

**INSECT MANAGEMENT STRATEGIES
IN BOLLGARD COTTON IN THE SOUTHEAST**

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Abstract

Bollgard insect management strategies vary across the southeastern cotton states of Alabama, Florida, Georgia, South Carolina, North Carolina and Virginia. Nine regions within this six state area are loosely identified by their insect control strategies in Bollgard cotton. These areas are described as follows: (1) Tennessee Valley / Northern Alabama, (2) Central Alabama, (3) Southern Alabama / Florida panhandle / Southwest Georgia, (4) Central Georgia, (5) Savannah River Valley - Eastern Georgia and lower South Carolina, (6) Carolina above the Santee-Cooper Lakes, (7) Central North Carolina, (8) Eastern Shore North Carolina and (9) Upper North Carolina / Virginia.

All areas within this region are tend to include foliar insecticides in their Bollgard management plan for optimal profitability. Scouting and supplemental insect treatment decisions vary slightly in each region based on overall pest populations.

Bollworm scouting techniques, originally thought to be over burdensome in Bollgard, have been refined by more progressive crop advisors. Using historic cotton bollworm (*Helicoverpa zea*) moth flight information, many have optimized their field survey techniques in Bollgard. These advisors are reporting Bollgard different but no more difficult to scout than conventional fields.

Secondary insects, including stink bugs, 3rd generation plant bugs and armyworms, have become more predominant economic pests in late season untreated Bollgard cotton.

Introduction

From the early field trials with *B.t.* transgenic cotton in 1991-1995, considerable debate surrounded field management strategies in transgenic insect protected cotton.

MaHaffey (1994, 1995) and others indicated that high numbers of bollworm could cause economic damage in Bollgard cotton. Yet, large field plots of *B.t.* transgenic cotton had not experienced sufficient escaped larvae to predict needed supplemental bollworm control measures. The first management uncertainty came from the Brazos

Valley area in Texas during the launch year of 1996. Intense bollworm pressure in this area resulted in bollworm larval escapes in Bollgard fields. It quickly became apparent that supplemental insect management in Bollgard cotton was necessary for optimal cotton production.

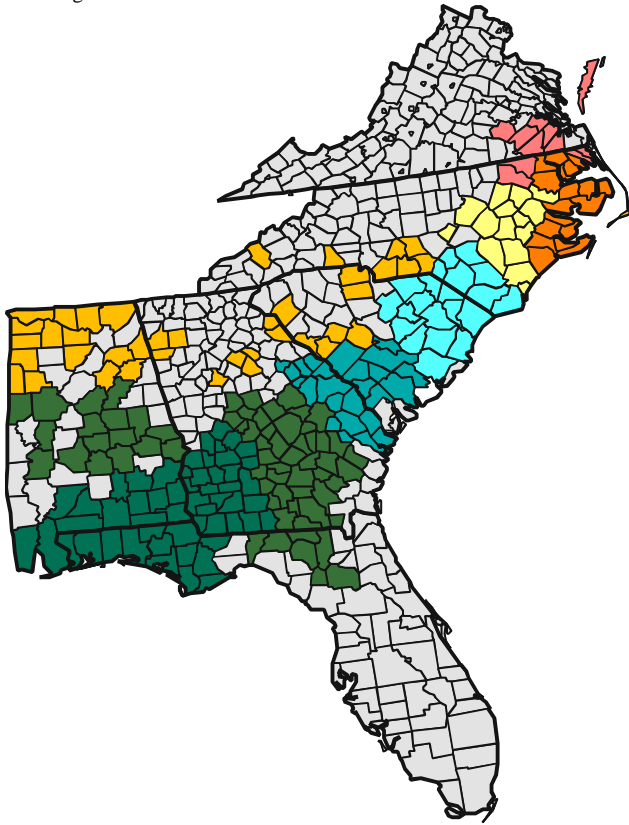
This paper will discuss some of these management strategies that have evolved over the last three field seasons in the six cotton states of the southeastern USA . Information in this presentation has been collected from consultants, extension and industry representatives from states stretching from Alabama through Virginia. Comments made in this presentation are not endorsements or recommendations, simply communications about how different Bollgard management practices have been implemented across the Southeast.

The six states included in this discussion are Alabama, Georgia, Florida, South Carolina, North Carolina and Virginia. This area covers around 3.2 million cotton acres which includes almost 1 million acres of Bollgard cotton.

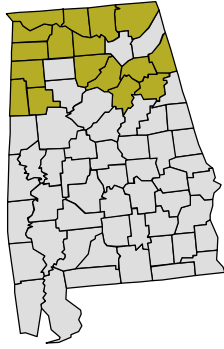
Regions

Conversations with cotton helped develop this rough map of 9 management areas. While variances will occur on a year to year basis from swings in insect cycles and weather, these areas are delimited by their Bollgard insect management practices. These areas are identified as follows:

(1) Tennessee Valley / Northern Alabama (including outlying northern counties in Georgia, the ridge counties in northern South Carolina, and western most counties in North Carolina) (2) Central Alabama (3) Southern Alabama / Florida panhandle / Southwest Georgia (4) Central Georgia (5) Savannah River Valley - Eastern Georgia and lower South Carolina (6) Carolina above the Santee -- Cooper Lakes (7) Central North Carolina, (8) Eastern Shore North Carolina (9) Upper North Carolina / Virginia.



North Alabama / Tennessee Valley Area



The Tennessee Valley area is most noted for its early season plant bug (*Lygus lineolaris*) populations. It is estimated that 50-75% of the fields are treated during the first part of June for plant bugs. Bollgard is no exception for plant bug management in this region.

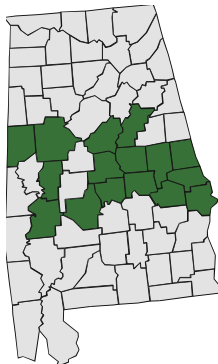
The bollworm moth flight occurs around July 21 results in 20% (eggs per 100 plants) eggs on a heavy night. About 80% of the conventional fields are treated 1 time for bollworms, and 40% a second time. Supplemental bollworm control is normally applied on 2-3% of Bollgard fields, although 25% of fields were sprayed in 1998.

Scouting in Bollgard fields has been amended to concentrate on blooms beginning at peak bollworm moth flight. Treatment decisions in Bollgard are driven by escaped larvae observed in blooms and dried bloom tags.

Strategy

- Control plant bugs early as needed
- Examine blooms and tags for bollworm escapes after peak moth flight
- Watch for secondary pests in August

Central Alabama



The normal bollworm flight occurs around July 18 with egg pressure from these flights ranging from 50-60%. Early season applications in cotton are those in conventional cotton for the first flight of tobacco budworm (*Heliothis*

virescens) since plant bugs seldom require early season control. Only one in three years has Bollgard required supplemental bollworm treatments.

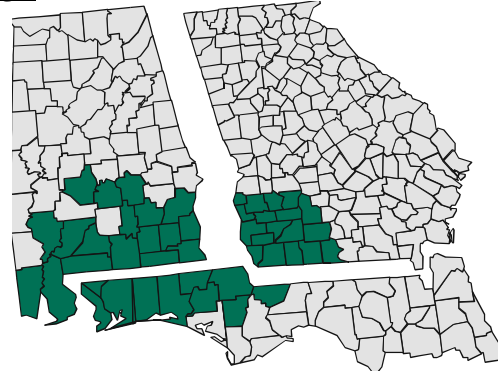
The major concern in Bollgard cotton is late season of tarnished plant bugs, cloudy plant bugs, flea hoppers and stink bugs. Most producers budget at least one application of a pyrethroid in early August to eliminate these sucking insects.

Since budworms are not a key pest in Bollgard fields, early season resources are shifted to conventional fields to determine specie identification critical to control of pyrethroid tolerant budworms. Bollgard fields are brought back into play during the peak bollworms moth flight with scouts concentrating on blooms, bloom tags and lower plant parts.

Strategy

- Concentrate on specie identification in conventional fields early
- At bollworm moth flight, check blooms, tags and lower plant parts in Bollgard for larval escapes, trigger supplemental worm control on escapes
- Watch for secondary pests in August Bollgard.

Southern Alabama / Florida Panhandle / Southwest Georgia



With high populations of pyrethroid tolerant tobacco budworms and a limited arsenal of effective alternative chemistries, Bollgard has found this as one of its most appreciated regions.

Early season plant bug applications are rare and conventional cotton normally requires 1-2 applications for the June budworm flight. The first major bollworm flight occurs around July 15 with egg numbers expected in the 100% range. The first anticipated larval treatments in Bollgard are about 1 week after this first moth flight. While treatment decisions are not timed to the egg lay, escaped larval thresholds are sensitized to this event. Initial supplemental larval treatments are directed to escaped bollworms, but more importantly toward building fall armyworm (*Spodoptera frugiperda*) populations.

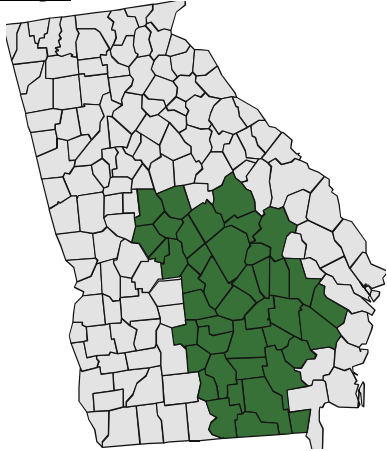
August management decisions in Bollgard are influenced predominantly by fall armyworms and stink bugs which will often eliminate or supersede escaped bollworm thresholds. Growers are budgeting an August pyrethroid application to blanket this group of boll feeders.

Scouting techniques in Bollgard are similar to conventional cotton, however, more attention is given to the interior of the plant including bolls and blooms. With late season pests becoming more important, field inspections now include small boll observations for stink bugs and 3rd generation plant bugs.

Strategy

- Concentrate early scouting in conventional fields for specie determination
- Beginning a the bollworm moth flight, rely on escaped larvae thresholds in Bollgard
- Late season, key on fall armyworms, late season plant bugs, escaped bollworms, and stink bugs

Central Georgia



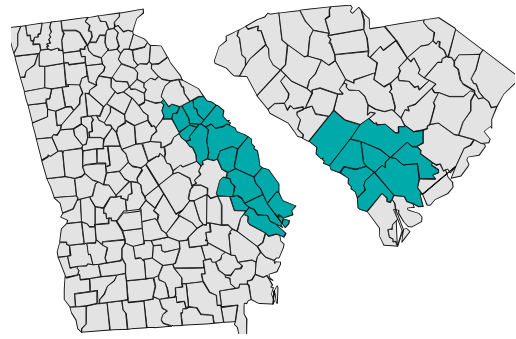
Budworms reach treatable levels in conventional fields in late June almost every year. The first bollworm flights arrive around July 15, with the northern section hit 7 days later. Peak bollworm moth flight numbers normally produce eggs in the 30-50% range. Bollgard applications are targeted to a mixed group of escaped bollworms, armyworms and late season stink bugs.

Field scouting of Bollgard concentrates in the middle portion of the plants. More attention is also directed to fall armyworm and stink bug damage.

Strategy

- Preserve beneficials
- Watch for escape bollworms in mid July
- Protect from stink bugs and fall armyworms in August

Savannah River Valley : Eastern Georgia – South Carolina Below the Lakes



There is no area in the southeast that has the intensity or predictability of bollworm pressure than this region. The initial bollworm flight occurs **July 10** and results in egg pressure well above **100% for 10+** days. Research data (Turnipseed 1998) and field scouting reports confirm the value of beneficial insects in this heavily saturated bollworm area. Early season applications for plant bugs, while rare, frequently promote bollworm escapes. Bollgard fields not treated early for plant bugs can often withstand the first days of this bollworm onslaught, but logistics of covering multiple fields for potential escaped bollworm larvae emphasize prompt action. Being the first area in the southeast to detect pyrethroid tolerant bollworms, early detection and treatment on escaped small larvae is crucial.

Supplemental bollworm application in Bollgard are initiated when egg numbers from this first flight exceed the 75% state threshold. A follow up application is planned within seven days. Fields are subsequently scouted for an anticipated third application using escaped bollworm larvae in blooms and dried bloom tags.

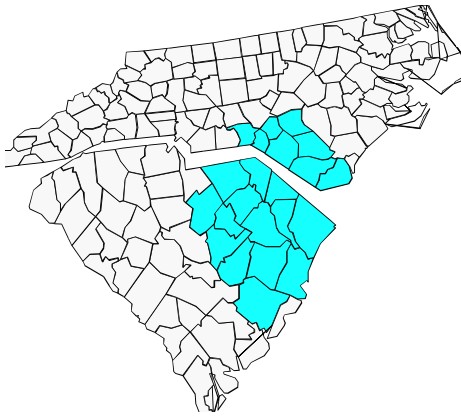
Adding to the need for supplemental bollworm control are the repeated influxes of fall armyworm in mid to late August. Stink bugs often become key in fields left untreated for 14 or more days, particularly in late August and early September.

Scouting concentrates on egg observations through the first week of the moth flight. Around 10 days after the initial flight, subsequent scouting shifts to escaped bollworm larvae in blooms and dried bloom tags. High egg mortality later in the season (late AUG - SEP) precludes egg threshold decisions after the major flight.

Strategy

- Preserve beneficials early
- Trigger first supplemental applications on Bollgard with Egg Threshold
- 7 day sequential application if flight persists
- August supplemental application based on escaped bollworms, fall armyworms and stink bugs

Carolina Above the Lakes / Lower North Carolina



Beginning just north of the Santee-Cooper lakes of South Carolina, and extending two counties deep into North Carolina, this area is a transition zone. Though insect pressure in hot spots often builds to extremely high numbers, the intensity and predictability of the bollworm flight is drawn-out compared to the cotton areas below the lakes. The normal bollworm flight occurs around the July 15 with egg counts in the 40-80% range. Escaped larvae are normally used as trigger for supplemental control. Many Bollgard fields are left untreated during this first moth flight, but most will reach escaped larval thresholds within 10 days if the flight persists.

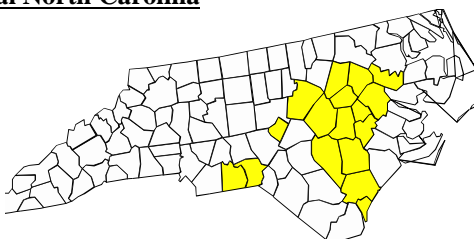
Stink bugs in late August and early September have become increasingly important, particularly in years of lower spray environments. Field sampling is predominantly done by examining small bolls for damage, frequenting an August application for sucking insects.

Bollgard scouting is concentrated into the canopy of the plants. Often field decisions are made on combination of egg and escaped larval numbers over a period of several days. After the first moth flush, emphasis is shifted to blooms, bloom tags and bolls.

Strategy

- Monitor egg pressure during initial bollworm flight
- Trigger initial supplemental application in Bollgard on spiked egg numbers or protracted egg numbers over the first week of moth flight
- Monitor for escaped bollworms after initial flight
- Protect against stink bugs and fall armyworms beginning in early August

Central North Carolina



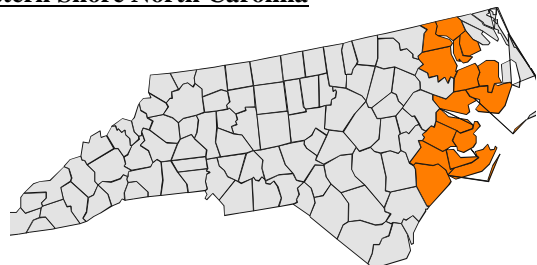
A collection of 17 counties extending from Pender County northwest to Nash County, in the eastern half of North Carolina make up this region. Early season plant bug treatments are put on less than 5% of these acres and less than 10% of conventional fields are treated for early season budworms on an annual basis. The initial bollworm moth flight hits this section around July 18 with egg counts approaching the 50% level. Conventional fields are routinely treated twice, with Bollgard fields seldom requiring supplemental bollworm control measures during the initial flight. Secondary pests in Bollgard, particularly stink bugs and 3rd generation plant bugs often do initiate over sprays in mid August. A budgeted single application over Bollgard fields for control of secondary pests in August has been shown profitable when pests are present.

Field scouting is done on a whole plant basis. New thresholds for the area take into effect low populations over a protracted period of time. Many growers have opted to anticipate a supplemental treatment on Bollgard fields 8-10 days after conventional fields have been treated. This allows the grower to sequence his applications after conventional fields as well as pick up secondary pests that have begun to build in the unsprayed Bollgard environment.

Strategy

- Watch for bollworm escapes after mid July bollworm flight
- Anticipate supplemental control on Bollgard fields 8-10 days after 2nd conventional field treatments.

Eastern Shore North Carolina



Positioned against the eastern shore around the Pamlico and Albemarle Sounds, weather conditions and other environmental factors evidently promote higher insect populations.

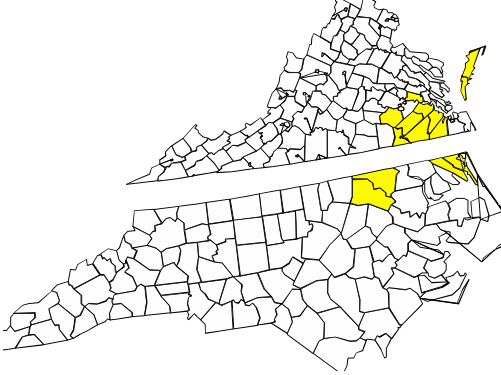
The unique area along the Chowan River is notable for its early season populations of tobacco budworm that result in 1 of 3 years requiring treatment in conventional fields. Early season plant bugs are also frequent in this group of counties. The initial bollworm flights hits this area around July 20 leaving egg counts of 15-25%. Bollworms are normally treated three times in conventional cotton. Bollgard over sprays are sometimes anticipated at 7-10 days after the peak flight with escaped larvae thresholds the most

often utilized. This over spray may also be directed for secondary pests.

Strategy

- Watch for bollworm escapes after late July bollworm flight
- Anticipate supplemental control on Bollgard fields 8-10 days after 2nd conventional field treatments.

Upper North Carolina and Virginia



One of the northern most cotton growing regions, this area normally treats conventional cotton 2 times per year. The first treatment in conventional cotton is primarily for bollworms, with the second positioned to cover both worms and secondary pests in mid August.

The main bollworm flight occurs in the first week of **August** with egg numbers hovering the **10%** level. It is sometimes between the 1st and 2nd conventional cotton treatments that Bollgard fields may be treated. This treatment is targeted solely on secondary pests particularly stink bugs since bollworm escapes seldom reach treatable numbers.

Most Bollgard scouting is done in the conventional manner, with terminal and square counts taken all season. More emphasis is placed on blooms after the first week of August to detect escaped worms.

Strategy

- Look at treating Bollgard for secondary pests around the time conventional fields are receiving their second worm control applications.

Overall Summary

Bollgard management strategies areas can be summarized as follows:

- Manage for preservation of beneficials early season
- Push scouting in Bollgard fields at bollworm moth flight
 - Scout for eggs at initiation of bollworm flight
 - Scout for escaped bollworm larvae in blooms, bloom tags and bolls after flight

- Watch for secondary pests (stink bugs, 2nd - 3rd plant bugs, armyworms) in low spray environments in Bollgard fields.

Three field seasons have helped cotton managers develop general Bollgard management plans for their areas. As long as there are differences in insect populations and weather, optimal insect management in Bollgard cotton will require continued refinements and adjustments to meet local production needs. We at Monsanto are, and will continue to support practical and profitable field management ideas for Bollgard cotton.

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References

MaHaffey, J. S., J. R. Bradley, Jr. And J.W. Van Duyn. 1995. B.t. Cotton: Field performance in North Carolina under conditions of unusually high bollworm populations. *In*, 1995 Proc. Beltwide Cotton Prod. Res. Conf., National Cotton Council of America, Memphis, TN, pp. 795-798.

Turnipseed, S.G., M.J. Sullivan. 1998. Consequences of Early-Season Foliar Insecticides in Cotton in South Carolina. *In*, 1995 Proc. Beltwide Cotton Prod. Res. Conf., National Cotton Council of America, Memphis, TN, pp. 1050-1051.