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BT COTTON ADOPTION AND PERFORMANCE IN MISSOURI

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Abstract

Within the past five years, Missouri cotton producers have dealt with rapid changes in their pest management systems. Boll weevil eradication, insecticide seed treatments, favorable weather conditions, shifting pest dynamics, and greater acceptance of *Bacillus thuringiensis* (Bt) technologies have all contributed to these changes. In particular, the tobacco budworm, *Heliothis virescens* (F.), outbreak of 2002 that required multiple insecticide applications, and improved varietial agronomic qualities (i.e. yield) have spurred greater adoption of Bt technologies by Missouri cotton producers. In University of Missouri varietial trials, the average yields for the top three Bt varieties have been several percentage points higher than those for the top three non-Bt varieties. Despite the recent shift in pest dynamics to the plant bug complex in Missouri, the state's cotton producers harvested another record crop in 2004. Continued improvements found in the second generation of Bt technologies (i.e. Bollgard II, VipCot, WideStrike) should provide greater value to Missouri cotton producers and their acceptance of these technologies in the future. Field trials conducted over the past few years have helped demonstrate that the latest Bt technologies will provide a greater spectrum of control for the lepidopteran pests commonly observed in Missouri. In 2000 and 2002, 2.5-4 fold fewer fruiting structures (squares, blooms, bolls) were infested in Bollgard II versus Bollgard I plots. Fewer fruiting structures also sustained less damage in Bollgard II versus Bollgard I plots. In 2000 during a moderate bollworm, *Helicoverpa zea* (Boddie), infestation, cotton yields were 7.1% and 28.6% higher in Bollgard II plots versus those observed in Bollgard I and conventional cotton plots, respectively.

Introduction

Since 2001, cotton pest losses and management practices have undergone a dramatic change in Missouri. In 2001, the Missouri Boll Weevil Eradication Program was initiated with fall diapause sprays followed by a full-season program in 2002. During the 1990's the boll weevil, *Anthonomus grandis grandis* Boheman, had frequently been the number one cotton pest in the state (Head 1991-1993; Williams 1994-2000). In 2002, record losses and control costs were reported for the bollworm, *Helicoverpa zea* (Boddie) / tobacco budworm, *Heliothis virescens* (F.), complex in Missouri (Williams 2003). Tobacco budworm infestations were unusually high as indicated by sustained moth captures and reports of larval infestations plus fruit damage in commercial cotton fields.

Following the bollworm / tobacco budworm outbreak in 2002, Missouri cotton producers rapidly adopted the *Bacillus thuringiensis* (Bt) technology. The percent acreage planted to varieties with the Bt technology increased from approximately 15% in 2002 to approximately 65% in 2003 and 2004 (Personal communication). Several factors partially contributed to the slower adoption of Bt technology in Missouri. 1) Bt varieties initially exhibited lower yield potential versus non-Bt varieties. In University of Missouri (MU) varietial trials for 2001, the top three Bt varieties across three locations (Portageville, Senath, Sikeston) averaged 5.2% lower yields versus the top three non-Bt varieties (Phipps 2001). In 2004 at the same three locations, the top three Bt varieties averaged 6.3% higher yields versus the top three non-Bt varieties (Phipps 2004). 2) Historically, the bollworm has been the primary lepidopteran pest in Missouri; whereas, the tobacco budworm has only been an important pest two or three years per decade. 3) Bt technology fees had been largely offset by less expensive pyrethroid insecticides to combat bollworm infestations.

Materials and Methods

In 2000 and 2002, field studies were successfully completed to compare Bollgard I and II technologies at the MU Delta Center's Lee Research Farm in Portageville, Missouri. In 2000, DeltaPine (DP) 50, DP 50 Bollgard (BG) I, and DP 50 BGII varieties were planted [8 rows (38-inch spacing) by 50 ft.] on May the 24th. In 2002, the same varieties were planted (same plot dimensions) on June 5th. The study was abandoned in 2001 because of severe stand losses following flood damage. On each of four dates per season, plots were visually sampled beginning with peak flowering by examining 10 terminals plus 45 squares, blooms, and/or bolls for larvae and feeding damage.

Any larvae collected were returned to the laboratory for positive identification. Plots were hand-harvested (10-25 ft. in two center rows) on November 1, 2000 and October 22, 2002.

Results and Discussion

In 2000, 2.83%, 0.83%, 0.33% of the fruiting structures were infested by caterpillars [96% bollworms and 4% yellowstriped armyworms, *Spodoptera ornithog*alli (Gunee)] in DP 50, DP 50 BGI, and DP 50 BGII plots, respectively. Yellowstriped armyworms were only collected from BGII plots. Percent damaged fruit was 7.08, 2.17, 0.83 in DP 50, DP 50 BGI, and DP 50 BGII plots, respectively. In BGII plots the damage to fruiting structures was limited to surface feeding on the bracts surrounding blooms and bolls. Average pounds of seed cotton harvested were 2016.67, 2420.00, and 2592.83 in DP 50, DP 50 BGI, and DP 50 BGII plots, respectively. This yield increase in BGI and BGII occurred despite no insecticide oversprays for other cotton pests.

In 2002, 0.83%, 0.33%, 0.08% of the fruiting structures were infested by caterpillars [64% bollworms, 18% tobacco budworms, and 18% fall armyworms, *S. frugiperda* (J.E. Smith)] in DP 50, DP 50 BG I, and DP 50 BGII plots, respectively. Percent damaged fruiting structures were 4.58, 1.75, 1.25 in DP 50, DP 50 BGI, and DP 50 BGII plots, respectively. As in 2000 the damage in BGII plots was limited to surface feeding on the bracts surrounding blooms and bolls. Average pounds of seed cotton were 3393.10, 3118.00, and 3301.43 in DP 50, DP 50 BGI, and DP 50 BGII plots, respectively. Lighter pressure from lepidopteran pests in 2002 largely contributed to no noticeable increase in yields for Bt versus non-Bt plots.

Summary

Within the past few years multiple factors have contributed to a dramatic shift in pest complexes and pest management systems by Missouri cotton producers. In particular, the state's boll weevil eradication efforts and greater acceptance of the Bt technology have greatly contributed to record cotton yields in the state. Field studies have shown that second generation Bt technologies (ex Bollgard II, WideStrike) potentially have even greater value to Missouri cotton producers in combating lepidopteran pests (ex. bollworm, fall armyworm) that occur more frequently than tobacco budworms. Missouri cotton producers will continue to face their most significant pest pressure from the plant bug complex for the foreseeable future, and a strong effort must be made to manage this complex and avoid 'devaluing' these new Bt technologies.

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