REMOVAL OF UPPER-CANOPY FRUIT AT INSECTICIDE TERMINATION TO IMPROVE YIELDS AND CONTROL BOLL WEEVILS

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RESEARCH PROBLEM

With the increasing cost associated with raising cotton (*Gossypium hirsutum* L.) and low fiber prices, producers are in need of higher yields and lower input costs to remain profitable. The main objective of this study was to evaluate the efficiency of various chemicals in removing fruit above NAWF=5. The second objective was to determine whether removing upper-canopy fruit increases the weight of first-position bolls at the NAWF=5 main-stem node, and seedcotton yield. This research project also has implications for better control of boll weevils by removing their late-season food sources, which may aid in the eradication process by reducing the number of late-season diapause sprays.

BACKGROUND INFORMATION

Cotton is a perennial with an indeterminate growth habit that will continue to produce fruit as long as the season persists. However, these late-season bolls are often small, low in fiber quality, costly to protect with increasing insect pressure, and provide a food source for insects (Bourland *et al*., 1992). Nodes above white flower (NAWF) is an integral concept used in the COTMAN crop-monitoring program for basing end-of-season decisions (Bourland *et al*., 1992). In COTMAN, a major aim is to identify the last effective boll population and project a date for insecticide termination (Cochran *et al*., 1996). Bagwell (1995) showed that bollworm [*Helicoverpa zea* (Boddie)] and boll weevil (*Anthonomus grandis* Boehman) damage to cotton bolls decreases dramatically at about 350 heat units after anthesis. This finding was supported by Kim (1998), who showed increased resistance of the boll wall to penetration at NAWF=5 plus about 350 heat units. Oosterhuis *et al.* (1999) reported that terminating insecticides at 350 heat units after physiological cutout (NAWF=5) results in a higher yield than when terminating before or after this time. The purpose of this study was to determine whether

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yields could be improved by actually removing this upper-canopy fruit once insecticide termination occurs. Based on work by Kim and Oosterhuis (1998), it is hypothesized that yields could be enhanced by improved partitioning of carbohydrates to lower developing bolls.

RESEARCH DESCRIPTION

In 1999, a field experiment was planted into a moderately well-drained Hebert silt loam at the Southeast Research and Extension Center, Rohwer Division, and a moderately well-drained Dundee silt loam at the Delta Branch Station at Clarkedale. An early-maturing Deltapine ‘DP20B’ cultivar was used for this field study to ensure that the cotton crop successfully reached physiological cutout. To allow for any potential problems in the research due to weather and to provide two growth patterns, two planting dates were included (early and mid-May). The experimental design for this study was a randomized complete block with four replications and seven treatments. The treatments included a hand-square-removal and a mechanical topping treatment (physical removal), cyclanilide (Finish) at 0.1 lb ai/acre, ethephon (Prep) at 0.2 lb ai/acre, chlormequat (CCC) at 8 oz/acre, maleic hydrazide (M-H 30) at 2 lb/acre (chemical removal), and control with no square removal. At the NAWF=5 stage, 20-30 first-position white flowers were tagged in the center two rows of each four-row plot. Daily heat units [(max. + min. temp./2) – 60°F] were accumulated from white flower until 350 heat units had accumulated. At that time (NAWF=5 + 350 heat units), the six square removal treatments were applied. One week after applying treatments, first-position square shed was determined for the five nodes above and below the tagged NAWF=5, as well as for the tagged NAWF=5 position. At harvest, weight of first-position bolls at the NAWF=5 main-stem node, and total seedcotton yields were determined.

RESULTS

The results from only the first planting will be mentioned with respect to efficiency of square removal, boll weight at NAWF=5, and seedcotton yields.

Efficiency of Square Removal

The results from this year’s square removal study were very similar between the two research locations. At both locations, cyclanilide was the most effective chemical for removing unwanted upper-canopy fruit (above NAWF=5) late in the season (Table 1). However, both cyclanilide and ethephon were able to remove more fruit ($P \leq 0.05$) than the control at both Arkansas locations. Unfortunately, cyclanilide also removed more first-position bolls at NAWF=5 (which represents the last harvestable boll population) at Clarkedale. Cyclanilide also numerically removed more bolls lower in the canopy at Clarkedale, as did mechanical topping at Rohwer (Table 1). Mechanical topping probably adversely affected lower bolls, causing them to shed, from wounding the plant and release of ethylene.

First-Position Boll Weights at NAWF=5

With the exception of cyclanilide, there were no significant differences between treatments for increasing the weight of first-position bolls at NAWF=5 at either location (Fig. 1). Cyclanilide showed the lowest weight of first-position bolls at NAWF=5, which were significantly lower than the control treatment (Fig. 1). These bolls were probably smaller because cyclanilide caused some early leaf defoliation, decreasing the leaf area needed for photosynthate production and further boll development.

Seedcotton Yields

Results from the Clarkedale location showed a maximized yield response by the control treatment where no fruit was removed, however, not by a significant margin (Fig. 2). At Rohwer, the control treatment also rendered the highest seedcotton yields, with cyclanilide significantly decreasing yields (Fig. 2). It was unfortunate that the treatment that removed the most fruit yielded the least. However, the low yields from the application of cyclanilide could be attributed to premature boll opening and early leaf defoliation causing bolls not to fully develop.

PRACTICAL APPLICATION

The primary objective of this study was to evaluate various chemicals to determine which ones were most effective at removing unwanted upper-canopy fruit late in the growing season. Secondly, we wanted to determine whether this removal of fruit affects the weight of NAWF=5 first-position bolls and subsequent seedcotton yields. There was evidence that some chemicals could be helpful in achieving this goal, but more research needs to be performed. This research could ultimately give growers better yields and control of late-season insects.

LITERATURE CITED

Bagwell, R.D. 1995. Monitoring the cotton plant for insecticide effects and late-season insecticide termination. Ph.D. Dissertation, University of Arkansas, Fayetteville, AR.

Bourland, F.M., D.M. Oosterhuis, and N.P. Tugwell. 1992. Concept for monitoring the growth and development of cotton plants using main-stem node counts. J. Prod. Agric. 5:532-538.

Cochran, M.J., D.M. Danforth, N.P. Tugwell, A. Harris, J. Reed, J. Benedict, R. Leonard, R. Bagwell, O. Abaye, and E. Herbert. 1996. A multi-state validation of insecticide termination rules based upon the COTMAN plant monitoring system: Preliminary results. Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. pp. 1124-1128.

Kim, M. 1998. Changes in the cotton fruit wall in relation to COTMAN insecticide termination rules. M.S. Thesis, University of Arkansas, Fayetteville, AR.

Kim, M.J. and D.M. Oosterhuis. 1998. Effect of upper canopy square removal before and after NAWF=5 plus 350 heat units on carbon partitioning from upper canopy leaves to bolls lower in the canopy. *In:* D.M. Oosterhuis (ed.). Proc. 1998 Cotton Research Meeting and Summaries of Research in Progress. University of Arkansas Agricultural Experiment Station Special Report 188:174-176.

Oosterhuis, D.M., C. Allen, F.M. Bourland, R.S. Brown, and M.J. Kim. 1999. Effect of late-season fruit removal on cotton yield and quality- Implications in insecticide termination. Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. pp. 532-533.

Table 1. First-position fruit shed percentages at tagged NAWF=5, as well as above and below the tag 1 week after application of treatments. (Planting Date 1, Summer 1999).

	First Position Fruit Shed					
	Clarkedale			Rohwer		
Treatment	NAWF=5	Above	Below	NAWF=5[z]	Above[y]	Below[x]
	%					
Control	27.5 ab[w]	61.5 d	27.0 abc	50.0 a	70.0 d	23.5 ab
Hand Square Removal	35.0 a	100.0 a	18.5 c	45.0 a	100.0 a	23.5 ab
Mechanical Topping	35.0 a	100.0 a	22.5 bc	37.5 a	100.0 a	29.0 a
Chlormequat	22.5 abc	73.5 c	24.0 bc	45.0 a	74.5 cd	19.5 b
Maleic Hydrazide	17.5 bc	73.5 c	23.0 bc	45.0 a	70.0 d	27.0 ab
Ethephon	22.5 abc	80.0 c	29.0 ab	47.5 a	80.5 bc	23.0 ab
Cyclanilide	12.5 c	90.0 b	35.0 a	50.0 a	86.0 b	23.5 ab

[z] Represents the percent of first-position fruit shed at the tagged NAWF=5 position.

[y] Represents the percent of first-position fruit shed averaged over the five nodes above NAWF=5.

[x] Represents the percent of first-position fruit shed averaged over the five nodes below NAWF=5.

[w] Treatment means within a column followed by the same letter are not significantly different at $P<0.05$.