Insecticide spray coverage and efficacy assessment of insecticides against aphids and whiteflies in California cotton

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In California, cotton aphids and silverleaf whiteflies pose a significant economic threat by producing sticky cotton. Insecticide sprays are the primary means of controlling their populations. However, regulations have restricted the use of a number of insecticides (including chlorpyrifos), limiting available options. Both aerial and ground application methods are commonly used for applying insecticides in cotton. However, aerial applications become relied upon much more as the season progresses, which is when these pests are most problematic. The efficacy of the insecticide likely depends on the coverage, which in turn depends on the method of application.

Here we provide an update on an ongoing project that is evaluating insecticide application coverage and efficacy against cotton aphids and silverleaf whiteflies.

Spray coverage in a commercial cotton field

One study examined spray coverage in commercial insecticide applications in cotton. We assessed spray coverage in four fields that used ground applications and four fields that used aerial applications. The ground applications were made using a tractor-driven boom sprayer, while the aerial application used fixed-winged planes. We used 2x3 inch water-sensitive cards to measure the spray coverage. In each field, we selected 30-36 plants located 50 meters from the field edge and placed two cards per plant on the 5th and 9th nodes (as shown in Figure 1). We initially placed cards in a horizontal orientation and facing both up and down, but next to zero material reached the cards facing down so we dropped those from the study. After the spray, we collected the cards, scanned them, and used ImageJ software to calculate the number of droplets and determine percentage coverage.

Figure 1. Water-sensitive cards on a cotton plant at the 5th and 9th nodes (left). Water sensitive card after an application with spray droplets (right).

At each field, we tested for the effect of card location on coverage. Overall, as we expected, the spray coverage was greater on the 5th leaf location compared to the 9th leaf location (Figure 2). The degree of difference varied by field and application method, but was at times substantial. Similarly, the number of droplets follow the same trend that higher number of droplets on 5th leaf (Figure 3).

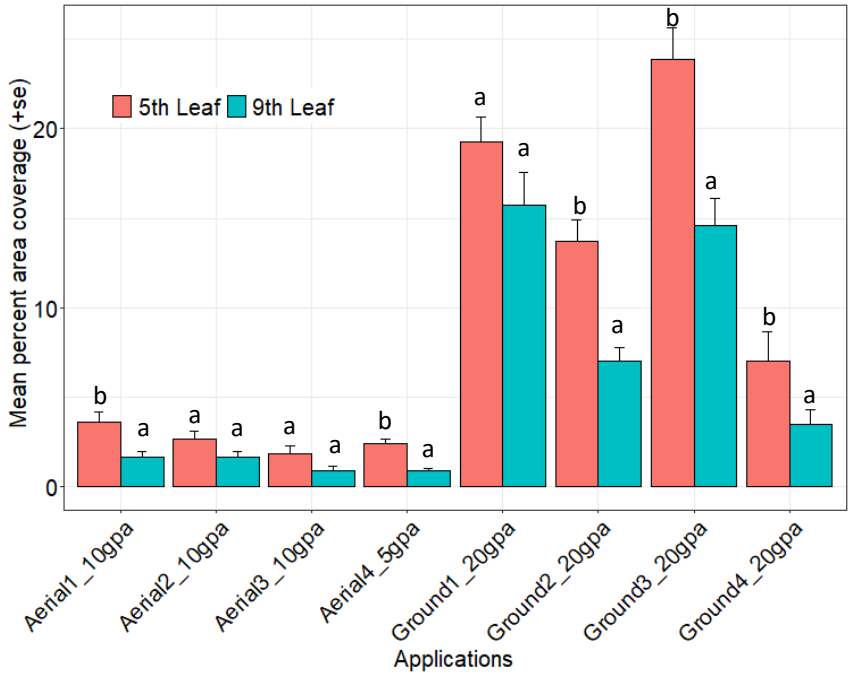

Figure 2. Percent coverage for aerial and ground applications as measured with water-sensitive spray cards. Cards were placed at both the 5th and 9th nodes for each application. Values are means and 1 standard error. Means not sharing a letter are significantly different within each application based on posthoc comparisons and $\alpha = 0.05$.

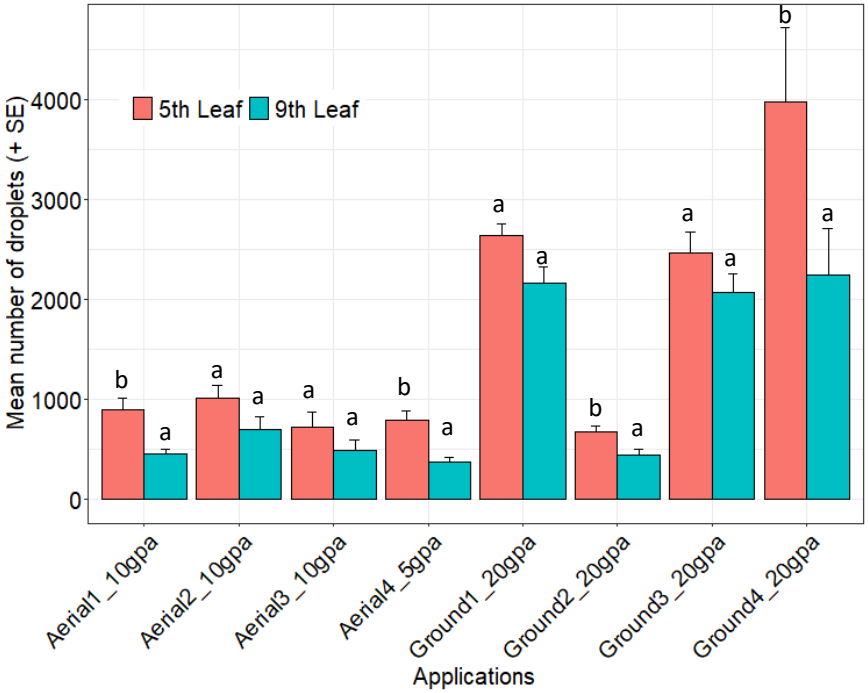

Figure 3. Droplet number for aerial and ground applications as measured with water-sensitive spray cards. Cards were placed at both the 5th and 9th nodes for each application. Values are means and standard error. Means not sharing a letter are significantly different within each application based on posthoc comparisons and $\alpha = 0.05$.

Efficacy of selected materials against cotton aphid and whitefly in on-farm trial, ground application

We conducted a spray trial with a tractor sprayer to evaluate various materials used for aphid and whitefly management in cotton under "standard" application parameters for our research farm spray trial (tractor-mounted sprayer, 30 GPA, standard + drop down nozzles), as well as a simulated aerial application using a tractor-mounted sprayer (10 GPA tank mixture) sprayed with low-flow nozzles to achieve ~3% coverage at the 5th node, comparable to commercial applications. Our plots were 5 rows x 55' and were planted with Pima cotton. For sampling, on multiple days after treatment (DAT), silverleaf whitefly adults were counted in the field on 10 leaves/plot. Whitefly nymphs and aphids were counted on 10 leaves/plot in the laboratory, with counts assessed on whole or half-leaf samples depending on time of the year and whitefly numbers on that DAT, but converted to whole leaf values. All analyses were conducted using R. Nymph and adult counts were summed across the trial and across applications and then analyzed using linear models.

Silverleaf whiteflies

For our research farm spray trial, the standard applications of acetamiprid, flupyradifurone (both rates), and pyrifluquinazon, followed by afidopyropen, were most effective for the different applications (Figure 4). The low coverage treatments were comparable to the control. It is possible that the whitefly pressure was simply too high or that the achieved coverage was too low. Effects on whitefly adults were generally comparable (Figure 5).

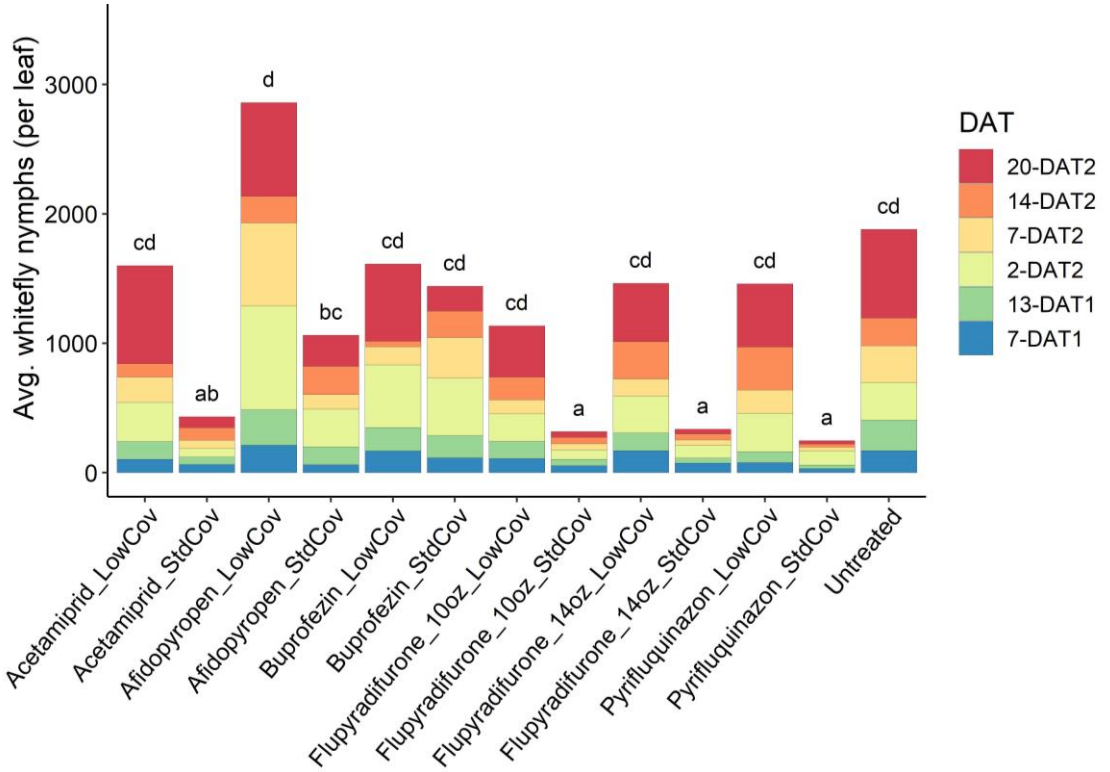

Figure 4. Silverleaf whitefly nymph counts in the research farm trial, presented for the entire trial and analyzed as summed counts across the entire trial. Means not sharing a letter are significantly different based on posthoc comparisons and $\alpha = 0.05$.

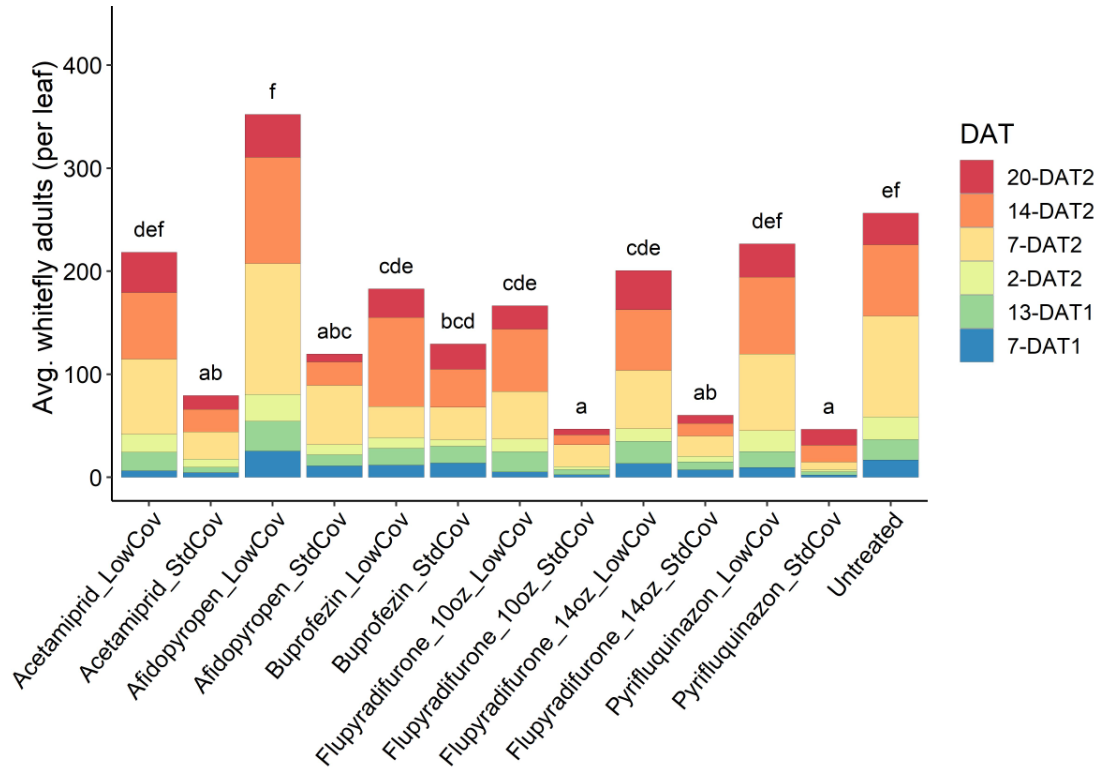

Figure 5. Silverleaf whitefly adult counts in the research farm trial, presented for the entire trial and analyzed as summed counts across the entire trial. Means not sharing a letter are significantly different based on posthoc comparisons and $\alpha = 0.05$.

Cotton aphids

For aphids, standard applications were again the most effective. Pyrifluquinazon and acetamiprid applied with low coverage were not significantly different than the untreated, but were intermediate in efficacy overall (Figure 6).

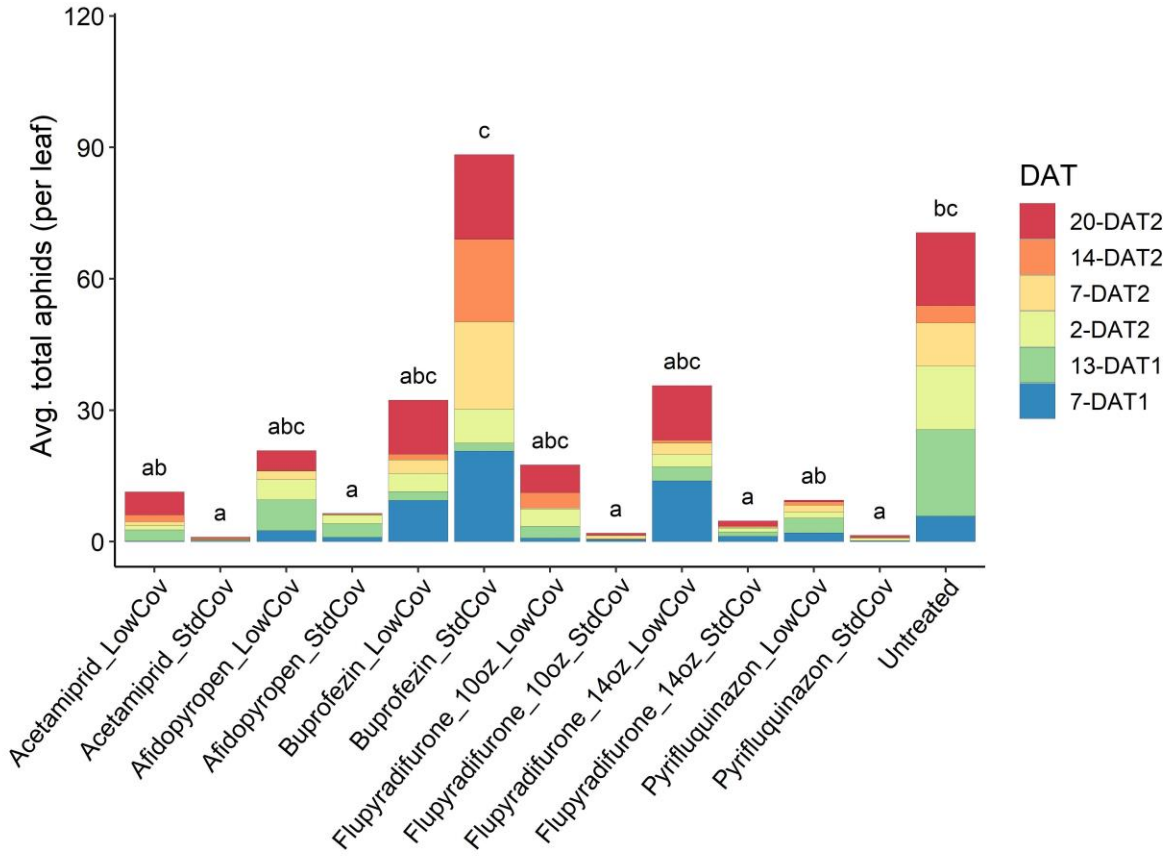

Figure 6. Aphid counts in the research farm trial, presented for the entire trial and analyzed as summed counts across the entire trial. Means not sharing a letter are significantly different based on posthoc comparisons and $\alpha = 0.05$.

Efficacy of insecticides, aerial on-farm trial

An aerial application trial was conducted in a commercial cotton field near Corcoran, CA. Three treatments were tested: afidopyropen at 14 oz/ac with a 10 GPA application volume, afidopyropen at 14 oz/ac with a 5 GPA application volume, and flupyradifurone at 14 oz/ac with a 10 GPA application volume, using a fixed-wing aircraft. Each plot measured 800m x 110m and was an entire irrigation check.

To assess whitefly nymph and aphid counts, two leaves (top and bottom) were collected from 40 plants per plot, 20 plants from 50 feet to the left and right of the center of our sampling area. Sampling started 150 ft from the edge of the plot and was taken every 10 ft until the 20th plant. A total of 40 leaves from the 5th node (top) and 40 leaves from the 9th node (bottom) were collected per plot. Sampling was done 0, 4, 7, and 12 days after treatment (DAT). No control plots were included in the study due to the trial being located in a commercial field and being very large scale.

To count whitefly nymphs and aphids, the entire leaf was examined for the top node leaves, and half of the leaf was counted for the bottom node leaves, with values doubled to obtain counts per leaf. For whitefly adults, 40 leaves from the 5th node were collected in the field and adults were counted by turning over the leaves. The mean number of whitefly adults and nymphs and aphid adults was calculated for each plot. A generalized linear model using the glm function in R was used to compare the mean number of whitefly nymphs between treatments for each individual sampling date.

There were differences for silverleaf whitefly adults with afidopyropen at either volume having fewer adults than flupyradifurone (Figure 7). For whitefly nymphs, there were no significant differences at the 5th node on any dates (Figure 8). There was a strong effect of leaf location with nymphs more abundant at the 9th node and increasing through time at this leaf location with lower volume of afidopyropen.

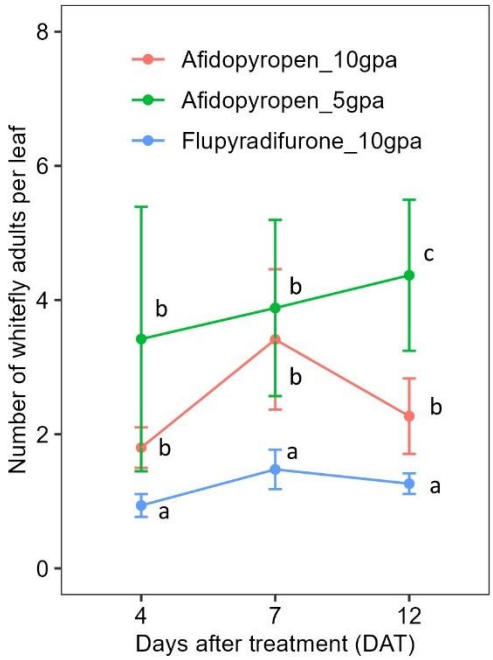

Figure 7. Average adult whitefly counts for the experimental treatments in the aerial spray trial conducted in a commercial field. The significance of treatment effects and differences among treatments are indicated with different letters for each date.

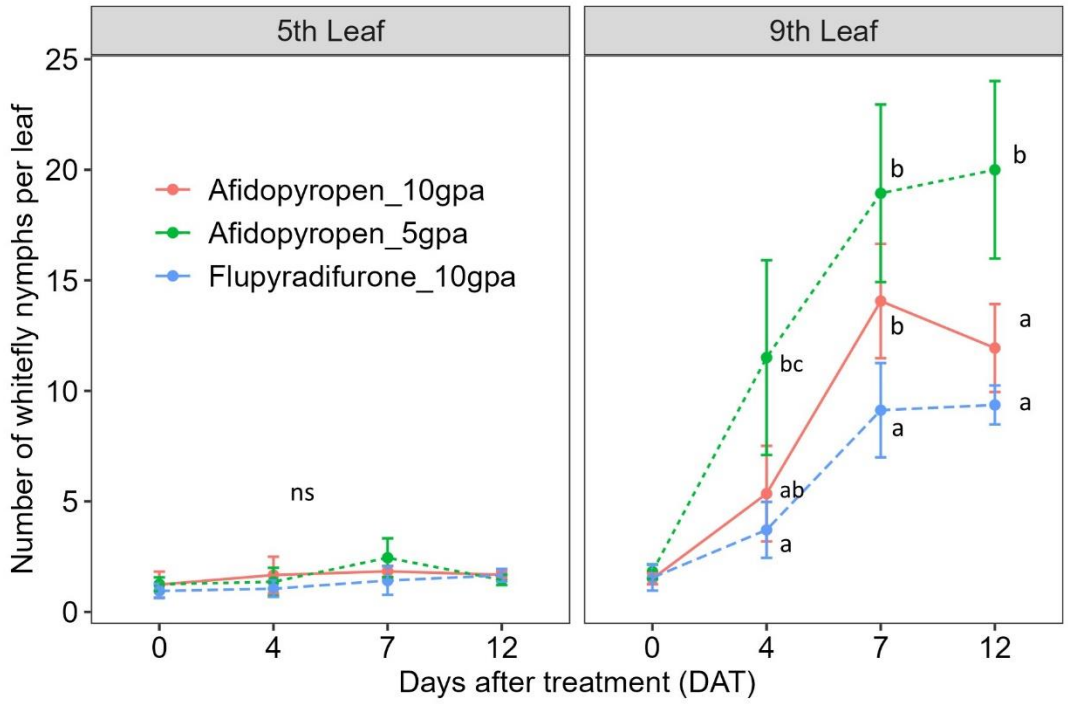

Figure 8. Average nymph whitefly counts for the experimental treatments in the aerial spray trial conducted in a commercial field. The significance of treatment effects and differences among treatments are indicated for each date.

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