PERFORMANCE OF BOLLGARD COTTON WITH AND WITHOUT INSECTICIDES

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Abstract

Bt cotton varieties are becoming a very important part of the cotton industry. Understanding this new technology and knowing how to manage Bt cotton varieties could improve cotton pest management and increase both profits and yields. Timely worm insecticide treatments to Bt cotton when worms reach economically damaging levels provide yield protection.

Introduction

Transgenic cotton which has the insecticidal endotoxin protein of Bacillus thurengiensis (Bt cotton) is one of the newly available and promising technologies which provide control of the insecticide resistant bollworm and tobacco budworm populations. The Bt genes are expressed in leaves, squares, and bolls (Perlak et al. 1990). When targeted pest feed on Bollgard cotton, a lethal dose of the protein is consumed and the pest dies before significant damage is done to the crop (Deaton 1995, Meyers et al. 1997).

In the Mississippi River Delta, Bt cotton is best suited for use in areas which are historically infested with high to moderate tobacco budworm populations. This is because of a number of factors. First, cheap and effective insecticides are available for bollworm control while much less effective chemical controls are available at higher costs for budworm control. This may justify the cost of purchasing Bt technology in areas more heavily infested with budworm.

Objectives

Evaluate the insect control and yield potential of several Bt cotton cultivars under irrigated Southeast Arkansas growing conditions.

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Methods and Materials

1996

Cotton was planted on 5-22-96 on a loam soil on the Southeast Branch Experiment Station near Rohwer, Arkansas. Plots were four rows by forty feet and were arranged in a Randomized Complete Block Design with a factorial arrangement of treatment. Two factors were incorporated in this study: Variety and insecticide spray termination date. Five Bt varieties and one non-Bt variety were planted. COTMAN termination strategy was used to make insecticide termination decisions. Insect control sprays were terminated in each plot at NAWF 5+350 DD60 heat units or at NAWF 5+650 DD60 heat units. An unsprayed treatment was also applied to each variety. Treatments were randomly assigned to plots and were replicated six times. Standard field preparations and practices were used.

At planting, standard herbicide, fungicide, and insecticide practices were used on all treatments. Tracer was applied to appropriate plots on 8-26, 8-30, and 9-4. Standard irrigation practices included four irrigations applied as needed according to the irrigation scheduler model.

Insect and damaged fruit data were taken by observing ten terminals (top of plant to bloom), ten blooms, and twenty bolls per plot. COTMAN data collection (plant mapping) was done on each plot to determine fruit set, node/internode development, cut-out, and spray termination. Standard harvest preparations were used and based on 850 DD60 heat units after node above white flower equal five. The field was picked on 10-24-96.

1997

Cotton was planted on 5-13-97 on the Southeast Branch Experiment Station near Rohwer, Arkansas and grown using standard production practices. Plots were four rows by forty feet and were arranged in a Randomized Complete Block Design with a factorial arrangement of treatment. Two factors were incorporated into this study: Variety and insecticidal sprays. Six Bt varieties were tested. Plots were either sprayed or unsprayed. Karate was applied to appropriate plots at 3.8 oz/ac on 8-4-97. Treatments were randomly assigned to plots and were replicated four times. Standard field preparation and fertilization practices were used.

At planting, standard herbicide, fungicide, and insecticide were used on all treatments. Standard irrigation practices included four irrigations applied as needed according to the irrigation scheduler model.

Insect and damaged fruit data were taken by observing ten terminals (top of plant to bloom), ten blooms, and twenty small bolls per plant. COTMAN data collection (plant mapping) was done on each plot to determine fruit set, node/internode development, cut-out, and spray termination.

Standard harvest preparations were used based on sixty percent open bolls for all varieties. The field was picked on 10-1-97.

1998

Nine Bt and one non-Bt variety were planted on 5-9-98 on the Southeast Branch Experiment Station near Rohwer, Arkansas. Plots were four rows by forty feet and were arranged in a Randomized Complete Block Design with a factorial arrangement of treatment. Two factors were incorporated into this study: Variety and insecticidal sprays. Plots were either spayed or unsprayed. Baythroid was applied at 2 oz/ac on 7-18-98 and 7-28-98. Treatments were randomly assigned to each plot and were replicated four times. Standard field preparation and fertilization practices were used.

At planting, standard herbicide, fungicide, and insecticide practices were used. Standard irrigation practices which included five irrigations were applied as needed according to the irrigation scheduler model.

Insect and damaged fruit data were taken by observing twenty-five terminals (top of plant), twenty-five squares (top one-third of plant), and twenty-five small bolls per plot. COTMAN data collecting (plant mapping) was done to determine fruit set, node/internode development, cut-out, and spray termination. Standard harvest practices were used based on percent open bolls (at least sixty percent open for all varieties). The field was picked on 9-24-98.

Plant mapping data were processed using COTMAN and data were analyzed in all three years using ANOVA and Duncan's Multiple Range Test (Costs statistical software) with a five percent level of significance.

Results

Yields of Bt Varieties

In 1996, Deltapine 90 Bt and MON 531 were the lowest yielding varieties. Deltapine 50 Bt and NuCotn 33b were the higher yielding varieties.

In 1997, Deltapine 90 Bt was again the lowest yielding variety (though not significantly lower than Paymaster 1215 BG). The top four varieties (Paymaster 1330 BG, Deltapine 20 Bt, NuCotn 32b, and NuCotn 33b) were not significantly different from one another in seed cotton yield.

In 1998, Delta pine 20 Bt was the lowest yielding Bt variety (though not statistically different than other varieties). Numerically, Deltapine 50 Bt, Deltapine 428, and NuCotn 32b were the highest yielders (Table 8).

Insecticide Treatment of Bt Cotton

In 1996, Deltapine 90 Bt and MON 531 were the only varieties which responded with significantly higher yields to insecticide treatments (Table 6).

Across all Bt varieties tested in 1996, plots treated for worm control yielded more but not significantly more seed cotton per acre than untreated plots.

In the 1997 trial, only NuCotn 33b responded to treatment for worm control with increased seed cotton yield.

In the 1998 trial, Deltapine 50 Bt and Deltapine 20 Bt responded the most to worm control treatments (Table 8) .

Across all Bt varieties except NuCotn 33b tested in the 1998 trial, plots treated for worm control yielded more but not significantly more than plots that were not treated.

Summarizing data across all three years, worm insecticide treatments produced a significant increase in seed cotton yields.

Worm Counts

Insecticidal sprays in 1996 significantly reduced worm counts in non-Bt varieties but had no such effects on Bt varieties. Worm counts were significantly lower on Bt than non-Bt varieties. Similar worm counts were found on sprayed and unsprayed Bt plots. Since the non-Bt. variety received three insecticidal treatments, worm count data from the 1996 study showed that Bt varieties with no insecticide applications exerted control pressure on worms that was equal to three insecticide applications on non-Bt varieties under the light worm pressure experienced in 1996.

Insecticidal sprays in 1998 significantly reduced worm numbers in Deltapine 50 Bt and Deltapine 20 Bt. While not all varieties responded significantly to treatments, a numerical trend indicated that sprays reduced worm counts.

Conclusions

Deltapine 90 Bt appears to be ill suited for Southeast Arkansas growing conditions, while Deltapine 50 Bt and NuCotn 33b appear to be better suited.

Over all three years, properly timed insecticide treatments for worm control produced higher yields. This is an indication that bollworms can cause injury and yield loss to Bt cotton lines.

Late insecticide treatments have little chance of producing yield increases for Bt cotton lines. Late sprays would not be expected to produce yield increases on Bt cotton lines, and in this study such yield increases were not observed.

References

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Table 1. Seed cotton yields (in pounds) of Bt cotton varieties as influenced by insecticidal sprays and termination date. Rohwer, AR 1996.

Insecticide/Termination	Bt Varieties	DPL 50
NAWF 5 + 350 heat units	3122 a	3628 a
NAWF 5 + 650 heat units	3103 a	3613 a
Unsprayed	2992 a	3139 a

Table 2. Seed cotton yields (in pounds) of Bt varieties as influenced by insecticidal treatments in 1996 and 1997 combined. Rohwer, AR

Insecticide	Yield
Sprayed	3509 a
Unsprayed	3363 b

Table 3. Seed cotton yield (in pounds) and worm damage of Bt and non-Bt varieties as influenced by insecticidal sprays. Rohwer, AR 1998

Insecticide	Yield	Damaged squares	Damagedbolls
Sprayed	2309 a	0.03 a	0.20 a
Unsprayed	1998 b	0.27 a	1.47 b

Table 4. Seed cotton yield (in pounds) and worm damage of Bt varieties sprayed and unsprayed and non-Bt varieties sprayed and unsprayed. Rohwer, AR 1998

Insecticide	Yield	Damaged squares	Damaged bolls
Sprayed Bt	2257 a	0.19 a	0.19 b
Unsprayed BT.	1993 b	1.105 a	1.47 ab
Sprayed non-Bt	1884 b	0.625 a	1.00 ab
Unsprayednon-Bt	1463 c	2.125 a	1.88 a

Table 5. Seed cotton yield of sprayed and unsprayed cotton varieties for 1996, 1997, and 1998. Rohwer, AR

Insecticide	Yield
Sprayed	3195 a
Unsprayed	2935 b

Table 6. Seed cotton yield of all Bt and non-Bt cotton varieties as influenced by insecticidal sprays and termination date. Rohwer, AR 1996

Variety	Insecticide/Termination	Yield
DP 50 Bt	Unsprayed	3861 a
DP 50 Bt	350 H.U.	3834 a
DP 50 Bt	650 H.U.	3796 a
NC 33b	650 H.U.	3716 a
DP 50	350 H.U.	3628 ab
DP 50	650 H.U.	3613 ab
NC 33b	350 H.U.	3605 ab
NC 33b	Unsprayed	3540 abc
DP 20 Bt	650 H.U.	3223 bcd
DP 50	Unsprayed	3139 cd
DP 20 Bt	Unsprayed	3104 d
DP 20 Bt	350 H.U.	3073 d
MON 531	650 H.U.	2932 de
MON 531	350 H.U.	2848 de
MON 531	Unsprayed	2569 ef
DP 90 Bt	350 H.U.	2252 fg
DP 90 Bt	Unsprayed	1885 g
DP 90 Bt	650 H.U.	1846 g

Table 7. Comparison of seed cotton yields of Bt cotton varieties as influenced by insecticidal treatments in 1997. Rohwer, AR

Variety	Insecticide	Yield
PM 1330 BG	Sprayed	3979 a
PM 1330 BG	Unsprayed	3915 a
NC 32 Bt	Sprayed	3974 a
NC 32 Bt	Unsprayed	3753 ab
NC 33b	Sprayed	3845 a
NC 33b	Unsprayed	3697 ab
DP 20 Bt	Sprayed	3788 ab
DP 20 Bt	Unsprayed	3834 a
PM 1215 BG	Sprayed	3713 ab
PM 1215 BG	Unsprayed	3492 bc
DP 90 Bt	Sprayed	3702 ab
DP 90 Bt	Unsprayed	3310 c

Table 8. Seed cotton yield, worm damaged squares, and worm damaged bolls of all Bt and non-Bt cotton varieties as influenced by insecticidal sprays. Rohwer, AR 1998

Variety	Insecticide	yield	Dmg sqs	Dmg bolls
DP 458	Unsprayed	1885	1.25	1.50
DP 458	Sprayed	2144	0.00	0.00
DP 655	Unsprayed	1968	1.25	1.63
DP 655	Sprayed	2098	0.88	0.25
NC 32b	Unsprayed	2233	1.00	0.63
NC 32b	Sprayed	2524	0.00	0.25
NC 35b	Unsprayed	1912	1.13	0.63
NC 35b	Sprayed	2093	0.38	0.63
NC 33b	Unsprayed	2054	0.88	1.00
NC 33b	Sprayed	2052	0.13	0.00
DP 90 Bt	Unsprayed	1862	0.50	2.25
DP 90 Bt	Sprayed	2334	0.13	0.38
DP 50 Bt	Unsprayed	2189	1.88	2.50
DP 50 Bt	Sprayed	2690	0.13	0.13
DP 20 Bt	Unsprayed	1695	1.00	2.00
DP 20 Bt	Sprayed	2247	0.00	0.13
DP 428	Unsprayed	2181	1.75	1.13
DP 428	Sprayed	2599	0.13	0.00
STV 373	Unsprayed	1465	2.13	1.88
STV 373	Sprayed	1885	0.63	1.00