MONITORING COTTON PLANT GROWTH AND RESPONSE USING COTMAN TO EVALUATE EFFECTS OF CHEMICAL CONTROL OF COTTON APHID

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Abstract

A pre-flower infestation of cotton aphid (*Aphis gossypii* (Glover)) in cotton significantly reduced total lint yield in this large scale, replicated field study in NE Arkansas. The infestation time extended from squaring node 5 to first flower at which time population numbers crashed due to an endemic entomopathogenic fungus. Treatment plots receiving 2 applications of Provado 1.6F applied at 2 ounces/acre produced a mean yield of 940 lb lint/acre compared to production of 863 lb lint/acre in the untreated check. Although insecticide applications resulted in higher yields, when chemical and application costs were included in the analysis, differences in net profit between protected and unprotected plots were only marginally significant (P=0.08). Crop monitoring information derived using the COTMAN system was used to evaluate crop response to stress, monitor square retention, and examine treatment effects on crop earliness. Stress associated with the timing of aphid infestation was evident in crop development curves generated by COTMAN. Square retention data indicated that other important pests likely were not involved in treatment effects. Earliness measured as days to cutout (when NAWF=5) and counts of open bolls was not affected by treatments.

Introduction

Infestations of cotton aphid in squaring cotton (pre-flower) can result in economic damage in Midsouth production systems. Andrews (1996) reported results from a replicated study by Layton where an aphid infestation in pre-flower cotton (8^{th} node) reduced lint yield 220 lbs compared to plots where numbers were suppressed with one insecticide application. Bagwell et al. (1991) found a significant yield reduction associated with high aphid numbers in pre-flower cotton. Results from their end-of-season plant mapping indicated that the aphid infestation resulted in reduced plant height, fewer plant nodes and bolls per plant including lower retention of 1^{st} and 2^{nd} position bolls on sympodial branches.

Despite a risk of yield loss, Midsouth cotton producers and their crop advisors often delay or abstain from making insecticide applications against cotton aphid. Instead they choose to rely on the entomopathogenic fungus, *Neozygites fresenii*, to eliminate the pest. This approach is appropriate if fungus epizootic is imminent and permanent damage has not yet occurred (Steinkraus et al. 1995). Decision makers who must choose between biological control (fungus) and chemical control tactics should include an appropriate sampling program for aphid populations to determine the incidence of fungal infection (Steinkraus 1996). Additional information important to the decision making process should come from crop monitoring data. This is particularly important if the potential for crop compensation following injury is considered.

The COTMAN crop management system has been useful in monitoring crop stress from plant to plant competition (Oosterhuis et al. 1999) and inadequate irrigation (Teague et al. 1999). In this study, COTMAN was used to monitor crop development to identify stress or crop delay resulting from a pre-flower aphid infestation. Yield and lint quality of protected and unprotected plots were compared, and net profit associated with aphid control estimated.

Materials and Methods

The experiment was conducted at Wildy Farms in NE Arkansas near Manila (Mississippi County) in a 77 acre field with Routon sandy loam soil. The variety BXN 47 was planted 3 May. Irrigation was supplied by center pivot sprinkler, and all other agronomic inputs were standard for the area.

Research plots were established following the second week of squaring after aphid numbers began to build in the field, and square retention, associated with TPB induced injury, had dropped to just below 90%. Plot size was 56 rows wide and 1/4 mile long; these were arranged in a RCB with 4 replications. There were 2 treatments: 1) Provado (imidacloprid) applied at the rate of 2 oz/acre (10 gpa) by ground on 24 June and on 1 July and 2) untreated check.

The original intent of our research was to monitor insecticide effects on tarnished plant bug (*Lygus lineolaris* (Palisot de Beauvois) and subsequent changes in square retention following the early season insecticide application. The focus was redirected at aphid effects as that infestation increased in severity.

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Sampling

Plants were examined for aphids by inspecting the top 2 unfurled leaves on 50 plants per plot. Infestations were noted as low (0 to 20) or high (>20). The crop was monitored using the COTMAN system; 4 sites per plot and 10 plants per site were examined twice weekly by the research team. The research mappers were instructed to choose sites that were not heavily infested by aphids. Plant mappers employed through the crop advising firm for the farm also monitored the field using COTMAN. Their sampling procedure was the standard 4 sites per field and10 plants per site, and their samples included heavily infested areas. End of season differences in crop maturity were monitored by weekly counts of open bolls across the entire width of each plot (56 rows). Samplers used a T-shaped stick with a 4 ft handle and 3 ft end to gently bend plants to make counts of open bolls/3 ft Cotton yields were collected with commercial equipment, and modules were built for each plot. Samples were taken from each bale for HVI fiber analyses. All data were subjected to AOV, and means separated by LSD.

Results

Aphids numbers were suppressed in Provado treated plots following insecticide application (Figure 1). Aphids continued to increase in treated and untreated plots until the population crashed in all plots following a fungus epizootic that began in early July.

Other insect pests had negligible effects on the crop during the remainder of the season. Infestations of tarnished plant bug were minor and likely did not affect yield (Figure 3). At no time were there were significant differences between treatments in 1st position square retention (Figure 4). Other pests through the season included a low level infestation of bollworm (*Helicoverpa zea* (Boddie)) in late July for which 2 applications of the synthetic pyrethroid, Karate, were made across all plots. Boll weevil (*Anthonomus grandis* Bohemann) population density was extremely low until well after the final stage of crop susceptibility (NAWF =5 plus 350 DD60s).

At the time of the first Provado application, the cotton had a mean number of 10.6 total nodes with approximately 5.5 squaring nodes. When compared to the Target Development Curve (Figure 4, 5), the crop development curve indicates a steady crop pace for the first 2 sample dates in June (Figure 6). Severe stress was apparent in the week following the 21 June sample period. These data were collected by the commercial crop advisor. Crop monitoring performed by the research team was focused on plants with minimal aphid infestations, and there were no differences between treatments on any date in nodal development and no significant difference in days from planting to cutout (Figure 7).

Yield was significantly ($P<0.05$) reduced by the pre-flower infestation of cotton aphid (Table 1). There was no difference in micronaire, length or strength between the treatments. Gross revenue (i.e. what the farmer received based on yield, classing and government payments) per acre was $654 for insecticide treated and $584 for untreated check ($P= 0.06$). When cost for the insecticide and the 2 applications were subtracted from gross revenue for treatment ($10/acre), the net revenues were $644/acre and $584 acre for control ($P = 0.08$).

Conclusions

Even though aphid numbers were suppressed by insecticide applications, these insect pests were not eliminated until the fungus epizootic. The beneficial effects of the fungus came too late, however, to prevent aphids from significantly reducing lint yield. When chemical and application costs were considered in an economic analyses, there was a increase in net profit associated with insecticidal control.

Unfortunately, a common error by decision makers is to wait on the fungus, let damage occur, lose confidence in the original decision, and **then** decide to spray, probably just as the epizootic occurs. Clearly, this is a waste of money. Timing is critical to making profitable aphid control decisions (Andrews 1996, Steinkraus 1996), and delays in taking action can be costly.

Acknowledgements

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Table 1. Mean lint yield (lbs/acre) observed in 1999 cotton aphid control study.

Treatment	First harvest	Total Yield
Provado (2 applications)	894	940
Untreated Check	812	862
P>F	0.05	0.05
LSD(.05)	81	63

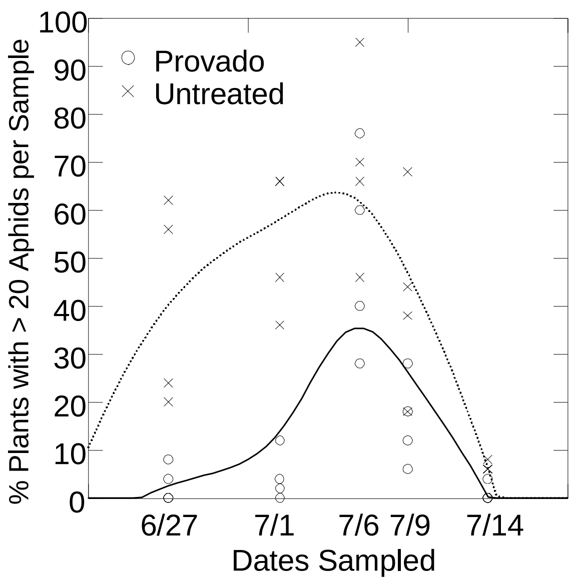

Figure 1. Plants (%) with greater than 20 aphids per sample; the 2 uppermost unfurled leaves of 50 plants were examined in each plot. Insecticide was applied on 24 June and 1 July.

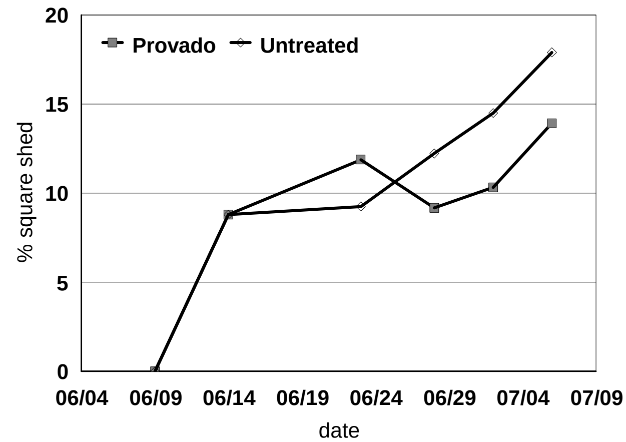

Figure 2. First position square shed (%) observed in treated and untreated plots on 6 sampling dates collected using the COTMAN system.

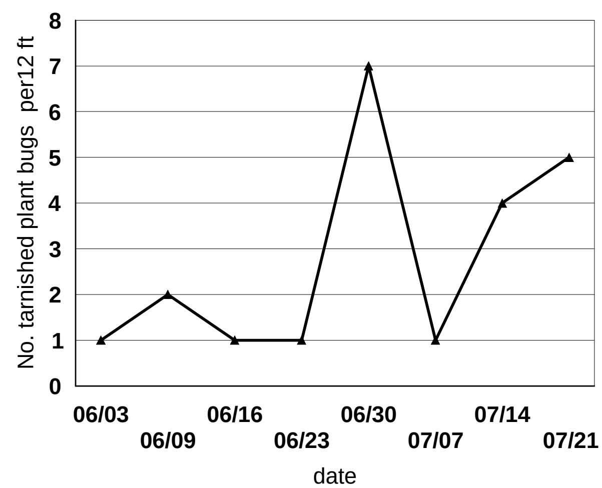

Figure 3. Mean no. tarnished plant bugs/12 ft of row for the season across the entire field (as monitored by the commercial crop advisor using 4 drop cloth samples per date).

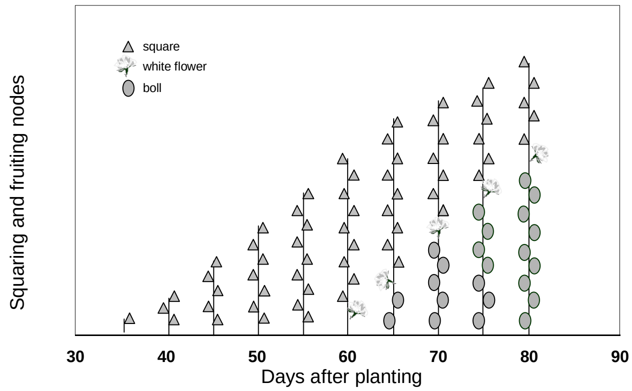

Figure 4. Nodal development expected in the COTMAN Target Development Curve. When squaring nodes are plotted in relation to days after planting the COTMAN target development curve is derived.

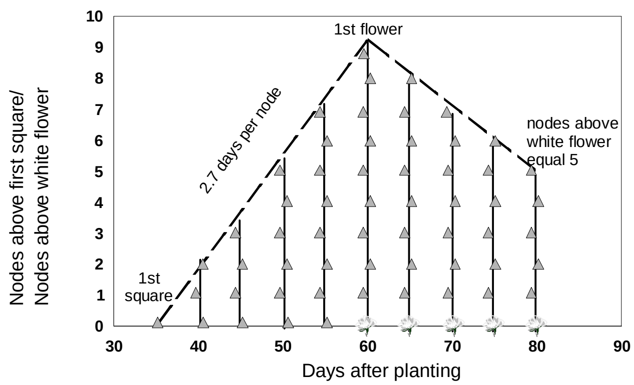

Figure 5. The COTMAN Target Development Curve provides a reference line for evaluating the pace of a crop's development.

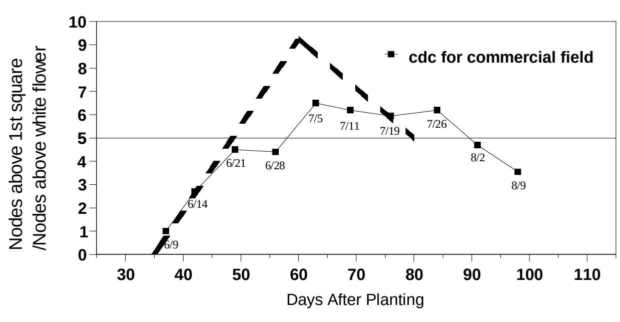

Figure 6. Crop development curve (cdc) for the test field as measured by the commercial crop advisor's mapping team.

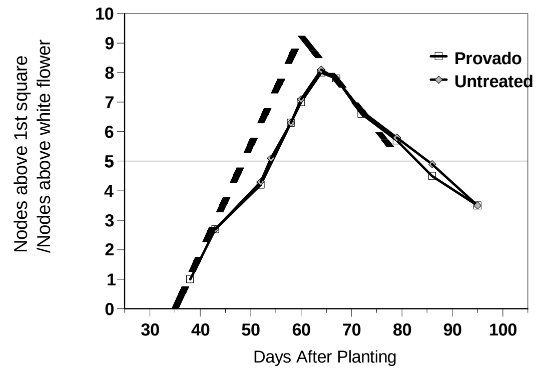

Figure 7. Crop development curve calculated from sampling by the research team whose sampling was focused on plants with minimial aphid infestations.

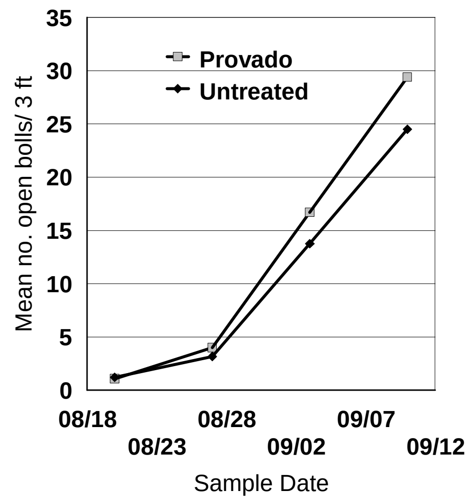

Figure 8. Mean no. of open bolls per 3 ft measured across 56 rows in each plot using a 3 ft T-stick.