MAFES COTTON INSECT PEST MANAGEMENT PROJECT: OVERVIEW AND FIRST YEAR RESULTS

J. T. Reed, R. G. Luttrell
Dept. of Entomology and Plant Pathology
Mississippi State University
Mississippi State, MS
F. A. Harris
Delta Research and Extension Center
Stoneville, MS
S. Stewart
Central Mississippi Research and Extension Center
Raymond, MS

Abstract

The Mississippi Agricultural and Forestry Experiment Station project to evaluate cost reduction strategies and major production changes instituted by industry, growers or researchers, and to revitalize a cooperative effort to develop decision making tools and simulators, was initiated in the spring of 1995. Field size units with a minimum of 25 acres per treatment were established in Lee, Madison, Tallahatchie and Yazoo Counties with each site serving as a replicate for the experimental treatments. All treatments were also replicated 4 times in field size units in Leflore Co. Small plot strategy research was also initiated in a delta and a hill location to help develop techniques to be advanced to the large plot trials and hence to growers. Fields of NuCotn33 (transgenic, B.t. cotton) that received no heliothine control, was compared in each location with DPL 5415 and a grower-chosen variety that received season long control of Lepidoptera according to the Mississippi Insect Control Guide. Average lint yield and insecticide input cost (insecticide only) results for all sites for the NuCotn33, DPL 5415, and 'grower variety' treatments, respectively, are: 840 lb., $35.37; 668 lb. $96.65; and 717 lb. $93.78. A fourth treatment that was to evaluate aggressive early season plant bug control was not triggered because of very low early season populations of tarnished plant bug.

Introduction

Cotton farmers in Mississippi are facing rising costs of insect control resulting primarily from failing insect control strategies that have not fully compensated for increasing insecticide resistance in major pests. Market competition from other areas and continually increasing pesticide and other production costs have also reduced the margin for profit in Mississippi cotton. Survival of the cotton industry in the state may well depend on cost effective management of all production parameters, but acceptable, economical control of cotton insect pests is critical to that survival. The Mississippi Agricultural and Forestry Experiment Station fills a critical research role in providing sound technology to the Mississippi Growers and has responded in part to their needs by channeling support for this project.

Historically much of our applied cotton-insect research has been associated with evaluating the efficacy of insecticides. Research associated with cropping strategies, including integrated pest management, cultural practices and the properly integrated use of new technology is also critically important, but much more difficult to fund. In addition there is a need to improve the outreach by extending the functional research results to the grower. The leap from small plot and laboratory research to the field is a large one and requires replicated in-field testing to provide an analyses with sufficient confidence to make proper recommendations to the cooperative extension network and ultimately to the Mississippi grower. In addition, the cotton growing regions within the state are diversified, and require some recommendations specific to the regions, the most obvious regions being the Mississippi River delta in west Mississippi and the hill regions in the eastern portion of the state.

The long-term management of cotton insect pests, the need for predictive capabilities relative to both seasonal and annual pest density expectations, and probable control problems are other aspects of cotton production research needs. There is a need for effective decision management tools that take advantage of current technology to improve production decisions. The disastrous tobacco budworm population that heavily damaged cotton in the hills of Mississippi this past season stands as a tragic reminder of our lack of capabilities in this respect. This project is expected to contribute directly to our knowledge of insect populations in cotton ecosystems, and help fuel the development of simulators that would provide important exploratory tools for scientists and, ultimately, predictive tools for growers.

Objectives

The objectives of the research project are: (1) Establish a coordinated program of evaluating cotton insect management options in replicated field plots in the delta and hill regions of the state. (2) Initiate an experimentally sound program of evaluating major changes to current recommended management strategies in production level fields. (3) Revitalize a cooperative management-science effort to develop decision tools and simulators necessary to introduce new management capabilities, guide research projects and create a pro-active approach to developing new cost-effective management options for cotton insects.

Materials and methods

The project may best be viewed as diagramatically represented in figure 1. Field size units with a minimum of

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1119-1121 (1996)
National Cotton Council, Memphis TN

25 acres per treatment were established in Lee, Madison, Tallahatchie and Yazoo Counties with each site serving as a replicate for the experimental treatments. All treatments were also replicated 4 times in field size units in Leflore Co. Small plot strategy research was initiated in a delta (Delta Research and Extension Center (DREC)) and a hill (Northeast Mississippi Research and Extension Center, (NEMREC)) location to help develop techniques to be advanced to the large plot trials and hence to growers.

Treatments in the large plots in all 5 locations included NuCotn33 without heliothine control, DPL 5415 (parent variety of NuCotn33 without the B.t. gene), and a 'grower-chosen' variety. The DPL 5415 and the grower variety received insect control according to the Mississippi Insect Control Guide (Layton, et al. 1995).

Small plot research was initiated at the DREC, Stoneville, MS and at the N. E. Mississippi Research and Extension Center, Verona, MS. Treatments differed between sites. Although some results have not yet been fully analyzed, four treatments included in the small plot trials at the NEMREC are of interest. These were, NuCotn33 plots, untreated plots, plots receiving treatment according to the control guide, and plots receiving Spinosad for Lepidoptera control. All plots other than the NuCotn33 were Suregrow 501 variety. Other treatments included in the small plot research were designed to identify whether any applications of insecticide which would normally be recommended if the control guide were followed could be eliminated.

Both field-sized and small plots were scouted weekly for insect pests and damage by scouting 25 terminals, squares and bolls, and making 25 sweeps with an insect net in each small plot or in each of 4 sites within a field. In addition, modified plant map and plant height data were collected at least weekly in accordance with the proposed node above first square and node above white flower concept under development by researchers at the University of Arkansas. These data will help relate insect populations with plant growth or fruiting characteristics.

A third component of the project involving computer simulation and the development of useful predictive tools for research and the commercial cotton grower has also been initiated. Although this aspect of the program is essentially one of long term commitment, work is currently underway to update and refine an expert system to assist insect control decision making by consultants and growers.

Results

In the large plots, the NuCotn33 that received no heliothine control, produced considerably more cotton per insecticide dollar than the parent, non-B.t. variety or a 'grower-chosen variety', both managed under current insect control guide recommendations for heliothine control. Averaged across the 5 locations, pounds of lint cotton per dollar of insecticide expenditure were 25, 6.9 and 7.7 for NuCotn33 (B.t. cotton), DPL 5415, and the 'grower variety', respectively. Yield in lint for the respective 3 treatments was 840, 668 and 717 pounds/acre. The cost of controlling insects on the B.t. cotton ranged from $11.00/acre (not including eradication applications of malathion) in the boll weevil eradication zone in Lee County, to $70.00 in Yazoo County. This comparison is of importance in estimating insecticide costs for the genetically engineered B.t. cotton following boll weevil eradication in Mississippi. In both of the hill locations, tobacco budworm densities were very high, severely testing the NuCotn33 and insecticidal control.

In addition to the yield and cost figures, detailed sampling for all major insect pests and beneficial arthropods was initiated in the field size units. Insects collected in weekly sweep net samples were identified to species. Such detailed information will be used to strengthen our understanding of relationships between beneficial and harmful arthropods in the cotton ecosystem, and of the effects of the various insecticide applications to arthropod populations throughout the season. Long term collection of data from these varied locations within the state will lead to simulation tools designed to give predictive information relative to the effects of individual chemical treatments and seasonal effects of cultural practices in cotton production.

Plots at the DREC had low heliothine densities. The NEMREC small plot research encountered exceptionally heavy tobacco budworm densities. At the NEMREC location, untreated control plots of Suregrow 501 averaged 412 pounds of seed cotton per acre. Multiple applications of Spinsosad, a non-registered compound, produced 4157 pounds per acre applied to plots of the same variety. NuCotn33 plots that received no heliothine control yielded 3641 pounds of seed cotton per acre, and plots of Suregrow 501 treated with commercially available materials applied according to the Mississippi Insect Control Guide recommendations yielded 2129 pounds of seed cotton. Yield of the NuCotn33 was not significantly different from that of the Suregrow 501 treated with Spinosad, however the untreated control and the control-guide managed plots differed significantly from each other and from the other two treatments (ANOVA, LSD; $p>F=0.0001$)

Other treatments in the small plot trials at NEMREC or DREC included work with aphids and tarnished plant bug, and the possibility of deleting an insect control application during the season to identify applications with least effect. For the most part, tarnished plant bug populations were too low for evaluation, but other results from the small plot research will be forthcoming.

Discussion

Because of the continuing problem of insecticide resistance in tobacco budworm, use of genetically engineered cotton or compounds with new modes of action will be necessary for Mississippi growers to produce a profitable crop in the future. It is obvious that tobacco budworm can reach population densities that become an inhibiting factor in cotton production in the state. Other major cotton pests such as the tarnished plant bug that has demonstrated both resistance to insecticides (Snodgrass and Elzen, 1995) and the ability to develop high density populations, may also require advanced technology to provide Mississippi growers with tools to adequately protect their crop. This year's results clearly demonstrate that B.t. cotton may still require considerable insecticide input to protect the fruit from pests other than tobacco budworm and corn ear worm. Beet armyworm is also a serious threat to Mississippi cotton growers, and was present in our fields during 1995. An integrated pest management approach with decreased emphasis on chemical control of insects during the season may have to be strongly considered for Mississippi because of this pest which may be resistant to currently registered insecticides. Future research within the confines of this project will be necessary to develop such recommendations for Mississippi.

References

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2. Snodgrass, G. L and G. W. Elzin. 1995. Insecticide resistance in a tarnished plant bug population in cotton in the Mississippi Delta. Proc. Beltwide Cotton Conf. 2:975-977.

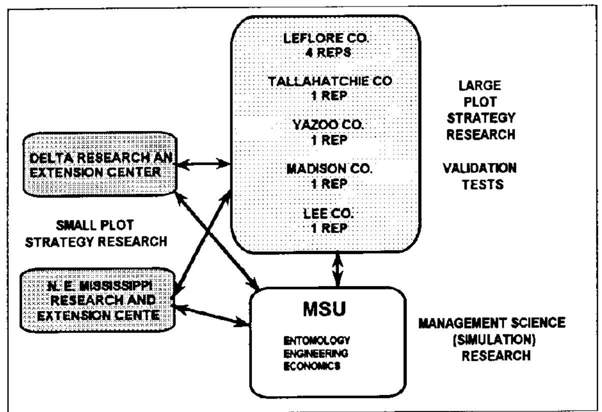

Figure 1. Structure of the MAFES cotton insect control strategy research project.