

Cooperative Extension

Wooly Whiteflies (*Aleurothrixus floccosus*)

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“Citrus Arthropod Pest Management in Arizona”)

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DESCRIPTION AND LIFE HISTORY: The woolly whitefly is a relatively new pest to Arizona, arriving in 1996 and is currently restricted to the Yuma area. Adult woolly whiteflies are small, flying insects resembling small white-winged moths with a yellowish-white abdomen and a light dusting of white powder (scales). The adults are about 1.5 mm in length and can be found roosting on the undersides of fully expanded leaves. Adult woolly whiteflies are not as active as most other whitefly species and when disturbed, will reluctantly fly and will usually quickly resume roosting. Adult woolly whiteflies may live as long as 24 days.



Figure 10. Adult woolly whitefly.

The eggs are laid on the underside of fully-expanded leaves and are distinctive of the species. They are attached to the leaf with a stalk, small (<0.3 mm in length), sausage shaped, and are laid in circle or semi-circular patterns. These egg circles are usually surrounded by a light dusting of waxy scales. When first laid, the eggs are pale white, but darken to brown with age. The eggs require 4 to 12 days hatch, although some eggs may overwinter. One female will typically lay as many as 200 eggs.

The immature stages (nymphs) are flattened and oval shaped, resembling scales. As they age they cover themselves with “woolly” white waxy filaments. The woolly whitefly goes through four nymphal stages. The first instar or crawler is about 0.3 mm in length and is the only nymphal stage that is mobile.



Figure 11. Second instar woolly whiteflies and eclosed eggs.

The crawlers will usually settle near the eggs from which they hatched. The second to fourth instars are sedentary, and will often be completely obscured by copious amounts of waxy filaments, droplets of honeydew, and cast skins. The fourth instar serves as the “pupal stage” and is about 0.6 mm in length. The fourth instar represents the most common stage for overwintering. Adults emerge from the pupae by vertically splitting its skin.



Figure 12. Third and fourth instar woolly whitefly covered by waxy filaments.

During warm weather, woolly whiteflies require about 21 day to complete its life cycle. In Arizona, adults will emerge from overwintering in March or April. These flights will be the first of five to six generations. Populations tend to be greatest in August, although very high populations are not uncommon in late May and June.

The fifth or sixth generation (depending on fall temperatures) will occur in October or November, during which it will overwinter primarily as third or fourth instars or sometimes as eggs.

Woolly whiteflies may be found on all varieties of citrus, some types of guava (*Psidium* sp. only), sea grape (*Coccoloba uvifera*), and it has been reported to occasionally be found on yellow trumpet flower (*Tecoma stans*). Among citrus, grapefruit, tangelos and tangerines appear to be most heavily colonized, followed by oranges and lemons, although large populations can be found on any citrus type.

DAMAGE: Woolly whiteflies suck phloem sap, causing leaves to wilt and drop when populations are large. Honeydew droplets collect dust and support the growth of sooty mold; large infestations where copious amounts of honeydew are produced, can result in the blackening of entire trees. This reduces photosynthesis, resulting in decreased fruit size. Honeydew and sooty mold can also contaminate the fruit. Although this contamination can be washed off at the packing shed, harvest is slowed in infested groves and harvest crews are hesitant to pick heavily contaminated fruit.



Figure 13. Sooty mold growth from woolly whitefly honeydew accumulation on citrus leaves.

MONITORING: Woolly whitefly monitoring should begin in March. Sample fully-expanded leaves by gently turning them over to observe the underside of the leaf, looking for adults, eggs, colonies of immatures, and adult parasitoids. Attention should be rendered to which growth stages of the whitefly are present since this will aid in making a proper management decision. Weekly sampling should be conducted until cool temperatures occur in late October or November.

When colonies of immature whiteflies are common it is important to determine how much parasitism is occurring. Gently scrap away the waxy accumulation revealing the large nymphs and eclosed pupae (pupae from which the adult insect has already emerged). Eclosed pupae exited by woolly whiteflies will have a vertical split on the anterior dorsum of the empty exuviae (skin) (a 10X or better hand lenses will be necessary). An eclosed pupae exited by a parasitoid will have a round hole on the anterior dorsum of the exuviae.

CONTROL

Cultural:

- Pruning & hedging.** Light infestations can be greatly reduced by hedging. This technique has proven to be especially effective on trees ten years old or younger. Additionally, pruning will aid in opening up the canopy to maximize spray penetration and coverage.

Biological:

- General Predators and Parasitoids.** Establishing biological control of woolly whitefly is ultimately the



Figure 14. Eclosed pupae (left) from an adult woolly whitefly leaving a vertical split and (right) from a parasitoid leaving a round hole.



Figure 15. *Eretmocerus* sp. is a common and very effective parasitoid of woolly whitefly in Arizona. They appear as small yellow “gnats” with three distinctive red dots (ocelli) on the tops of their heads.

best and most effective means of controlling this pest. There are several natural enemies that attack the immature stages of woolly whiteflies. Among parasitoids, an *Eretmocerus* sp. has proven to be extremely effective. This parasitoid is common, particularly during late summer and early fall. There are also a number of predaceous insects that aid in suppressing woolly whitefly. Yuma spider mite and *Tydeus* spp. are common predaceous mites of woolly whitefly.

General insect predators found feeding on woolly whitefly include: lacewings, coccinellid beetles, nabids, *Orius*, and six-spotted thrips. Large outbreaks of woolly

Woolly Whitefly Management Guidelines for Arizona Citrus

Establishing biological control is key to sustainable management

• Spring

- Use spray oils to suppress woolly whitefly populations before prohibitive due to high temperatures.
- Avoid harsh insecticides for citrus thrips control, especially in May and June.
- Where moderate to large colonies of immature whiteflies are present in conjunction with high citrus thrips infestations; use Provado or Danitol + OP tank-mixes since these will control the whiteflies and aid in citrus thrips control.

• Summer / Fall

- When adults are present and/or small colonies of immatures; chemical control is not advisable.
- When moderate to large colonies of whitefly immatures are present; use Esteem or Applaud. Provado or Danitol + OP tank-mixes are also effective but are detrimental to parasitoids.

• For the most effective and sustainable management

- Try to preserve natural enemies.
- Treat before the infestation becomes heavy.
- Make ground applications only; good coverage is essential.
- On groves with large trees, or for tight groves, use high spray volumes; 200 to 500 gal/ac.
- The addition of narrow-range spray oil with insecticide treatments will aid in control.

Figure 16. Current University of Arizona woolly whitefly management guidelines.

whitefly can be prevented or large infestations brought under control by utilizing selective insecticides that will conserve whitefly natural enemies. When *Eretmocerous* sp. adults, parasitoid eclosed pupae, and or predators are common, chemical control is usually not necessary.

Commonly used Chemicals: Since woolly whitefly is a relatively new pest in Arizona, chemical control

techniques are still being evaluated.

• Pyriproxyfen. 1 day PHI. Pyriproxyfen (ESTEEM) is an insect growth regulator used to control whiteflies though control is slow, taking about a month to see visual results. It acts by sterilizing the adults causing them to lay unviable eggs, and can cause nymphal mortality. Pyriproxyfen should be applied when a majority of the woolly whitefly population is small nymphs. It is applied at rates of 0.05 to 0.07 lbs-ai per acre. Pyriproxyfen is fairly selective, and although it is not known to disrupt parasitoid activity; it can negatively impact vedalia and other lady beetle populations, as well as lacewing larvae. Do not exceed 0.17 lbs-ai per acre per season. Do not exceed two applications per season. Allow at least 21 days between applications. The restricted entry interval for pyriproxyfen is 12 hours.

• Imidacloprid. 0 day PHI. Imidacloprid (PROVADO, ADMIRE) is a neonicotinoid insecticide that mimics the nerve poisoning action of nicotine. Admire is the soil-applied formulation and Provado is the foliar formulation of this chemical. When applied to the soil through a drip-irrigation or emitter system, Admire has effectively controlled woolly whitefly. However, at this time, it is not certain if similar efficacy would occur if Admire were injected around trees with a shank applicator followed by flood irrigation. Regardless of application method, it may take as long as six weeks before a fully effective dosage of Admire is distributed within the tree. Admire is applied at a rate 0.25 to 0.5 lbs-ai per ac. No more than 0.5 lbs-ai per acre of Admire may be applied per acre per year. Provado has shown good activity towards woolly whitefly and can be applied at 0.125 to 0.25 lbs-ai per acre. Effective timing in April and May maybe beneficial since high rates of Provado have citrus thrips efficacy under cool condition. Provado is active towards whitefly nymphs, but is especially active against the adults. Provado may not be applied during bloom or within 10 days before bloom. Do not exceed 1.0 lbs-ai per acre of Provado per year, and allow at least 10 days between applications. Imidacloprid is safe towards many beneficial insects, especially when applied as a soil treatment. The restricted entry interval for imidacloprid is 12 hours.

• Buprofezin. 60 day PHI. Buprofezin (Applaud) is an insect growth regulator that disrupts the molting process through chitin synthesis inhibition. Buprofezin has activity on many whitefly species, scales, and mealybugs. However, the current Applaud label only lists California red scale under its citrus crop listing of controlled pests.

Additionally, the labeled rates for buprofezin in citrus are those recommended for scales, 1.5 to 2.0 lbs-ai per acre. It is conceivable that a lower rate may be effective against woolly whitefly, and research is being conducted to test this hypothesis. Since this material affects molting, treatment should be made during peak crawler (1st instar) emergence. Woolly whitefly nymphs will go through several molts before they are killed, which may take several weeks before it is noticeable. Do not apply more than two applications per season, and allow at least 60 days between applications. Buprofezin is very selective and although it will negatively impact ladybeetle and lacewing larvae to a limited degree, it is very safe for predaceous mites and parasitoids. The restricted entry interval for buprofezin is 12 hours.

•**Cyfluthrin.** 0 day PHI. Cyfluthrin (BAYTHROID, RENOUNCE) is a broad-spectrum pyrethroid insecticide that is widely used at a rate of 0.1 lbs-ai per acre primarily for thrips control. Cyfluthrin is also fairly effective against woolly whitefly adults, and in combination with chlorpyrifos or dimethoate, and has proven to be effective against immature whiteflies as well. However, alone or in combination with chlorpyrifos, it is extremely toxic to predatory and parasitic insects and mites, which may lead to significant pest resurgence. Only one application per crop per season is permitted. Care should be taken to not apply cyfluthrin following fenpropathrin as well since these are similar chemistries. Do not apply to trees less than 4 years of age. The restricted entry interval for cyfluthrin is 12 hours.

•**Fenpropathrin.** 1 day PHI. Fenpropathrin (DANITOL) is a broad-spectrum pyrethroid insecticide that is widely used at a rate of 0.4 lbs-ai per acre primarily for mites and thrips control. Like cyfluthrin, it is fairly effective alone against woolly whitefly adults, and in combination with chlorpyrifos or dimethoate, it has proven to be effective against immature whiteflies as well. However, alone or in combination with chlorpyrifos, it is extremely toxic to predatory and parasitic insects and mites, which may lead to significant pest resurgence. It is recommended that not more than one application be made per year, but there is an allowance of up to 0.8 lbs-ai per acre per year, and sequential applications of fenpropathrin are not recommended due to the potential for the develop of resistance. Additionally, care should be taken to not apply fenpropathrin following cyfluthrin since these are similar chemistries. The restricted entry interval for fenpropathrin is 24 hours.

•**Chlorpyrifos.** 28 day PHI at rates exceeding 3 lbs-ai per acre or 14 days PHI for rates of 3 lbs-ai per acre or less. Chlorpyrifos (LORSBAN) is an organophosphate has proven to be effective against woolly whitefly, especially when applied in combination with fenpropathrin. Chlorpyrifos is applied at an average rate of 4 to 6 lbs-ai per ac. Thorough coverage is needed to be most effective. Chlorpyrifos is toxic to bees and should not be applied during daylight hours during bloom. Additionally, chlorpyrifos is toxic to predatory insects and mites, and parasitoids. Do not apply more than 10 lbs-ai per acre per season. The restricted entry interval for chlorpyrifos is 1 day.

•**Dimethoate.** 15 day PHI. Dimethoate (DIMETHOATE) is an organophosphate that is widely used to control citrus thrips, and has proven to be efficacious towards woolly whitefly when applied at a citrus thrips rate of 2.0 lbs-ai per acre in combination with fenpropathrin. Use of dimethoate is prohibited during any time of day when the grove has 10% or more open blooms until there has been at least 75% petal fall on the north side of the trees. Dimethoate may be used during the time between one hour after sunset until three hours before dawn under the following conditions: before petal fall when less than 10% of the blooms have opened, after the initiation of petal fall when there are less than 25% open bloom remaining in the grove, and it is between the calendar dates of February 15 and May 1. Dimethoate is toxic to bees, both beneficial mites and beneficial insects, and may disrupt biological control. Dimethoate offers good control under cool conditions, and moderate control under hot conditions. Applications to citrus seedlings are prohibited, and no more than 2 applications can be made to mature fruit. The restricted entry interval for dimethoate is 4 days.