EFFECT OF BOLL WEEVIL ERADICATION AND PLANTING BOLLGARD VARIETIES ON CHANGES IN THE INSECT SPECTRUM AND CHEMISTRY NEEDED FOR COTTON IPM IN ALABAMA

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Abstract

Genetically altered cotton varieties and the elimination of the boll weevil have caused tremendous changes in cotton insect management and control in Alabama. These changes have resulted in lower insecticide use and significant changes in the cotton pest spectrum, which has dictated subsequent changes in scouting techniques, treatment thresholds, and the type of insecticide chemistry needed.

Discussion

By 1995, the boll weevil eradication program resulted in the elimination of any yield losses in cotton due to boll weevil damage. Losses to the bollworm and tobacco budworm were consistently low from 1980 to 1992, during a period when pyrethroid insecticides were most effective. From 1993-1995, losses increased to 20-50% of the total yield, reflecting the development of resistance in the budworm species to all classes of available insecticides.

Growers had a desperate need for new control techniques, and fortunately genetically altered cotton varieties that produce the Bt toxin became available in 1996. The percent of acres planted to Bollgard varieties averaged from 62 to 77% during the 1996-98 years. Losses to budworm were zero on acres planted to Bollgard varieties in 1996 to 1998. One additional tool for budworm control became available in 1997. Spinosin, a new class of chemistry introduced by Dow Agrosciences, is very effective on the budworm species. However, supplies have been limited, and many growers have had difficulty timing applications for maximum effectiveness. A low level of damage from the bollworm species occurs on Bollgard varieties. Bollgard is less effective on the bollworm, and under high infestations, economic level of escapes may occur during the mid season window that coincides with the movement of bollworms from maturing corn to cotton.

Due to these changes in cotton production, the number of insecticide applications on cotton has been reduced from the historical average of six to 12 to approximately zero to four on Bollard planted acreage. This low spray environment has created a situation where low levels of several species, including plant bugs, fall armyworms, and stinkbugs, move into fields and increase in numbers over a period of several weeks, eventually reaching threshold levels. Beneficial insects offer only limited potential in reducing populations of these specific species.

Plant bugs have been an erratic economic insect pest in cotton, with losses varying from year to year. The variation has been closely associated with planting dates, and late spring (May-June) weather conditions. In general, late squaring cotton is more susceptible to plant bug injury. Plant bugs move to new hosts as older wild hosts mature, reduce flowering, and dry down. Wet, cloudy weather in May and June tends to keep wild host plants along field borders lush and blooming over a longer period of time. This in turn lengthens the time wild hosts serve as a reservoir for plant bugs and extends the plant bug migration into cotton. Conversely, an extended drought in May results in poor survival of plant bugs during the generation prior to their movement into cotton. The low insecticide use pattern on cotton at present may magnify this variability in year to year damage by the plant bug.

Previously, plant bugs were an economic insect only in the prebloom period because insecticide applications targeted toward other pests, such as weevils and caterpillars suppressed plant bugs in mid to late season. Determining percent pinhead square retention is an effective means of measuring plant bug damage and making treatment decisions in the early season window. In mid to late season, the damage often is more evident on large squares, just prior to bloom, or on immature bolls. No thresholds are available for this stage of cotton or in this period of the fruiting season.

The cotton leafhopper and clouded plant bug (CPB) also have become more evident in the past three years. Damage from both species is similar to the plant bugs except the CPB is more of a mid-to late season boll feeder. CPB damage may be confused with stinkbug damage.

The fall armyworm (FAW) is another pest that has increased in importance in the low-insecticide use environment on cotton. This is especially true for the Coastal Plains and Gulf Coast areas of Alabama and the other southeastern states. In past years, pyrethroid sprays targeted for the bollworm-budworm complex were effective in suppressing fall armyworms. At present there is a reduced need for in-season caterpillar sprays on Bollgard varieties, resulting in a wide window of the season in which FAW may become established. Recent infestations have been seen as early as June 20 (early bloom stage of cotton) on the Gulf Coast area of Alabama, and by the end of July can be detected in cotton statewide.

Typically, two FAW generations may damage cotton. In 1996 and 1997 most of the damage was localized in the extreme southern counties; therefore, the increased damage

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is not as evident in statewide yield losses. In 1998 economic damage also occurred in central Alabama. The FAW has been responsible for increased losses and control costs incurred during the past three seasons. This trend is expected to continue in future years.

Since the FAW is often the only caterpillar species present on Bollgard cotton, and the early instar larvae infest the plant differently than other species, special emphasis has been placed on field scouting techniques. Routine scouting techniques of the past are not adequate to detect and quantify early instar FAW populations on cotton. Some first instar FAW's occur in white and red blooms. However, the majority occur and feed for several days low on the plant inside the bracts of the oldest, most mature bolls. Scouts must monitor each individual boll on the plants sampled to detect and measure these developing populations. This is a very time-consuming process, requiring as much as five minutes per cotton plant.

The third insect that is assuming a much more prominent economic role following weevil eradication and the planting of Bollgard varieties is the stinkbug. This insect has become more damaging in all areas where the boll weevil has been eliminated, and a reduced need for phosphate insecticides has occurred. This increased loss occurred immediately after the widespread adoption and planting of Bollgard varieties in 1996. Pyrethroids targeted for tobacco budworm control kept the stinkbug in check from 1989 through 1995.

Damage to cotton fruit by the stinkbug is primarily in mid-to late season (late July to maturity) following this movement from corn and other maturing host crops. No scouting techniques or treatment thresholds were established or needed in Alabama prior to 1996 and most scouts, growers, and consultants did not recognize stinkbug damage. After three seasons of field validation the drop cloth appears to be the most effective scouting technique. Field surveyors may also use a percentage of damaged bolls near the top of the plant as an indicator of the need for insecticide controls.

Stinkbug control is rather economical compared to some other pests. One to three sprays in August may prevent up to 25% yield loss. Field tests have shown that phosphate insecticides at 0.25 to 0.5 pound active ingredient (a.i.) per acre ($3-4) give more than 95% control. Pyrethroids, at standard label rates for bollworms, will give approximately 70-85% suppression of stinkbugs. If pyrethroids are applied for fall armyworms, adequate suppression of stinkbugs may be obtained without tank mixing a phosphate insecticide. Since stinkbug controls are usually needed in August, the suppression of beneficial insects is not as critical as earlier, when the fruit is less mature.

Based on the first three seasons with this lower insecticide use pattern, it appears that stinkbugs may be a greater economic pest of cotton in the Coastal Plains and the Gulf Coast regions of the Southeast than they are in other parts of the Cotton Belt. This is likely due to the mild winters and wide range of early spring host crops in which stinkbug populations increase rapidly.

This lower spray environment has had a positive impact on natural control of the beet armyworm (BAW), thereby reducing its importance as an economic pest. This insect almost demolished the cotton industry in Alabama and Georgia between 1988 and 1995. Historically, there have been wide fluctuations in losses and control cost from year to year. However, these figures do not accurately reflect the severity of the BAW in a particular field, farm, or region. Losses in numerous fields during outbreak years were from 50 to 100% of the total yield.

The BAW was not a significant economic pest prior to the first full season of boll weevil eradication in 1988. No field has had an economic level of BAWs since widespread area-wide malathion applications were terminated following the 1995 season. Many persons associated with cotton production believe that drought is the primary factor causing BAW outbreaks. However, extreme drought occurred in the deep sandy soils of Southeast Alabama during the 1996 to 1998 seasons. However, no BAW outbreaks have occurred. Three factors associated with boll weevil eradication may have been important contributors to these outbreaks: (1) malathion, the most residual of all phosphates, was used for weevil control; (2) insecticide applications were applied ULV, which extends the residual and drift to nontarget crops, or areas that serve as reservoirs for beneficials; and (3) all fields within a large geographical area were oversprayed at the same time during the early years of the eradication program. This is quite different from growers treating individual fields on an as needed basis, which had always been the pattern prior to an area-wide program.

Under the present conditions and situation, the BAW is not expected to be an economic pest of cotton in the southeastern U.S. in the foreseeable future. However, several other armyworm species and insects are being detected in fields under this reduced insecticide input regime. Most of these have little or no potential to become economic pests. Growers should not overreact just because a caterpillar has an "armyworm" name. Other species found in low insecticide input cotton fields are the yellow striped and southern armyworm, cotton square borer, garden webworm, and cotton leafworm. Other insects that need to be recognized by those monitoring cotton fields are: cotton leafrollers, false chinch bugs, loopers, European corn borers, spined soldier bugs, rove beetles, and hooded beetles. Thrips, aphids, whiteflies, and spider mites have not been significantly affected by this new environment. These pests historically have been more sporadic and more influenced by weather conditions, especially droughty periods.

Summary

The combination of planting Bollgard varieties in areas where the boll weevil has been eliminated as a pest has resulted in a much lower insecticide use environment, which has caused shifts in species of key economic insects of cotton. As new insects take on a potentially higher economic profile, identification, scouting techniques, thresholds, damage recognition, and effectiveness of insecticides must all be learned by scouts, growers, consultants, entomologists, and the agrichemicals industry. Alabama is currently three years into this new cotton production system. Much has been learned about the evolving IPM aspects already. To obtain the maximum returns on cotton production, additional and continuous fine tuning will be necessary in cotton IPM.