SEVERITY AND DISTRIBUTION OF THE 1995 TOBACCO BUDWORM OUTBREAK IN MISSISSIPPI

M. B. Layton, M. R. Williams, G. Andrews, and S. D. Stewart
Extension Entomology Specialists, Mississippi State University
Mississippi State, MS

Abstract

In 1995 cotton producers in the hill area of Mississippi experienced a severe outbreak of tobacco budworm (*Heliothis virescens*). Infestation levels approached 100% infested plants with multiple eggs and larvae per plant in most heavy infested fields, and this level of pressure persisted over three weeks. Many fields sustained 50% to 90% boll damage and several thousand acres were completely destroyed by tobacco budworm. Total estimated insect control costs for the hill area of Mississippi were the highest ever at ca. $118 per acre with approximately $85 of this cost being directed specifically against tobacco budworm. Hill producers applied an estimated 8.2 foliar applications per acre against tobacco budworm yet still sustained an estimated 23.3% average yield loss to this pest. Severity of the tobacco budworm outbreak was similar for hill cotton both inside and outside the Boll Weevil Eradication Program Area. Tobacco budworm infestations were somewhat lighter than normal in the delta area of the state.

Introduction

For the past several growing seasons Mississippi cotton producers have faced a crisis situation with respect to ability to control tobacco budworm, *Heliothis virescens*, (TBW). Since resistance to synthetic pyrethroids in TBW was first documented in 1986 the frequency of resistance has continued to rise. Survival levels of greater than 50% have often been documented in pyrethroid resistance assays conducted during mid to late season. In addition, resistance has also been documented to carbamate and organophosphate insecticides. Because of these high levels of resistance, entomologists have cautioned that TBW could no longer be effectively controlled any time high infestation levels occurred over a prolonged period of time.

Fortunately, through most of the early 1990s TBW populations remained at manageable levels. However, increasing resistance levels caused growers to have to increase frequency of application and rely on more costly tank mixes, resulting in alarming increases in per acre control costs, particularly in years such as 1992 when TBWs were abundant in the Mississippi delta (Table 1).

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:820-822 (1996)
National Cotton Council, Memphis TN

Mississippi cotton production is divided between two major production regions: the Mississippi delta which consists of approximately 950,000 acres and the Mississippi hills which consist of approximately 450,000 acres of cotton grown throughout the remainder of the state. Approximately 105,000 acres of Mississippi hill cotton located along the eastern edge of the state was involved in the first full year of the Boll Weevil Eradication Program in 1995, following start up with fall diapause sprays in 1994.

Delta producers typically incur higher insect control costs, due primarily to more problems with budworm/bollworm and greater problems with resistance (Table 2). However, most delta producers experienced unusually low budworm/bollworm populations in 1995 and insect control costs generally remained within budget. This was not the case in the Mississippi hills which experienced a disastrous outbreak of TBW and severe yield losses, despite the highest insect control costs ever recorded for the region (Tables 1 and 3).

Review of the 1995 Outbreak

Through much of the Mississippi hills pre-bloom (June) infestations of TBW were more common than normal. More importantly, this TBW flight was much more prolonged than usual, lasting from mid June and into the first week of July. In most cases these June infestations were light to moderate and caused little real damage. However, several localized areas scattered throughout the hills experienced severe June infestations and sustained high levels of square loss despite intensive control efforts. In the most severe cases, the level of square damage exceeded 50% and high numbers of TBW larvae survived and pupated. However fields affected to this degree constituted a relatively small portion of the total hill cotton acreage. Surprisingly, these June infestations seemed to be more common and more severe in that portion of the hills which was not involved in boll weevil eradication.

Despite these localized problems, most of the hill crop entered July with high levels of fruit retention and mid-July yield potential of both the hill and delta cotton crop appeared to be excellent. This changed drastically in the hill portion of the state with the arrival of second generation TBWs. Beginning the third week of July, extremely heavy budworm egg lay was encountered over much of the hills. Moth flushing counts verified that this population was essentially 100% TBW.

Infestation levels varied considerably within this area, but in the most heavily infested areas, initial second generation population levels ranged from 50 to 100 percent infested plants with multiple eggs per plant, and oviposition continuing nightly. This level of pressure persisted for two to three weeks before declining to infestation levels of 20 to 50%. It is again noteworthy that these severe infestations occurred in hill cotton both inside and outside of the active boll weevil eradication area.

The combination of high, sustained infestation and high levels of insecticide resistance made it impossible for producers in the most heavily infested areas to achieve control. Despite timely, frequent application of costly treatment combinations, many hill fields experienced severe damage. Populations as high as 3 to 6 large larvae per plant were observed following 3 to 4 well timed, closely spaced insecticide applications. Many hill producers saw yield potential plummet from excellent to poor, or even none, in a 2 to 3 week period due to the severe boll and square damage inflicted by TBW.

Based on levels of field control obtained by producers, it appeared that high levels of resistance existed to all classes of insecticide chemistry. Pyrethroids were particularly ineffective, especially in areas where they had been used prior to bloom against first generation budworms.

Information presented in Table 4, summarizes results of an insecticide efficacy trial conducted against TBW in 1995. Although this trial was conducted outside the most heavily infested area, the levels of control obtained in this trial, ranging from 26% to 67%, mirror the control being obtained by producers and provide an indication of the levels of resistance present in the 1995 TBW population.

By the first week of August the most heavily infested fields had sustained 50 to 90% damaged bolls with many large larvae still present and actively feeding. Many fields were being abandoned (no additional cost inputs), due to high levels of boll damage and inability to obtain effective control.

August budworm infestations were even higher, with counts of 10 to 30 eggs per plant being common in much of the hill cotton. Tremendous numbers of TBW moths could be flushed when scouting fields or observed flying over fields at dusk. Shortages of insecticides also contributed to the overall pro-blem as supplies were depleted due to unusually heavy usage. Fortunately, this third generation was easier to control than the July generation, presum-ably because of increased mortality from parasitism and disease, and many hill producers were able to salvage a partial crop, albeit at greatly inflated control costs. Late season pressure intensified in the delta also, but most of the delta crop matured in time to escape severe damage.

This discrepancy between TBW pressure in the hills and delta is notable, especially in view of the fact that the delta area typically experiences greater TBW problems. However, there was a very distinct difference in severity of infestations between the two areas. Several Mississippi counties that contain both hill and delta areas reported much more severe problems in the hill portion of the county. There is no documented explanation for this difference between hills and delta. However, overwintering TBW pupae are known to be susceptible to high mortality when subjected to sustained saturated soil conditions and delta soils are much more prone to such conditions. Also, there are some differences in species of wild host plants of TBW between the two areas.

Discussion of Possible Contributing Factors

Several factors are thought to have contributed to the 1995 TBW outbreak with the 3 most important being: 1) environmental factors favorable to TBW development, 2) insecticide resistance, and 3) destruction of beneficial insects resulting from heavy early insecticide use.

Environmental Factors

The winter of 1994-1995 was extremely mild. At Mississippi State University, which is located in the area of the TBW outbreak, date of first freeze was 12 days latter than normal (Nov. 24 vs Nov. 12) and date of last freeze was 13 days earlier than normal (Mar. 10 vs Mar 23.). In addition, minimum winter temperatures for the Northeast crop reporting district were 4 to 5 degrees warmer than normal for every month except February, which was normal (Table 5). These factors would favor development of higher numbers of the overwintering generation of TBW, increased survival of over-wintering TBW pupae, and greater abundance and earlier availability of spring host plants. Unfortunately, no monitoring of overwintering or spring populations of TBW was conducted. However, this combination of condi-tions would appear to be highly favorable to increased TBW populations.

Insecticide Resistance

The problem of insecticide resistance in TBW has been previously discussed and data presented in Table 4 illustrate the levels of control provided by each of the 3 major classes of insecticide chemistry and commonly used tank mixes available for growers to use against TBW. Obviously such control is insufficient to deal with the population levels encountered by producers in 1995. Inability to effectively control TBW in earlier generations contributed to the high populations experienced in subsequent generations.

Destruction of Beneficial Insects

The mild winter was also highly favorable to survival of overwintered boll weevils and spring populations of this pest were high. Consequently, growers throughout that portion of the Mississippi hills not involved in the Boll Weevil Eradication Program had to treat more than usual for control of overwintered boll weevils. Within the Boll Weevil Eradication area, overwintered weevil numbers were much lower as a result of the fall diapause program, but because of the low treatment threshold associated with eradication, essentially all acreage still received treatments for control of overwintered weevils.

Cotton aphids were a particular problem in 1995, with high populations occurring throughout the state. Damaging infestations appeared much earlier than normal, occurring on pre-blooming cotton, and much acreage was treated for aphids during late June and the first week of July before the aphid population was controlled by a naturally occurring fungal disease. These aphid treatments served to further reduce beneficial insect populations.

The final insect to require increased numbers of early insecticide treatments and thus to contribute to the destruction of naturally occurring parasites and predators were the TBW themselves. In many of the situations where TBW required treatment in June the treatments were not very effective because of resistance. However, many of the insecticides used against the June TBW infestations are detrimental to beneficial insects and these treatments served to further remove beneficial insects as a mortality factor against TBW. Thus in cases where June insecticide treatments provided only partial control of the target TBW population, because of resistance or other factors, the generational increase in TBW numbers may have been greater than had no treatment been applied.

Role of Boll Weevil Eradication

The coincidence of this tremendous TBW outbreak with the first full season of Boll Weevil Eradication resulted in much speculation over the eradication program's role in causing the outbreak. Some believe that the intensive applications of ULV malathion associated with eradication were the primary cause of the outbreak. However, it must be noted that only approximately 105,000 acres of cotton in the Eastern Mississippi hills was involved in eradication while essentially all of the Mississippi hills, approximately 450,000 acres, were seriously affected by the TBW outbreak. As previously noted, the initial problems in June seemed to be somewhat more common and widespread outside the eradication area. Of the public entomologists and private consultants who worked in hill cotton both within and outside the eradication area, all agree that, by mid and late season, the TBW outbreak appeared to be equally severe in both areas. Distribution of the outbreak area followed the hill-delta boundary quite closely through the central part of the state, but did not follow the boundary line for the boll weevil eradication.

Table 6 provides a preliminary comparison of 1995 yield deficits relative to prior years for the 9 Mississippi crop reporting districts. The Northeast and East Central areas consist of approximately 96,000 acres of cotton located wholly within the Boll Weevil Eradication Area while the North Central and Central areas consist of approximately 341,000 acres of primarily hill cotton, none of which was in the 1995 eradication area. Based on these preliminary figures, it appears that there was little difference in yield deficits between that portion of the hills in the eradication area and that portion outside eradication. Final yield and acreage estimates could change and these will be available by early summer of 1996.

Note that while the two delta districts also show a substantial yield deficit for 1995, hot dry environmental conditions were the primary cause of poor yields in these areas. These conditions existed to a lesser extent over portions of the hills, but boll damage inflicted by TBW was clearly the major cause of yield loss in much of the hills.

There is no question that the malathion sprays applied as part of the boll weevil eradication effort destroyed beneficial insects and thus contributed to the TBW outbreak in the eradication area. However, sprays targeting overwintered and first generation boll weevils, aphids, and other pests by hill producers outside the eradication area also had a similar effect. From a long term perspective, elimination of the boll weevil and the early season insecticide treatments required to control this pest would be highly beneficial to overall cotton pest management and would lessen the risks of outbreaks of this nature occurring.

Table 1. Mississippi cotton insect control costs, 1989 to 1995.

	Estimated Insect Control Costs per Acre (all pests)		
Year	Hills	Delta	State Avg.
1989	$47.62	$64.42	$60.38
1990	$35.83	$47.48	$44.79
1991	$32.67	$48.62	$42.19
1992	$69.21	$121.18	$101.94
1993	$85.75	$102.62	$96.87
1994	$63.74	$74.77	$70.19
1995	$118.51	$76.32	$89.78

From Beltwide Cotton Insect Losses Estimates, 1989-1995.

Table 2. Mississippi, Average Losses to Budworm/Bollworm, 1992-1994.

Region	% Yield Loss	# Sprays	$ Spent per Acre
Hills	3.4%	3.3	$27.13
Delta	4.3%	5.3	$54.89
State	3.9%	4.5	$44.12

From Beltwide Cotton Insect Losses Estimates, 1992-1994.

Table 3. Mississippi Average Losses to Budworm/Bollworm, 1995.

Region	% Yield Loss	# Sprays	$ Spent
Hills	23.3%	8.2	$85.12
Delta	3.2%	4.5	$46.94
State	8.0%	5.7	$59.33

From Beltwide Cotton Insect Losses Estimates, 1995.

Table 4. Results of replicated small plot tobacco budworm efficacy trial, Carroll County, MS, 1995.

Insecticide lbs. Ai/A	% Control at 6DAT relative to untreated Check
Karate 1EC 0.031	26%
Karate 1EC 0.031 + Larvin 3.2SC 0.25	48%
Karate 1EC 0.031 + Dipel ES 1 pt.	30%
Larvin 3.2SC 0.64	33%
Curacron 8E 1.0	61%
Curacron 8E 0.66 + Larvin 3.2SC 0.32	67%

Source: M. B. Layton, unpublished data
Plots were treated June 25, 1995.
Pre-treatment count was 28% plant infested with 2 to 3 day larvae.
Treatments applied with CO_2 backpack sprayer in 10 GPA spray volume.

Table 5. Departure from Normal Temperatures NE MS District, 94-95

	Avg. Temp	Avg. Min. Temp
Nov	+ 3	+ 4
Dec	+ 4	+ 5
Jan	+ 2	+ 4
Feb	0	0
Mar	+ 3	+ 4

Source: Southern Regional Climate Center, Baton Rouge, LA

Table 6. Preliminary estimates of 1995 Cotton yield deficit for Mississippi crop reporting districts relative to 1994 and to past 5 year average.

Crop Reporting District	**Lbs. less lint per harvested acre in 1995 relative to prior years[1]**		**95 Yield as % of 90-94 Avg**
	95 vs 94	**95 vs 90-94 Avg**	
1) Upper Delta	- 181	- 120	85%
2) North Central	- 244	- 126	79%
3) Northeast	- 210	- 144	70%
4) Lower Delta	- 133	- 95	88%
5) Central	- 269	- 199	73%
6) East Central	- 209	- 148	73%
7) Southwest	- 184	- 196	73%
8) South Central & 9) Southeast	- 50	- 18	97%
State Avg.	**- 182**	**- 127**	**83%**

[1] 1995 yields are from December 1, 1995 crop report.

Source: Mississippi Agricultural Statistics Service, NASS, USDA, Jackson, MS