CONFIRMATION OF INSECTICIDE TERMINATION RULES IN LOUISIANA

K. D. Torrey, J. H. Fife, B. R. Leonard, R. D. Bagwell, E. Burris, D. Cook, V. Mascarenhas, and J. Adamczyk
LSU Agricultural Center
Baton Rouge, LA

Abstract

Field tests (1993-96) were conducted in North Louisiana to evaluate the effects of terminating insect control strategies for bollworm/tobacco budworm (BW/TBW) and boll weevil at selected intervals on seedcotton yields. The termination intervals were based on cotton plant development measured as plant mainstem nodes above white flower (NAWF) and heat unit (HU) accumulation. Treatment termination intervals based on crop development rules and weather oriented rules included NAWF = 5, NAWF = 5 + 200 HU, NAWF = 5 + 350-400 HU, NAWF = 5 + 500-600 HU and NAWF = 5 + 600-800 HU. In 1993, 1995, and 1996, there were no significant differences in yields among termination intervals. In 1994, yields increased as insecticides were applied up to NAWF = 5 + 400 HU. Plots with insecticides terminated at this interval produced yields that were significantly higher than that for plots when treatments were terminated earlier.

Introduction

Insecticide treatment termination at the end of the production season is one of the most important decisions that cotton growers have to consider. Protection of the harvestable crop is a goal that must be balanced with high insect control costs, insecticide resistance problems, and crop maturity management. Early crop maturity can avoid losses caused by late-season insect injury (Isely 1957). However, there currently is no recommended procedure for determining when the harvestable crop has become mature and is safe from insect injury.

Crop growth status during mid-late season can be measured by using the node above white flower (NAWF) method (Bourland et al. 1992). The nodal position of the highest white flower on the main axis relative to the plant apex has been a reliable description of the relationship between fruit set and rate of plant terminal growth. By using the NAWF + accumulated heat units (HU) method, decisions can be made to terminate insecticide treatments when the last effective boll population accumulates sufficient HU to become tolerant to specific insect pests. Arkansas researchers have reported that the harvestable crop is generally safe from bollworm, *Helicoverpa zea* (Boddie), and boll weevil, *Anthonomus grandis grandis* Boheman, at NAWF = 5 + 350 HU (Bernhardt el al. 1986, Bagwell and Tugwell 1992). After this date, additional insecticide treatments may prove to be uneconomical. Therefore, these end-of-season management practices may be used to reduce production costs and improve net profits.

A project supported by Cotton Incorporated has been initiated in several states to validate these insecticide termination procedures (O'Leary et al. 1996). Cochran et al. (1996) summarized the economics of these studies in 1995 and generally showed that late-season applications (NAWF = 5 + 350 HU) were not cost-effective. This report summarizes the results of studies (1993-1996) to evaluate a cotton plant development monitoring methods that indicates the appropriate time for termination of late-season insecticide applications in Louisiana.

Materials and Methods

Crop Development Rules

Treatment termination intervals based on crop development rules including NAWF = 5, NAWF = 5 + 200 HU, NAWF = 5 + 350-450 HU, NAWF = 5 + 500-650 HU and NAWF = 5 + 600-800 HU. In 1993 (Test MRS93), 1994 (Test MRS94) and 1995 (Test MRS95), cotton seed (DP20, Stoneville LA887 and Stoneville LA887, respectively) was planted on 11, 13, and 25 May, respectively, at the Macon Ridge location (MRS) of the Northeast Research Station (NRS) near Winnsboro, LA. In 1995, Test NRS95 was planted with DP20 on 19 May at the St. Joseph location of the Northeast Research Station. For each test, the treatments were arranged in a randomized complete block design and replicated 5 times except for Test MRS95 which had 10 replications.

In 1996, Tests MRS961 and MRS963 were planted with cotton seed (DP51 and NuCotn 33, respectively) on 10 and 20 May, respectively, at the Macon Ridge location. In 1996, Test NRS96 was planted with STV 474 on 1 May at the St. Joseph location. The plots consisted of 4 rows (40-inch centers) x 50 ft. The treatments were arranged in a randomized complete block design and replicated 4 times.

Insecticide treatments were applied with a high clearance sprayer calibrated to deliver 6 gal total spray/acre through Teejet TX-8 hollow cone nozzles (2/row) at 44 psi for all tests. Insecticide treatments consisted of product tank-mixtures to manage the specific pest complex present across the test plots. All tests (1993-1996) conducted at the Macon Ridge location received sprinkler or furrow irrigation "as needed" to maintain adequate moisture during the season. The tests conducted at the Northeast Research Station were non-irrigated.

Weather Oriented Rules

Weather oriented rules are used only when crop development based on NAWF = 5 does not occur by the calendar date (Aug 15) on which the last effective boll

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population is present on plants. Treatment termination intervals based on weather oriented rules included NAWF = 5, NAWF = 5 + 350 HU, NAWF = 5 + 450 HU, NAWF = 5 + 550 HU and NAWF = 5 + 650 HU. These rules are applicable to a crop which will be late-maturing and does not follow the target plant development curve. In 1996, Test MRS962 was planted with a Paymaster 144 x Coker 312 (RR) line on 10 Jun (late planting date) at the Macon Ridge location. The treatments were arranged in a randomized complete block design and replicated 4 times. The plots consisted of 4 rows (40 inch centers) x 50 ft. Insecticide treatments were applied with a high clearance sprayer calibrated to deliver 6 gal total spray/acre through Teejet TX-8 hollow cone nozzles (2/row) at 44 psi. Insecticide treatments consisted of product tank-mixtures to manage specific pest complexes in the test plots. Test MRS962 was non-irrigated.

Data Collection and Analysis

Ten plants/plot (100/replication) were sampled 1-2 times weekly to determine the flowering pattern based on NAWF. NAWF was recorded from first bloom until NAWF < 5. The HU were recorded daily from NAWF = 5 until defoliation.

Insect pest injury was determined by examining 25 terminals and 25 squares per plot for evidence of bollworm/tobacco budworm (BW/TBW) and boll weevil damage. The two center rows were mechanically harvested to determine seedcotton yields. Cumulative HU, termination dates, harvest intervals, and treatment application timing are presented in Tables 1 and 2. Data were analyzed with ANOVA, and means were separated according to DMRT.

Results and Discussion

Populations of BW/TBW and boll weevil varied considerably in the tests during 1993-1996 and were generally low compared to adjacent tests in the same fields (unpublished). Insect infestations were highest in Tests MRS94, NRS95, MRS962, and MRS963 and significantly affected yields in Test MRS94. Applications were applied to plots in all tests, regardless of insect pest density, and probably reduced injury levels in some plots not designated to receive treatments due to the small plot size.

In Test MRS94, seedcotton yields were significantly higher in plots that had termination intervals equal to or greater than NAWF = 5 + 400 HU (Table 3). There were no significant differences in seedcotton yields among termination intervals beyond NAWF = 5 + 400 HU. Although there were no statistical differences among termination intervals in the other tests during 1993-1995, seedcotton yields generally increased as treatment termination was delayed until NAWF = 5 + 350-400 HU (Tables 3 and 4). After that interval, the data became more variable, probably as a result of environmental conditions, higher BW/TBW densities, and crop injury by other insect pests. In 1996, there were no significant differences among termination intervals for insecticide termination timing using crop development or weather oriented rules (Table 5 and 6).

These studies will continue for several years to refine the proper interval for terminating late-season insecticide applications in Louisiana. Differences in insect pest species, variety, and fall weather conditions will be factors influencing the success of these procedures. Additional studies are being done to evaluate insecticide treatment timing for other insect pests including fall armyworms, Spodoptera frugiperda, (J. E. Smith), beet armyworms, Spodoptera exigua (Hübner), and soybean looper, Pseudoplusia includens (Walker).

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Table 1. Development of cotton plants and treatment application timing using crop development rules.

Application Timing	Date	Days From Planting	Actual HU	Dates of Insecticide Application
MRS93				
Planting	11 May	------	------	------
≤ 5 NAWF	2 Aug	82	------	2 Aug
+ 200[1]	10 Aug	90	202	2, 10 Aug
+ 400[1]	18 Aug	98	397	2, 10, 17 Aug
+ 600[1]	26 Aug	106	595	2, 10, 17, 26 Aug
+ 800[1]	3 Sep	114	809	2, 10, 17, 26, 30 Aug
Defoliation	17 Sep	128	1011	------
Harvest 1	24 Sep	135	1168	------
Harvest 2	12 Oct	153	1377	------
MRS94				
Planting	13 May	------	------	------
≤ 5 NAWF	4 Aug	83	------	4 Aug
+ 200[1]	13 Aug	92	199	4, 9 Aug
+ 400[1]	24 Aug	103	418	4, 9, 15 Aug
+ 600[1]	2 Sep	112	610	4, 9, 15 Aug; 9 Sep
+ 800[1]	13 Sep	123	804	4, 9, 15 Aug; 9, 14 Sep
Defoliation	21 Sep	131	912	------
Harvest 1	27 Sep	137	961	------
Harvest 2	25 Oct	165	1217	------
MRS95				
Planting	25 May	------	------	------
≤ 5 NAWF	8 Aug	75	------	8 Aug
+ 200[1]	16 Aug	83	214	8, 18 Aug
+ 350[1]	21 Aug	88	350	8, 18 Aug
+ 500[1]	28 Aug	95	523	8, 18, 29 Aug
+ 650[1]	2 Sep	100	650	8, 18, 29 Aug; 5 Sep
Defoliation	18 Sep	116	936	------
Harvest 1	29 Sep	127	1060	------
Harvest 2	6 Oct	134	1145	------
NRS95				
Planting	16 May	------	------	------
≤ 5 NAWF	31 Jul	75	------	31 Jul
+ 200[1]	7 Aug	83	214	31 Jul; 9 Aug
+ 350[1]	13 Aug	88	350	31 Jul; 9, 17 Aug
+ 500[1]	19 Aug	95	523	31 Jul; 9, 17, 24 Aug
+ 650[1]	25 Aug	101	653	31 Jul; 9, 17, 24 Aug; 12 Sep
Defoliation	18 Sep	125	1159	------
Harvest 1	10 Oct	147	1143	------
MRS961				
Planting	10 May	------	------	------
≤ 5 NAWF	16 Jul	67	------	16 Jul
+ 200[1]	25 Jul	76	193.5	16, 25 Jul
+ 350[1]	2 Aug	84	355	16, 25 Jul; 1 Aug
+ 500[1]	9 Aug	91	503	16, 25 Jul; 1, 7 Aug
+ 650[1]	17 Aug	99	642	16, 25 Jul; 1, 7, 16 Aug
Defoliation	13 Sep	126	1131	------
Harvest 1	23 Sep	136	1266.5	------
Harvest 2	9 Oct	152	1395.0	------
MRS963				
Planting	20 May	------	------	------
≤ 5 NAWF	11 Aug	82	------	13 Aug
+ 200[1]	22 Aug	93	210.5	13, 26 Aug
+ 350[1]	30 Aug	101	358.5	13, 26 Aug; 2 Sep
+ 500[1]	8 Sep	110	510.0	13, 26 Aug; 2, 9 Sep
+ 650[1]	17 Sep	119	655.0	13, 26 Aug; 2, 9, 17 Sep
Defoliation	8 Oct	140	852.0	------
Harvest 1	18 Oct	150	885.0	------
Harvest 2	24 Oct	156	899.0	------
NRS96				
Planting	1 May	------	------	------
≤ 5 NAWF	21 Jul	81	------	21 Jul
+ 200[1]	31 Jul	91	179.5	21 Jul; 2 Aug
+ 350[1]	8 Aug	99	367.5	21 Jul; 2, 9 Aug
+ 500[1]	16 Aug	107	507.5	21 Jul; 2, 9, 16 Aug
+ 650[1]	23 Aug	114	651.5	21 Jul; 2, 9, 16, 23 Aug
Defoliation	13 Sep	135	1016.0	------
Harvest 1	23 Sep	145	1151.5	------

[1]Heat units.

Table 2. Development of cotton plants and treatment application timing in test MRS962 using weather oriented rules.

Application Timing	Date	Days From Planting	Actual HU	Dates of Insecticide Application
Planting	10 Jun	------	------	------
≤ 5 NAWF	18 Aug	68	------	18 Aug
+ 350[1]	7 Sep	88	------	18 Aug; 2 Sep
+ 450[1]	12 Sep	93	364.5	18 Aug; 2, 9 Sep
+ 550[1]	19 Sep	99	455.5	18 Aug; 2, 9, 19 Sep
+ 650[1]	30 Sep	110	655.0	18 Aug; 2, 9, 19, 25 Sep
Defoliation	7 Oct	117	720.0	------
Harvest 1	24 Oct	134	775.0	------

[1]Heat units.

Table 3. Seedcotton yields in tests MRS93 and MRS94 using crop development rules.

	Yield (Lb Seedcotton/Acre)	
Treatment/Interval	MRS93	MRS94
≤ 5 NAWF	2389.3a	2493.5b
≤ 5 NAWF + 200 HU	2390.6a	2546.2b
≤ 5 NAWF + 400 HU	2541.8a	2742.2a
≤ 5 NAWF + 600 HU	2458.9a	2638.1ab
≤ 5 NAWF + 800 HU	2624.5a	2713.8a
(P>F)	0.07	<0.01

Means with columns followed by a common letter are not significantly different *(P = 0.05; DMRT)*.

Table 4. Seedcotton yields in tests MRS95 and NRS95 using crop development rules.

	Yield (Lb Seedcotton/Acre)	
Treatment/Interval	MRS95	NRS95
≤ 5 NAWF	1508.1a	1661.3a
≤ 5 NAWF + 200 HU	1582.6a	1726.6a
≤ 5 NAWF + 350 HU	1619.2a	1788.6a
≤ 5 NAWF + 500 HU	1591.0a	1860.6a
≤ 5 NAWF + 650 HU	1564.3a	1881.8a
(P>F)	0.16	0.72

Means with columns followed by a common letter are not significantly different *(P = 0.05; DMRT)*.

Table 5. Seedcotton yields in tests MRS961, MRS963, and NRS95 using crop development rules.

	Yield (Lb Seedcotton/Acre)		
Treatment/Interval	MRS961	MRS963	NRS96
≤ 5 NAWF	1819.6a	2726.3a	3185.4a
≤ 5 NAWF + 200 HU	1852.3a	2646.1a	3194.4a
≤ 5 NAWF + 350 HU	1943.8a	2911.1a	3072.8a
≤ 5 NAWF + 500 HU	1901.3a	3401.1a	3023.8a
≤ 5 NAWF + 650 HU	1885.0a	3161.6a	3140.0a
(P>F)	0.52	0.06	0.74

Means within columns followed by a common letter are not significantly different *(P = 0.05;DMRT)*.

Table 6. Seedcotton yields in test MRS962 using weather oriented rules.

Treatment/Interval	Yield (Lb Seedcotton/Acre)
≤ 5 NAWF	490.1a
≤ 5 NAWF + 350 HU	588.0a
≤ 5 NAWF + 450 HU	559.0a
≤ 5 NAWF + 550 HU	562.6a
≤ 5 NAWF + 650 HU	522.7a
(P>F)	0.72

Means within a column followed by a common letter are not significantly different (P = 0.05;DMRT).