INSECT MANAGEMENT

Cotton insect management has changed dramatically since the successful elimination of the boll weevil as an economic pest. Prior to elimination of the boll weevil Georgia producers annually applied 10 to 20 insecticide treatments each season for control of boll weevils and other pests. During 1986, the year prior to initiation of the Boll Weevil Eradication Program (BWEP), the estimated number of insecticide applications totaled 15.8 per acre. Upon elimination of the boll weevil as an economic pest, the number of insecticide applications was reduced to four or five during 1992 to 1995. Commercialization of Bt cotton during 1996 further reduced the need for insecticides by eliminating the need to treat tobacco budworm and significantly reducing the need to treat for corn earworm. Producers in Georgia continue to fully utilize an integrated approach to pest management (IPM) utilizing a variety of control tactics rather than relying solely on one method of control such as insecticide use. Cultural practices, variety selection, biological control, and insecticides used on an as-needed basis are the building blocks of an IPM program. Pests are managed so that economic damage and harmful environmental side effects are minimized while maximizing profits. In most IPM programs insecticide use decreases which results in lower production costs, delayed resistance problems, and improved competitiveness and profitability. A successful and economical cotton pest management program mandates the use of this multi-tactical or IPM approach to insect control.

Scouting

Insect scouting is a **necessity**. All fields, both non-Bt and Bt cotton, should be scouted on a regular basis. Insect populations vary from year to year and even from field to field during the year. Fields should be scouted at least every five days, many scouts monitor fields twice per week. **Once a week scouting on non-Bt cotton is unacceptable**. Although not recommended, once a week scouting may be acceptable on Bt cotton but there is associated risk with this reduction in field visits. Management decisions should be made independently for each field based on the pest(s) situation. Accurate monitoring of fields will allow growers to make timely applications of the correct insecticide(s) and rates to prevent damage from reaching economic levels. (See ***Cotton Scout Handbook*** for a detailed discussion of insects and scouting techniques and Appendix I for insecticides and rates.)

Beneficial Insects

In addition to monitoring for pest insects, counts of beneficial species should also be made. Several species of predatory and parasitic insects are present in Georgia cotton. These natural controls are our most economical pest management tools and conservation of beneficial populations should be considered especially during early season. Big-eyed bugs, minute pirate bugs, fire ants, and *Cotesia* wasps are four important beneficials. The presence of these natural controls may delay the need to treat for some insect pests. The use of beneficials should be maximized in attempts to reduce production costs. Conservation of beneficial insects is most important during June and early July and becomes less critical later in the season.

Thresholds

Action or economic thresholds have been established for major cotton insect pests and are defined as the pest density at which action must be taken to prevent economic damage.
The decision to apply an insecticide should be based on scouting and the use of thresholds. Thresholds for major cotton insects found in Appendix I should serve as a guide for decision making. **Scheduled or automatic applications of insecticides should be avoided**. An

unnecessary application can be more costly than just the cost of the insecticide due to the destruction of beneficial insects. In the absence of beneficial insects, the risk of economic infestations for many pests increases. Application of insecticides on an as-needed basis allows beneficials to be preserved and reduces the likelihood of secondary pest outbreaks such as beet armyworm.

Early Season Insects

Thrips are early season pests which feed in the terminal bud of developing seedlings. Thrips injury results in stunted plants, delayed maturity, reduced yield potential, and in severe cases reduced stands. Early season thrips should be controlled with a preventive treatment at planting (See Appendix I for insecticides, rates, and thresholds). Foliar sprays may be needed if no preventive treatment has been used, environmental conditions are not conducive for uptake of at-planting systemic insecticides, or if unusually heavy thrips infestations occur.

Banding Insecticide Applications

For band applications with high clearance or conventional sprayers, a minimum band width of 20 inches should be used. If applications are made in conjunction with a precision cultivation operation, a nozzle set to cover a band width of 6-8 inches wider than the row canopy at average plant height should be acceptable. Check plants for adequate coverage.

Tobacco Budworm / Corn Earworm Management

Tobacco budworm and corn earworm comprise the bollworm complex. Although these two species appear very similar in the egg and larval stages and cause similar damage, they are different insects and their susceptibility to specific insecticides differ. Three generations of tobacco budworm infest cotton each year. The first generation usually occurs in early June, the second in early July, and the last during August. These time periods vary from year to year and locality within the state but generally occur on a four-week cycle. Two generations of corn earworm infest cotton. The first corn earworm infestation is typically observed during mid-July when corn begins to dry down and a second generation occurs approximately 30 days later.

It is important that we accurately distinguish between these two species. The adult or moth stage of tobacco budworm and corn earworm can be easily distinguished (See ***Cotton Scout Handbook*** for a detailed discussion of insects and scouting techniques). Observation of "flushing" moths during scouting and other field activities provides an opportunity to recognize which is the predominant species. Populations of tobacco budworm infesting Georgia cotton are resistant to the pyrethroid class of insecticides and therefore **non-pyrethroid insecticides should be used to control tobacco budworm**.

On non-Bt cotton insecticide applications should target larvae 1/4 inch in length or less (3 days old). Coverage and penetration of the canopy are also important. These basic principles of insect control are especially important if high populations or difficult to control larvae are present.

Distinguishing tobacco budworm and corn earworm is also important in Bt cotton. Corn earworm is less susceptible to the Bt toxin compared with tobacco budworm. Supplemental treatments may be needed for corn earworm control on Bt cotton whereas control of tobacco budworm has been excellent.

Pyrethroid Resistant Tobacco Budworm

Pyrethroid resistant tobacco budworm populations were first documented in Georgia during 1997 where resistance levels greater than 30-fold were present in a Decatur county population. During 2004 and 2005 all tobacco budworm populations bioassayed exhibited some level of pyrethroid resistance. Erratic and often unacceptable control has also been observed when pyrethroids were used for control of tobacco budworm. In areas where tobacco budworm commonly infests cotton, producers should utilize Bt cotton which has provided excellent control. On non-Bt cotton, pyrethroid insecticides should not be used for control of tobacco budworm. Non-pyrethroid insecticides should be used in a timely basis for control of tobacco budworm.

Difficult to Control Corn Earworm

During late August and early September of 2005, difficulty controlling corn earworm with pyrethroids was observed in some areas. In problem fields multiple sprays were needed. Acceptable but not excellent control of corn earworm with pyrethroids was observed in Bt cotton, whereas unacceptable control was observed in some, but not all, non-Bt fields.

For several years corn earworm susceptibility to pyrethroids has been monitored using cypermethrin (pyrethroid) treated glass vials. To conduct these Adult Vial Tests, moths are collected from pheromone traps and placed in pyrethroid treated vials and mortality is evaluated 24 hours later. Since 2000 we have observed a trend for increased survival in pyrethroid treated vials but experienced no field control problems of corn earworm with pyrethroids. Prior to 2005, the majority of monitoring data has been from corn earworm populations collected in Tift County. Moths from larvae collected in problem fields (Crisp, Terrell, Mitchell, and Seminole Counties) showed a significant increase in survival in cypermethrin treated vials. Topical assays with cypermethrin were used to generate LD50s on these problem populations and did not indicate high resistance levels (Leonard, LSU). However results from adult vial tests and the topical assays do indicate that a change in susceptibility of corn earworm to pyrethroids has occurred.

Recommendations for control of corn earworm in 2006 include the use of high rates of pyrethroids for low to moderate infestations. Under heavy pressure, consider adding an ovicide or another larvacide with the pyrethroid. Efficacy of pyrethroid sprays should be evaluated three days after application. If poor control of corn earworm is observed and other factors of poor control (coverage, rate, timing of application) can be ruled out, a non-pyrethroid insecticide should be used. We cannot predict if this problem will develop further or if, when, or where it may occur.

Resistance Management

In a population of insects, insecticide resistance levels to a particular class of insecticide increase each time that class of insecticide is used. Once an insecticide is used, its level of effectiveness will likely be reduced against subsequent generations within the season. Therefore **alternating the use of insecticide classes on different generations** of insects during the season is a recommended resistance management tactic. Since most cotton insect pests are highly mobile, such a strategy will be most effective if adopted by all producers in a large geographic area.

Bt Cotton Management (Single-Gene and Two-Gene)

Scouting for insect pests remains important in Bt cotton. Single gene Bt cotton (Bollgard) has excellent activity on tobacco budworm and good activity on corn earworm, but no activity on

"bug" pests such as plant bugs and stink bugs. Field observations indicate that single gene Bt cotton has little activity on fall armyworm and soybean looper. Single gene Bt cotton should be monitored closely for corn earworm and fall armyworm during mid to late July when these pests typically infest cotton. Fields should also be monitored closely for **stink bugs** once plants begin to set bolls.

A two-gene Bt cotton (Bollgard II) was commercialized during 2003. In addition to the Cry1Ac toxin found in Bollgard cotton, Bollgard II also expresses a Cry2Ab toxin. The addition of the Cry2Ab gene has enhanced the efficacy and spectrum of activity on caterpillar pests compared with single-gene (Cry1Ac) Bt cotton. Based on research and field observations, we do not anticipate there will be a need to treat a high percentage of the acres for caterpillar pests in Bollgard II cotton. The potential for economic damage from caterpillar pests in Bollgard II remains and scouting will still be needed. The continued reduction in the use of caterpillar insecticide applications such as pyrethroids in Bollgard II will further reduce coincidental control of stink bugs and other boll feeding bugs.

A second two-gene Bt cotton (WideStrike) was commercialized in 2005. In addition to Cry1Ac, WideStrike also expresses a Cry1F toxin. The addition of Cry1F gene also enhanced the efficacy and spectrum of activity compared with single-gene (Cry1Ac) Bt cotton, especially on loopers and armyworm species. As with other Bt cottons, all fields should be scouted for caterpillar pests and treated on an as needed basis.

Bt Cotton Resistance Management

Since Bt cotton provides continuous season long activity against tobacco budworm and corn earworm, there is a high potential for one or both of these pests to quickly develop resistance if an effective resistance management plan is not implemented. Resistance management in Bt cotton uses the refuge approach to maintain a pool of susceptible moths to mate with any resistant moths that may survive on Bt cotton. Producers should maintain full knowledge of the details and follow resistance management requirements of use agreements with suppliers of transgenic seed or technology.

Stink Bug Management

The pest status of stink bugs in Georgia cotton and other areas of the Southeast has been elevated in recent years due to the reduction of broad spectrum insecticide use. Eradication of the boll weevil, greater utilization of natural controls, commercialization of Bt transgenic cotton, and development of caterpillar specific insecticides have all contributed to the reduced use of broad spectrum insecticides. Routine use of broad spectrum insecticides, such as pyrethroids, to control other pests in years past suppressed stink bugs below economic levels. In the absence of coincidental control of stink bugs, populations can build to damaging levels.

The most important species of stink bugs that we observe in Georgia are the southern green, green, and brown stink bugs. Of the three, southern green is generally the most common. The organophosphate insecticides provide excellent control of all stink bug species. Pyrethroids provide good control of southern green and green stink bugs and are useful when populations of both caterpillar pests and stink bugs infest the same field. Research indicates that the brown stink bug is less susceptible to pyrethroids compared with southern green stink bug. If brown stink bugs are present at economic levels an organophosphate insecticide should be used. However, the

key to successful management of stink bugs in cotton is to know when and if a stink bug insecticide application is needed.

Stink bugs have piercing sucking mouthparts and damage cotton by feeding on the seeds of developing bolls. Stink bugs feed by piercing the boll wall with their beak and injecting a digestive enzyme into the boll in or near the seed to soften or dissolve plant tissues so the bug can remove them. In addition to physical damage, this process allows for entry of rot organisms that contributes to degradation of bolls reducing yield and quality. Bolls damaged by stink bugs may show a sunken, purple spot about the size of a pinhead on the outside boll wall, however this is not a reliable indicator of stink bug damage. Internal symptoms of injury are a much better indicator of stink bug feeding and include stained or yellowish lint and/or a callous growth or wart on the inner surface of the boll wall where the stink bug penetrated the boll. The wart or callous growth on the inner surface of the boll wall will form within 48 hrs. on developing bolls. As bolls mature and open, damage often appears as matted or tight locks with localized discoloration that will not fluff. Severely damaged bolls may not open at all.

Scouting for stink bugs should be a priority as plants begin to set bolls. In addition to being observant for nymphs and adult stink bugs, scouts should assess stink bug populations by quantifying the percentage of bolls with internal damage or with a drop cloth. Estimating boll injury has proven to be a reliable technique for timing insecticide applications when needed. Bolls are considered injured if stained lint is observed or a warty growth is present on the inner surface of the boll wall. Bolls approximately the diameter of a quarter should be examined. Bolls of this age can be squashed easily between your thumb and forefinger. It is important that bolls of this size (soft) are selected. The recommended economic is when 20% of quarter sized bolls display internal signs of stink bug feeding and stink bugs are observed in the field. If bolls which are the diameter of a quarter are not present, i.e. the first or second week of bloom, sample the largest bolls present. Be observant for boll shed, if stink bugs feed on small bolls they may be shed by the plant. In addition to stink bugs, other bug species such as tarnished plant bug and leaf-footed bugs may injure developing bolls.

Research suggests that in addition to yield loss, excessive stink bug damage can reduce fiber quality characteristics. Fiber characteristics associated with length, maturity, and color are reduced when excessive stink bug damage is present.

Stink bugs are a primary pest of Georgia cotton and require management. Not all fields will require treatment, but for profit maximization scouting and treating on an as-needed basis is required. Fields at highest risk for stink bug infestations are those that have not received a broad spectrum insecticide such as a pyrethroid during the past two weeks.

Boll Weevil Eradication Program

The BWEP is in the containment phase. Activities include reduced trapping but active spraying in areas where boll weevils are detected. Boll weevils are the responsibility of the program, so growers with suspected boll weevil problems should notify their local field supervisors. Everyone growing cotton is required to pay an assessment for the BWEP based on planted acreage. Boll weevil traps should be placed in all fields by late July to monitor for reinfestations. It is vitally important that all fields are trapped and that traps are standing and functional. If a trap is accidentally knocked down or destroyed, stand it back up or contact your local field supervisor.

All attempts to prevent reinfestation should be taken. A common means for boll weevils to reenter Georgia is on used farm machinery such as pickers. If you plan to acquire machinery from a non-eradicated area, be sure it is boll weevil free. Contact the boll weevil eradication program for more details.