AN EXTENSION ENTOMOLOGIST'S 1996 OBSERVATIONS OF BOLLGARD (Bt) TECHNOLOGY

Ron H. Smith, Professor
Department of Entomology
Auburn University
Auburn, AL

Abstract

Alabama cotton growers planted a higher percentage of their acreage to Bollgard varieties than any other state. This paper will discuss the performance of this technology and its impact on the entire cotton insect complex.

Introduction

Resistant tobacco budworms caused near total crop failure in one or more major cotton production areas of Alabama in both 1994 and 1995. Many farms yielded less than 200 pounds of lint per acre and numerous fields were plowed under without harvesting. As a result, Alabama growers planted 430,000 acres of the state's 560,000 acres, 77%, to Bollgard varieties in 1996. Many growers chose the 96 - 4% refugia option. Information presented in this paper is a summary of observations, surveys and field test results made by members of the Extension entomology cotton team, combined with feedback from private consultants, Extension county agents, agrifieldmen and others.

Discussion

The first generation of Heliothine infestations occurred in June (early square stage of cotton) and were almost entirely tobacco budworms, Heliothis virescens. No survivors were reported on Bollgard varieties. Mortality was also very high on other varieties. This was likely due to an abundance of beneficial insects and natural mortality factors. Foliar sprays of currently registered insecticides, applied to control budworms in non Bollgard cotton in test plots, were no more effective than beneficial insects in untreated plots. Very few budworms occurred during the remainder of the season.

Bollworm (Helicoverpa zea) numbers peaked at two points in the season (mid to late July and again in early September on late maturing cotton). This first period coincided with the movement from maturing corn to cotton. In 1996 this activity lasted about three weeks due to the staggered planting and maturity of corn. As soon as this activity began, escapes were reported on Bollgard varieties. Early on, the bollworm escapes on Bollgard cotton appeared to be related to extremely high numbers (up to 400 eggs/100 plants). After about 10 days it was apparent that the escapes did not relate to numbers but was almost entirely related to the location of egg deposition -- that being on dried bloom tags. Escapes were also observed under modest bollworm pressure. This attraction to dried bloom tags was not thought to be related to Bollgard varieties since it was also occurring in standard varieties. Beneficial insects in the system reduced the number of bollworm escapes dramatically over fields where beneficials had been suppressed by insecticides targeted to other pests. Beneficials appear to add another valuable layer of control or protection to Bollgard cotton.

The most important of the predator insects in 1996 appeared to be Orius, minute pirate bug, over much of the state. Populations of up to 45,000 Orius per acre (3/ft) were recorded. In the northern region of the state Geocoris (big eyed bugs) appeared to be the most common predator. A shift from Orius to Geocoris was noted in several other areas in late season (early September). Fields planted to Bollgard cotton had as many or more total beneficials, and as wide a variety of species, as did non Bollgard cotton. This mid-to-late July period will likely be a critical window for Bollgard cotton. Both Bollgard and non Bollgard cotton may require from zero to three foliar applications during this window in future years. A major factor in this need for foliar sprays will be the presence or absence of beneficial insects and of course to some degree the level of pressure.

Where foliar applications were made to both Bollgard and non Bollgard cotton for control of July, August and September bollworms, the results were good to excellent. Pyrethroids at mid-label rates gave equal to or better results than the newer chemistry under development. None of the alternative new chemistry under development, (Pirate, Tracer, Proclaim, Intrepid) targeted for bollworms and budworms, appeared to have "clean-up" capabilities. Foliar Bt's over sprayed on Bollgard cotton did not reduce the number of escape bollworms over untreated plots.

Beet armyworms (Spodoptera exigua) are less likely to occur at economic levels on Bollgard cotton due to a reduced insecticide load, higher numbers of beneficials, especially Cotesia, and the suppression (30-60%) of BAW's by Bollgard cotton itself. Based on first year observations, aphids may also be a reduced pest on Bt cotton due to a greater impact of beneficials.

Fall armyworms (Spodoptera frugiperda) were a significant economic pest in the Gulf Coast area of Alabama and throughout most of the Coastal Plains of the Southeastern U.S. Populations will likely continue to be higher on Bt cotton due to the lack of suppression gained by insecticides (all classes) targeted towards bollworms and budworms. On the other hand, where beneficials remain in the system during the time when FAW's occur (in mid-to-late July) they likely will give a significant level of suppression, especially the pirate bug (Orius) which tends to search the entire plant better than most beneficial species. Pirate bugs were most

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always found inside boll bracts low on the plant and inside red blooms where early instar FAW's routinely occur. The second generation of FAW's in cotton (about mid August) went untreated in most fields. This generation resulted in few survivors, and little fruit damage.

No currently registered insecticide or combination gave over 30 to 50% control of the July fall armyworm infestation. New chemistry is desperately needed to control this pest which infested over one million acres of cotton in 1996, stretching from southwest Alabama through the Florida panhandle, the coastal plains of Georgia and into South Carolina. Both Pirate and Tracer showed better activity than currently registered insecticides. However, coverage is a major factor with all chemistry in the control of this pest. In the absence of beneficial insects, 30 to 50% suppression of FAW's, with currently labelled chemistry, is better than no control. Growers who spent $30 per acre with tank mixtures to control the mid-season generation of FAW's got a return on their investment.

Bollworms or tobacco budworms, on a per caterpillar basis, have a much greater damage potential than do fall armyworms on cotton. FAW's do not feed on as many different fruit per larvae, therefore economic thresholds should be 2 to 4 times higher than for bollworms or budworms. When targeting mixed populations, growers should concentrate on bollworms and/or budworms in making their insecticide selection. In other words, on Bollgard cotton, target escape bollworms and just obtain as much suppression as possible on FAW's, allowing escape FAW's to cycle out.

Plant bugs were not a major economic insect in 1996, likely due to the effects of a May drought on their wild host plants. These insects (actually both the tarnished plant bug and the cotton fleahopper) will likely be a more widespread pest in the early square season (June) most years. If populations do not reach economic levels in early season they most surely will in mid to late season (mid-July to early August). Clouded plant bugs were an increasing problem in late season (late July to September) due to the reduced insecticide load on Bollgard cotton. This pest has a greater boll feeding tendency. All fields will not be infested at equal levels by this pest. Locations near water may have higher populations as button bush is a good host for clouded plant bugs.

Stink bugs are a major threat to damage bolls in untreated Bollgard cotton fields after peak bloom (late July to September). This build up on cotton coincides with the maturity of corn and will likely be greater where cotton and corn fields are adjacent. In the early stages of infestation this pest will tend to clump on field borders near corn, lending themselves to border treatments. Damage from this pest is easy to identify but is not well recognized by most scouts and some consultants.

Conclusions

Bollgard refugia fields in the Coastal Plains area of the southeast often incurred 50 to 80% yield losses to fall armyworms and bollworms where beneficials had been suppressed by foliar insecticides applied to control other economic pests such as plant bugs. For this reason the 96-4% refugia option will not be advisable in future years under the current 1996 restrictions. Some refugia fields, with two bale potential of mature bolls in late July, were reduced to unharvestable.

Bollgard cotton is much more valuable to growers after completion of boll weevil eradication. Thresholds and strategies that will preserve beneficials in Bollgard cotton to the maximum extent possible should be encouraged for managing the remaining economic insects. A priority should be given to selective chemistry when targeting economic levels of pest in Bollgard cotton. Selectivity against beneficial insects will be a major plus for future cotton insecticides. Where hard chemistry is the best or only alternative, the ideal method is to "get in and get out" as quickly as possible with the fewest applications--allowing beneficials to rebuild. Both Tracer and Provado appeared to be soft on beneficials in 1996 tests.

Bollgard cotton places a premium on effective and timely scouting. During certain windows of the season, and when surveying for certain pests such as escape bollworms, plant bugs (square retention), stink bugs and fall armyworms, Bollgard cotton will require more time to monitor than conventional cotton. Bollworm surveys may have to be modified or changed from one time to another during the season to adequately quantify the population. A modified whole plant survey will be necessary. Economic thresholds are more difficult to determine in Bollgard cotton. Therefore, the cost of scouting, monitoring or consulting will likely need to increase somewhat with Bollgard cotton. The ideal interval to scout Bollgard cotton is similar to conventional cotton--that being every 4 to 5 days. Twice per week is actually too close an interval, and once per week too wide. The problem with 4 to 5 day intervals is weekends. Scouts and consultants need breaks in their routine that weekends traditionally give.

Cotton insects are evolving and changing habits in recent years. With the completion of boll weevil eradication in certain regions and the introduction of Bollgard cotton, experience and patience in scouting has become critically important. First year scouts may not have adequate training, except where working under the direct daily supervision of experienced scouts and/or consultants.

All in all, Alabama went from the worst year on record for cotton insect losses (over $41 million) in 1995-to in 1996, the lowest amount of insecticide applications and usage since the introduction of synthetic insecticides in the 1940s. Less than 20% of the total cotton acreage in Alabama

received any foliar insecticides in 1996. Less than 10% of the Bt acreage was treated a single time. Most of this was in the Gulf coast region where beneficials had been suppressed by plant bug sprays and fall armyworm populations were heaviest. Yield potential on most farms ranges from good to well above average (600-1200 lbs lint). The statewide yield estimate is over 750 pounds of lint which will be the second highest yield in history.

Bollgard cotton has met or exceeded expectations in most instances and has given growers a return on their technology assessment fee, even in a light cotton insect year. Most growers who planted Bollgard cotton in 1996 have stated that they will plant it again in 1997. Several factors will determine whether the overall Bollgard acreage will go up or down. These are: the final gin and yield turn out in 1996, the technology fee in 1997, the Bt variety choices and availability, the availability and price of new chemistry under development and the perceived likelihood of damaging levels of resistant tobacco budworms occurring.