Efficacy of Insecticides Targeting Cotton Aphids and Impact on Key Aphid Predators

Brant Baugh[1] and David Kerns[2]

[1]Texas AgriLife Extension Service, Lubbock Co.,

[2]Texas AgriLife Research and Extension Center, Lubbock, TX

Introduction

Cotton aphids, *Aphis gossypii* Glover are a common pest of cotton grown in the High Plains of Texas (Figure 1). Where aphid outbreaks occur, natural enemies such as lady beetles, are undoubtedly one of the most important natural factors for reducing aphid numbers below economically damaging levels (Figure 2). The University of Arkansas has developed a decision making process that incorporates lady beetle counts for determining when to treat for aphids. Key predators are not only important in suppressing aphid populations below threshold, but are also important in preventing resurgence of aphids post treatment and assisting in control following treatment.

The Texas AgriLife Extension Service action threshold for initiating an insecticide application targeting aphids in cotton is 50 aphids per leaf prior to boll opening and 10 aphids per leaf thereafter. The low threshold after boll opening is to prevent honeydew accumulation on the lint, resulting in sticky cotton.

Figure 1. Typical cotton aphid colony on the underside of a leaf.

Figure 2. Lady beetles are usually the most prevalent and important aphid predators in High Plains cotton.

Objectives

1. To determine the efficacy of commonly used aphicides at mitigating aphid populations in cotton.
2. To determine which aphicides have the least detrimental impact on key aphid predators.
3. To collect data to support or refute the current aphid action threshold.

Materials and Methods

This test was conducted at the Texas AgriLife Research and Extension Center in Lubbock, Texas. Cotton 'DeltaPine 174 RF' was planted on 4 June 2008 and 9 June 2009 on 40-inch rows and irrigated using furrow run irrigation. Plots were 4-rows wide × 25-feet long. Plots were arranged in a randomized complete block design with 4 replicates. An aphid outbreak was induced by overspraying the entire test area with Karate 1EC (lambda cyhalothrin) at 4.0 fl-oz per acre on 18 July and 7 August in 2008, and on 23 and 29 July and 4 August 2009. The aphicide treatments and rates are outlined in Table 1. All treatments were applied with a CO_2 pressurized hand boom calibrated to deliver 10 gallons/acre. The boom consisted of 2 hollow cone TX-6 nozzles per row spaced at 20 inches.

Treatments were applied on 21 and 28 August in 2008 and 2009, respectively, when the aphid population was approaching or had exceeded the action threshold of 50 aphids per leaf.

Materials and Methods (continued)

Table 1. Aphicide treatments and rates.

Treatment	Active Ingredient	Rate (product/ac)
1) Untreated	--	--
2) Bidrin 8	Dicrotophos	8.0 fl-oz
3) Carbine 50WG	Flonicamid	1.5 oz
4) Centric 40WG	Thiamethoxam	2.0 oz
5) Intruder 70WSP	Acetamprid	0.6-0.75 oz*
6) Trimax Pro 4.44SC	Imidacloprid	1.8 fl-oz

All treatments included crop oil concentrates at 1.0% v/v.
** Rate for Intruder was 0.75 oz in 2008 and 0.6 oz in 2009.*

The aphid population was estimated by counting the number of aphids per leaf. Ten 3 to 4 node terminal and ten mid to lower canopy leaves were randomly sampled per plot.

Predators were estimated utilizing a 36-inch x 40-inch black drop cloth. Drop cloths were laid between the rows and approximately 1.5 ft-row of cotton were shaken onto the drop cloth from each row, and the type and number of predators were counted. Only lady beetle larvae data are presented. The % reduction in lady beetle larvae relative to the untreated was estimated using Henderson-Tilton's equation.

The plots were harvested on 19 November in 2008 using an HB hand stripper. A 1/1000th acre section was harvested from the middle two rows of each plot. Samples were ginned at Texas AgriLife Ginning Facility in Lubbock. In 2009 yield data was not taken due to herbicide damage compounded by an early freeze.

All count data were analyzed using PROC MIXED and the means were separated using an F protected LSD ($P \leq 0.05$). The 2008 yields were correlated with aphid densities using a exponential decay linear regression model.

Results and Discussion

Aphids - 2008

On 21 August, the aphid population was averaging across all plots, 46.66, 19.82 and 33.24 aphids per leaf on the mid to lower canopy leaves, 3 to 4th node leaves, and averaged across both leaf locations respectively (Figure 3A). There were no statistical difference among treatments at this time. Although the aphid population was not at the treatment threshold, since the population appeared to be rapidly increasing treatments were initiated on 23 August. On 26 August, 3 days after treatment (DAT), aphids in the untreated plots had increased to slightly over threshold (Figure 3B). All of the aphicides had fewer aphids than the untreated throughout the plant canopy. There were no differences among the aphicides for aphids on the 3 to 4th node leaves, but Bidrin and Intruder had fewer aphids on the mid to lower canopy leaves than Carbine. Carbine was not expected to exhibit full activity at 3 DAT since this chemistry acts as an anti-feedent and requires time for the aphids to starve and/or desiccate. At 5 DAT, aphid numbers in the untreated were slightly lower than at the 3 DAT evaluation (Figure 3C). All of treatments had significantly fewer aphids than the untreated; however, Trimax Pro did not differ from the untreated in the number of aphids infesting the mid to lower canopy. Based on the mean number of aphids from both leaf locations,

Results and Discussion (continued)

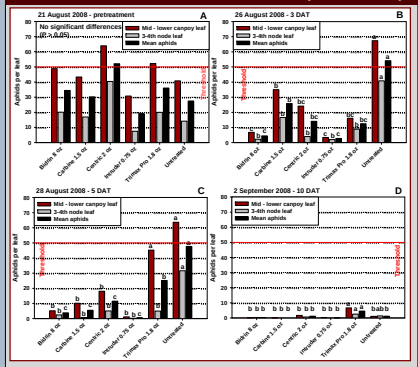

Figure 3. Number of cotton aphids per leaf in 2008 before application (A), 3 DAT (B), 5 DAT (C), and 10 DAT (D) during 2008. Same colored bars capped with the same letter are not significantly different based on a *F* protected Mixed Procedure (LSD, $P < 0.05$).

Trimax Pro did not perform as well as the other aphicides. Aphid numbers in the Trimax Pro plots on the mid to lower canopy leaves increased 181.62% from 3 DAT to 5 DAT . None of the other treatments exhibited an increase in aphid numbers. The increase in aphids in the Trimax Pro plots may have been due to its impact on lady beetles. By 10 DAT, the aphid population had declined considerably across the entire test, and none of the treatments were exceeding threshold (Figure 3D).

Aphids - 2009

In 2009, the aphid populations was substantially greater than in 2008. On 28 August, the aphid population was averaging across all plots, 110.48, 166.07 and 138.28 aphids per leaf on the mid to lower canopy leaves, 3 to 4th node leaves, and averaged across both leaf locations respectively (Figure 4A). There were no statistical difference among treatments at this time. Bidrin, Intruder and Carbine reduced the aphid population below threshold at 3 DAT, and all of the treatments were significantly lower than the untreated (Figure 4B).

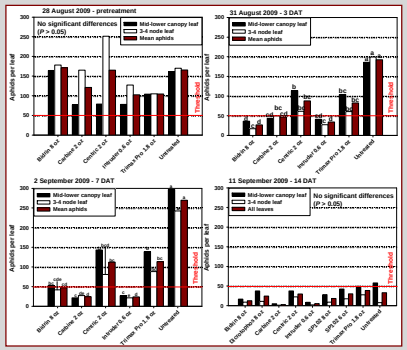

Figure 4. A & B. Number of cotton aphids per leaf in 2009 before application (A), at 3 DAT, 5 DAT (B), 7 DAT (C) and 10 DAT (D). Same colored bars capped with the same letter are not significantly different based on a *F* protected Mixed Procedure (LSD, $P < 0.05$).

Results and Discussion (continued)

By 7 DAT, similarly to 2008, aphids in the Carbine continued to decrease while aphids in the Intruder-treated plots remained low and static (Figure 4C). Aphids in the Bidrin, Centric and Trimax Pro plots increased slightly from 3 to 7 DAT. Bidrin increased to near threshold while Centric and Trimax Pro remained well above threshold. At 14 DAT the aphid population had crashed across all treatments (Figure 4D).

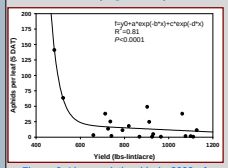

Figure 6. Linear relationship in 2008 of cotton aphid density at 5 DAT and yield.

Although we could not detect any differences among treatments in yield in 2008, we were able to demonstrate a significant relationship between aphids density at 5 DAT and yield (Figure 5). Although more data is needed to alleviate spuriousness, these data suggest yield loss began to occur when the aphids averaged 25 to 50 per leaf. Thus our current action threshold of 50 aphids per leaf appears to be fairly accurate.

Lady Beetles

Convergent lady beetle, *Hippodamia convergens* Guérin-Méneville was the most prevalent predator present in these tests both years. Before treatment, lady beetle larvae averaged 9.28 and 4.08 per 6 ft-row in 2008 and 2009 respectively. In 2008 at 3 DAT, lady beetle larvae did not suffer significant mortality in the Carbine or Bidrin treatments relative to the untreated plots, while all of the neonicotinoids (Centric, Intruder and Trimax Pro) contained fewer lady beetle larvae than the untreated (Figure 6). In 2009, perhaps because the lady beetle population was 50% lower than in 2008, differences were less clear and Carbine was the only treatment that did not differ from the untreated (Figure 6). The reason Bidrin caused significant mortality in 2009 but not in 2008 may be due to plant height and canopy density. The cotton in 2009 was smaller than in 2008 and inner canopy coverage may have been better in 2009.

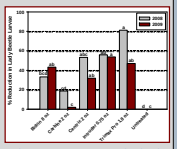

Figure 6. Percentage reduction in lady beetle larvae based on a Henderson-Tilton's equation. Same colored bars capped with the same letter are not significantly different based on a *F* protected Mixed Procedure (LSD, $P < 0.05$).

The University of Arkansas suggests that at least 0.2 lady beetle larvae or 0.3 lady beetle adults per 1 ft-row may be sufficient to biologically manage an aphid infestation. Lady beetle larvae averaged 2.58 and 1.04, while the adults averaged 0.28 and 0.25, in 2008 and 2009 respectively at 0 DAT. Although the number of adults were similar between years, there were fewer larvae in 2009; but still above the suggested 0.2 per 1 ft-row density. However, we did not observe the rapid decrease in the aphid population in 2009.

Acknowledgements

This project was funded in part by Plains Cotton Growers, Inc.