ANTICIPATED CHANGES IN MID-SOUTH INSECT MANAGEMENT RESULTING FROM ADOPTION OF BT-TRANSGENIC COTTON

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Abstract

Utilization of Bt-transgenic cotton will greatly reduce the number of foliar insecticide applications required to control caterpillar pests such as bollworm and tobacco budworm. This reduction in foliar insecticide use will indirectly affect populations of non-caterpillar pests. Beneficial insect populations will be affected favorably and should thus be able to provide additional suppression of pests such as aphids, whitefly, and spider mite. However, the number of insecticide treatments specifically targeting pests such as: boll weevils, plant bugs, and stink bugs will likely increase in Bt-transgenic cotton. This is due to the absence of the inadvertent control of these pests that is often provided by mid to late season treatments targeting caterpillar pests.

Bt-transgenic cotton is one of the most innovative methods of insect control ever to be developed for use in Mid-South cotton fields. Its introduction comes at a time when there is a critical need for new technology with which to manage cotton insect pests, as widespread resistance to currently available insecticides has caused control costs to rise to alarming levels and risks of control failures increase each year. Therefore, adoption of Bt cotton likely will be very rapid, especially in areas where resistance problems are most severe.

One of the basic tenets of integrated pest management is that any change in methods of controlling one pest in the cropping system will usually affect populations and management options for other pests in the system as well. This will certainly be true for adoption of a control method so novel as Bt cotton, and it is vital that growers who chose to utilize this technology be aware of the potential effects its use will have on their overall insect management program.

First we must recognize that, at this point in its development, there is no way to accurately foresee all of the effects of adoption of Bt cotton. However, it has been tested in many field trials using plots up to several acres in size, and enough has been learned to demonstrate that insect management in Bt cotton will be considerably different from that in conventional cotton. It is particularly important to recognize that this technology is not a cure-all for insect problems in Mid-South cotton, but rather it is a tool for use as part of an overall cotton IPM program.

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The budworm/bollworm complex, which currently accounts for over half of the total insect control budget of most Mid-South producers, is the primary target of this control method. Field trials have shown it to be very effective against both pests. However, bollworm is considerably less susceptible to Bt cotton than tobacco budworm, and, under extremely high populations, enough bollworm larvae can potentially survive to cause economic damage to Bt cotton. This is not likely to be a common occurrence in the Mid-South, but it does emphasize the first major point relative to managing Bt cotton. Bt cotton will still need to be scouted for budworm/bollworm so that foliar treatments can be applied if populations are high enough to overwhelm the protection provided by the Bt toxin. Also, because of the difference in susceptibility between budworm and bollworm, maintaining an awareness of which species is most prevalent at any given time will be important in managing Bt cotton.

Because the Bt toxin is inside the plant, larvae must feed on part of the plant before control can occur. It takes very little feeding to produce control, especially for tobacco budworm. Therefore, feeding damage is minimal. This, however, does have major implications for the way in which Bt cotton is scouted. Because control does not occur until after eggs have hatched and some feeding has taken place, neither numbers of eggs nor newly hatched larvae can be used as a basis for applying foliar sprays. It will still be important to count both eggs and newly hatched larvae to provide information on background pest population levels, but supplemental foliar treatments should not be triggered until significant numbers of surviving larvae greater than approximately 1/8 to 1/4 inch are present. Given the current effectiveness of Bt cotton, the need for supplemental foliar treatment is expected to be uncommon, but effective scouting will continue to be essential.

One of the major benefits of Bt cotton is that it will reduce the number of foliar treatments required to produce a cotton crop. Fewer foliar sprays means greater opportunity to utilize beneficial insects to control secondary pests such as aphids and mites. However, fewer foliar sprays also means less inadvertent control of other cotton pests, and growers need to be aware that some pests may increase in importance as a result of widespread adoption of Bt-cotton.

In areas where it still occurs, boll weevil is one pest that will be of greater concern in Bt-transgenic cotton. Many of the insecticides currently used to control budworm\bollworm also have activity against boll weevil, and intensive spraying for this pest complex during mid to late season also contributes to suppressing weevil as well. When these sprays are removed from the system, the number of foliar sprays required specifically to control boll weevil will increase. Fortunately, the Boll Weevil Eradication Program is currently reaching the Mid-South, and promises to eventually eliminate the weevil as an economic pest in the area. Successful eradication of the

boll weevil is critical if Mid-South producers are to realize the maximum potential economic benefit of adopting Bt cotton.

Tarnished plant bug is another pest that is often suppressed by mid season budworm/bollworm treatments. Therefore, adoption of Bt cotton will likely result in higher populations of plant bugs during mid to late season as a result of the reduced number of sprays associated with Bt cotton. Scouting for plant bugs during this time will become more important, and the number of treatments required specifically to control plant bugs during this time period will likely increase.

It is during the period prior to bloom that cotton is most susceptible to injury by plant bug, and adoption of Bt cotton may not greatly affect plant bug populations during this time. Prior to bloom, treatment for budworm/bollworm is relatively less common than after bloom and the primary materials used have little activity against plant bugs. Therefore, elimination of pre-bloom budworm/bollworm sprays should not result in drastic increases in number of treatments applied against plant bug. However, this is the period when treatment for plant bugs is most commonly required and scouting for plant bugs will remain one of the most important insect management concerns in pre-blooming cotton.

Insecticides used to treat plant bugs prior to bloom adversely affect beneficial insects also and thus have a tendency to increase the likelihood of budworm/bollworm infestations. This problem should be minimized in Bt cotton due to the budworm/bollworm control provided by the plant. However, this should not be used as a rationale for increasing insecticide use against early season plant bugs. Excessive early season insecticide could eliminate some of the long-term economic benefits associated with Bt cotton by increasing problems with secondary pests and by selecting for resistance in pests such as tarnished plant bug. Given that the high efficacy of Bt cotton against budworm/bollworm greatly reduces square mortality from these pests, Bt cotton may actually be able to tolerate slightly higher plant bug numbers before sustaining yield loss. However, the overall status of plant bug as a pest in Bt cotton will undoubtedly increase, and producers will have to remain vigilant against this pest.

There are several species of stink bugs occurring in the Mid-South that have the potential to cause significant damage to cotton. These pests are susceptible to many insecticides and are currently kept in check by mid and late season sprays targeting budworm/bollworm. Elimination of these mid and late season sprays due to adoption of Bt cotton will undoubtedly provide more opportunities for stink bug populations to increase. Therefore, scouting for stink bugs, especially during late season when stink bug populations are highest, also will become more important in Bt cotton.

Activity of Bt cotton against the armyworm complex is considerably less than that against budworm/bollworm, and both beet armyworm and fall armyworm can survive and cause damage to Bt cotton. However, Bt cotton still provides important advantages, especially against beet armyworm, because the reduced number of mid to late season foliar sprays allows better preservation of key beneficials that help keep beet armyworms in check.

From the above discussion it is obvious that there are some potential problems associated with Bt cotton. However, most of these potential problems are relatively minor and, with careful scouting and judicious treatment, are easily managed. Budworm/bollworm typically accounts for around half of the annual insect control costs in Mid-South cotton. Therefore, the potential advantages of Bt cotton appear to far outweigh any disadvantages.

One potentially under appreciated benefit of Bt cotton relates to its potential impact on insecticide resistance. Reducing the number of foliar treatments required to control budworm/bollworm also reduces inadvertent selection for resistance in pests such as aphids and tarnished plant bugs and should result in improved ability to control these pests with current materials and a prolonged life span for any new materials that are developed.

Avoiding the development of resistance in budworm/bollworm to Bt cotton is a critical concern accompanying introduction of this technology. The genetic potential for resistance to Bt is already known to be present in tobacco budworm populations. Unlike foliar applied insecticides, which are used only intermittently, Bt cotton exerts control continuously throughout the season, and selection pressure for resistance will be very intense. Therefore, producers are encouraged to carefully adhere to guidelines on minimizing the potential for resistance development that will accompany introduction of this product.