

Insecticidal Control of Woolly Whiteflies¹

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Abstract

Four foliar insecticides (*Esteem*, *Provado*, *Applaud* and *Assail*) and one soil systemic insecticide (*Admire*) were evaluated for their control of woolly whitefly in lemons. These insecticides were chosen for evaluation because they have demonstrated efficacy to other whitefly species and have little or no impact on whitefly parasitoids. *Admire* was injected with a single shank about 5-in deep around each tree approximately at the tree's drip line. All of the foliar insecticides were effective in controlling woolly whitefly. *Admire* also appeared to have efficacy, but due to inconsistent data on one sample date more testing should be conducted. Six weeks after the beginning of this test, whitefly parasitoids, *Eretmocerus comperei* or *E. dozieri* (exact species not certain) reduced the whitefly population across all treatments. Within two more months, no live whiteflies could be found in the test grove, and as of July 15, 2002, there was still no detectable woolly whitefly activity.

Introduction

Woolly whitefly, *Aleurothrixus floccosus*, was first observed in Florida in 1909 and may be native to that area traditionally feeding on *Coccoloba uvifera* prior to the introduction of citrus. In Florida, it is of practically no economic importance, and is controlled by at least five species of parasitoids, the principle one being *Eretmocerus haldemani*. In California, the woolly whitefly was first discovered in San Diego County in 1966 and has since spread throughout Southern California with the exception of Imperial County. Early attempts to eradicate the woolly whitefly from California met with little success and in fact may have aggravated the problem. Currently, much of California's woolly whitefly control in the coastal areas is attributed to parasitoids such as *Amitus spiniferus* and *Cales noacki*. However, biocontrol is not always successful and many growers utilize oils to suppress woolly whiteflies until biological control agents can become effective. In Arizona, the woolly whitefly first appeared in Yuma County in dooryard citrus in 1997, and has since spread throughout much of the Yuma Mesa and Yuma Valley citrus production areas. Parasitoid activity on woolly whitefly has been observed in Arizona since 1998, but parasitism rates were relatively low in most groves until 2001 when *Eretmocerus comperei* or *E. dozieri* (exact species not certain) appeared in large numbers.

Although biological control agents of woolly whitefly are becoming more effective in Arizona, there are occasions when the woolly whitefly populations reach economically damaging levels, and chemical control would be beneficial. The ultimate key to sustainable control of woolly whitefly lies in promoting parasitoid activity. Thus the most desirable insecticide regime for woolly whitefly management would ideally have a minimal impact on these parasitoids. There are several insecticides labeled for use in citrus that would meet this criteria, *Esteem* (pyriproxyfen) and *Imidacloprid* (*Provado* and *Admire*), as well as several insecticide currently under development that may have potential for controlling woolly whitefly, *Applaud* (buprofezin) and *Assail* (acetamiprid). However, we are not certain how effective these products are in controlling woolly whitefly. The goal of this study was to evaluate the efficacy of these insecticides on woolly whitefly in Arizona citrus.

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Materials and Methods

This experiment was conducted on 10-yr old lemons grown on sand on the Yuma Mesa using flood irrigation and normal growing practices. The test was a randomized complete block design with four replicates. Each plot consisted of three trees. Treatments consisted of an untreated control, five foliar insecticides, and one soil applied systemic insecticide. Foliar treatments included of Esteem at 10 and 17 oz/ac, Assail at 0.25 lb-ai/ac, Provado at 20 oz/ac, and Applaud at 1.5 lbs/ac. All foliar applied treatments included Kinetic non-ionic surfactant at 0.1% v/v. The foliar treatments were applied using a hand-gun sprayer calibrated to deliver 150 gal/ac, on September 5, 2001. The soil applied systemic treatment was Admire at 36 oz/ac. Prior to applying the Admire, the grove was flushed with irrigation water to make the soil pliable. After 24-h, on September 12, 2001, the Admire was injected with a single shank about 5-in deep around each tree approximately at the tree's drip line. Immediately following the Admire injection, the grove was irrigated using normal flood irrigation practices.

Five new fully expanded leaves and five hardened leaves were sampled for adult whiteflies, and then removed from the tree and transported to the lab. Leaf discs, 1 in², were taken from the middle of each leaf bisecting the mid-vein. Whiteflies were sampled on the leaf discs by counting the numbers of eggs, nymphs, and eclosed pupae. The data from the new and older leaves were pooled and analyzed using ANOVA and an F protected ($P < 0.05$) LSD for means separation.

Results and Discussion

Whitefly populations were moderate in density in the test area at the beginning of the test. However, the population densities were extremely variable among trees, and on various branches of individual trees. This variability made unbiased sampling difficult and resulted in a large amount of variability among samples. The pre-application sample taken on September 4 indicated no significant differences among treatments in any of the whitefly stages evaluated (Figures 1, 2, 3, and 4). The adult whitefly population was extremely variable and we could not detect any differences among treatment on any of the sample dates (Figure 1). Similarly, we did not detect any differences among treatments in egg counts (Figure 2). Small plot sizes may have resulted in movement of adult whiteflies from untreated trees to the treated plots. This may have contributed to the lack of detectable significant differences for whitefly adults and eggs.

Differences among treatments in the density of whitefly nymphs were significant on several sample dates (Figure 3). On September 20 and October 15, all the insecticide treatments contained significantly fewer nymphs than the untreated, but did not differ among each other (Figure 3). Additionally, on September 27, all of the treatments except Admire, contained fewer nymphs than the untreated (Figure 3). The reason Admire did not differ from the untreated on September 27, while it did on September 20 and October 15 is not clear, but should be further investigated before Admire is recommended as a viable treatment on flood irrigated citrus. By October 30, the whitefly population had dropped to low levels in all of the treatments including the untreated, and there were no differences in whitefly nymphs among the treatments (Figure 3). This drop appeared to be due to the heavy parasitism which was very effective in controlling the whitefly population. By mid-December 2001, no live whiteflies could be found in the test grove, and as of July 15, 2002, there was still no detectable woolly whitefly activity.

Eclosed pupae indicate the ability of a whitefly to complete its life cycle and are thus an important indicator of the overall ability of a treatment to interfere with whitefly development and control. Differences among treatments in eclosed pupae counts were detected on October 3 and 15 (Figure 4). On both of these dates, all of the insecticide treatments contained fewer eclosed pupae than the untreated, but did not differ from each other.

Overall, all of the treatments we evaluated appear to have potential for controlling woolly whiteflies in citrus. The only product with questionable efficacy was Admire, which had some inconsistent data. Under moderate pressure was observed no benefit from using a 17 oz/ac rate of Esteem over the 10 oz/ac rate. More data should be collected and evaluated on all of these products to verify these findings. Additionally, data should be collected regarding the definitive impact these insecticides have on whitefly parasitism.

Current Woolly Whitefly Management Guidelines for Arizona Citrus

- **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

- **Summer / Fall**

- When adults are present and/or small colonies of immatures; use Provado
- When moderate to large colonies of immatures are present; use Esteem

- **Always**

- Try to preserve natural enemies
- Make ground applications only; good coverage is essential
- On groves with large trees or for tight groves; use high spray volumes; 200 to 1500 gal/ac

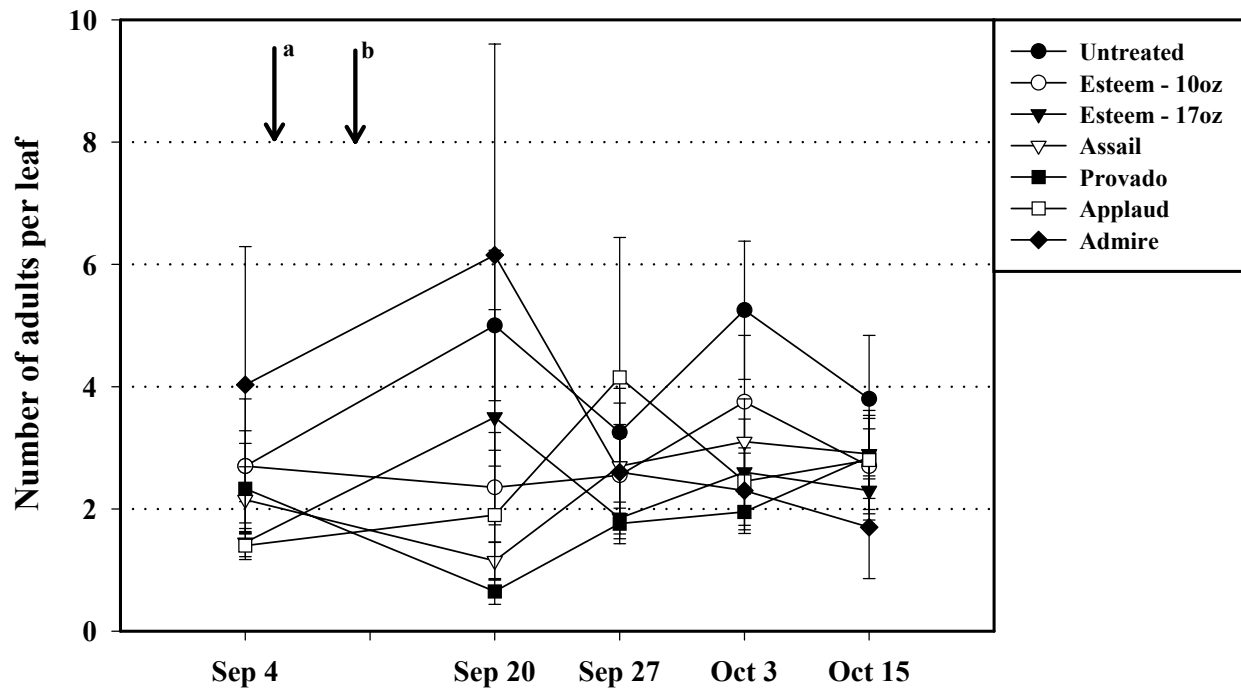


Figure 1. Mean number of adult woolly whiteflies sampled from new fully expanded leaves and hardened leaves. ^aFoliar treatments applied on Sep 5. ^bAdmire applied as a soil treatment on Sep 12.

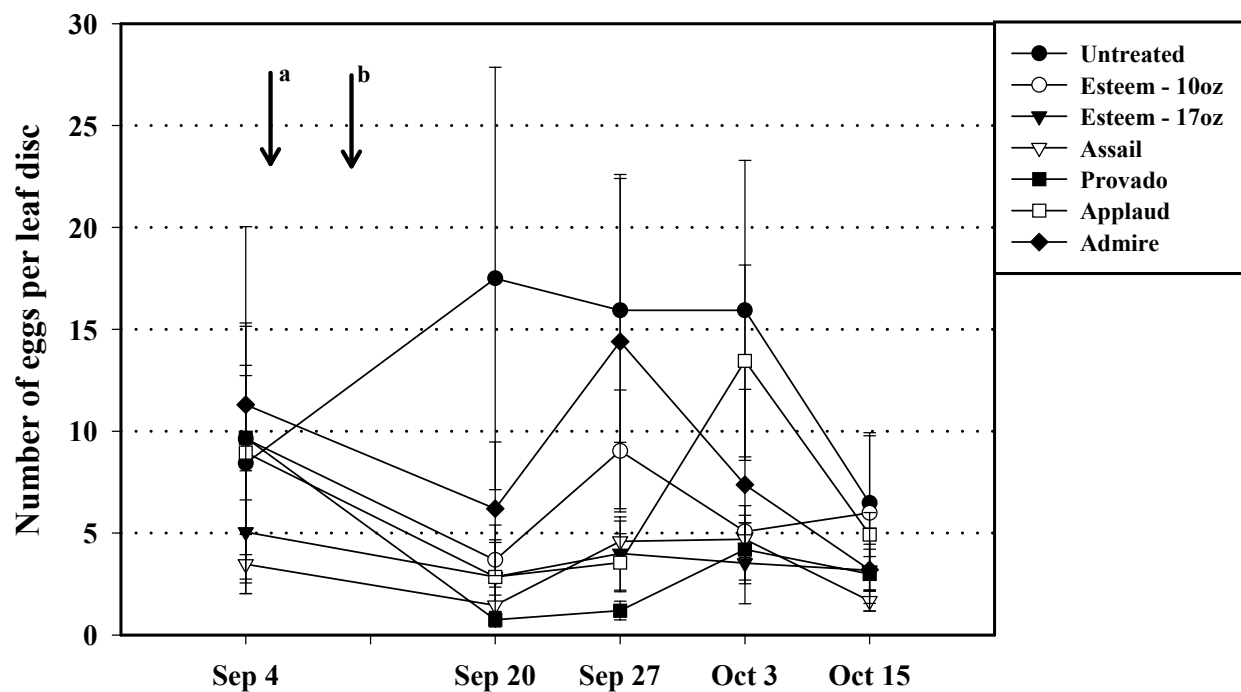


Figure 2. Mean number of woolly whitefly eggs sampled from new fully expanded leaves and hardened leaves. ^aFoliar treatments applied on Sep 5. ^bAdmire applied as a soil treatment on Sep 12.

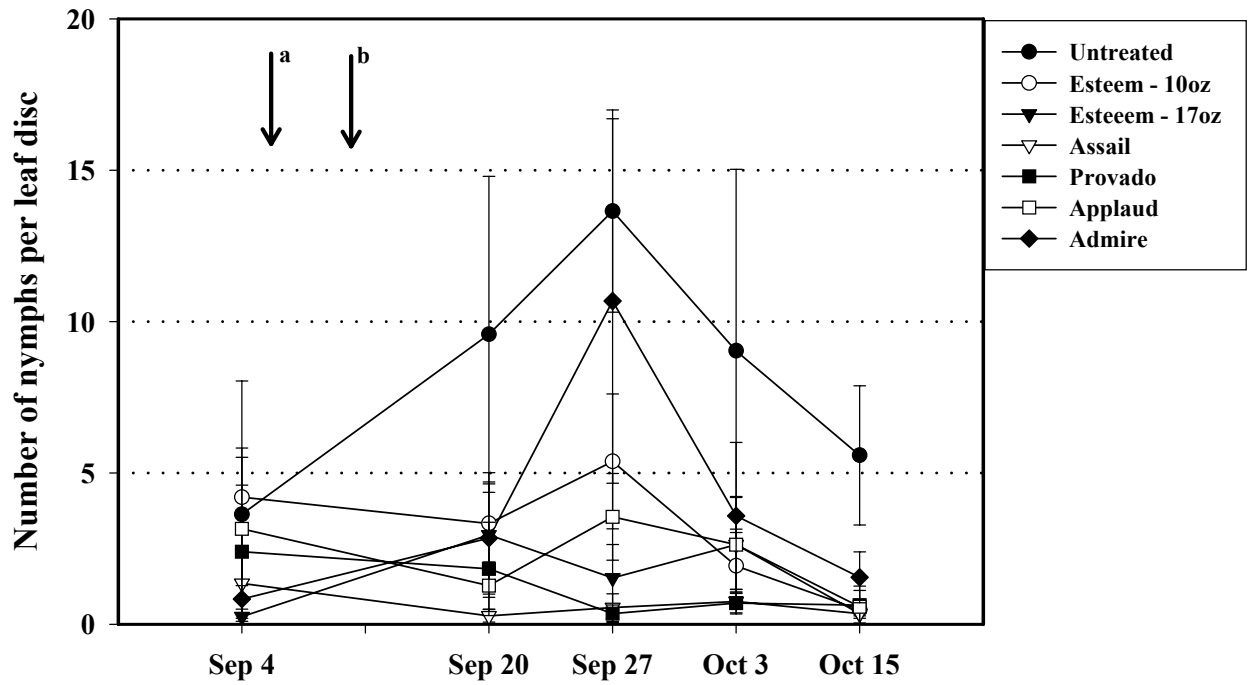


Figure 3. Mean number of adult woolly whiteflies sampled from new fully expanded leaves and hardened leaves. ^aFoliar treatments applied on Sep 5. ^bAdmire applied as a soil treatment on Sep 12.

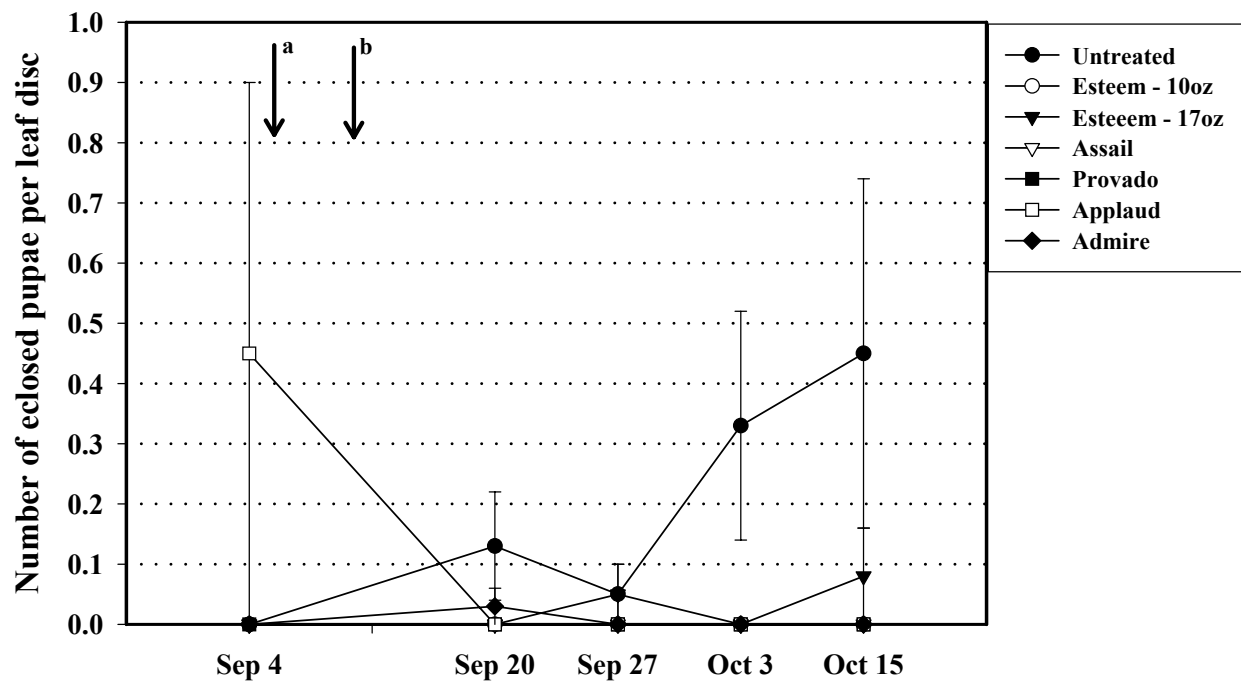


Figure 4. Mean number of woolly whitefly eggs sampled from new fully expanded leaves and hardened leaves. ^aFoliar treatments applied on Sep 5. ^bAdmire applied as a soil treatment on Sep 12.