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2024–2025 Florida Citrus Production Guide: Asian Citrus Psyllid[1]

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Psyllid Feeding Damage and Pathogen Transmission

The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama, was first detected in Florida in 1998, and it has since become the key pest of citrus due to its role as vector of the pathogen that causes citrus greening disease, also known as huanglongbing (HLB) detected in 2005. The HLB pathogen, *Candidatus* Liberibacter asiaticus (CLas), is transmitted and spread by adult ACP but acquired primarily by nymphs. ACP are sucking insects, related to aphids, that obtain most of their nutrition from phloem sap, which they access by feeding on leaves. Young flush is required by the female to mature eggs, for egg laying, and by nymphs for development. Developing leaf buds and feather-stage flush are preferred for egg laying. Feeding on young shoots results in twisting and distortion of the leaves due to toxins present in saliva that are injected during ingestion. CLas can be transmitted from an infected adult to the next generation of nymphs through the intermediary of the flush, enabling both the tree and the next generation of ACP to become infected within as little as a month. However, infected trees do not show characteristic HLB symptoms of leaf mottling, dieback, and fruit drop until the root system becomes at least partially dysfunctional.

Factors Affecting Psyllid Populations

Once young leaves have expanded and are no longer suitable for egg laying, adult psyllids may either feed on mature leaves of the same tree or leave in search of other host plants. ACP is only able to reproduce on citrus or citrus relatives like orange jasmine (*Murraya paniculata*), although other plants may be used for adult survival. Target plants may be citrus trees within the same grove (particularly young resets, which flush more often) or trees in neighboring groves. Therefore, psyllid management practices in one grove affect future psyllid populations in nearby surrounding citrus groves. Temperature is also closely linked to the abundance of psyllids in the field. Ideal temperatures for maximum egg production are between 77°F–86°F. Above 93°F, lifespan decreases to less than 30 days, with a corresponding decrease in fecundity. Egg laying below 60°F slows to under two per day, and development time increases to two months. ACP populations in Florida

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are consistently lower during the midsummer months and in winter compared to late spring and even early fall due to both temperature and flush availability.

Psyllid Management

ACP control slows spread of HLB and is critical for young trees, which are most susceptible to HLB and most attractive to ACP due to frequent flushing. However, effective management is also required on mature infected trees to reduce reinoculation of the pathogen and allow the tree to produce healthy flush. Thus, vector control is a critical component of HLB management. The goal of psyllid management programs in commercial citrus groves is to reduce psyllid populations to as low levels as possible and remain economically viable.

Chemical Control

Use of insecticides to control ACP is a major component of HLB management strategies in Florida and elsewhere. Management programs should optimize benefits while minimizing cost of pest control, risk of pest resistance to insecticides, and negative impacts of insecticides on beneficial insects and mites useful for control of ACP and other pests. The information provided in this chapter is intended to aid in the development of site-specific psyllid management. Products recommended in this chapter for psyllid suppression have been demonstrated in field trials conducted by UF/IFAS to be effective for reducing ACP populations. However, *most of these products will have negative effects on natural enemies of insect and mite pests.* Therefore, *new pest problems may develop as a result of increased insecticide use for psyllid suppression*. However, the problems posed by these other potential pests are generally less serious than the threat posed by ACP as vector of the HLB causal pathogen.

NONINSECTICIDAL CONTROL

Exclusion mesh, in the form of CUPS (see chapter 21) or Individual Protective Covers (IPCs) can prevent psyllid access to trees, thereby reducing the likelihood of *C*Las infection. Implementation of either tool comes with other challenges including cost and management of other arthropods and pathogens. However, exclusion mesh is currently the only tool that can fully prevent ACP infestation in citrus and that has been proven to nearly eliminate HLB infection when trees are covered with the protective structures.

NONBEARING TREES

Young trees are most susceptible to infection with *C*Las. The multiple flushes they produce throughout the year place them at greater risk of disease infection, compared to mature trees, because adult psyllids are attracted to new flush. Even without HLB, young trees in the field need to be protected for about four years from psyllids and leafminers to grow optimally. Soil-applied systemic insecticides have historically provided the longest-lasting control of psyllids with the least impact on beneficial insects. Currently, three neonicotinoid (all group 4A mode of action) insecticides (imidacloprid, thiamethoxam, and clothianidin) and one group 28 insecticide (cyantraniliprole) are available for soil application to control ACP on young nonbearing trees. Because of the cost of the group 28 product, most use is presently restricted to 4A products. Depending on formulation, systemic insecticides are best applied to the soil, which is far more effective on young trees than foliar sprays.

Most soil applications of systemic insecticides are applied as drenches, and for reset trees, this is the only application method. However, injection is effective and efficient once roots have established around emitters in solid blocks on drip irrigation. Soil drenches are best applied using an applicator metered to deliver 8–10 oz of formulated drench solution per tree. Drench applications should be applied directly at the soil-rootstock interface. Use restrictions limit the number of applications that can be made in a growing season. Imidacloprid applications are limited to no more than 0.5 lb a.i./acre per growing season, regardless of application method. This equates to 14 fl oz/acre for 4.6F formulations, 16 fl oz/acre for 4F formulations, or 32 fl oz/acre for 2F formulations. Thiamethoxam applications are limited to no more than 0.172 lb a.i./acre (or 3.67 oz Platinum 75 SG/acre) per growing season. Clothianidin (Belay 50 WDG) is currently labeled for use on nonbearing trees only and is limited to 0.4 lb a.i./acre (or 12.8 fl oz Belay 50 WDG/acre) per growing season. However, the Florida Department of Agriculture and Consumer Services (FDACS) has issued a Section 18 Emergency Exemption for Belay 2.13 Insecticide (EPA Reg. No. 59639-150) permitting two applications at a rate of 12 fl oz/acre each to bearing citrus trees. Applicators must have the 24c SLN label for Belay Insecticide and the letter issued by the Commissioner (FDACS) present when making applications of Belay Insecticide to bearing citrus.

Due to restrictions on the amount of neonicotinoid insecticide products that can be used per growing season, the number of allowed applications in solid plantings of trees 5–9 feet in height is greatly limited. It is also important to note that imidacloprid, thiamethoxam, and clothianidin share the same mode of action and are therefore not considered alternatives for rotation to prevent resistance. Foliar sprays of products with modes of action other

than the ones used in drenches should be used between soil-drench applications to provide additional control of ACP and to help minimize pest selection for insecticide resistance development.

BEARING TREES

Foliar sprays of broad-spectrum insecticides targeting adults are most effective when used prior to the presence of new flush. Once psyllids begin reproducing on new flush, it becomes increasingly difficult to gain control of rapidly increasing populations. Management programs should begin by targeting overwintering adult psyllids with insecticidal sprays when the trees are not producing flush. Elimination of overwintering ACP adults greatly reduces populations in the following spring flushes and is recommended regardless of adult population size. Targeting adult ACP with broad-spectrum insecticides (organophosphates, group 1B, or pyrethroids, group 3A; see Table 1) early in the year may provide sufficient suppression of psyllid populations to reduce the need for psyllid sprays during bloom, when pollinators are present and most pesticides cannot be applied. Additional sprays of insecticides for psyllids should be made when observing an increase in adult populations in a grove. A threshold of one adult per 10 tap samples during the growing season has been shown to provide an economically viable level of suppression in mature trees with high incidence of HLB and fruit destined for the process market. Rotating modes of action throughout the year is important to reduce pest selection for insecticide resistance and conserve critically needed products.

BEE CAUTION

Citrus growers should be aware that most insecticides recommended for psyllid control have restrictions on the pesticide label due to the impact these products may have on pollinators. Planning to control psyllids prior to the presence of bloom will help reduce the need to apply pesticides during the bloom period. Check the pesticide label for restrictions on application of a product when trees are in bloom. Currently, there are 4 products in addition to horticultural mineral oil that are considered effective and to have minimal effects on pollinators when used as directed. Products listed in Table 2 are recommended for psyllid control during the period when citrus is in bloom.

Biological Control

While a single female psyllid may lay up to 800 eggs in the laboratory, studies in Florida have shown that over 90% of the resulting nymphs never make it to adulthood in the field, even in the absence of insecticides. Most are consumed by predaceous insects such as ladybeetles and spiders. The parasitic wasp *Tamarixia radiata* has become established in parts of Florida and contributes some mortality. Additionally, there are many pests, such as mites, leafminers, scales, mealybugs, whiteflies, and so forth, that are currently suppressed or maintained at low levels in Florida citrus either by biological control or the additional sprays now being used to control psyllids. Excessive sprays could result in resurgence of these pests. Foliar insecticide applications to mature trees during the growing season are best made with selective insecticides to minimize impact on natural enemies that help control psyllids and other pests.

Other Management Considerations

Management practices used within a grove can affect psyllid populations, especially those practices that promote new flush such as hedging, topping, and fertilization. Trees should always be sprayed with a broad-spectrum insecticide prior to or just after hedging and topping and before flush develops. Management strategies that reduce or limit the duration of flush may help to keep psyllid populations at low levels and reduce the need for additional pesticide applications. Alternate host plants, such as orange jasmine (*Murraya paniculata*) and box orange (*Severinia buxifolia*), near the grove can serve as sources of psyllids for infestation. When possible, these plants should be removed from areas surrounding commercial citrus groves.

Recommended Chemical Controls

READ THE LABEL!

Some product labels specify rates per acre, while others specify rates per volume delivered (e.g., per 100 gal). Refer to the label for details on how product should be mixed for desired targets.

Rates for pesticides are given as the maximum amount required to treat mature citrus trees unless otherwise noted. When treating smaller trees with commercial application equipment including handguns, mix the per-acre rate for mature trees in 100 gal of water. Calibrate and arrange nozzles to deliver thorough distribution and treat as many acres as this volume of spray allows.

Table 1. Recommended chemical controls for the Asian citrus psyllid.

IRAC MOA[1]	Pesticide Trade Name	Rate/Acre[2]	Comments	Other Pests Controlled
1 B	**Dimethoate**			
	Dimethoate 4 E	16 fl oz	Highly toxic to bees; do not apply during bloom. Do not make more than 2 applications per crop season. Consult label for buffering instructions when water pH is greater than 7.	Aphids, scales except snow scale and black scale, flower thrips
1 B	Phosmet			
	Imidan 70 W	1.0 lb	Highly toxic to bees; do not apply during bloom. Consult label for buffering instructions when water pH is greater than 7. Do not make more than 2 applications per season. EPA SLN No. 10163-169, FIFRA 2(ee).	Citrus root weevils
3 A	**Beta-cyfluthrin**			
	Baythroid XL	3.2 fl oz	Restricted use pesticide, FIFRA 24(c). Maximum Baythroid XL allowed per crop season 6.4 fl oz/acre (0.05 a.i./acre).	Aphids, weevils
3 A	**Fenpropathrin**			
	Danitol 2.4 EC	16 fl oz	Restricted use pesticide. Highly toxic to bees; do not apply during bloom.	Flower and orchid thrips, adult root weevils
3 A	**Zeta-cypermethrin**			
	Mustang Insecticide	4.3 fl oz	Restricted use pesticide. Highly toxic to bees; do not apply during bloom. Do not make more than 4 applications (0.20 lb a.i.) per acre per season.	Citrus root weevils
4 A	**Clothianidin** (soil drench)			
	Belay 50 WDG	3.2–6.4 oz	For use on nonbearing trees only, do not apply within 1 year of fruit harvest. Do not exceed 12.8 oz/acre (0.4 lb a.i./acre) of Belay 50 WDG per acre per year. Do not apply this product to blooming, pollen-shedding, or nectar-producing parts of plants if bees may forage on the plants during this time period.	Aphids, citrus leafminer
	Belay Insecticide	3–12 fl oz	Refer to the Section 24c SLN label issued by the Florida Department of Agriculture and Consumer Services for application directions of this product to bearing citrus trees. For bearing trees, do not apply more than 12 fl oz per acre per application, and do not apply more than 24 fl oz per acre in a 12-month period.	Aphids, citrus leafminer
4 A	**Imidacloprid**			
	Various products, 2F, 4F and 4.6F		Limit of 0.5 lb a.i./acre per growing season regardless of application type (soil and/or foliar) and trade name of imidacloprid product used.	Aphids
	Foliar application	Half to full rate	Do not apply during bloom, within 10 days of bloom, or when bees are actively foraging.	
	Thiamethoxam (foliar application)			
	Actara	4.0–5.5 oz	Do not exceed a total of 11.0 oz/acre (0.172 lb a.i./acre) of Actara or 0.172 lb a.i. of thiamethoxam-containing products per acre per growing season. Do not apply during prebloom or during bloom when bees are actively foraging.	Aphids
	Thiamethoxam (soil drench)			
	Platinum 75 SG	1.83–3.67 oz	Do not exceed a total of 3.67 oz/acre (0.172 lb a.i./acre) of Platinum 75 SG or 0.172 lb a.i. of thiamethoxam-containing products per acre per growing season. Do not apply during prebloom or during bloom when bees are actively foraging.	Citrus leafminer, aphids, scales

IRAC MOA[1]	Pesticide Trade Name	Rate/Acre[2]	Comments	Other Pests Controlled
4 D	**Flupyradifurone** (foliar application)			
	Sivanto 200 SL	14 fl oz	Not recommended for soil applications against ACP. Do not tank mix with azole fungicides (FRAC group 3) during bloom period. In order to minimize exposure to pollinators, it is recommended that foliar insecticides are applied late in the afternoon, evening, or at night outside of daily peak foraging periods.	Aphids
5	**Spinetoram**			
	Delegate WG	4 oz + 2% v/v	Highly toxic to bees; do not apply during bloom. Do not apply more than 12 oz of product (0.188 lb a.i.) per acre per season. Do not make more than 3 applications per calendar year. Best when applied with horticultural mineral oil 97+% (FC 435-66, FC 455-88, or 470 oil).	Citrus leafminer
21 A	**Tolfenpyrad**			
	Apta	14–27 fl oz	Do not apply by air. Do not apply more than 27 oz/acre per growing season. Do not make more than 2 applications per year. Allow at least 14 days between applications.	Citrus rust mite, spidermites (higher rates)
	Fenpyroximate			
	Portal	32–64 fl oz	Do not apply more than 4.0 pt per acre per growing season. Do not make more than 2 applications per growing season. Allow 14 days between applications.	Suppression of spider mites and rust mites (high rate)
23	Spirotetramat		Only controls psyllid nymphs, not adults. Limit of 0.32 lb a.i. per acre per 12 months. Minimum interval of 21 days between applications.	Citrus rust mites, some scale insects, mealybugs
	Movento 240	10 fl oz + 3% v/v	Do not make more than one application during primary citrus bloom period. Recommended to be applied in 2% horticultural mineral oil.	
	Movento MPC	16 fl oz + 3% v/v	Do not apply within 10 days prior to bloom, during bloom, or until petal fall is complete. Recommended to be applied in 2% horticultural mineral oil.	
28	**Cyantraniliprole** (Cyazypyr) (foliar application)			
	Exirel	13.5–20.5 fl oz	Do not apply a total of more than 0.4 lb a.i./acre (20.5 fl oz Exirel/acre) or other cyantraniliprole-containing products per year. See label for bloom restrictions. Recommended to include 2% horticultural mineral oil.	Citrus leafminer, orange dog
	Cyantraniliprole (soil application)			
	Verimark	15–30 fl oz	Use the lower rate for trees 3 ft or less in height.	Citrus leafminer, orange dog
4 A + 6	**Thiamethoxam + Abamectin**			
	Agri-Flex	8.5 fl oz + 2% v/v	Do not exceed a total of 17 fl oz/acre or 3 applications per season of Agri-Flex or 0.172 lb a.i./acre of any thiamethoxam-containing products or 0.047 lb a.i./acre of abamectin-containing products per growing season. Must be mixed with a minimum of 2 percent oil to be effective. Do not apply during prebloom or during bloom when bees are actively foraging.	Aphids, citrus leafminer, citrus rust mites
4 A + 28	**Thiamethoxam + Chlorantraniliprole**			
	Voliam Flexi	7 oz	Do not exceed 14 oz/acre/season of Voliam Flexi or 0.172 lb a.i. of thiamethoxam-containing products per growing season. Do not apply during prebloom or during bloom when bees are actively foraging.	Aphids, citrus leafminer

IRAC MOA[1]	Pesticide Trade Name	Rate/Acre[2]	Comments	Other Pests Controlled
UN[3]	**Horticultural Mineral Oil**			
	97+% (FC 435-66, FC 455-88, or 470 oil)	5 gal	Do not apply when temperatures exceed 94°F. 470 weight oil has not been evaluated for effects on fruit coloring or ripening. These oils are more likely to be phytotoxic than lighter oils.	Citrus leafminer, citrus rust mite, aphids, scales

[1] Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 (2024).
[2] Lower rates may be used on smaller trees. Do not use less than the minimum label rate.
[3] Mode of action unknown. No resistance potential exists for these products.

Table 2. Recommended chemical controls for Asian citrus psyllid during bloom.

IRAC MOA[1]	Pesticide Trade Name	Rate/Acre[2]	Comments	Other Pests Controlled
4 D	**Flupyradifurone** (foliar application)			
	Sivanto 200 SL	14 oz	Not recommended for soil applications against ACP. Do not tank mix with azole fungicides (FRAC group 3) during bloom period. In order to minimize exposure to pollinators, it is recommended that foliar insecticides are applied late in the afternoon, evening, or at night outside of daily peak foraging periods.	Aphids
15	**Diflubenzuron**			
	Micromite 80WGS	6.25 oz	Controls psyllid nymphs only. Do not apply more than 3 applications per season. See restrictions on label. Do not apply when temperatures exceed 94°F. Recommended to be applied in 2% horticultural mineral oil 97.	Citrus root weevils, citrus rust mites, citrus leafminer
21 A	**Fenpyroximate**			
	Portal	32–64 fl oz	Do not apply more than 4.0 pt per acre per growing season. Do not make more than 2 applications per growing season. Allow 14 days between applications.	Suppression of spider mites and rust mites at higher rate
23	**Spirotetramat**			
	Movento	10 fl oz	Only controls psyllid nymphs, not adults. Limit of 0.32 lb a.i. per acre per season. Do not make more than one application during primary citrus bloom period. Recommended to be applied in 2% horticultural mineral oil 97.	Citrus rust mite, some scale insects, mealybugs
UN[3]	**Horticultural Mineral Oil**			
	97+% (FC 435-66, FC 455-88, or 470 oil)	5 gal	Do not apply when temperatures exceed 94°F. 470 weight oil has not been evaluated for effects on fruit coloring or ripening and is more likely to be phytotoxic than lighter oils.	Citrus leafminer, citrus rust mite, aphids, scales

[1] Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification v. 11.1 (2024).
[2] Lower rates may be used on smaller trees. Do not use less than the minimum label rate.
[3] Mode of action unknown. No resistance potential exists for these products.