NEONICOTINOID INSECTICIDE CONTROL OF APHIDS AND EFFECTS ON SQUARE RETENTION

Lyndon K. Almand and M. Brian Sweeden
Bayer Corporation
Benoit, MS

Abstract

Timely foliar application of Calypso (thiacloprid) or Leverage (imidacloprid & cyfluthrin) against cotton aphid resulted in yield increases of at least 104 lbs. of lint per acre. Plots treated for cotton aphid had greater boll retention on nodes corresponding to the time of aphid infestation than did untreated plots. Results suggest that aphid levels below established thresholds may cause yield losses due to plant stress. Gaucho seed treatment and Temik in-furrow resulted in similar yield and early fruit retention.

Introduction

The cotton aphid, *Aphis gossypii* Glover, is a persistent pest in much of the U.S. cotton producing area. Many states consistently report the cotton aphid as among the important and noteworthy pests (Williams 1999, Williams 1998, Williams 1997). It was the number one cotton pest of the U.S. in 1991 (Hardee and Herzog 1992). Aphid infestations on seedling cotton can stunt seedling growth, but are easily controlled with a Gaucho seed treatment or one of a choice of in-furrow treatments. Late season infestations are of concern due to honeydew contaminating lint of open bolls thus reducing lint quality. In many cotton producing areas, particularly the Mid-South, cotton aphid infestations during the mid-season time of plant growth receive the most attention; a time which is conceivably the most damaging as the aphids are competing with developing fruit for plant nutrients.

Research results of the cotton aphid effect on yield of cotton have been variable. Andrews and Kitten (1989) showed a curvilinear relationship between aphid density and cotton yield with steeply declining yield under an infestation represented by 200-250 aphid days. Karner, et al (1997) reported a noticeable yield loss when aphid numbers exceeded 50 per leaf. A four pound lint/acre yield loss per each aphid/leaf increase in peak populations of 30-150 aphids/leaf was reported by McNally and Mullins (1996). In a Mississippi test, Layton, et. al (1996) had a 220 lb/acre yield loss due to cotton aphids. Although the yield results were inconclusive, Hardee and Adams (1998) reported a maximum yield increase of 102 lb lint/acre when cotton aphids were treated with an effective insecticide. A yield reduction of 78 lb lint/acre was evident in research by Teague et al. (2000). No significant effect on yield was found in one test by Godfrey, et al. (1997) while another test had a yield loss of 0.36 lb/ aphid day. Wells, et al. (2000) did not detect a significant difference in yield between plots treated for aphid control and the untreated plots.

Cotton aphid infestations have been shown to increase following treatments of ULV Malathion for boll weevil control in the Boll Weevil Eradication Program (Layton and Long 1999). These same treatments aimed at boll weevils have been also reported to reduce yield losses due to the tarnished plant bug (Layton et al. 1999). Therefore, BWEP sprays should afford an excellent opportunity to conduct a test for cotton aphid control with minimal interference from other sucking pests in the same time period. During 2000, the first in-season applications of the Mississippi BWEP were due in the area in which the Bayer Research Station is located.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:799-801 (2001)
National Cotton Council, Memphis TN

Methods and Materials

In order to determine the effects of cotton aphid infestations in cotton, a test was designed with insecticide applications timed for when the first aphid colonies were detected in the field. Multiple applications, up to three, would be made at no closer than weekly intervals in an attempt to hold infestations below 50 aphids/leaf.

A split plot design with either Gaucho seed treatment or Temik in-furrow as the main plots and foliar treatments as the sub plots was utilized. These Gaucho and Temik treatments were selected to provide good protection from thrips injury and desirable seedling growth. The Gaucho seed treatment rate was 4 oz ai/cwt while Temik was applied at the rate of 0.53 lb ai/A in-furrow. A plot size of 18 (38") rows 300 feet in length with 2 replications was used for the foliar treatments. Cotton 'DPL 50' was planted May 12 using a conventional 6-row John Deere 1700 MaxEmerge Plus vacuum planter with a spacing of 4 inches between seeds. The field was furrow irrigated as needed throughout the growing season to maintain adequate plant growth.

Treatments selected for aphid control were Calypso (thiacloprid) and Leverage (imidacloprid & cyfluthrin). Calypso is a new neonicotinoid insecticide being developed by Bayer Corporation and has shown good performance against cotton aphids in numerous tests (Unpublished data). Hopkins et al. (2000) summarized data from many areas of the Mid-South showing 81% to 92% cotton aphid control with Leverage. The rates utilized were: Calypso 4F 0.047 lb ai/A and Leverage 2.7 SE 3.75 fl oz/A (imidacloprid 0.047 lb ai/A & cyfluthrin 0.032 lb ai/A). Applications were made with a John Deere HiCycle 6000 equipped with a 6 row auxillary spray system having 6X cone tips delivering 5.75 GPA under 55 PSI. The first applications of Calypso and Leverage were made June 21. These were followed by an afternoon thunderstorm of 0.46" approximately 2 hours after Calypso was sprayed and 1 hour after the Leverage application. The second (and final) application of these treatments was made July 14. The first application of ULV Malathion by the BWEP was made June 6 and the second application September 6. Subsequent applications of ULV Malathion were later in the season and not relevant to this discussion.

Aphid infestation levels were determined by fixed site examination of 3 locations per plot. Each site was marked for subsequent inspections and counts of aphids per leaf were determined by examining the 4^{th} leaf down from the terminal on 10 consecutive plants. Experience has shown that examining the same plant for aphid infestation levels over time reduces the variability of results from one inspection date to the next.

All plots were treated uniformly for Heliothine infestations as needed with an effective insecticide.

Plants were mapped at the end of the season by selecting 10 plants at 3 sites in each plot. The number of bolls set per node and fruiting branch position was determined by visual inspection beginning with the cotyledon node as Node 0.

Yields were determined by machine harvesting 12 rows in each plot and weighing the amount of seed cotton picked. Yields were converted to pounds of lint based on actual gin turnout of the Leverage and Untreated plots, which was 37%.

Results and Discussion

The aphid infestation was low, by many standards, when the first test application was made. The population continued to increase in the untreated check to peak at 28 aphids/leaf 6 days after treatment initiation, (Fig. 1). The numbers of aphids continued to decline in the Calypso plots for approximately 2 weeks after application, at which time aphid numbers were essentially equal and very low in all plots. Aphid numbers in the Leverage plots increased slightly following treatment but peaked considerably lower than the untreated. This is, in reality, rather good performance considering the length of time between application and a significant thundershower event soon after the first Leverage application.

The infestation appeared to be making an atypical resurgence by July 11 and a second application to all treated plots was scheduled. Subsequent post treatment evaluations revealed that the population was declining at the time of treatment and totally crashed due to a fungal epizootic by July 21.

First position fruit set on the bottom 5 fruiting branches, (Fig. 2), shows an increase in boll set in the treated plots vs. the untreated check. The level of fruit set at this stage follows the same trend as aphid infestations in the plots, that being the untreated check with the lowest fruit set and the highest infestation and Calypso with the lowest infestation and the highest fruit set.

Cotton in the test plots had 8 nodes at the time of initial Calypso and Leverage applications. Plant mapping data show an increase in boll set in the treated plots on the lower nodes corresponding to the time of reducing the cotton aphid infestation, (Fig. 3). This trend continues for the next few nodes until treated and untreated boll set rate becomes equal. Teague, et al. (2000) also detected an effect on fruiting rate when the crop development curve from Cotman sampling of aphid infested plants showed severe plant stress coinciding with the time of an aphid infestation.

There is a second increase in boll set in the treated plots on later nodes. That time frame may coincide with the time of the second application of Calypso and Leverage. Data are not available to confirm this relationship.

The final plant response measurement and perhaps the ultimate factor is yield. After all, that is the reason for growing a crop. The yield of the main plots of Gaucho and Temik were very comparable, (Fig. 4). These results agree with earlier tests (Almand 1996, Graham 1999). An interesting comparison to the Gaucho and Temik yield data is the fruit set on the bottom 5 fruiting branches in those same plots, (Fig. 5). The trend established at this early stage in plant development seemed to carry through to the end of the season.

Yield in the foliar treatment plots followed the response indicated by plant mapping data. As shown in Figure 6, the untreated check yielded 104 lb/A less than the Calypso treated plots and 173 lb/A less than the Leverage treatment. The higher yield in the Leverage plots vs. the Calypso plots likely represents the broader spectrum of activity of Leverage and an effect on pests not detected in this test.

As evidenced in this test, and by numerous others who have applied insecticides for cotton aphid control, insecticide applications alone seldom if ever totally eliminate an aphid infestation. The entomopathogenic fungus, *Neozygites fresenii*, is often the reason for aphid populations being reduced to extremely low numbers. The devastation of an aphid infestation by a fungal epizootic can be a dramatic and satisfying event to a cotton producer. However, as pointed out by Teague, et al. (2000) this often occurs too late to prevent significant yield loss. Timing of insecticide applications for cotton aphid control is critical to making profitable decisions and delays in taking action can be costly, Teague, et al. (2000).

Although the treatments in this test did not eliminate the cotton aphid infestation and a fungal epizootic was the ultimate demise of the aphid population, the timely insecticide application prevented a yield loss of at least 104 lbs of lint. While it is generally accepted that the fungal epizootic is insect density dependant, the combination of insecticide treatment to lower aphid numbers and a subsequent epizootic are not mutually exclusive. Numerous authors have shown that *N. fresenii* appears to be compatible with chemical insecticides. Wells et al. (2000) observed that the fungal epizootic appeared capable of developing in the presence of imidacloprid at relatively low aphid densities.

The peak cotton aphid population reached in the current study was considerably lower than established treatment thresholds of many states. These data as well as others referenced in this paper suggest that rather than simply a number-of-aphids-per-leaf damage threshold, the "aphid days" concept is a more reliable predictor of aphid yield loss.

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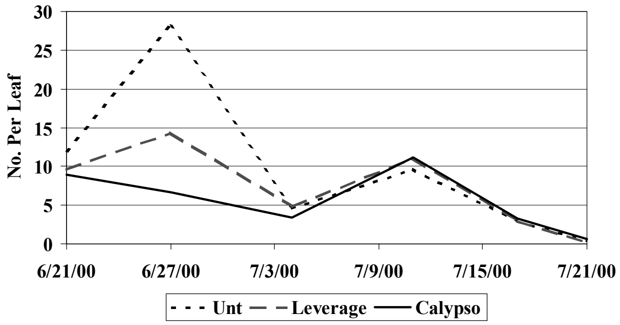

Figure 1. Aphid infestation levels for cotton plots, Benoit, MS, 2000.

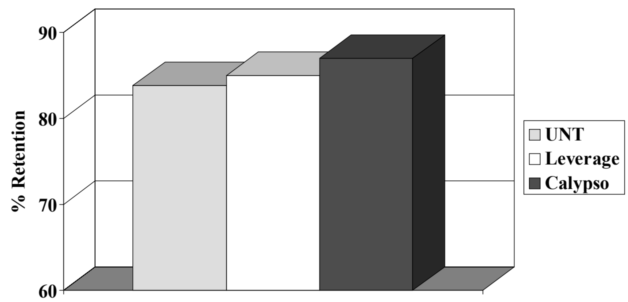

Figure 2. Early boll set (1st position on bottom 5 fruiting branches) in cotton plots, Benoit, MS, 2000.

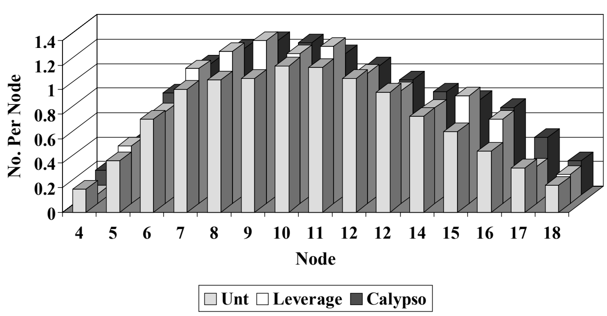

Figure 3. Boll set by node (1st and 2nd position fruit) in cotton plots, Benoit, MS, 2000.

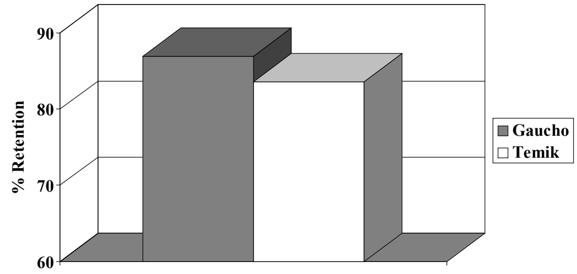

Figure 4. Cotton lint yield as influenced by at -planting insecticides (main plot effects), Benoit, MS, 2000.

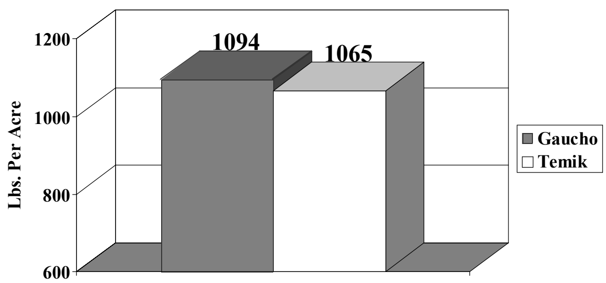

Figure 5. Early boll set (1st position of bottom 5 fruiting branches) as influenced by at-planting insecticides, Benoit, MS, 2000.

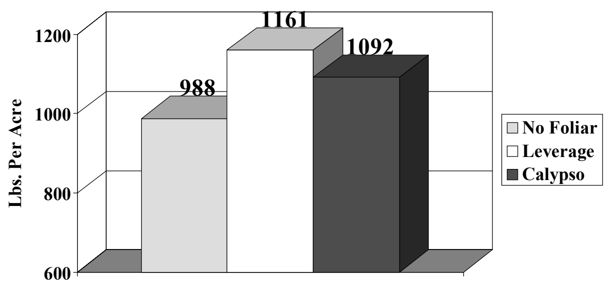

Figure 6. Cotton lint yield as influenced by foliar treatments for cotton aphid, Benoit, MS, 2000.