

# Control of Early Woolly Whiteflies Infestations with Foliar Insecticides<sup>1</sup>

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## Abstract

Five foliar insecticide treatments (*Esteem*, *Provado*, *Applaud*, *Assail*, and *Danitol* + *Lorsban*) were evaluated for their control of early woolly whitefly infestations in lemons. *Esteem* and *Applaud* are insect growth regulators that should have little impact on whitefly parasitoids. The impact of *Provado* and *Assail* on whitefly parasitoids is not certain, but at high rates may be detrimental, while *Danitol* + *Lorsban* will be especially harmful to parasitoids. The impact of these insecticides on woolly whitefly could not be fully determined in this trial due to the effectiveness of parasitoids, *Eretmocerus comperei* or *E. dozieri* (exact species not certain), on controlling the whiteflies in this test. However, other research (not reported here) has indicated that all of the insecticide treatments evaluated have good activity against woolly whitefly. Because parasitoids can be extremely effective in mitigating woolly whiteflies populations during the early phases of colonization, it is recommended that chemical control not be utilized until woolly whitefly colonies are common. However, previous experiences suggest that allowing woolly whitefly populations develop extremely high populations should be avoided.

## Introduction

Woolly whitefly, *Aleurothrixus floccosus*, has been a pest of citrus grown in North America since the beginning of the 20<sup>th</sup> century. In the 1920s, it was considered the most economically damaging pest of Florida citrus until woolly whitefly parasitoids were introduced in the early 1930s. Presently 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

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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 Applaud (buprofezin) have potential for controlling woolly whitefly while having little detrimental impact on parasitoids. However, there are instances where concurrent infestations of other pests such as citrus thrips, *Scirtothrips citri*, with woolly whiteflies dictate that broad spectrum insecticides be used that will impact both pest populations. Additionally, early tests have suggested that it is advisable to control woolly whiteflies before they develop heavy infestations, but there is no information to suggest if it is better to mitigate early whitefly infestations rather than allowing them to build to moderate infestations. The goal of this study was to evaluate the efficacy of a several insecticides on an early infestation of woolly whitefly in Arizona citrus.

## Materials and Methods

This experiment was conducted on 14-yr old lemons grown on sand on the Yuma Mesa using commercial growing practices. The test was a randomized complete block design with four replicates. Each plot consisted of 25 trees arranged in a 5 X 5 square. Treatments consisted of an untreated control and five foliar insecticides. The foliar treatments included of Esteem (pyriproxyfen) at 10 oz/ac, Assail (acetamiprid) at 0.25 lb-ai/ac, Provado (imidacloprid) at 20 oz/ac, Applaud (buprofezin) at 0.35 lbs-ai/ac, and Danitol (fenpropathrin) at 16 oz/ac + Lorsban (chlorpyrifos) at 6 pts/ac. All treatments included Kinetic non-ionic surfactant at 0.1% v/v. The treatments were applied using a standard orchard air-blast sprayer calibrated to deliver 100 gal/ac spray volume at 100 psi. Applications were initiated at the first indication of whitefly colonization. Treatments were applied on 24 July 2002.

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. Whiteflies were sampled on the leaves by counting the numbers of eggs, live nymphs, and eclosed pupae. Additionally, parasitized whitefly nymphs were counted. 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

On the day of application, 24 July, adult woolly whiteflies were averaging 1.25 per leaf (Figure 1), while the nymphs and eclosed pupae were both averaging 2.25 per leaf (Figures 3 & 4). Although this is a low population, the numbers were suitable to determine the efficacy of foliar insecticides applied during early whitefly colonization, with the goal of preventing colonization relative to the untreated check. By 7 days after treatment (DAT), the adult population in the untreated, and the Applaud and Esteem treated plots had not significantly changed (Figure 1). However, adult counts in the Provado, Assail, and Danitol + Lorsban treated plots had dropped considerably. This finding was not unexpected since neither Esteem nor Applaud have adulticidal activity, whereas Provado, Assail, and Danitol + Lorsban are known to be active against adults. Esteem and Applaud are insect growth regulators. Esteem mimics juvenile hormone which is involved in regulating molting and egg production. Whitefly nymphs treated with Esteem will undergo additional molts and eventually die. Adult female whiteflies treated with Esteem will lay unviable eggs that will fail to hatch. Applaud is a chitin synthesis inhibitor and treated nymphs will fail to molt properly resulting in death.

By 14 DAT, there were no differences among treatments in adult whiteflies (Figure 1). The reason for the decline in adults in the untreated is not certain, but probably indicates that there was little subsequent whitefly movement into the test area following the initial infestation. However, at 38 DAT an increase in whitefly eggs was noted while a similar spike in adults was not detected (Figures 1 & 2). There was a great deal of variability in the increase in eggs at 38 DAT and there were no statistical differences among any of the treatments (Figure 2). The adult population remained low for the remainder of the test period although a slight increase was observed at 58 DAT at which point there were no differences among any of the treatments (Figure 1).

At the initiation of this study, immature woolly whiteflies and eclosed pupae were both averaging 2.25 per leaf, but the populations had severely decline in all plots by 14 DAT (Figures 3 & 4). At no point were there significant differences in whitefly immatures or eclosed pupae among the treatments (Figures 3 & 4). The primary reason for lack of woolly whiteflies appears to be due to the activity of parasitoids, *Eretmocerus comperei* or *E. dozieri* (exact species not certain) which were common during this test. On 26 July and 27 August, the parasitism rate was 50 and 25% respectively (Figure 5). At the low woolly whitefly population encountered in this trial, parasitoid activity was especially effective. Because of the effectiveness of parasitoids for controlling woolly whitefly, it would be beneficial to know how the insecticides affected the parasitoid population and subsequent parasitism rate. However, due to the low whitefly population we could not detect any differences in parasitoid activity among any of the treatments (Figure 6).

Based on this trial and others conducted over the past few years, all of the treatments we evaluated here appear to have potential for controlling woolly whiteflies in citrus. Because parasitoids can be extremely effective in mitigating woolly whiteflies populations during the early phases of colonization, it is recommended that chemical control not be utilized until woolly whitefly colonies are common. However, previous experiences suggest that allowing woolly whitefly populations develop extremely high populations is not advisable.

## **Current Woolly Whitefly Management Guidelines for Arizona Citrus**

- **Spring**

- Use spray oils to suppress woolly whitefly at low to moderate populations before prohibitive due to high temperatures.
- When possible, avoid harsh insecticides for citrus thrips control, especially in May and June.
- When 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.

- **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 500 gal/ac.

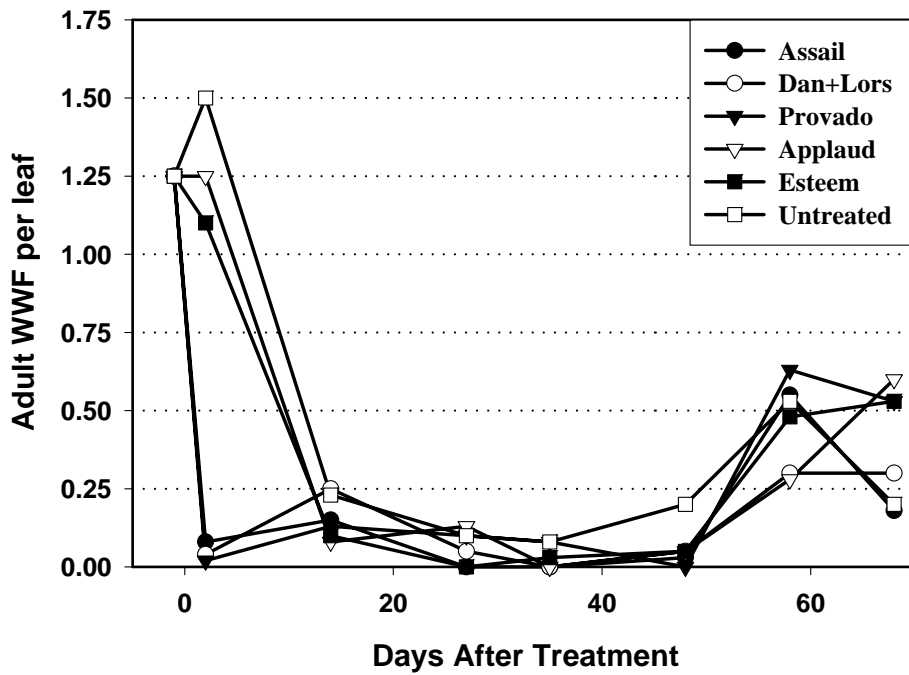


Figure 1. Mean number of adult woolly whiteflies sampled from new fully expanded leaves and hardened leaves. Treatments applied on 24 July.

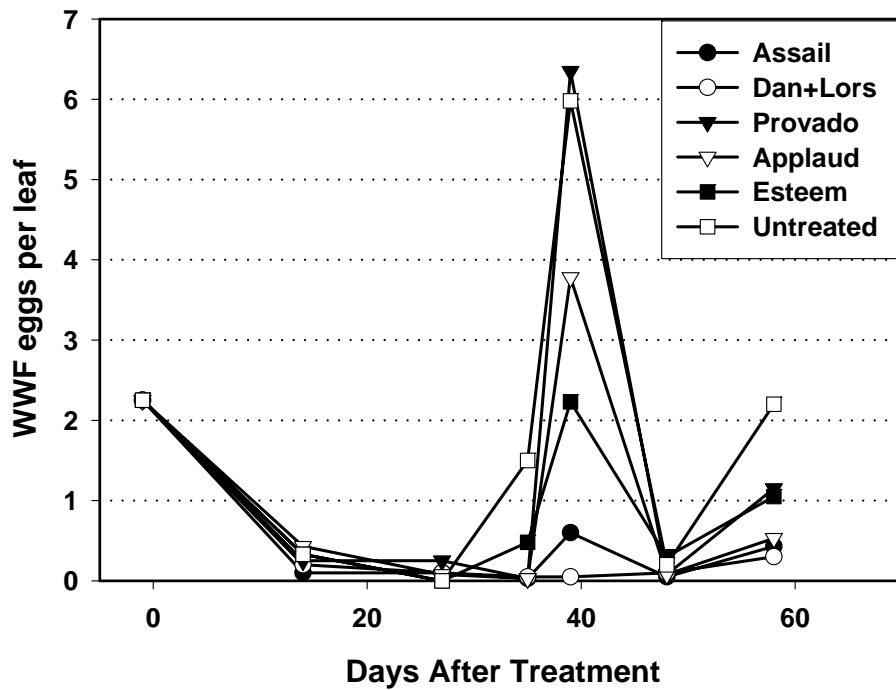


Figure 2. Mean number of woolly whitefly eggs sampled from new fully expanded leaves and hardened leaves. Treatments applied on 24 July.

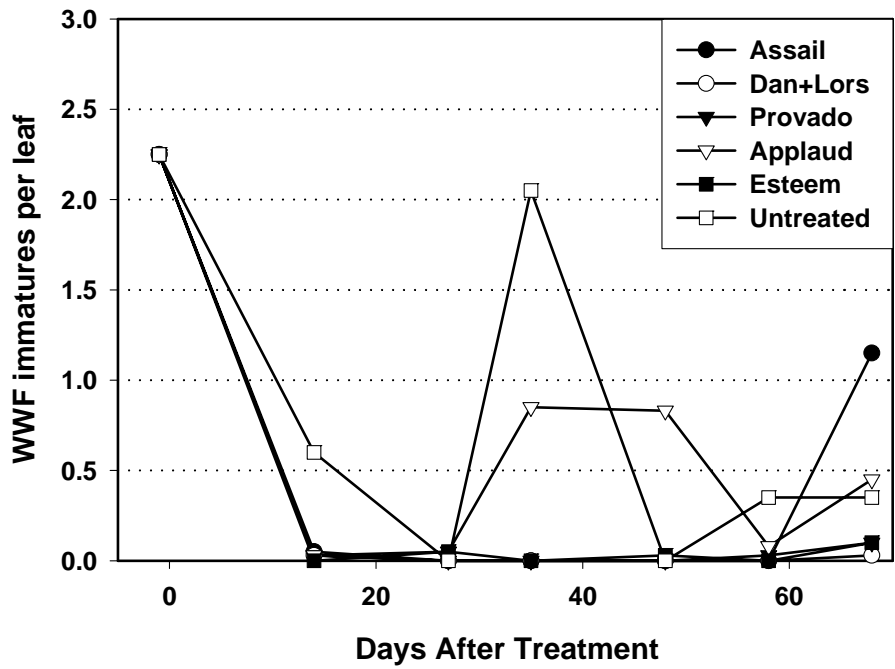


Figure 3. Mean number of adult woolly whiteflies sampled from new fully expanded leaves and hardened leaves. Treatments applied on 24 July.

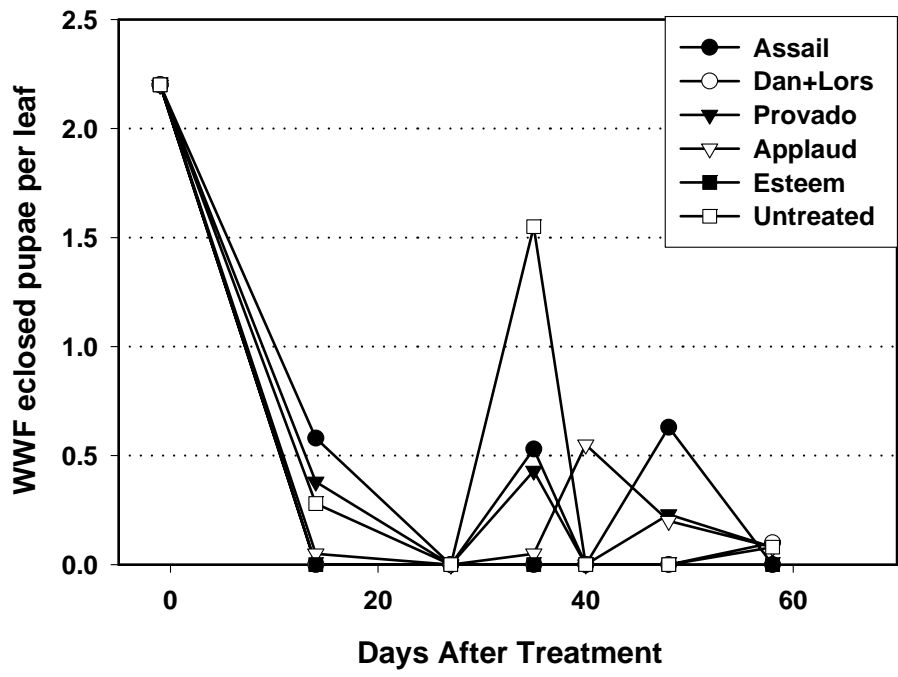


Figure 4. Mean number of woolly whitefly eggs sampled from new fully expanded leaves and hardened leaves. Treatments applied on 24 July.

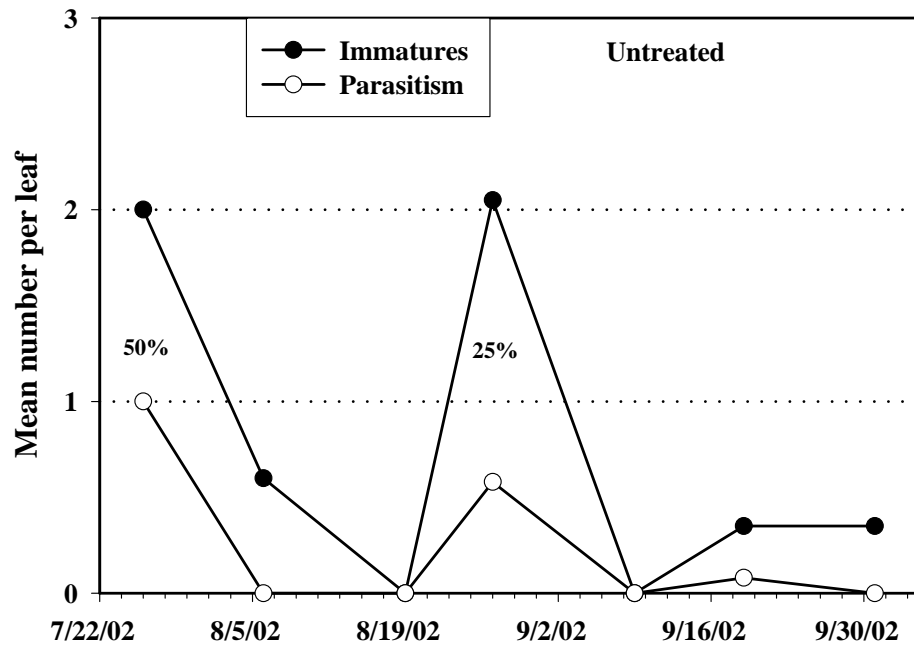


Figure 5. Mean number of parasitized and non-parasitized woolly whitefly nymphs sampled from new fully expanded leaves and hardened leaves in the untreated check.

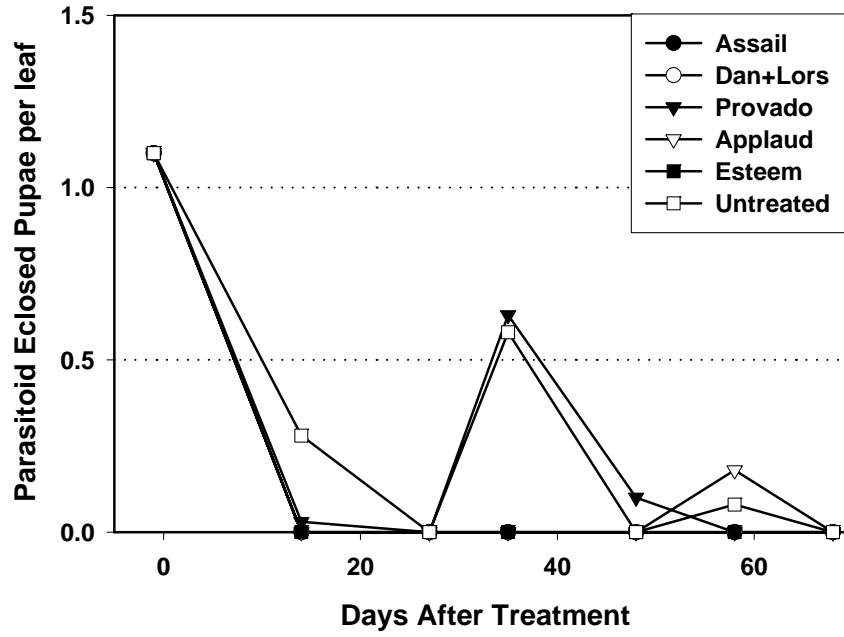


Figure 6. Mean number of woolly whitefly pupal cases with parasitoid exit holes sampled from new fully expanded leaves and hardened leaves. Treatments applied on 24 July.