	8 EC	1/2 pt.	10
white grubs	lindane (Isotox-lindane)	25 WP	1-2 lbs.	preplant (soil)
wireworms	diazinon	14 G	21-28 lbs.	preplant
	diazinon	2 B	50 lbs.	none listed
	diazinon	14 G	70 lbs.	preplant, broadcast
	diazinon	4 EC	10 qts.	preplant, broadcast
	fonofos (Dyfonate)	10 G	20 lbs.	preplant, broadcast
	lindane (Isotox-lindane)	25 WP	1-2 lbs.	preplant (soil)

TOMATOES

INSECT	INSECTICIDE	FORMULATION	RATE/ACRE	MIN. DAYS TO HARVEST
wireworms (cont.)	parathion	10 G	30-40 lbs.	preplant, broadcast & disc 3 wks. preplanting
	parathion	4 EC	5 qts.	apply to soil surface pre-planting & work 6-9" into soil.

*Any toxaphene used must have been purchased prior to December 31, 1983 and must be labelled for tomatoes for the pest in question.

SUGGESTED HERBICIDES FOR TOMATOES

W. M. Stall, Vegetable Crops Department

NOTE: Herbicides must be applied at exactly the correct rate and time to selectively control weed growth in a vegetable crop. Obtain consistent results by reading the herbicide label and other information about the proper application and timing of each herbicide. To avoid confusion between commercial formulations, suggested rates listed in this guide are stated as pounds active ingredient per acre (lbs. ai./acre) unless otherwise indicated. Apply lower rates for sandy and rockland soils with low organic matter and clay contents. Not all labled herbicides are suggested due to either a lack of Florida data, or due to data indicating a degree of crop injury when applied under Florida conditions. When limited data is available the materials are suggested for use on a trial basis. Read each herbicide label for specific weeds controlled.

TOMATOES

Herbicide	Labelled crops	Time of application	Rate (lbs. ai./acre) to crop
Chloramben (Amiben)	Tomatoes (established)	Postemergence or posttransplant	3.0

Granular formulation may be applied to cultivated non-mulched transplanted or established direct seeded tomatoes. Plants should be at the 5-6 leaf stage. Apply only when foliage is dry. Will not control established weeds.

	Tomatoes	post planting or post transplanting	3.0

A special Local needs 24 (c) Label for Florida. Apply once per crop season after existing weeds in row middles have been removed. Lable states control of many annual grasses and broadleaf wees. Among these are crabgrass, goosegrass, lambsquarter, wild mustard, black nighthade, pigweed, purslane, common ragweed and Florida beggarweed.

TOMATOES

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
DCPA (Dacthal)	Established tomatoes	Posttransplanting after crop establishment (non-mulched)	6.0 to 8.0
		Mulched row middles after crop establishment	6.0 to 8.0

Controls germinating annuals. Apply to weed free soil 6-8 weeks after crops is established and growing rapidly or to moist soil in row middles after crop establishment. Note label precautions of replanting non registered crops wihtin 8 months.

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
Diphenamid (Enide)	Tomatoes	Pretransplant Preemergence Postemergence Posttransplant Incorporated	3.0 to 4.0

Controls germinating annuals. Apply to moist soil 1 week before or within 4 weeks after transplanting crop. Incorporate 0.5 to 2 inches. May be applied as directed band over "plug" planting or to mulched row middles. Label states control of many grasses and broadleaf weeds including spiny ameranth, bermudagrass, goosegrass, seedling johnsongrass, lambsquarter, pigweed, perslane, Fla. pusley and others.

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
Metribuzin (Sencore Lexone)	Tomatoes	Postemergence Posttransplanting after establishment	0.25 to 0.5

Controls small emerged weeds after transplants are established or direct seeded plants reach 5-6 true leaf stage. Apply in single or multiple applications with minimum of 14 days between treatments and a maximum of 1.0 lb ai/acre within a crop season. Avoid applications for 3 days following cool, wet or cloudy weather to reduce possible crop injury.

TOMATOES

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
Metribuzin (Sencore Lexone)	Tomatoes	Directed spray in row middles	0.25 to 1.0

Apply in single or multiple applications with a minimum of 14 days between treatments and maxiumum of 1.0 lb ai/acre within crop season. Avoid applications for 3 days following cool, wet or cloudy weather to reduce possible crop injury. Label states control of many annual grasses and broadleaf weeds including, lambsquarter, fall panicum, ameranthus sp., Florida pusley, common ragweed; sicklepod, and spotted spurge.

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
Napropamid (Devrinol)	Tomatoes	Preplant incorporated	1.0 to 2.0

Apply to well worked soil that is dry enough to permit thorough incorporation to a depth of 1-2 inches. Incorporate same day as applied. For direct seeded or transplanted tomatoes.

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
	Tomatoes	Surface treatment	2.0

Controls germinating annuals. Apply to bed tops after bedding but before plastic application. Rainfall or overhead irrigate sufficient to wet soil 1 inch in depth should follow treatment within 24 hours. May be applied to row middles between mulched beds. A special Local Needs 24(c) Label for Florida. Label states control of weeds including Texas panicum, pigweed, purslane, Florida pusley, and signalgrass.

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
Paraquate (Ortho paraquat Gramoxone)	Tomatoes	Premergence Pretransplant	0.5 to 1.0

Controls emerged weeds. Use a non-ionic spreader and thoroughly wet weed foliage.

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
	Tomatoes	Post directed spray in row middle	0.5

Controls emerged weeds. Direct spray over emerged weeds 1 to 6 inches tall in row middles between mulched beds. Use a non-ionic spreader. Use low pressure and shields to control drift. Do not apply more than 3 times per season.

TOMATOES

Herbicide	Labelled crops	Time of Application to crop	Rate (lbs. ai./acre)
Trifluralin (Treflan)	Tomatoes (except Dade County)	Pretransplant incorporated	0.75 to 1.0

Controls germinating annuals. Incorporate 4 inches or less within 8 hours of application. Results in Florida are erratic on soils with low organic matter and clay contents. Note label precautions of planting non-registered crops within 5 months. Do not apply after transplanting.

	Seeded Tomatoes (except Dade County)	Post directed	0.75 to 1.0

For direct seeded tomatoes, apply at blocking or thinning as a directed spray to the soil between the rows and incorporate.