EVALUATION OF CHEMICAL AND PHYSICAL MEANS OF REMOVING LATE-SEASON COTTON FRUIT TO IMPROVE YIELDS AND CONTROL BOLL WEEVILS

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Abstract

Increasing yields in cotton (*Gossypium hirsutum L.)* is an ongoing concern for many researchers. It has been shown that removal of upper-canopy squares at nodes above white flower five plus 350 heat units (NAWF=5 + 350 H.U.) may actually divert carbohydrates to developing bolls with a yield advantage. This study evaluated different chemical and physical methods of removing upper-canopy late-season squares to potentially increase seedcotton yields and help control boll weevils (*Anthonomus grandis)* by removing the weevils late-season food supply. The research was performed in northeast and southeast Arkansas on two cultivars (DP 20B and NuCotn 33B), and included two planting dates (early and mid May). The treatments were: Prep (ethephon), Finish (cyclanalide), Cycocel (chlormequat), M-H 30 (maleic hydrazide), a mechanical topping treatment, and removal of squares by hand. Maleic Hydrazide and the defoliants Prep and Finish were the most successful chemicals at removing upper-canopy fruit. Boll weight at NAWF=5 was increased the most when squares above NAWF=5 were removed by hand, however, Prep and Cycocel also aided in increasing boll weight at NAWF=5. Seedcotton yields were the highest for the Prep, Finish and control treatments. This research could ultimately lead to higher yields and improved control of boll weevils.

Introduction

COTMAN is a successful management program for cotton that facilitates the use of Target Development Curves. These curves provide the basis for measuring the efficiency of management strategies that promote earliness in the cotton crop. Nodes above white flower (NAWF) is an integral concept used in COTMAN for basing end-of-season decisions. It has been reported that bollworm (*Helicoverpa zea)* and boll weevil (*Anthonomus grandis)* damage to cotton bolls decreases dramatically at about 350 heat units after NAWF=5 (Bagwell, 1995). This is a phenomenon which is made use of in the COTMAN cotton monitoring management program for decisions about terminating insecticide application. Furthermore, research and field observations have indicated that terminating insecticides at 350 heat units after physiological cutout (NAWF=5) results in higher yields than when terminating at either 250 or 450 heat units (Oosterhuis et. al., 1999). This timely but early terminating of insecticide application could save growers a significant amount of money, especially in the southern part of Arkansas (Cochran, et. al., 1995). Preliminary studies have shown that removal of squares at (NAWF=5) +350 heat units may actually divert carbohydrates to developing upper-canopy bolls with a resultant yield advantage (Kim and Oosterhuis, 1998).

The main objective of our study was to evaluate the efficiency of various chemicals in removing fruit above NAWF=5. The second objective was to determine if removing upper-canopy fruit increased the boll weights of first position bolls at NAWF=5, and total seedcotton yields. A mechanical topping treatment and a treatment with removal of squares by hand were included. These treatments have obvious implications in boll weevil control.

Materials and Methods

In the summer of 1997 we first evaluated various chemicals to see which rates of certain chemicals performed the best at removing upper-canopy fruit. This rate study was performed at Rohwer, in southeast Arkansas on a Suregrow 125 cultivar planted in early May. This past 1998 summer was the second season for this square removal project. The trial was conducted at two locations: southeast Branch Research Station at Rohwer, AR and the Delta Branch Station in northeast Arkansas. Two cultivars were used, an early maturing DP20B cultivar and a late-season NuCotn33B cultivar. To provide two growth patterns, we included two planting dates (early and mid May). The treatments for the 1998 season included: a hand square removal and mechanical topping treatment (physical removal of fruit), as well as, Finish @ 0.1 lb/acre, Prep @ 0.2 lb/acre, Cycocel (CCC) @ 8 oz/acre, and Maleic Hydrazide (used in tobacco) @ 2lb/acre (chemical removal). The experimental design was a Randomized Complete Block with four replications. At the NAWF=5 stage, 20-30 first position white flowers at NAWF=5, were tagged on the center two rows of each four-row plot. Daily heat units were accumulated thereafter until 350 heat units were reached. At this time, (NAWF=5)+350 heat units, the seven treatments were applied. Two weeks after applying treatments, first position square shed was determined for the 5 nodes above and below the tagged node at NAWF=5, as well as, the tagged NAWF=5 position. Total seedcotton yield, boll weight at NAWF=5, and HVI (fiber quality) were determined for the various treatments at final harvest.

Results and Discussion

Efficiency of Square Removal

During the summer of 1997 a rate study was performed at Rohwer (southeast Arkansas) to determine which chemicals were the most efficient at removing upper-canopy squares. Only the higher rate of Prep (0.2lb/acre) gave a significant square shed, causing 83% of the first position squares

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above NAWF=5 to shed compared to 55% shed by the control. Maleic Hydrazide and Cycocel also showed potential as chemicals that may successfully remove fruit above the NAWF=5 position.

In 1998 at Rohwer (southeast Arkansas), Prep and Finish were the most effective chemicals removing 67% of the upper-canopy fruit. This was significantly higher (P=0.05) than the control which only removed 51% of the squares; the lowest for the DP20B cultivar. For the NuCotn33B cultivar at Rohwer, Prep gave the highest upper-canopy fruit shed of 73%, which was higher than the 65% by the control (Table 1). At Clarkedale in 1998 (northeast Arkansas), there was no significant difference (P=0.05) among treatments for square shed for the DP20B cultivar. However, Cycocel outperformed the other treatments by shedding 89% of the squares above NAWF=5, which was significantly higher than the other treatments for the NuCotn33B cultivar (Table 2). Overall, there was no treatment effect in square shed below the tagged NAWF=5, and only the Maleic Hydrazide chemical treatment showed significant shedding of fruit at the NAWF=5 position when compared to the control treatment.

Seedcotton Yields

The seedcotton yield at Clarkedale for the first planting date showed no significant differences (P=0.05) between treatments for either cultivar (Table 3). For the second planting date at Clarkedale, Maleic Hydrazide, Finish and the control treatments all gave the highest yields, with Cycocel giving the lowest yields for the DP20B cultivar. For the NuCotn 33B cultivar the mechanical topping and Maleic Hydrazide treatments gave the highest yields and Finish gave the lowest yields (Table4). For the first planting date at Rohwer there was no significant difference in treatment effects on yield for the DP20B cultivar, although the control gave the highest yield and the mechanical topping treatment gave the lowest yield for the NuCotn33B cultivar (Table 5). The second planting date at Rohwer showed very little difference between treatments for the DP20B cultivar except that mechanical topping reduced yields significantly. Finish was the best treatment at increasing yields for the NuCotn33B cultivar with the control, hand square removal, and Maleic Hydrazide treatments giving the poorest yields (Table 6).

First Position Boll Weights at NAWF=5

For the boll weight at NAWF=5 there was no significant differences between treatments for the first planting date at Clarkedale (Table 3). At Clarkedale, only DP20B showed any significant difference for the second planting date. Here Maleic Hydrazide and the mechanical topping treatments gave the lowest boll weights and hand square removal and Cycocel treatments gave the highest boll weights(Table 4). At Rohwer, the hand square removal treatment gave the highest boll weight at NAWF=5 for the DP20B cultivar, and the control and mechanical topping treatments gave the lowest boll weights. For the NuCotn 33B cultivar, Prep and Finish gave the highest boll weights with the control giving the lowest (Table 5). For the second planting date at Rohwer, the hand square removal gave the highest boll weight and the control and finish seemed to reduce boll weight at NAWF=5 for the DP20B cultivar. For NuCotn33B cultivar, Cycocel gave the largest boll weight whereas mechanical topping reduced boll weight significantly (Table 6).

Conclusions

Overall, mechanical topping was not a successful treatment for increasing total seedcotton yield and boll weight at NAWF=5. Mechanical topping successfully removed the unwanted squares above NAWF=5, but it also removed the upper photosynthesizing leaves which would aid in increasing boll weight and seedcotton yield. The hand square removal treatment was very successful in increasing boll weight at NAWF=5, but not as successful in obtaining higher yields. The plots treated with Prep, Finish, and Maleic Hydrazide seemed to have potential as methods to increase yield by square removal. There was no single treatment, however, that was able to remove squares effectively, as well as, increase boll weight at NAWF=5 and total seedcotton yield This project will be repeated in 1999 with some modifications including monitoring of weevils and using more commonly used cultivars. This project could ultimately be very beneficial to farmers in helping to increase yields and control boll weevil (*Anthonomus grandis).* Future research will include monitoring of overwintering weevils.

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Table 1. First position fruit shed percentages for the tagged NAWF=5, as well as, the 5 nodes above and below the tagged NAWF=5 two weeks after application of treatments. Rohwer, AR (PD1) May 6, 1998.

	Deltapine 20B			NuCotn 33B		
Treatment	Shed @ NAWF=5	Shed Above	Shed Below	Shed @ NAWF=5	Shed Above	Shed Below
	%	%	%	%	%	%
Control	28.2a[1]	51.1b	41.3a	13.8c	67.1ab	48.6a
Hand Rem.	13.3a	-----[2]	-----[3]	28.3abc	-----[2]	-----[3]
Cycocel	21.2a	63.2ab	48.2a	20.4bc	68.6ab	48.3a
Maleic Hyd.	26.9a	63.2ab	37.9a	41.4a	59.8b	52.2a
PREP	30.4a	67.1a	40.7a	22.6bc	73.1a	47.1a
Finish	24.4a	67.0a	44.0a	28.5abc	63.1ab	52.1a
Mech. Top.	35.8a	-----[2]	-----[3]	33.0ab	-----[2]	-----[3]

[1]Treatment means within a column followed by the same letter are not significantly different @ P=0.05.
[2]All squares removed by treatment.
[3]Fruit shed not recorded.

Table 2. First position fruit shed percentages for the tagged NAWF=5, as well as, the 5 nodes above and below the tagged NAWF=5 two weeks after application of treatments. Clarkedale, AR (PD1) May 6, 1998.

	Deltapine 20B			NuCotn 33B		
Treatment	Shed @ NAWF=5	Shed Above	Shed Below	Shed @ NAWF=5	Shed Above	Shed Below
	%	%	%	%	%	%
Control	16.8a[1]	85.0a	55.6a	55.7a	86.3ab	55.6a
Hand rem.	17.2a	-----[2]	-----[3]	23.8b	-----[2]	-----[3]
Cycocel	14.0a	84.4a	50.6a	28.0b	88.8a	57.5a
Maleic H.	24.9a	87.5a	47.5a	38.3ab	86.3ab	58.8a
PREP	23.1a	85.6a	49.4a	35.2ab	79.4b	55.0a
Finish	9.2a	85.6a	56.9a	19.2b	83.8ab	52.5a
Mech. Top.	19.5a	-----[2]	-----[3]	26.8b	-----[2]	-----[3]

[1]Treatment means within a column followed by the same letter are not significantly different @ P=0.05.
[2]All squares removed by treatment.
[3]Fruit shed not recorded.

Table 3. Effect of chemical and physical fruit removal on seedcotton yields and boll weight at NAWF=5. Clarkedale, AR (PD1) May 6, 1998.

	Deltapine 20B		NuCotn 33B	
Treatment	S.C Yield	Avg Boll Wt.	S.C. Yield	Avg Boll Wt.
	(kg/ha)	(g)	(kg/ha)	(g)
Control	2383a1	4.39a	1919a	4.06a
Hand rem.	2406a	4.37a	1936a	4.31a
Cycocel	2151a	4.51a	1540a	4.44a
Maleic H.	2313a	4.21a	1714a	3.90a
Prep	2407a	4.49a	1863a	3.86a
Finish	2336a	4.67a	1918a	4.13a
Mech. Top.	2372a	4.14a	1722a	3.85a

[1]Treatment means within a column followed by the same letter are not sgnificantly different @ P=0.05.

Table 4. Effect of chemical and physical fruit removal on seedcotton yields and boll weight at NAWF=5. Clarkedale, AR (PD2)May 22, 1998.

	Deltapine 20B		NuCotn 33B	
Treatment	S.C Yield	Avg Boll Wt.	S.C. Yield	Avg Boll Wt.
	(kg/ha)	(g)	(kg/ha)	(g)
Control	1815a[1]	4.76a	1265ab	4.50a
Hand rem.	1585ab	4.84a	1210ab	4.63a
Cycocel	1322b	4.92a	1326ab	4.55a
Maleic H.	1777a	4.28b	1349a	4.25a
Prep	1571ab	4.51ab	1240ab	4.75a
Finish	1848a	4.82a	1160b	4.59a
Mech. Top.	1544ab	4.23b	1344a	4.54a

[1]Treatment means within a column followed by the same letter are not significantly different @ P=0.05.

Table 5. Effect of chemical and physical fruit removal on seedcotton yields and boll weight at NAWF=5. Rohwer, AR (PD1) May 6, 1998.

	Deltapine 20B		NuCotn 33B	
Treatment	S.C Yield	Avg Boll Wt.	S.C. Yield	Avg Boll Wt.
	(kg/ha)	(g)	(kg/ha)	(g)
Control	3101a[1]	3.60b	3390a	3.55b
Hand rem.	2998a	4.46a	3089abc	3.86ab
Cycocel	3068a	3.93ab	2918bc	3.66ab
Maleic H.	3032a	4.15ab	3188ab	3.65ab
Prep	3047a	4.00ab	3025bc	4.23a
Finish	3136a	4.20ab	2965bc	4.19a
Mech. Top.	3073a	3.60b	2875c	3.94ab

[1]Treatment means within a column followed by the same letter are not significantly different @ P=0.05.

Table 6. Effect of chemical and physical fruit removal on seedcotton yields and boll weight at NAWF=5. Rohwer, AR (PD2) May 20, 1998.

	Deltapine 20B		NuCotn 33B	
Treatment	S.C Yield	Avg. Boll Wt.	S.C. Yield	Avg. Boll Wt.
	(kg/ha)	(g)	(kg/ha)	(g)
Control	2557a[1]	4.06b	2801b	3.93ab
Hand rem.	2506a	4.65a	2826b	3.90ab
Cycocel	2487a	4.30ab	2865ab	4.11a
Maleic H.	2540a	4.24ab	2834b	3.96ab
Prep	2585a	4.44ab	2864ab	3.97ab
Finish	2509a	4.16b	3028a	3.98ab
Mech. Top.	2295b	4.26ab	2566c	3.59b

[1]Treatment means within a column followed by the same letter are not significantly different @ P=0.05.