A MULTI-STATE VALIDATION OF INSECTICIDE TERMINATION RULES BASED UPON THE COTMAN PLANT MONITORING SYSTEM: PRELIMINARY RESULTS

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Abstract

Preliminary results from a multistate validation of the insecticide termination rules of the COTMAN expert system are discussed. COTMAN recommends insect control be terminated at 350 heat units after the flower date of the last effective boll population. Small plot experiments in Arkansas, Texas and Louisiana show no significant yield difference from terminating insect control for bollworm and boll weevils at NAWF=5 + 350HU. Large plot experiments in Arkansas, Texas and Mississippi demonstrated higher yields, lower insect control costs and higher net revenues from following the COTMAN termination rules.

Introduction

One of the more difficult tasks in cotton management is the decision on when to terminate insecticide controls. Recent advances in applying plant monitoring techniques have demonstrated great potential to facilitate this task. The COTMAN expert system has been developed around a procedure that can identify the last effective boll population and estimate when that boll cohort has reached physiological maturity where these bolls are no longer susceptible to bollworm and boll weevil damage (Bourland et al. 1992; Bagwell and Tugwell 1992).

A fundamental plant monitoring technique employed in COTMAN is the mainstem nodal development. After first flower, the number of mainstem nodes above the highest first position white flower (NAWF) is recorded on a weekly basis. The last effective boll population is the last boll cohort that will significantly contribute to the harvestable yield. Within COTMAN, the flower date of the last effective boll population is defined as NAWF=5 for Type I growth patterns and the date of the latest possible cutout date for growth patterns (Type II) that reflect significant stress resulting in crop delays. The latest possible cutout date is determined within COTMAN based upon long term historical weather patterns and a user supplied acceptable risk level (Cochran et al. 1995). In caged experiments, it has been shown that bolls are no longer susceptible to bollworm and boll weevil damage 350 heat units after flower. Therefore, COTMAN provides a guide to terminating insecticide treatments at 350 heat units after the flower date of the last effective boll population.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1124-1128 (1996)
National Cotton Council, Memphis TN

Data and Methods

In 1995, a series of experiments was conducted to validate the COTMAN insecticide termination rules in a number of different production conditions. Two sets of experiments were designed to validate the rules. First, in small plots five treatments were compared to test the hypothesis that termination at NAWF=5 + 350 HU would not result in lower yields. The experimental design is displayed in a schematic diagram in Table 1. Second, to validate the system in large plots and under conditions of significant late season insect pressure, NAWF counts were collected in a number of actual growers' fields. A subset of the fields was selected as having the conditions most likely to challenge the validity of the system. In these fields, treatments were replicated in strips of 7 to 10 acres. Two treatments were examined: 1) terminate insect control for bollworms and boll weevils at NAWF=5 + 350HU, and 2) apply the grower's normal action thresholds and terminate insect control for bollworms and boll weevils at NAWF=5 + >500HU. Yields, insect control costs and net revenues were compared in the large plot experiments. Small plot experiments were performed in Arkansas, south Texas, Louisiana, and Virginia. Data from large plots was successfully collected in Arkansas, south Texas, and Mississippi.

Results and Discussion

The mean yields for the small plot treatments are compared in Tables 2-7. In most cases, no significant differences were observed between mean yields, providing evidence that there should be no yield decrease from boll weevil and bollworm damage associated with terminating insecticide treatments at NAWF=5 + 350HU.

Data for 14 large plot comparisons were collected. The comparisons of mean yields are presented in Figures 1-4. In only two fields (Young and Wildy31 from Arkansas) are the mean yields significantly different. In seven of the 14 fields, the COTMAN rule produced higher (but statistically insignificant) yields. When the yields and the late season insect control costs are used to calculate net revenues, a similar trend is uncovered. Two lint prices were used to estimate the net revenues. First, the 1994 season average price for the Delta ($0.87/lb) was employed. The net revenues using this price are presented in Figures 5-8. Only three of the fields had statistically significant differences in these net revenues (Young, Wildy31 and Wildy49 -- Arkansas) with two generating higher net revenues from the COTMAN rules. If the traditional target price of $0.72/lb is used as the lint price, only two fields have significant differences in net revenues and both favor the COTMAN rules (Young and Wildy49 - Arkansas).

When all large plot data are analyzed as a group, regression analysis can show that the termination rule of NAWF=5 + 350HU resulted in statistically significant and higher lint yields of 49 lbs/A. Similar analysis on the net revenues indicates statistically higher returns of $46 to $53 per acre.

The statistical results for this analysis are presented in equations 1-3.

Equation 1	Yield = 867.90 -49.43 Full (.0001) (.0175)	R^2 = .04
Equation 2	NR87 = 755.43 -53.11 Full (.0001) (.0033)	R^2 = .06
Equation 3	NR72 = 625.25 -45.69 Full (.0001) (.0023)	R^2 = .07

where, Yield = lbs/a lint
NR87 = Net Revenue at $0.87/lb (Gross Revenue-Insect Control costs after NAWF=5)
NR72 = Net Revenue at $0.72/lb (Gross Revenue-Insect Control Costs after NAWF=5)
Full = Termination at NAWF =5 + >500 HU

Summary

The multi-state validation efforts of the COTMAN insecticide termination rules suggest that great potential exists to cease bollworm and boll weevil control when the last effective boll population has received 350 heat units from its flower date. In most comparisons, there was no significant yield loss from terminating following this rule. Net revenues, in general, appear to be higher and insect control costs lower. Additional advantages can possibly be realized through resistance management.

Validation efforts will continue and provide additional focus on the performance of the termination rules with late season infestations of defoliators, Bt cottons, resistant budworms and Type II growth patterns.

Acknowledgments

We gratefully acknowledge funding for this research from Cotton Inc.

References

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Bourland, R.M., D. M. Oosterhuis, and N. P. Tugwell. 1992. Concept for monitoring cotton plant growth and development using main-stem node counts. J. Prod. Agric. 5:532-8.

Cochran, M. J., N. P. Tugwell, F. Bourland and D. Oosterhuis. 1995. The COTMAN Crop Monitoring System: Update, Implementation and Future Plans. Proc. 1995 Cotton Research Meeting. Arkansas Agric Exp. Station Special Report 172, Dec. 1995. pp. 29-33.

Table 1. Experimental Design: Small Plot, Four Replicas

	Sprays				
Treatment	1st (NAWF=5)	2nd (200)	3rd (300)	4th (500)	5th (>650)
NAWF=5	Y	N	N	N	N
+200 HU	Y	Y	N	N	N
+350 HU	Y	Y	Y	N	N
+500 HU	Y	Y	Y	Y	N
+>650 HU	Y	Y	Y	Y	Y

Table 2. Small Plot Yield Comparisons: SJCT9501, Macon Ridge, LA

t-grouping	Mean lint (lb/A)	Termination Treatment
A	640	NAWF = 5 + 650 Heat units
A	633	NAWF = 5 + 500 Heat units
A	587	NAWF = 5 + 200 Heat units
A	565	NAWF = 5
A	564	NAWF = 5 + 350 Heat units

LSD = 134; Replications = 4; Variety = DP20

Table 3. Small Plot Yield Comparisons: MRCT9526, Macon Ridge, LA

t-grouping	Mean lint (lb/A)	Termination Treatment
A	587	NAWF = 5 + 200 Heat units
A	575	NAWF = 5 + 350 Heat units
A	555	NAWF = 5
A	531	NAWF = 5 + 500 Heat units

LSD = 71; Replications = 5; Variety = LA887

Table 4. Small Plot Yield Comparisons: MRCT9525, Macon Ridge, LA

t-grouping	Mean lint (lb/A)	Termination Treatment
A	520	NAWF = 5 + 200 Heat units
A	514	NAWF = 5 + 350 Heat units
A	510	NAWF = 5 + 500 Heat units
A	496	NAWF = 5

LSD = 34; Replications = 5; Variety =LA887

Table 5. Small Plot Yield Comparisons: Marianna Cotton Branch Station, AR

t-grouping		Mean lint (lb/A)	Termination Treatment
	A	974	NAWF = 5 + 350 Heat units
B	A	905	NAWF = 5 + 500 Heat units
B	A	893	NAWF = 5
B		859	NAWF = 5 + 650 Heat units

LSD = 110; Replications = 4; Variety = DP51

Table 6. Small Plot Yield Comparisons: Asgrow, San Patricio County, TX

t-grouping		Mean lint (lb/A)	Termination Treatment
	A	815	NAWF = 5 + 200 Heat units
B	A	763	NAWF = 5 + 650 Heat units
B	A	757	NAWF = 5 + 350 Heat units
B	A	738	NAWF = 5 + 500 Heat units
B		698	NAWF = 5

LSD = 104; Replications = 4; Variety = Hartz 1220

Table 7. Small Plot Yield Comparisons: TAES, Nueces County, TX

t-grouping	Mean lint (lb/A)	Termination Treatment
A	773	NAWF = 5 + 350 Heat units
A	771	NAWF = 5 + 200 Heat units
A	766	NAWF = 5 + 500 Heat units
A	752	NAWF = 5
A	741	NAWF = 5 + 650 Heat units

LSD = 98; Replications = 4; Variety = Hartz 1220

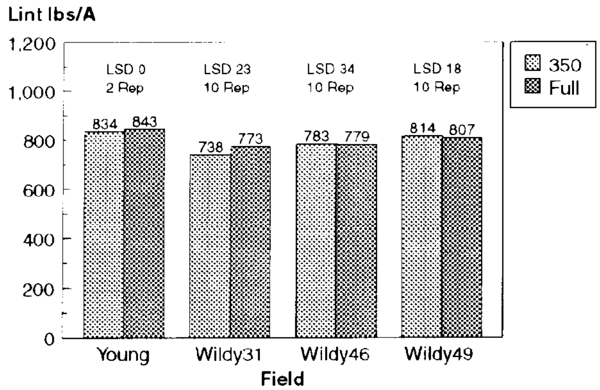


Figure 1. Large Plot Yield Comparisons: Arkansas

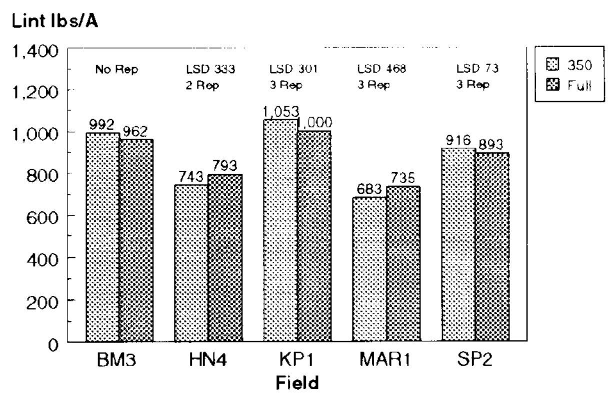


Figure 2. Large Plot Yield Comparisons: Mississippi Delta

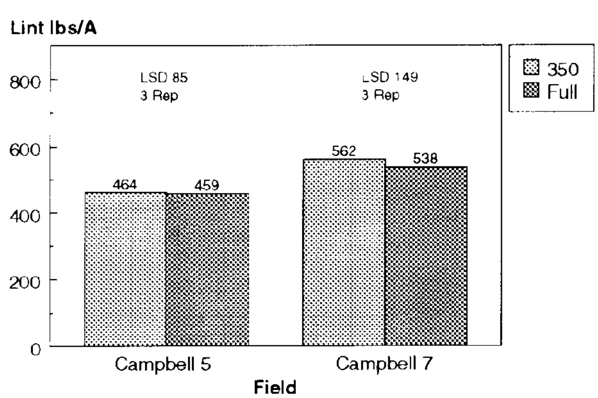


Figure 3. Large Plot Yield Comparisons: Hill Country, Mississippi

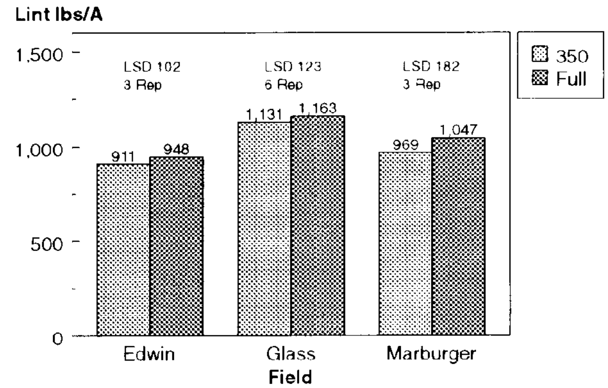


Figure 4. Large Plot Yield Comparisons: Corpus Christi, TX

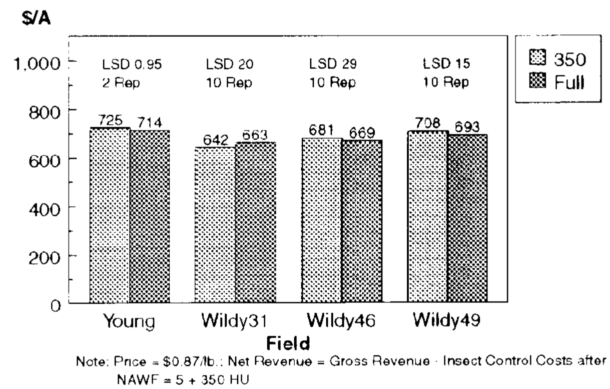


Figure 5. Large Plot Net Revenue Comparisons: Arkansas

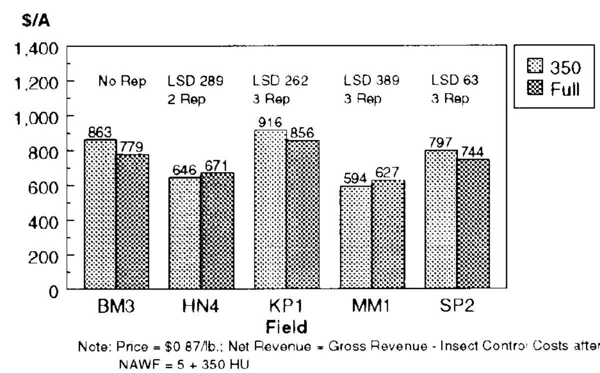
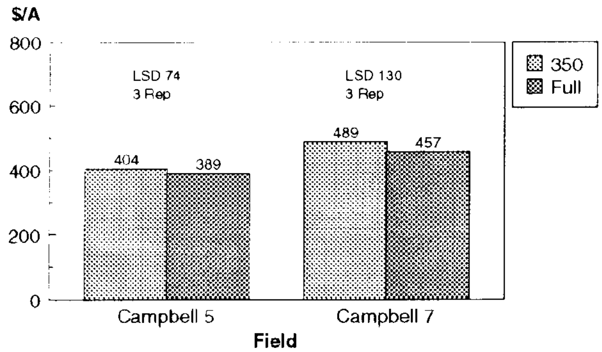
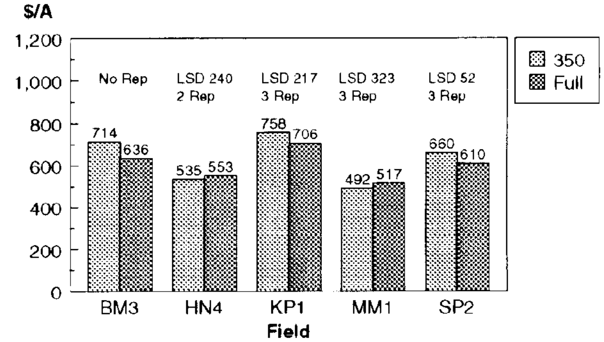


Figure 6. Large Plot Net Revenue Comparisons: Mississippi Delta



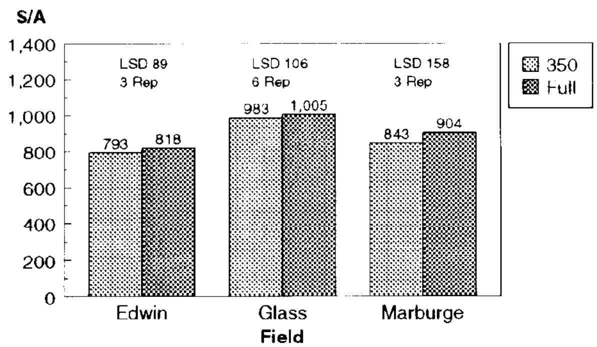
Note: Price = $0.87/lb.; Net Revenue = Gross Revenue - Insect Control Costs after NAWF = 5 + 350 HU

Figure 7. Large Plot Net Revenue Comparisons: Hill Country, MS



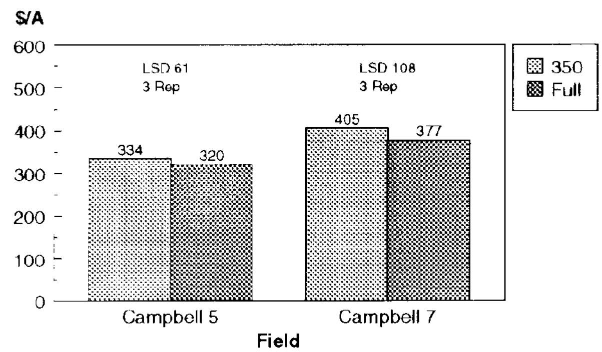
Note: Price = $0.72/lb.; Net Revenue = Gross Revenue - Insect Control Costs after NAWF = 5 + 350 HU

Figure 10. Large Plot Net Revenue Comparisons: Mississippi Delta



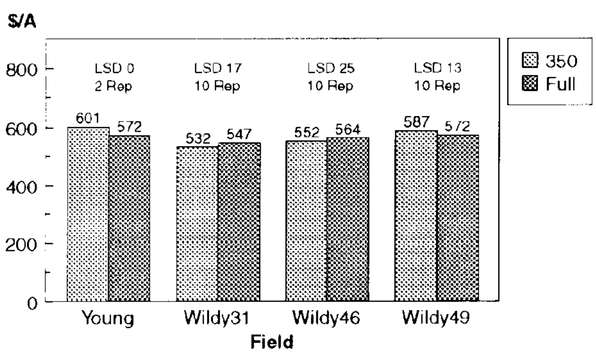
Note: Price = $0.87/lb.; Net Revenue = Gross Revenue - Insect Control Costs after NAWF = 5 + 350 HU

Figure 8. Large Plot Net Revenue Comparisons: Corpus Christi, TX



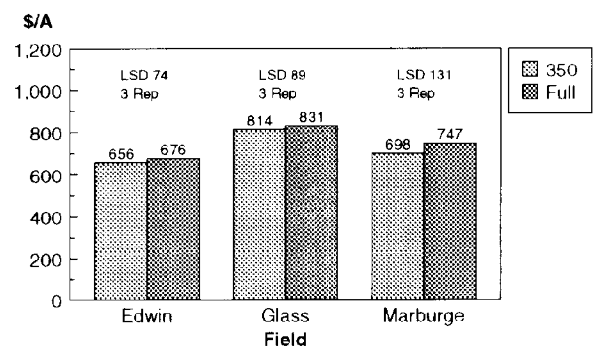
Note: Price = $0.72/lb.: Net Revenue = Gross Revenue - Insect Control Costs after NAWF = 5 + 350 HU

Figure 11. Large Plot Net Revenue Comparisons: Hill Country, MS



Note: Price = $0.72/lb.; Net Revenue = Gross Revenue - Insect Control Costs after NAWF = 5 + 350 HU

Figure 9. Large Plot Net Revenue Comparisons: Arkansas



Note: Price = $0.72/lb.; Net Revenue = Gross Revenue - Insect Control Costs after NAWF = 5 + 350 HU

Figure 12. Large Plot Net Revenue Comparisons: Corpus Christi, TX