

Asian Citrus Psyllid and Citrus Leafminer¹

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PSYLLID FEEDING DAMAGE AND DISEASE TRANSMISSION

The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama was first detected in Florida in 1998 and has since become the key pest of citrus due to its role as vector of the pathogen which causes citrus greening disease, known as huanglongbing (HLB). 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 penetrating the leaf to access a sieve tube with their long proboscis. 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 oviposition. Feeding on young shoots results in twisting and distortion of the leaves due to toxins present in saliva that are injected during ingestion. We now know that Clas can be transmitted from an infected adult to the next generation of nymphs through the intermediary of the flush. Thus, both the tree and the next generation of ACP can become infected within a 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 serve 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 77-86°F. Lifespan above 93°F decreases to less than 30 days with a corresponding decrease in fecundity. Egg laying below 60°F slows to less than 2 per day and development time increases to 2 months. Thus, ACP populations under Florida conditions will be lower during the mid-summer 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 to 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 of levels as possible and still remain economically viable.

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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 and area wide psyllid management. Products recommended in this chapter for psyllid suppression have been demonstrated in field trials conducted by the University of Florida to be effective for reducing ACP populations. However, *most of these products will have negative effects on natural enemies of insect and mite pests. Thus, it is possible that 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.

Nonbearing Trees

Young trees are most susceptible to infection with *Clas*. 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 4 years from psyllids and leafminers to grow optimally. Soil-applied systemic insecticides will provide the longest lasting control of psyllids with 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 than foliar sprays on young trees.

Most soil applications of systemic insecticides are applied as drenches, and this is the only application method for reset trees. 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 AI/A per growing season, regardless of application method. This equates to 14 fl oz/ac for 4.6F formulations, 16 fl oz/ac for 4F formulations or 32 fl oz/ac for 2F formulations. A 24(c) Special Local Need (SLN) label was issued for Admire Pro 4.6F. This SLN is valid until December 31, 2018 or until otherwise amended, withdrawn, canceled, or suspended, and permits application of up to 28 fl oz/A of

Admire Pro (1.0 lb AI/A) as a soil drench per 12 months. No more than 14 fl oz/A may be applied at one time. This SLN for Admire Pro allows for an additional soil drench application to protect citrus trees 5-9' in height. Thiamethoxam applications are limited to no more than 0.172 lb AI/A (or 3.67 oz Platinum 75 SG/A) per growing season. Clothianidin (Belay 50 WDG) is currently labeled for use on non-bearing trees only and is limited to 0.4 lb AI/A (or 12.8 fl oz Belay 50 WDG/A) 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/A each to bearing citrus trees. Applicators must have the Section 18 label for Belay Insecticide and letter issued by Commissioner Putnam (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' in height is greatly limited. It is also important to note that imidacloprid, thiamethoxam and clothianidin are not considered alternatives for rotation to prevent resistance because these insecticides share the same mode of action. 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 numbers. Targeting adult ACP with broad-spectrum insecticides (organophosphates – group 1B or pyrethroids – group 3A, 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 which 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 adults 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 throughout Florida, is being actively released in many groves, and contributes some mortality. Additionally, there are many pests such as mites, leafminers, scales, mealybugs, whiteflies, etc. 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.

CITRUS LEAFMINER

Citrus leafminer (CLM) adults, *Phyllocnistis citrella*, are tiny moths that hide within the canopy during the day and emerge at

dusk and at night to lay eggs individually on young, expanding leaf flushes. The egg first appears as a tiny dew drop, usually alongside the midvein on the underside of the unexpanded leaf. The larva emerges directly into the leaf tissue, mining first along the midvein, then back and forth as it makes its way to the leaf margin where pupation occurs.

Leafminer populations decline to their lowest levels during the winter due to cool temperatures and the lack of flush for larval development. Populations of leafminer build rapidly on the spring flush, although their presence is not apparent until late spring as populations increase while the amount of new flush decreases. Throughout the ensuing warm season, leafminer populations vary with the flushing cycles and subsequent flushes are often severely damaged.

The spring and summer period of high leafminer damage coincides with the rainy season when canker spread is most likely. CLM greatly exacerbates the severity of citrus canker caused by *Xanthomonas axonopodis* pv. *citri*. This insect is not a vector of the disease although tunnels made by its larvae are especially susceptible to infection and tunnels infected by canker pathogen produce many times the amount of inoculum than in the absence of leafminer. Control of leafminer should be optimized where infection by canker is high, especially in young trees and susceptible varieties such as grapefruit and to a lesser extent, early oranges.

LEAFMINER MANAGEMENT

Nonbearing Trees

Leafminers are effectively controlled in young trees by systemic insecticides applied against ACP. Soil applications of neonicotinoids should be made about 2 weeks prior to leaf expansion to allow time for the pesticide to move from the roots to the canopy. Applications of neonicotinoids in summer should be timed to avoid rain events within 24 h which would cause leaching of product away from the root zone. The appearance of leafminers in young flush of these trees is an indication that residual effects have worn off and reappearance of ACP is soon to follow. Foliar applications of products effective against CLM target larvae and at best provide no more than 3 weeks protection. Therefore, optimal timing is important, and sprays directed against CLM should be applied when flush is about half way extended to kill the maximum number of larvae.

Bearing Trees

Healthy trees with leafminer damaged leaves are more likely to become sites for new canker infection if canker is already present in close proximity. The only products currently available for leafminer control on large trees are for use as foliar sprays (Table 3). While several products are effective against

this pest, achieving control of leafminer using foliar sprays on large trees is difficult due to the unsynchronized flush typically encountered during summer and fall. However, since leafminers affect only developing leaves, coverage of peripheral leaves in the canopy should be adequate to achieve suppression with foliar pesticides. Foliar sprays are directed against the larvae and thus should be timed to coincide with the appearance of the first visible leaf mines which occur immediately following the feather leaf stage or about 13 days after budbreak. At this time, insecticide applications will provide protection for most of the leaves in the new flush. Pheromone traps are also available commercially to help monitor CLM population trends. The pheromone itself has been used with some success for control by mating disruption.

Natural enemies already present in Florida initially respond to leafminer infestations, causing up to 90% mortality of larvae and pupae. These natural enemies include the introduced parasitoid *Ageniaspis citricola* that has established throughout most of Florida and has been responsible for up to 30% of this mortality, mostly later in the year.

RECOMMENDED CHEMICAL CONTROLS

READ THE LABEL!

Some product labels specify rates per acre, while others specify rates per volume delivered (e.g. per 100 gallons). 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 gallons 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
Chlorpyrifos				
1B	Lorsban 4 E	80 fl oz	Restricted Use Pesticide. Highly toxic to bees, do not apply during bloom. Lorsban 4E has a 2(ee) label for control of Asian citrus psyllid; other formulations of chlorpyrifos are not currently labeled for psyllid control.	Mealybug, orangedog, katydids, grasshoppers, aphids, thrips
Dimethoate				
1B	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
Phosmet				
1B	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
Beta-cyfluthrin				
3A	Baythroid XL	3.2 fl oz	Restricted Use Pesticide, FIFRA 24(c). Maximum Baythroid XL allowed per crop season 6.4 fl oz/A (0.05 AI/A)	Aphids, weevils
Fenpropathrin				
3A	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
Zeta-cypermethrin				
3A	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 AI) per acre per season.	Citrus root weevils
Clothianidin (Soil Drench)				
4A	Belay 50 WDG	3.2-6.4 oz	For use on non-bearing trees only, do not apply within 1 year of fruit harvest. Do not exceed 12.8 oz/A (0.4 lb AI/A) 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
4A	Belay Insecticide	3-12 fl oz	Refer to the Section 18 Emergency Exemption 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
Imidacloprid				
4A	Various products, 2F, 4F and 4.6F		Limit of 0.5 lb AI/A per growing season regardless of application type (soil and/or foliar) and trade name of imidacloprid product used.	
4A	Foliar Application	Half to full rate	Do not apply during bloom or within 10 days of bloom or when bees are actively foraging.	Aphids
4A	Soil Application	Half to full rate	SLN FL-120008, permits up to 1.0 lb a.i. (28 fl oz of Admire Pro 4.6F) per acre per 12 months when applied to soil. Do not exceed 0.5 lb/AI per application. See SLN for additional information.	Citrus leafminer, aphids scales
Thiamethoxam (foliar application)				
4A	Actara	4.0-5.5 oz	Do not exceed a total of 11.0 oz/A (0.172 lb AI/A) of Actara or 0.172 lb a.i. of thiamethoxam-containing products per acre per growing season. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Aphids
Thiamethoxam (soil drench)				
4A	Platinum 75 SG	1.83-3.67 oz	Do not exceed a total of 3.67 oz/A (0.172 lb AI/A) of Platinum 75 SG or 0.172 lb a.i. of thiamethoxam-containing products per acre per growing season. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Citrus leafminer, Aphids, scales
Flupyradifurone (foliar application)				
4D	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
Spinetoram				
5	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 AI) 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
Tolfenpyrad				
21A	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)

TABLE 1. Recommended Chemical Controls for the Asian Citrus Psyllid.

IRAC MOA ¹	Pesticide Trade name	Rate / Acre ²	Comments	Other Pests Controlled
CONTINUED TABLE				
21A	Fenpyroximate		Do not apply more than 4.0 pints 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)
	Portal	32-64 fl oz		
23	Spirotetramat		Only controls psyllid nymphs, not adults. Limit of 0.32 lb ai per acre per 12 month. 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	Cyantranilprole (Cyazypry) (Foliar application)		Do not apply a total of more than 0.4 lb ai/A (20.5 fl oz Exirel/A) or other cyantranilprole containing products per year. See label for bloom restrictions. Recommended to include 2% horticultural mineral oil	Citrus leafminer, orange dog
	Exirel	13.5-20.5		
28	Cyantranilprole (soil application)		Use the lower rate for trees 3 ft or less in height	Citrus leafminer, orange dog
	Verimark	15-30 fl oz		
4A + 28	Thiamethoxam + Chlorantranilprole		Do not exceed 14 oz /A/season of VoliamFlexi or 0.172 lb a.i. of thiamethoxam containing products per growing season. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Aphids, citrus leafminer
	VoliamFlexi	7 oz		
4A + 6	Thiamethoxam + Abamectin		Do not exceed a total of 17 fl oz/A or 3 applications per season of Agri-Flex or 0.172 lb a.i./A of any thiamethoxam containing products or 0.047 lb a.i./A of abamectin containing products per growing season. Must be mixed with a minimum of 2 percent oil to be effective. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Aphids, citrus leafminer, citrus rust mites
	Agri-Flex	8.5 fl oz + 2% v/v		
UN ³	Horticultural Mineral Oil		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 rustmite, aphids, scales
	97+% (FC 435-66, FC 455-88, or 470 oil)	5 gal		

¹ Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification V.8.4 (2018).

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 the Asian citrus psyllid during bloom

IRAC MOA ¹	Pesticide Trade name	Rate / Acre ²	Comments	Other Pests Controlled
4D	Flupyradifurone (foliar application).		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
	Sivanto 200 SL	14 oz		
15	Diflubenzuron		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
	Micromite 80WGS	6.25 oz		
21A	Fenpyroximate		Do not apply more than 4.0 pints 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
	Portal	32-64 fl oz		
23	Spirotetramat		Only controls psyllid nymphs, not adults. Limit of 0.32 lb ai 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
	Movento	10 fl oz		
UN ³	Horticultural Mineral Oil		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 rustmite, aphids, scales
	97+% (FC 435-66, FC 455-88, or 470 oil)	5 gal		

¹ Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification V.8.4 (2018).

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 3. Recommended Chemical Controls for Citrus Leafminer.

IRAC MOA ¹	Pesticide Trade name	Rate/Acre ²	Comments	Other Pests Controlled
4A	Clothianidin (soil-drench)			
	Belay 50 WDG	3.2 – 6.4 oz	For use on non-bearing trees only. Do not apply within 1 year of fruit harvest. Do not exceed 12.8 oz/A (0.4 lb AI/A) 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.	Asian citrus psyllid, Aphids
4A	Imidacloprid (Soil Drench)			
	Various products, 2F, 4F and 4.6F		Limit of 0.5 lbs AI per acre per growing season regardless of application type (soil and/or foliar) and trade name of imidacloprid product used.	Asian citrus psyllid, Aphids, scales
4A	Thiamethoxam (soil drench)			
	Platinum 75 SG	1.83-3.67 oz	Do not exceed a total of 3.67 oz/A (0.172 lb AI/A) of Platinum 75 SG or 0.172 lb a.i. of thiamethoxam-containing products per acre per growing season. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Asian citrus psyllid, Aphids, scales
5	Spinetoram			
	Delegate WG + horticultural mineral oil 97+% (FC 435-66, FC 455-88, or 470 oil)	3-6 oz + 2% v/v	Do not apply more than 12 oz of Delegate WG in a growing season. Do not make more than 3 applications in a growing season. Do not apply within 7 days of last treatment.	Asian citrus psyllid, orangedog, thrips
5	Spinosad			
	Entrust	1.25 – 6 oz	Recommended to include 2% horticultural mineral oil. Approved for organics	Orangedog, thrips
6	Abamectin			
	Various 0.15 EC products	5 fl oz	Always apply with a minimum of 1 gal oil horticultural mineral oil 97+% (FC 435-66, FC 455-88, or 470 oil). Do not apply any abamectin-containing product, (1) within 30 days of last treatment, (2) more than 3 times in any one growing season, or (3) more than 0/47 lb AI/A in a growing season. Do not apply in citrus nurseries.	Citrus rust mite Asian citrus psyllid at higher rates.
	Agri-Mek SC	1 fl oz	Always apply with a minimum of 1 gal oil horticultural mineral oil 97+% (FC 435-66, FC 455-88, or 470 oil). Do not apply any abamectin-containing product, (1) within 30 days of last treatment, (2) more than 3 times in any one growing season, or (3) more than 0/47 lb AI/A in a growing season. Do not apply in citrus nurseries.	Citrus rust mite Asian citrus psyllid at higher rates.
15	Diflubenzuron			
	Micromite 80 WGS	6.25 oz	Do not apply more than 3 applications per season. See restrictions on label. Do not apply when temperatures exceed 94°F. Recommended to apply with 2% horticultural mineral oil	Citrus root weevils, citrus rust mites, citrus psyllids
18	Methoxyfenozide			
	Intrepid 2 F	8 fl oz	Do not apply more than 16 fl oz /A per application or 64 fl oz/A per season. Do not apply within 14 days of last application. No bloom restriction. Recommended to apply with 2% horticultural mineral oil	Orangedog worm
28	Cyantraniliprole (foliar application)			
	Exirel	16 fl oz + 1% v/v	Do not apply a total of more than 0.4 lb AI/A of Cyazapyr or cyantraniliprole containing products per year. Recommended to apply with 2% horticultural mineral oil. See label for bloom restrictions.	Asian citrus psyllid Orangedog
28	Cyantraniliprole (soil application)			
	Verimark	15-30 fl oz	Use the lower rate for trees 3 ft or less in height	Asian citrus psyllid Orangedog
28	Chlorantraniliprole			
	Altacor	3-4.5 oz	No more than 3 applications per season. Not more than 9 oz or 0.2 lb a.i. of chlorantraniliprole containing products per acre per year. Minimum treatment interval 7 days	Orangedog
28	Thiamethoxam + Chlorantraniliprole			
	Voliam Flexi	7 oz	Always apply with a minimum of 1 gal oil horticultural mineral oil 97+% (FC 435-66, FC 455-88, or 470 oil). Do not exceed 14 oz /A/season of VoliamFlexi or 0.172 lb a.i. of thiamethoxam containing products per growing season. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Aphids, citrus psyllids

TABLE 3. Recommended Chemical Controls for Citrus Leafminer.

IRAC MOA ¹	Pesticide Trade name	Rate/Acre ²	Comments	Other Pests Controlled
CONTINUED TABLE				
4A + 6	Thiamethoxam + Abamectin			
	Agri-Flex	8.5 fl oz + 2% v/v	Do not exceed a total of 17 fl oz/A or 3 applications per season of Agri-Flex or 0.172 lb AI/A of any thiamethoxam containing products or 0.047 lb AI/A of abamectin containing products per growing season. Must be mixed with a minimum of 0.2 percent oil. Do not apply during pre-bloom or during bloom when bees are actively foraging.	Aphids, citrus leafminer, citrus rust mites
UN ³	Horticultural Mineral Oil			
	97+% (FC 435-66, FC 455-88, or 470 oil) NR ³	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.	Asian citrus psyllid, aphids, mites, scales

¹ Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification V.8.4 (2018).

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