PREVATHON APPLICATION TIMINGS AND USE STRATEGIES IN COTTON

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Abstract

Experiments were conducted in 2012 to determine alternative management strategies for bollworm, *Helicoverpa zea* (Boddie), in Non-Bt and dual gene Bt cotton using chlorantraniliprole (Prevathon®, DuPont Crop Protection). Multiple rates of Prevathon were applied at every tarnished plant bug application or every other tarnished plant bug application and compared to Prevathon and Belt at their labeled use rates. Prevathon applied at reduced rates was effective in reducing bollworm damage in the Non-Bt cotton with the exception of 1.5 fl oz/A of Prevathon applied at every other tarnished plan bug application. Similar results were observed with yield in the Non-Bt experiment. All plots treated with the diamide chemistry in dual gene Bt cotton yielded significantly higher than the untreated control. No significant reduction in damage was observed. These preliminary data suggest bollworms can reduce yields in dual gene Bt cottons.

Introduction

Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), and bollworm, *Helicoverpa zea* (Boddie), are the most damaging insect pests of cotton, *Gossypium hirsutum* L., in the mid – South (Scott et al. 1985, Williams 2009). Tarnished plant bug is almost exclusively controlled with insecticides (Snodgrass and Gore 2007).

Documented resistance to organophosphates and pyrethroids in the tobacco budworm, *Heliothis virescens* (F.), made management difficult in the early- to mid-1990's with insecticides (Leonard et al. 1988, Plapp et al. 1990, Elzen et al. 1992). This led to the introduction of genetically modified cotton containing genes from the soil bacterium *Bacillus thuringiensis* (Bt) by Monsanto (Cry 1 Ac Bollgard) during the 1996 growing season. The introduction of single gene Bt varieties greatly reduced the number of applications targeting *H. virescens*; however, it provided less than complete control *H. zea*.

Dual-gene (Cry 1 Ac and Cry 2Ab) Bt cottons were introduced in 2003 (Bollgard II®, Monsanto). The introduction of a second gene provided enhanced control of Lepidopteran pests resulting in additional reduction of foliar applied insecticides. However, Bt cottons producing two Bt proteins still sustain economic damage from *H. zea* and supplemental insecticide applications are needed under high pressure.

L. lineolaris and *H. zea* utilize field corn for development during the R1 (silking) stage (Abel and Snodgrass 2003, Lincoln 1972). As corn begins to senesce, cotton becomes the preferred host for these species. Observed susceptibility of *H. zea* to Bt technologies has been highly variable (Adamczyk et al. 2001) and an increase in insecticide applications targeting *H. zea* has been observed. This is similar with *L. lineolaris* where application numbers have steadily increased from approximately 1 application in 1986 to approximately 8 applications in 2011 on average. Many of these applications are made as co-applications in order to reduce application costs from equipment use.

Recently, two new insecticides have been registered that target insect ryanodine receptors (Cheek 2008). Ryanodine receptors are a class of ligand-gated calcium channels that control the release of calcium from intracellular stores (Cheek 2008). The first of these insecticides is the phthalic acid diamide, flubendiamide (Bayer) (Ebbinghaus-Kintscher et al. 2006, Masaki et al. 2006, Nauen 2006, and Tohnishi et al. 2005). The second is the anthranilic diamide, chlorantraniliprole (Prevathon®, DuPont) (Lahm et al. 2007, Cordova et al. 2006, and Lahm et al. 2005).

These insecticides provide effective control of Lepidopteran pests in numerous crops. The introduction of these compounds and the reduction of *H. virescens* pressure combined with the increased number of insecticide applications targeting *H. zea* in Bollgard II® cotton has led to an increased interest in the use of Non-Bt cotton varieties. Also, these compounds provide extended residual control and may provide additional benefits for resistance management in dual-gene cottons. The focus of this study is to evaluate alternative management strategies of *H. zea* in non – Bt and dual – gene cotton.

Materials and Methods

Two experiments were conducted in 2012 at the Delta Research and Extension Center in Stoneville, MS to evaluate alternative control methods of *H. zea* utilizing the diamide chemistry. Two varieties were used DP 174 RF and DP0912 RFBG2. Experiments were conducted as a randomized complete block design with four replications and nine treatments (Table1).

Table 1: Treatment list for both Non-Bt and Bt study.

Treatment	Timing
Prevathon at 6.0 fl oz/A	Every TPB Spray
Prevathon at 3.0 fl oz/A	Every TPB Spray
Prevathon at 1.5 fl oz/A	Every TPB Spray
Prevathon at 6.0 fl oz/A	Every Other TPB Spray
Prevathon at 3.0 fl oz/A	Every Other TPB Spray
Prevathon at 1.5 fl oz/A	Every Other TPB Spray
Prevathon at 27 + 20 fl oz/A	Larval Threshold
Belt at 3 + 3fl oz/A	Larval Threshold
Untreated Control	

Scouting for tarnished plant bug began at first square and continued throughout the flowering period. Management was based on Mississippi State University Extension Service recommendations. *H. zea* treatments were applied following *L. lineolaris* treatments. Plots were sprayed with a John Deere high clearance sprayer with a compressed air system calibrated to deliver 10 GPA through TX – 8 hollow cone nozzles at 47 psi and 5 mph. Plots were 8 rows on 40 inch centers X 50ft.

Plots were sampled one week following application of larval treatments. Treatments were sampled by examining 25 plants per plot. Numbers of eggs, larvae, damaged terminals, damage squares, and damaged bolls were recorded. At the end of the growing season plots were mechanically harvested. All data were analyzed with analysis of variance.

Results and Discussion

Non – Bt: The Non – Bt study was planted earlier and in a different field than the Bt study. It was subjected to lower levels of plant bug numbers and received a total of four plant bug applications throughout the season. In Non – Bt cotton, Prevathon was effective in reducing *H. zea* damage. All treatments with the exception of Prevathon applied at 1.5 fl oz/A reduced boll damage numbers below the untreated control (Figure 1).

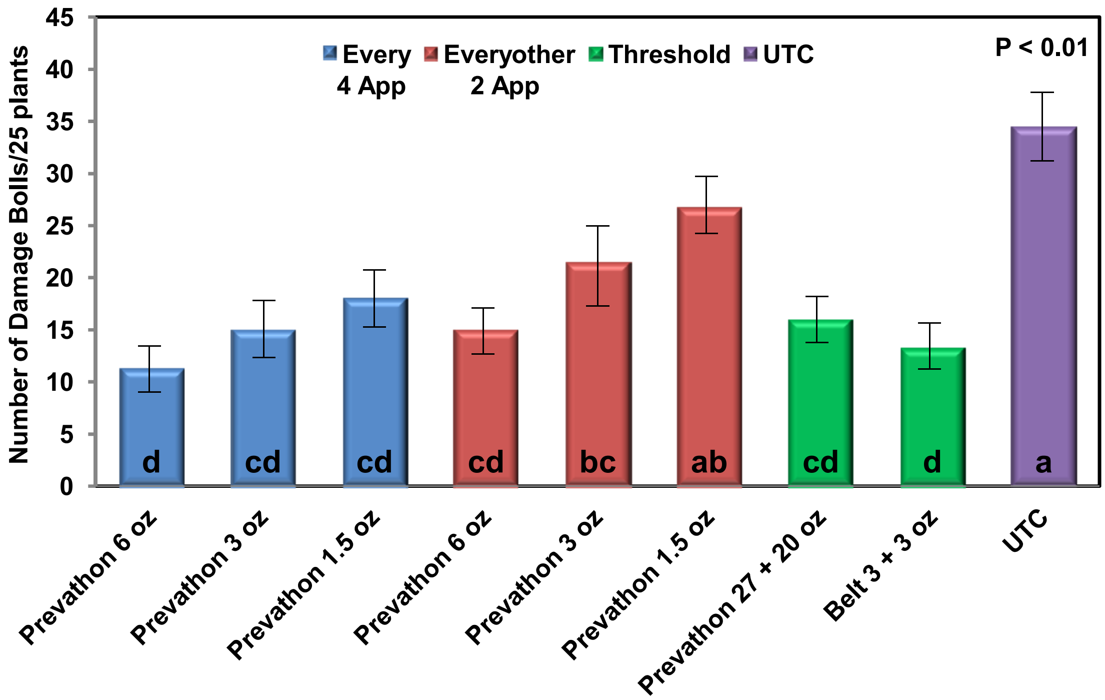

Figure 1: Performance of Prevathon in Non – Bt. Number of damaged bolls per 25 plants.

The use of Prevathon at 6 fl oz and 3 fl oz applied with every tarnished plant bug application was as effective at controlling *H. zea* as currently labeled rates of Prevathon and Belt. All treatments with the exception of Prevathon at 1.5 fl oz/A yielded significantly higher than the untreated control (Figure 2).

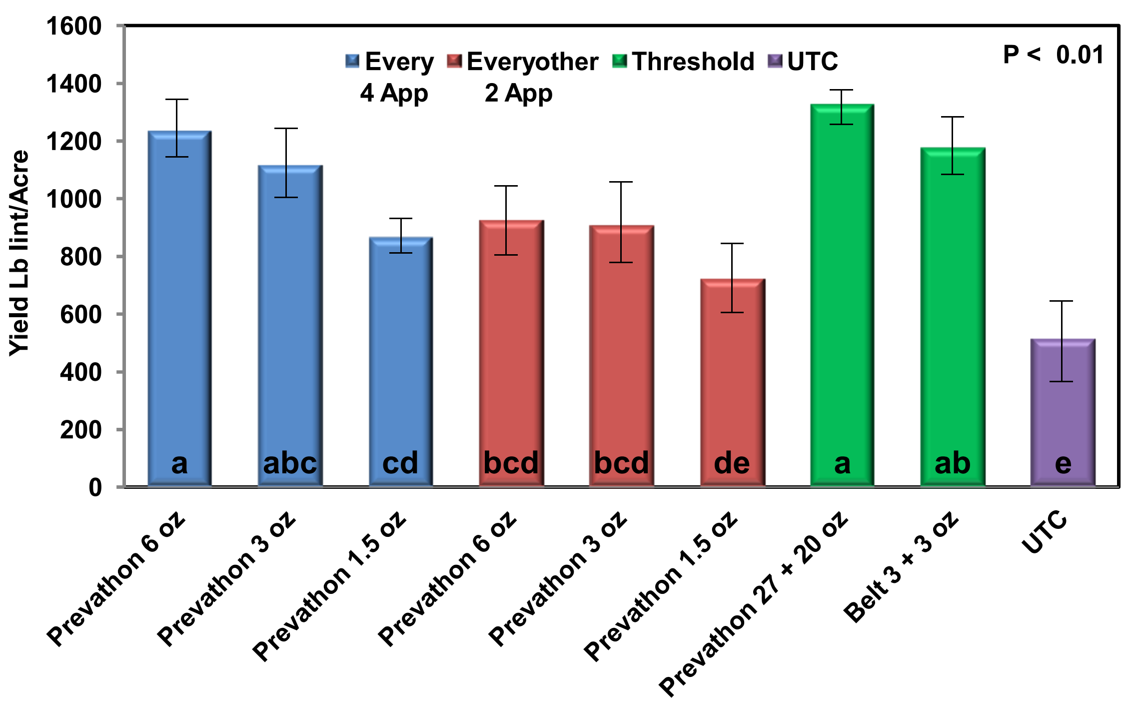

Figure 2: Performance of Prevathon in Non – Bt. Yield in lb lint per acre.

Overall treatments of Prevathon at 6 fl oz/A (24 total fl oz/A) and Prevathon at 3 fl oz/A (12 total fl oz/A) did not yield significantly different from two applications of Prevathon (47 total fl oz/A) and Belt (6 total fl oz/A) applied at larval threshold. However, resistance concerns may become an issue because only one mode of action is being applied at a reduced rate. This will not be a recommended practice in Non-Bt cotton production.

Bt: The Bt study was planted later and in a different field than the Non-Bt study. It was subjected to higher levels of plant bug numbers and received a total of six plant bug applications throughout the season. Numbers of damaged bolls were not significant. No boll damage was observed in treatments where Prevathon was applied at 6 fl oz/A and 3 fl oz/A at every plant bug application, where Prevathon was applied at 6 fl oz/A applied at every other plant bug application and where Prevathon was applied at 27 fl oz/A at threshold (Figure 3).

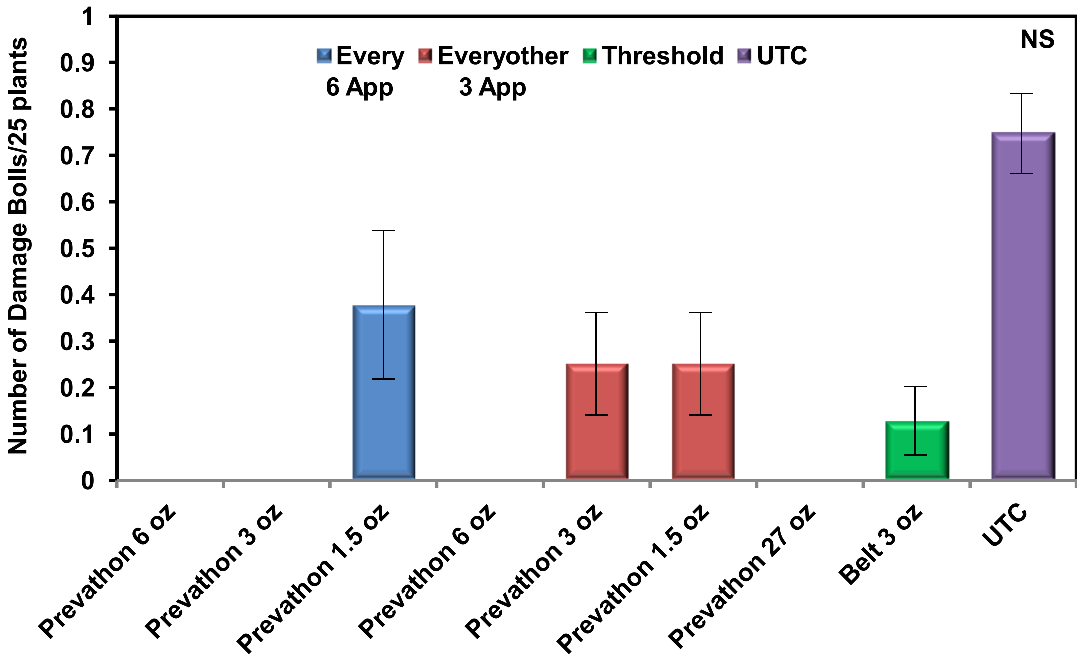

Figure 3: Performance of Prevathon in dual gene cotton. Number of damaged bolls per 25 plants.

The use of Prevathon at a reduced rate combined with tarnished plant bug applications yield significantly higher than the untreated control and not different from current labeled rates (Figure 4). Using Prevathon at a reduced rate in combination with tarnished plant bug applications proved to be effective in protecting cotton yields in Bollgard II cotton. Where the diamide chemistry was not used significant yield losses were observed. Plots treated with the diamide chemistry yielded 194 ibs lint/A more than the untreated control.

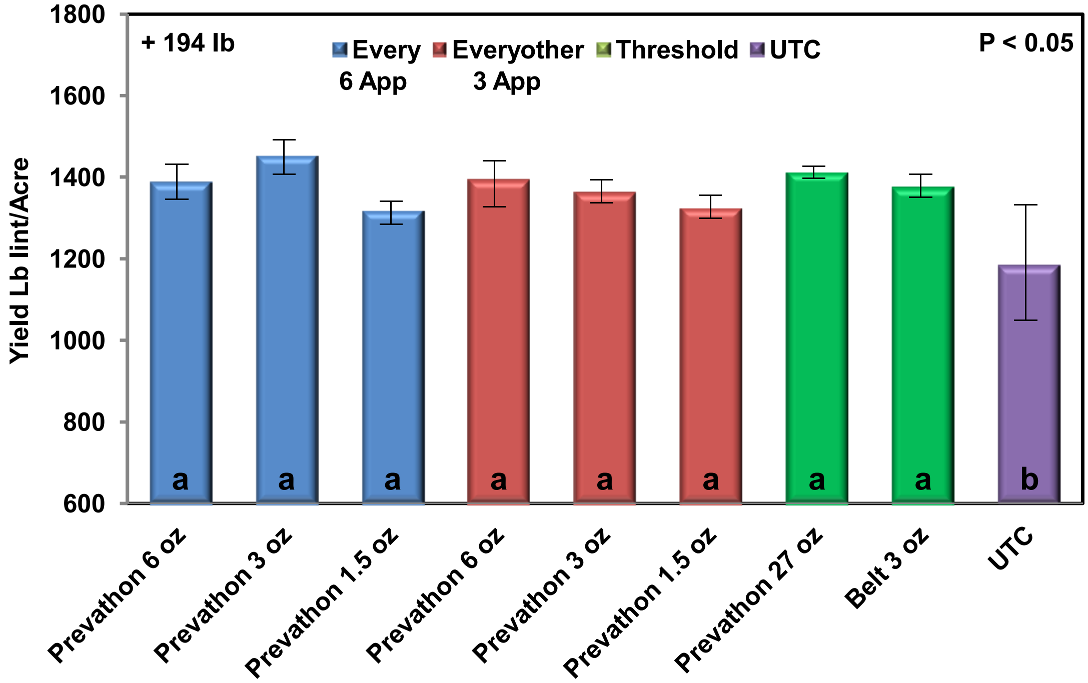

Figure 4: Performance of Prevathon in dual gene cotton. Yield in lb lint per acre.

These data suggest that supplemental foliar applications of the diamide chemistry may protect yields in dual-gene cotton even when Heliothine numbers and observed damage is low. The application of Prevathon at reduced rates in dual gene cotton may prove to be an effective tool in resistance management in dual-gene cotton; however, the results of this study should be considered preliminary with no definitive recommendations proposed by the authors. Further research needs to be conducted in order to determine the effectiveness and long term impacts of this strategy.

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