INFLUENCE OF EARLY SEASON TREATMENTS ON INSECT POPULATIONS AND YIELD IN BOLLGARD (96 BG-1) AND SURE GROW 501 COTTON VARIETIES

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Abstract

Results of a study in1996 that compared the effects of various early-season treatments on insect populations and yieldshow that during a low insect year, yield responses to seed treatments (imidacloprid, acephate), in-furrow treatments (imidacloprid, aldicarb), and in-furrow plus sidedress treatments (aldicarb) in both Bollgard (NuCotn-33B) and Sure Grow 501 were similar. The highest yield in both cotton varieties were in treatments with the high rate of imidacloprid and the aldicarb in-furrow plus sidedress treatments. The total insect control cost for Bollgard cotton was $66.20 per acre per acre of which $32.00 was technology charge, and $64.34 per acre in the Sure Grow 501.

Introduction

Advances in transformation technology have made it possible to produce cotton plants containing the Bt gene, Armstrong et al. (1990). The new technology of the genetic engineering revolution could be a tremendous aid for the management of insect pests in cotton. Deaton (1995) reported that the Bollgard™ gene provided cotton growers with a completely new tool to control major caterpillar pests such as the tobacco budworm, *Heliothis virescens* (F.), cotton bollworm, *Helicoverpa zea* (Boddie), and pink bollworm, *Pectinophora gossypiella* (Saunders). Luttrell et al. (1995) reported that Bt cotton had high insecticide activity against the tobacco budworm in large-plots that were artifically infested. It was noted in the same study that broad spectrum insecticides will still be necessary to control non-lepidopteran pest such as the boll weevil, *Anthonomus grandis* Boheman, and the tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois). Transgenic cotton expressing delta endotoxin protein from *Bacillus thuringiensis* (Bt cotton) has been demonstrated to be highly effective against tobacco budworms bollworms in small plot experiments (Benedict et al. 1992, Jenkins et al. 1992, Jenkins et al. 1993, Luttrell and Herzog 1994, Mascarenhas et al. 1994). Bradley (1995) reported that the greatest potential benefit of Bt cotton should occur in areas where tobacco budworm control can not currently be achieved with synthetic insecticides. Davis et al. (1995) reported that Bt lines of cotton have a good potential use with yields that were competitive with the more traditional lines. In these same studies, tarnished plant bugs required 4-5 insecticide applications for control.

A very high percentage of the cotton seed planted in the Mississippi Delta is treated with a fungicide and an insecticide for disease and thrips control. Depending upon the growing season, the insecticide seed treatment may or may not provide adequate thrips control. Scott et al. (1985) reported that in addition to thrips control, temik applied in-furrow suppressed populations of tarnished plant bugs. Higher yields were associated with treatments that had lower plant bug numbers as compared to an untreated check. Scott and Adams (1994) reported that in a two year study that cotton planted with an in-furrow application of temik had higher yield than cotton that was foliar sprayed for early season insect control.

The tobacco budworm and cotton bollworm are common pests of cotton in the Mississippi Delta. In recent years, control of the tobacco budworm has constituted a major part of the total insect control budget in cotton due to the development of high levels of resistance to most classes of insecticides. Scott et al. (1995) reported on the cost and changes of insect control over a several year period. It was pointed out in this study that transgenic Bt cotton could reduce insecticide use for control of the bollworm/budworm. However, its use could also result in higher costs for controlling the boll weevil and tarnished plant bug.

The present study was specifically designed to determine the effectiveness of seed, in-furrow and sidedress insecticide treatments, on early season insect populations and yield. It also compared the effectiveness of Bt transgenic cotton for control of bollworms and tobacco budworms to a non-Bt variety.

Materials and Methods

The research was carried out on a farm in Sunflower County, Mississippi during 1996. Sure Grow 501 and Bollgard (96 BG-1) were planted in separate fields divided by a field road. There were approximately 80 acres of each variety planted on May 8-9, 1996. The treatments in both varieties were: (1) gaucho (imidacloprid) treated seed, (2) orthene (acephate) treated seed, (3) temik (aldicarb) in-furrow at planting at 0.60 lbs AI/acre, (4) temik (aldicarb) in-furrow at planting plus a sidedress application at 0.60 + 1.05 lb AI/acre, (5) temik (aldicarb) in-furrow at planting plus a sidedress application 0.60 + 1.5 lbs AI/acre, (6) Admire (imidacloprid) in-furrow at 0.125 lb AI/acre, and (7) Admire (imidacloprid) in-furrow at 0.25 lb AI/acre. The sidedress applications of temik were made on 14 June at pin head square. Treatments were replicated four times and plots were three to four acres in size.

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Sampling. After cotton emergence, insect populations in each plot were sampled weekly. The number of thrip per plant were determined by counting the total number of thrips on ten plants per plot. Tarnished plant bugs were sampled by sweep net (100 sweeps) and drop cloth (3 ft in 4 locations) in each plot. Aphid numbers were determined by counting the number of aphids per square inch on the 3rd fully expanded leaf from the plant terminal on fifteen plants per plot. Bollworm/budworm eggs, larvae, larvae damaged squares and bolls, and boll weevil damage was determined by making whole plant examinations on five row feet at three locations per plot. Soil samples taken after harvest and analyzed by the Plant Patholody Department at Mississippi State University showed extremely low populations of nematodes.

In 1996, thrips populations were low and did not require a foliar insecticide for control. Aphid infestations were light during June in all treatments of both 96 BG-1 (Bollgard) and Sure Grow 501 cotton. Foliar applications of insecticides began on 11 July these treatments and targeted pests in both cotton varieties for the remainder of the season can be seen in Table 1.

Yield Data. Eight rows in each plot were machine harvested with a four-row John Deere cotton picker and dumped into a boll buggy equipped with four load cells for weight. Lint cotton was determined by multiplying pounds of seed cotton by 35 percent.

Results

No foliar insecticide applications were made for control of thrip in the test. Figure 1 shows the average number of thrips per plant at their highest level during late May. At this time, thrips were still below the threshold of one per plant. Aphid populations were low across all treatments and persisted for about three weeks. Bidrin 0.40 lbs AI/acre was applied to all plots in both 96 BG-1 and Sure Grow 501 cotton on 11 July. Tarnished plant bug populations were low in both cotton varieties until the week of July 10 (Figs. 2 and 3). Plant bug populations were higher overall at this time in Bollgard treatments than in the 501 cotton. Numbers of plant bugs sampled by sweep net on 18 July averaged three times higher in Bollgard than 501 cotton when averaged across all treatments (Fig. 4). Plant bugs and boll weevils continued to increase in both cotton varieties into August (Fig. 5). Snodgrass and Scott (1996) reported that during 1995 in the Mississippi River Delta, the number of plant bug populations with pyrethroid resistance increased from 57.7% in the spring to 84.7% in the fall (based on testing populations from 71 locations). In the fall of 1996, the number of plant bug populations with pyrethroid resistance from the same locations was slightly higher than in 1995 (Snodgrass, personal communication). The wide spread use of pyrethroids to control mainly bollworms in the midsouth and in surrounding fields could have aggravated the plant bug numbers in our test field. Weevil numbers increased during the same time due to movement of weevils from surrounding fields that were near cut-out.

The bollworm/budworm population in 1996 was low and was almost exclusively bollworms. The number of bollworm eggs in each treatment for both Bollgard and 501 cotton on two dates are shown in Figure 6. During the weeks of 23 and 29 July there were slightly higher egg counts found in the 501 cotton. Although individual plots in both Bollgard and 501 fields were sampled weekly, bollworm larvae were almost non-existent during June. Numbers continued to be low into July. On 16 July, the number of bollworm larvae per acre was almost zero in the Bollgard cotton (Fig. 7). At this same time, low numbers were also found in the treatments of 501 cotton. Low numbers of larvae were found in both cotton varieties during the week of 29 July. By the end of July, Sure Grow 501 cotton was sprayed twice for low numbers of bollworms, and Bollgard cotton was treated once for aphids and twice for plant bugs. Although the number of bollworm damaged squares were low in both Bollgard and 501 cotton throughout the month of July, considerably more were found in 501 (Fig. 8). Even though the test was conducted in an area that had extremely low early-season insect pressure, yield response to the various early-season treatments in both cotton varieties were similar (Fig. 9).

Sure Grow 501 yielded slightly higher in each treatment than 96 BG-1 cotton. The highest yields in both cotton varieties were in treatments with the high rate of Admire and the temik in-furrow plus sidedress treatments. The temik in furrow treatment had slightly higher yields than the low rate of Admire treatment and both had slightly higher yields than both seed treatments. When yield in both cotton varieties were averaged across all treatments, Sure Grow 501 averaged 912 pounds as compared to 878 pounds of lint per acre for 96 BG-1 cotton. Each cotton variety was sprayed 8 times throughout the season. Total cost for 96 BG-1 was $66.20 per acre of which $32.00 was technology charge. The cost of insect control in Sure Grow 501 was $64.34 per acre. It is a posssibility from this test that a large late-season plant bug population may have influenced yield, especially in the Bollgard cotton that was somewhat later than 501 in maturity.

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Table 1. Foliar Treatments

	96 BG-1 (bollgard)		SureGrow 501	
Date	Insecticide lbs AI/acre	Target	Insecticide lbs AI/acre	Target
7/11/96	Bidrin 0.40	Aphids/ Plant Bug	Bidrin 0.40	Aphids/ Plant Bug
7/18/96	Bidrin 0.40	Plant Bug	Karate 0.03	Bollworm/ Plant Bug
7/27/96	Orthene0.5 0	Plant Bug	Karate 0.03	Bollworm
8/02/96	Bidrin 0.40	Plant Bug	Baythroid 0.033 + Orthene 0.50	Bollworm/ Plant Bug
8/16/96	Vydate 0.30	PlantBug/ Weevil	Karate 0.03 + Orthene 0.50	Bollworm/ Plant Bug
8/22/96	Vydate 0.30	Plant Bug/ Weevil	Vydate 0.30	Plant Bug/ Weevil
8/29/96	Vydate 0.30	Plant Bug/ Weevil	Curacron 1.0	Bollworm
9/10/96	Methyl Parathion 0.25	Weevil/ Plant Bug	Karate 0.03	Bollworm/ Plant Bug

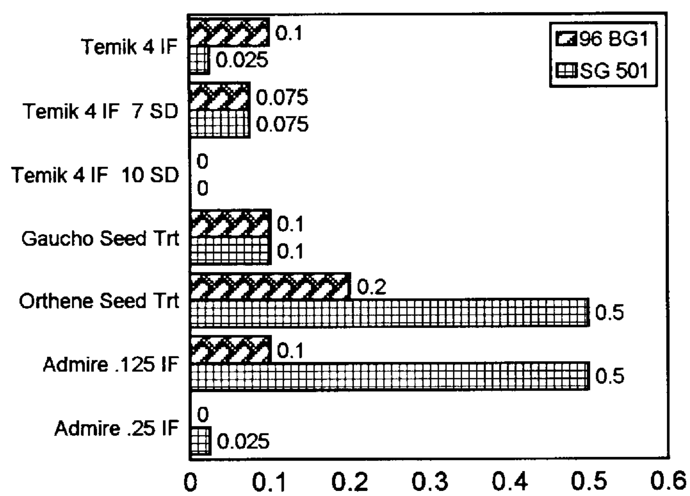

Figure 1. Average numbers of thrips per plant in SureGrow 501 and Bollgard cotton in May 1996 in Sunflower Co., MS.

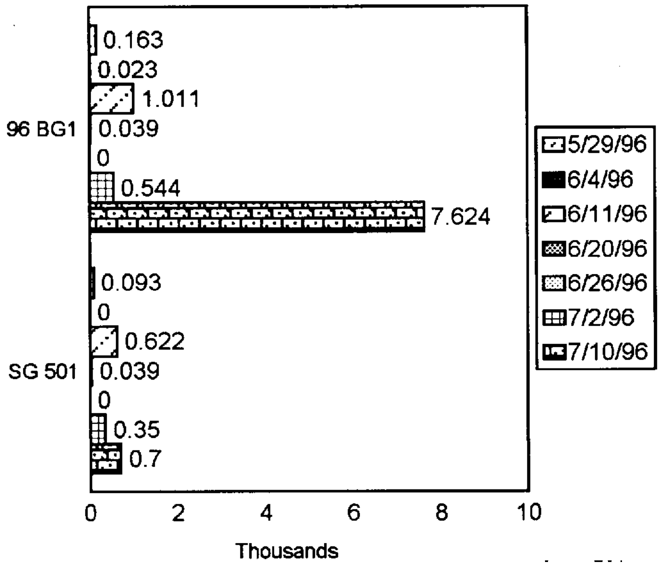

Figure 2. Average numbers of tarnished plant bugs in SureGrow 501 and Bollgard cotton sampled with a drop cloth in Sunflower Co., MS.

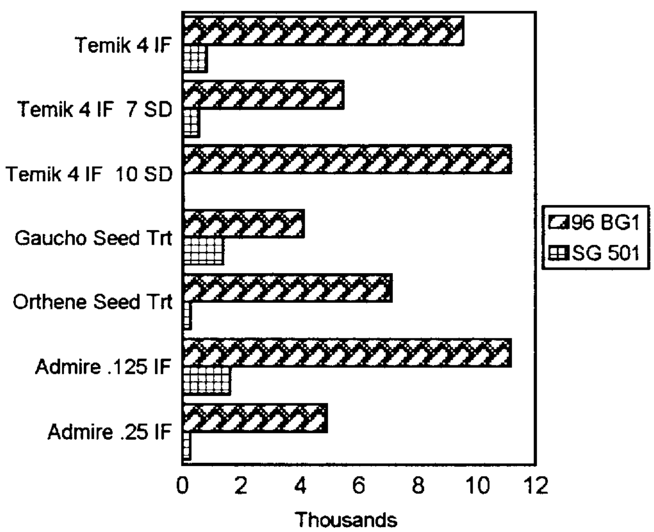

Figure 3. Average numbers of tarnished plant bug populations in SureGrow 501 and Bollgard Cotton 10 July, 1996 in Sunflower Co., MS.

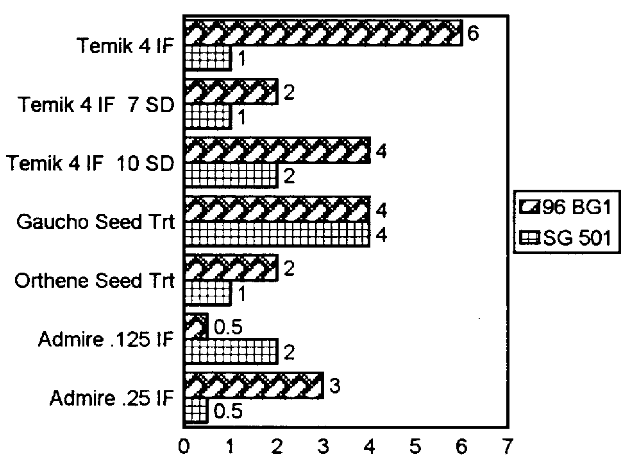

Figure 4. Average numbers of tarnished plant bug populations in SureGrow 501 and Bollgard Cotton 18 July, 1996 in Sunflower Co., MS.

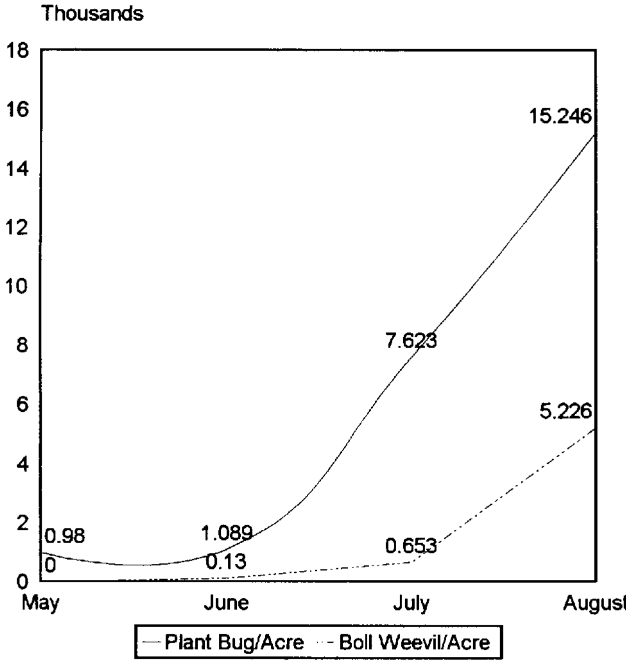

Figure 5. Tarnished plant bug and boll weevil populations levels in a cotton field in Sunflower Co., MS in 1996.

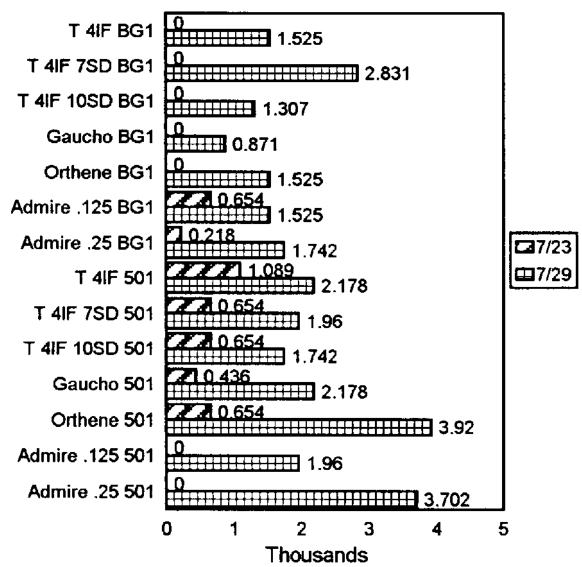

Figure 6. Bollworm/tobacco budworm eggs found in SureGrow 501 and Bollgard Cotton in July in a field in Sunflower Co., MS.

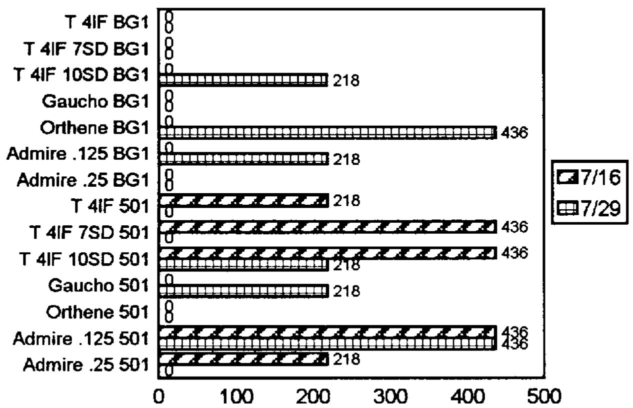

Figure 7. Bollworm larvae found in different treatments in SureGrow 501 and Bollgard Cotton in July in a field in Sunflower Co., Ms.

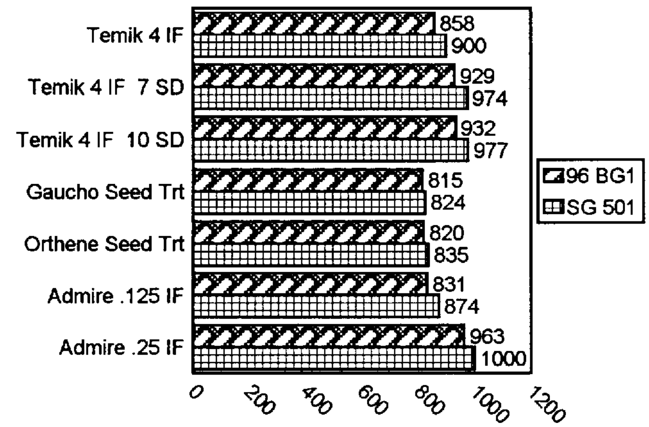

Figure 9. Lint yield in different treatments in SureGrow 501 and Bollgard Cotton in 1996 in a field in Sunflower Co., MS.

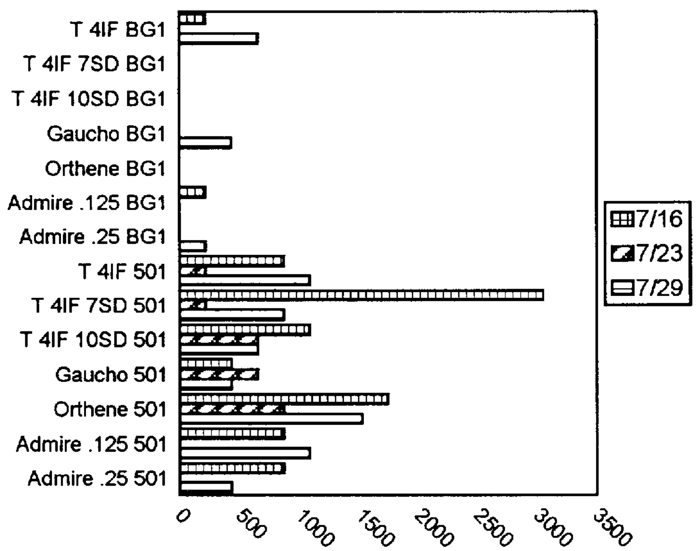

Figure 8. Square damage by bollworm larvae in SureGrow 501 and Bollgard Cotton in July in a field in Sunflower Co., MS.