11.7 Integrated Pest Management of the Asian Citrus Psyllid (ACP) in Florida

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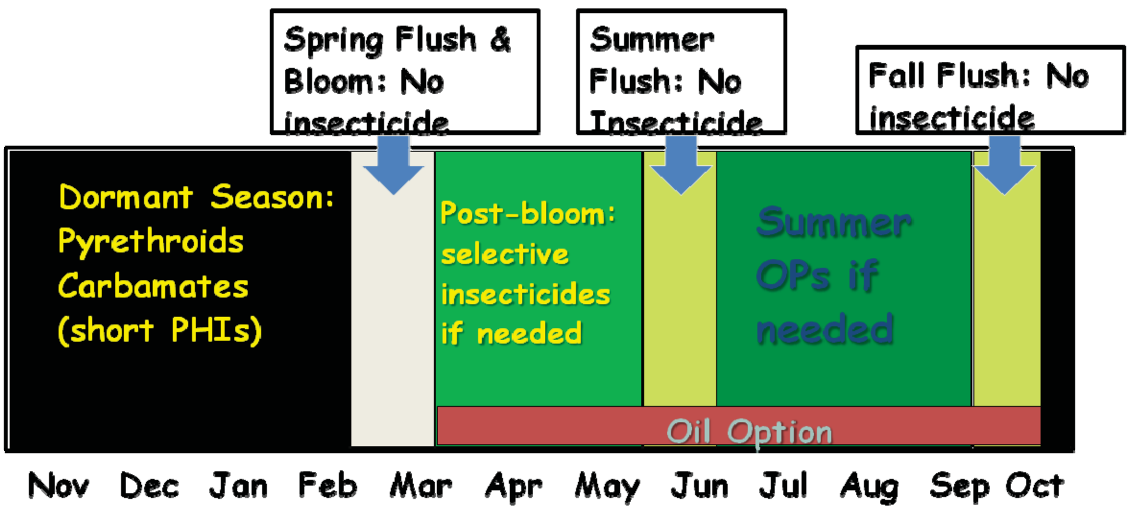
The foundations of Integrated Pest Management (IPM) were laid 50 years ago in a seminal paper by Stern et al. 1959. The concept is based on optimal integration of biological, chemical and cultural controls. Insecticides were relegated to last resort when all else failed and pest damage was projected to exceed the cost of control, the so-called economic threshold. Therefore, monitoring the pest population became critically important. In spite of the difficulty in determining economic thresholds for one and especially a complex of pests, the general concept served well in Florida citrus where most pests were maintained well below economic threshold by a diverse complex of natural enemies, especially in processed fruit. A frequent exception in fresh fruit was the citrus rustmite *Phyllocoptruta oleivora* for which sampling plans and thresholds were developed and widely used.

All this has changed in Florida since the advent of HLB in 2005, principally because of uncertainty regarding potential damage. How many psyllids can we tolerate and still remain viable? No one knows, so the only safe answer appears to be zero, an impossible goal that would lead to economic ruin. Therefore, we are obliged to choose a more rational approach that will optimize an affordable psyllid control program while minimizing negative impacts on key natural enemies. The goals are to maintain a viable operation by slowing down the spread of HLB, extend the productive life of citrus trees, and maintain other pests below economic thresholds**.**

The program includes elements of cultural, biological, and chemical control. Cultural controls include foliar micronutrients to counteract the debilitating effect of HLB, possibly combined with phosphites and inducers of systemic acquired resistance. Flush control to limit psyllid reproductive opportunities is another practice that merits investigation. Biological control includes naturally present predators such as lacewings and ladybeetles which together may account for over 90% mortality of naturally occurring cohorts of ACP. The parasitoid *Tamarixia radiata* from Viet Nam and Taiwan was released in 2000 and 2001 and has spread throughout the state. Although up to 50% parasitism has been observed, control is less than seen in other citrus growing areas. Therefore, we are investigating the possibility of mass releasing *T. radiata* to reinforce populations in the spring. We are also importing and testing additional strains of *T. radiata* and species such as *Diaphorencyrtus aligarhensis* from different parts of Asia in hopes of finding a better fit for Florida conditions.

Chemical control is used in the most efficient and least damaging manner possible. This includes soil applied systemic insecticides to the extent they are available, of which imidacloprid is the most effective. However, the maximum allowable rate for this material is 0.5 lb ai/ac/year (0.56 kg ai/ha/year) which is only sufficient for protecting young trees. Foliar applications of insecticides should be directed at adults since immature stages are hidden in fast growing flush, difficult to control but also attractive to natural enemies. A useful strategy is the dormant spray, a foliar application of broad spectrum insecticide directed at a declining population of overwintering adults. The advantages are that absence of new flush denies refuge to immature stages while not attracting psyllid predators. Consequently, adult psyllids are effectively controlled before they can enter into the spring flush and with minimum impact on natural enemies. We have been able to observe control for up to 6 months following just a single spray in January.

No sprays are recommended during bloom to protect bees and other beneficial insects. The post-bloom period is also critical for many natural enemies and therefore, only selective insecticides should be used if infestations warrant. These include horticultural spray oils (HMO), combined or not with products such as spintetoram, spirotetramat, diflubenzuron and abamectin. Later in the season, it may be necessary to apply another broad spectrum spray directed at adults prior to fall flush. An alternative we have been experimenting with is frequent (fortnightly) ultralow volume applications of pure HMO. A diagrammatic version of the program is presented in Figure 1.



A critical activity to guide this entire program is regular psyllid monitoring. Monitoring should correspond to psyllid generation time and thus be most frequent (every two weeks) during the growing season. Young blocks also require special attention due susceptibility and frequent flushing. Three parameters are necessary to obtain a complete picture of the psyllid population: adults, percentage infested flush, and flush density. Highest priority is adult ACP which vectors HLB and is the target of most sprays. Sticky traps are labor intensive, expensive and only provide data after a week or more. In contrast, the "tap" sample is rapid, accurate, and provides recordable data immediately (Qureshi & Stansly 2007, Hall et al., 2007). A laminated sheet or clipboard is held about 30 inches below a branch to be sampled which is tapped 3 times with the hand or a stick to dislodge the psyllids which fall on the sheet to be counted. Other pests and beneficials can also be included in the count. This can be done ten times in each of 10 locations in a single block. Percentage infestation is estimated at each location by determining how many of 10 shoots contain any psyllid stage. This number can be correlated to number of psyllids according to Setamou et al., 2008. Flush density is estimated by noting the number of trees searched in order to find the 10 shoots. This parameter is used for evaluating flushing patterns and for converting flush infestation into an estimate of overall population density.

The psyllid population toward the end of winter following the dormant spray can be considered as a lower benchmark to which all future populations can be compared. Attempts to drive the population below that level will probably be counterproductive. Systemic insecticides should be used to the fullest possible extent in young trees, with imidacloprid best applied to soil and lower trunk in late spring and early fall. Significant increases in adult numbers during the growing season compared to the dormant baseline should trigger some intervention. All but the dormant spray should be justified by scouting and the earlier in the growing season the greater the importance of choosing a selective insecticide. Hopefully, by following these recommendations we can return to a sustainable and viable integrated management program for ACP and other pests of Florida citrus.

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