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2017-2018 FLORIDA CITRUS PRODUCTION GUIDE:

Soft-Bodied Insects Attacking Foliage and Fruit[1]

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This section of the Citrus Pest Management Guide provides information on the group of insects belonging to the order Homoptera which affect foliage, twigs, and fruit of citrus in Florida. The insects covered here include scale insects, mealybugs, whiteflies, and aphids. These insect species affect tree health and fruit quality, and can impact mature fruiting trees as well as newly planted groves and resets. Their biologies, generation times, plant parts affected, and injury vary, but similar approaches to their monitoring and management cause them to be grouped here.

Individual discussions of some families and species are provided, and the tables of management options are organized accordingly. Information on Asian citrus psyllid can be found in a separate chapter of the Florida Citrus Production Guide, Asian Citrus Psyllid and Citrus Leafminer (ENY-734).

SCALE INSECTS

The most important armored scale pests in Florida are snow scale (*Unaspis citri*), Florida red scale (*Chrysomphalus aonidium*), purple scale (*Lepidosaphes beckii*), Glover's scale (*Lepidosaphes gloveri*), and chaff scale (*Parlatoria pergandii*). Important soft scale insects include Caribbean black scale (*Saisseta neglecta*), brown soft scale (*Coccus hesperidium*), and Florida wax scale (*Ceroplastes floridensis*). Pest management of both armored and soft scale insects in Florida citrus is based on highly successful action of native and introduced exotic natural enemies, including predators, parasites, and pathogens. These relatively specific natural enemies co-exist with their hosts in the citrus grove under most conditions and can respond to suppress pest numbers when they periodically increase in individual groves. Thus, scale insects should not be considered key pests in development of seasonal pesticidal programs. However, there are conditions under which natural enemies may not function well. It is in these cases that scale insects achieve importance in our overall IPM program. Factors that are most often responsible for increases in scale populations are: a) weather conditions that disrupt biological control; b) movement of the pest to groves where natural enemies do not occur; and c) disruption of natural enemies by other practices, particularly the repeated use of non-selective insecticides during a period when natural enemies are active and exposed.

When these disruptions occur, scale populations can increase to the point where leaf, fruit, twig, branch and/or trunk populations cause damage. The sessile nature of scale insects promotes high concentrations of scales in limited areas within the grove, thus building populations can go unnoticed for several generations. Generation times for most scale species require more than one month to progress from egg to adult. Thus, populations do not build quickly like some other pest groups such as mites or aphids.

In approaching management of scale insects, the first consideration should be to determine if the problem is induced by management practices and, if so, to determine if it can be solved by changing those practices. In particular, if repeated applications of non-selective pesticides are responsible for scale population increase, then the solution is to desist and allow natural enemies to recover. If, on the other hand, seasonal fluctuations have brought about population levels of concern, then some intervention with insecticides may be required. The basis for this decision should be population levels of **live** scales that are deemed sufficient to cause damage directly or through the production of honeydew and sooty mold (soft scales only). Scale bodies from previous generations often remain on the plant for several months and may be mistaken for live scales,

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resulting in the application of scale pesticides at inappropriate times. For effective suppression, most scale species should be in young nymphal stages, since pesticides are not very effective against eggs, large nymphs, or adults. No economic injury levels or thresholds are available for scale insect pests. Thus, the manager must evaluate each situation, taking into account the intensity and extent of scale populations and how much damage is likely to result. Generally, the intent of spraying for scale insects is to reduce populations with a single application in a way that no additional sprays are necessary during that season and in a way that is least disruptive to the system.

Treatment, when warranted, should focus on selection of an appropriate material (see Table 1), but equally important, should be applied with thorough coverage in mind. Since scale insects are immobile, direct contact is essential. Spray volume, ground speed, nozzling, and location of the pest populations should all be emphasized to get maximum target coverage. If only a few trees are involved, then spot treatment with a handgun or other focused application equipment will provide the best results. Generally, spray applications designed for contact with pests on the outer canopy are not effective at suppressing scales, especially if the scales are numerous in the interior of the tree. The follow-up to pesticidal applications for scale insects should involve evaluation of **live** scale on the appropriate parts of the tree. Dead scale will not be visibly different from live scale at first. Hatching crawlers will also create the impression that the spray was not effective. Complete elimination of scale insects following a pesticidal spray is neither practical nor necessary, and in fact may be counterproductive.

Brown soft scale generally is not a pest needing treatment. Following mild winters and when populations build within specific groves, treatment, where needed, should be based on scouting for crawlers and young nymphs (still tan in color) during the generation that develops in April-May. Applications at other times are ineffective.

Citrus snow scale likewise is a local problem requiring occasional treatment in specific groves or portions of groves. Evidence for the need to treat includes high populations of crawlers showing on patches of bark that have been brushed clean during the previous week, and the association of visible snow scale populations with bark splitting, particularly on young trees that are rapidly increasing in trunk girth. Spot treat wood of heavily infested trees to runoff with a handgun application.

MEALYBUGS

Citrus mealybugs (*Planococcous citri*) are normally under good biological control by a complex of natural enemies in citrus. Their waxy covering, sedentary lifestyle, and preference for feeding in concealed locations make them very difficult to kill with insecticides. Only the most toxic materials have appreciable efficacy against mealybugs, materials that also pose risks to the environment and are most likely to disrupt biological control of other pests. Consequently, treatment is warranted only in cases of severe infestations, or when the fruit itself is attacked. Systemic materials give superior control while minimizing impacts on beneficials, but may not act quickly enough to prevent damage when high populations are established.

WHITEFLIES

The most important whiteflies in Florida are citrus whitefly (*Dialeurodes citri*), the cloudy-winged whitefly (*D. citrifolii*), the wooly whitefly (*Aleurothrixus floccosus*), and citrus blackfly (*A. woglumi*). Whiteflies are dependent on new growth for their development and reproduction; consequently, they are active in citrus only during periods of flush. Large populations of these insects can deposit considerable volumes of honeydew, leading to sooty mold accumulation. These insects are constantly present in most groves in very low numbers and are normally under good biological control by various specialist parasitoids and generalist predators. Populations are rarely heavy enough to warrant treatment unless biological control has been disrupted. Serious infestations of whiteflies are an indication that management practices should be reviewed.

APHIDS

The most common aphids in Florida citrus are the green citrus aphid (*Aphis spiraecola*), the cotton or melon aphid (*A. gossypii*), and the brown citrus aphid (*Toxoptera citricida*). Brown citrus aphid is particularly important as a vector of citrus tristeza virus. Aphids are dependent on the availability of newly expanding leaves for their development and reproduction, so these insects may be problems during periods of new citrus growth, primarily spring and fall. Aphids are largely controlled by many generalist natural enemies such as ladybeetles, hoverflies, and lacewings, that normally maintain their populations, and those of other flush-feeding insects, below levels that warrant treatment in producing groves. Excessive honeydew accumulation on leaves will result in the growth of sooty mold fungus that blocks light and reduces photosynthetic activity. However, mature groves sustain little damage and should not need treatment. Treatment is warranted only in young groves (< 3 yrs old) if a large portion (i.e. > 50%) of expanding terminals is infested. Surveys for aphids should be conducted early in flushing cycles when most terminals are still in the feather stage. Systemic materials, such as Temik or Admire, applied to the soil will give good control with minimal impact on beneficial species, but the time required for uptake of these materials by the tree restricts their usefulness as preventive, rather than responsive, treatments.

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 label for details on how product should be mixed for desired targets.

See Table 1.

Rates for pesticides are given as the maximum amount required to treat mature citrus trees unless otherwise noted. To treat smaller trees with commercial application equipment including handguns, mix the per acre rate for mature trees in 250 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 Scale Insects[1], Mealybugs, Whiteflies, and Aphids

Pesticide	IRAC MOA[2]	Mature Trees Rate/Acre[3]	Comments	Other Pests Controlled
Scale Insects				
Dimethoate 2.67 EC Dimethoate 4 EC Dimethoate 5 EC	1B	See label	Does not control citrus snow scale or black scale.	Aphids
Chlorpyrifos 4 EC	1B	5 pt	May increase spider mite populations. (4 EC is a restricted use pesticide.)	Mealybugs, orangedog, katydids, grasshoppers, aphids, thrips
Chlorpyrifos 50 W		5 lb		
Malathion 5 EC	1B	6 pt	Glover and yellow scale. Does not control chaff or black scale.	Plant bugs, crickets
Malathion 8 EC				
Petroleum Oil 97+% (FC 435-66, FC 455-88, or 470 oil)	NR[4]	10 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 rust mites, whiteflies, greasy spot, sooty mold
Carbaryl 80 S	1A	3.1 lb	May increase citrus red mite and Texas citrus mite populations. Do not exceed 20 lb a.i./acre/year for all uses.	Adult root weevils, orangedog, crickets, katydids, grasshoppers
Carbaryl 4 F		2.5 qt		
Sevin XLR		2.5 qt		
Mealybugs				
Chlorpyrifos 4 EC	1B	5 pt	May increase spider mite populations. (4 EC is a restricted use pesticide.)	Aphids, crickets, flower and orchid thrips, grasshoppers, katydids, orangedog, scale insects
Chlorpyrifos 50 W		5 lb		
Whiteflies				
Petroleum Oil 97+% (FC 435-66, FC 455-88, or 470 oil)	NR[4]	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.	Spider mites, scale insects other than citrus snow scale, sooty mold
Aphids				
Admire 2 F	4	See label	Soil applied systemic intended for use on young trees. Apply prior to or at onset of pest infestation for optimal results. See label for application options. Do not apply more than 32 oz/A/yr.	Citrus leafminer, citrus root weevils, citrus psyllid
Dimethoate	1B	See label		Flower thrips, scale insects except citrus snow and black scale
Chlorpyrifos 4 EC	1B	5 pt	May increase spider mite populations. (4 EC is a restricted use pesticide.)	Crickets, flower and orchid thrips, grasshoppers, katydids, mealybugs, orangedog, scale insects
Chlorpyrifos 50 W		5 lb		
Provado 1.6 F	4	10 to 20 fl oz per acre	Foliar applied systemic. Do not apply more than 32 oz/A/yr.	Citrus psyllid

[1] Pesticides will control all major scale pests unless otherwise noted under comments.

[2] Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification V.7.3 (2014). Refer to ENY624, Pesticide Resistance and Resistance Management, in the 2017-18 Florida Citrus Production Guide for more details.

[3] Lower rates may be used on smaller trees. Do not use less than minimum label rate.

[4] No resistance potential exists for these products.