ON FARM VALIDATION OF COTMAN DEFOLIATION RULES

N. R. Benson
Univ. of Arkansas
Keiser, AR
W. C. Robertson
Univ. of Arkansas
Little Rock, AR
F. M. Bourland and E. D. Vories
Univ. of Arkansas
Keiser, AR

Abstract

COTMAN defoliation rules were evaluated in three large plot on-farm trials. COTMAN defines cutout as the date when the average number of nodes above the uppermost first position white flower equals 5 (NAWF = 5). COTMAN further recommends defoliation once 850 heat units (HU's) have been accumulated beyond cutout. Two fields were evaluated in Mississippi County (northeast Arkansas) and one field in Jefferson County (southeast Arkansas). Within each location, defoliation treatments were applied based on COTMAN recommendations and based on conventional producer practices for timing defoliation. Plots were machine harvested and seedcotton yields of the defoliation treatments compared. Seedcotton yields were not significantly different in 2 of 3 trials. Seedcotton yields from plots defoliated based on COTMAN rules were significantly lower at one location in Mississippi county. Harvest at this location however, was seven days earlier for plots defoliated based on COTMAN recommendations. Data from all locations support the use of COTMAN as a tool for timing defoliation. COTMAN may also help facilitate earlier harvest and reduce end-of-season risk.

Introduction

COTMAN, a COTton MANagement program developed by the University of Arkansas, aids producers with end-of-season management decisions by identifying the maturity of the last effective flower population. COTMAN defines the last effective flower population as the date when the average number of nodes above the highest first position white flower equals five (NAWF = 5). Bourland et al. (1992) defined NAWF = 5 as "cutout" based on yield and retention data obtained from first position bolls tagged as white flowers. Their results, based on individual plant observations, showed reduced seedcotton yield and retention from bolls originating from white flowers set above NAWF = 5. COTMAN, therefore, bases end-of-season management recommendations such as defoliation timing, on the maturity of the boll population identified by NAWF = 5.

The effects of temperature on boll development and maturity have long been recognized (Martin et al., 1923; Hesketh et al., 1968; Gipson and Ray, 1970). In a study conducted in El Paso, Texas, Young et al. (1980) showed that an average of 745 heat units (HU's) (equal to approximately 950 DD60's) were required to mature a white flower to an open boll for cotton planted in April and May. Wells (1991) suggested that HU's (based on 60^0 F minimum temperature) accumulated past the last effective flower population could be used to time cotton defoliation. Results of his study indicated that defoliation treatments may begin at 850 HU's beyond NAWF = 5 (cutout), provided at least 40% of the plant population are actually at cutout.

Results of Bourland et al. (1992) and Wells (1991) provide the basis for the defoliation rules in COTMAN. Based primarily on small plot and individual plant observations, COTMAN rules recommend defoliation at 850 HU's beyond NAWF = 5. The objectives of this study were to validate the application of COTMAN defoliation rules on large on-farm field trials.

Materials and Methods

Weekly COTMAN data were collected from two fields in Mississippi County and one field in Jefferson County, located in northeast and southeast Arkansas, respectively. Data were collected as described by Tugwell et al. (1998) and included monitoring nodes above white flower (NAWF) until cutout (NAWF = 5). At cutout, HU accumulations were calculated by subtracting 60^0F from the average daily temperature. Defoliation treatments were initiated when approximately 850 HU's had been accumulated beyond cutout and based on producers standard practices for timing defoliation (generally 60% open bolls). All other production practices were based on University of Arkansas recommendations for cotton production (Bonner, 1995).

Tests were machine harvested and seedcotton yield per acre calculated. Data were analyzed to compare the effects of defoliation timing on seedcotton yield.

Miller Location

Cotton, cultivar Deltapine DP 388, was planted 11 May 1999 on a 60 acre center pivot irrigated field in Mississippi County (northeast Arkansas). Plots were established at cutout and were 20-rows (planted on 38 inch centers) by 1600 feet long arranged in a randomized complete block design replicated three times.

Defoliation treatments consisted of Def® and Prep® applied at a rate of 1/2 pint per acre and 2 2/3 pint per acre,

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respectively. Treatments were initiated at cutout plus approximately 850 HU's and approximately 60% open bolls. Actual HU's at time of treatment and date applications were made varied across locations (Table 1). Prior to each defoliation treatment, open boll percentages were determined by calculating percentage of open bolls in a 3-row foot section of each plot. The center 8-rows from each plot were machine harvested and seedcotton yields calculated and analyzed.

Wildy Location

Cotton, cultivar Deltapine DP 5111, was planted 12 May 1999 on a 80 acre center-pivot irrigated field in Mississippi County (northeast Arkansas). Plots were established at cutout and were 36-rows (planted on 38 inch centers) by 2400 feet long arranged in a randomized complete block design replicated three times.

Defoliation treatments consisted of Def® and Finish® applied at a rate of 1/2 pint per acre and 1 1/2 quart per acre, respectively. Treatments were initiated at cutout plus 850 HU's (approximately) and approximately 60% open bolls. Prior to each defoliation treatment, percentage of open boll estimates were made. Entire plots were harvested approximately three weeks after each treatment and seedcotton yields calculated and fiber data collected. A second harvest of the center 8-rows from each plot was also collected.

Bryant Location

Cotton, cultivar Deltapine DP 20B, was planted 10 May 1999 on a 17 acre irrigated field in Jefferson County (southeast Arkansas). Plots were established at cutout and were 8-rows (planted on 38 inch centers) wide arranged in a randomized complete block design replicated four times.

Defoliation treatments consisted of an initial application of Dropp® and Finish® applied at a rate of 0.10 lb per acre and 1/3 pint per acre, respectively. A second application of Finish® at 1 1/2 quart per acre was applied one week after each initial treatment. Treatments were initiated at cutout plus 850 HU's (approximately) and approximately 60% open bolls. Prior to the 850 HU defoliation treatment, percentage of open bolls was determined from boll counts. The center 8-rows from each plot were machine harvested and seedcotton yields calculated and analyzed.

Results and Discussion

Miller Location

Miller field reached cutout on July 28, 78 days after planting (dap). Although the 850 HU's beyond cutout defoliation treatment (COTMAN recommendation) had significantly lower percentage of open bolls at time of treatment, yields were numerically higher than for plots where defoliation was delayed (Table 2). Yields however, did not vary significantly between treatments. Plots defoliated based on producer standard practices had only 37.7% open bolls at time of treatment. Calendar date and harvest capacity dictated time of defoliation and precluded waiting until 60% open bolls for defoliation. To facilitate producer harvesting sequence, both treatments were harvested on the same day. These data suggest 850 HU's beyond cutout is an acceptable rule for initiating defoliation.

Wildy Location

Wildy field reached cutout on July 24, only 73 dap. Although not statistically analyzed, percentage of open bolls tended to increase as defoliation was delayed (Table 3). Yield obtained from a first harvest was significantly greater in plots defoliated based on the producer standard (delayed) than plots defoliated at cutout plus 850 HU's (COTMAN recommendation). Plots defoliated based on COTMAN recommendations however, were harvested seven days earlier than plots defoliated based on producer standard. Second harvest yields were higher in plots defoliated based on COTMAN recommendations. Increased yields from a second harvest however, were not sufficient to compensate for the difference in yield obtained from the first harvest.

These data suggest a yield advantage for delaying defoliation. However, end-of-season risk was not evaluated. Allowing harvest to begin earlier may improve the importance of COTMAN as a defoliation tool.

Bryant Location

Bryant field reached cutout on July 27, 78 dap. At cutout plus 850 HU's, the field had less than 30% open bolls (Table 4). Percentage of open bolls was not calculated prior to the producer standard defoliation treatment. Defoliation timing had no significant effect on seedcotton yield at this location. Harvest, however, was initiated 19 days earlier in plots defoliated based on COTMAN rules than plots defoliated by conventional producer standards.

Conclusions

Yields from plots defoliated based on COTMAN recommendations were not effected in two of the three locations in this study. Wildy field, approximately 80 acres, represented the only location in which yields were significantly lower when defoliation was based on COTMAN rules. Fields at Miller and Bryant were 60 and 17 acres, respectively. Sampling large areas (ie. Wildy field) may have resulted in defining an incorrect cutout date and, therefore, allowed an advantage for later defoliation.

These results suggest defoliation at 850 HU's past cutout is an acceptable method for timing defoliation, assuming the last effective boll population is accurately identified. These data

further suggest the use of COTMAN my allow producers to take better advantage of earliness and reduce late-season risks.

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Table 1. Heat units, date of treatments and date of harvest for plots in 1999 Arkansas defoliation timing trials.

Location/Treatment	Actual HU's[1]	date of Defoliation[2]	date of Harvest
Miller			
850	838	3 Sep	4 Oct
Standard	1035	14 Sep	4 Oct
Wildy			
850	855	31 Aug	17 Sep and 3 Nov
Standard	1008	7 Sep	24 Sep and 3 Nov
Bryant			
850	862	3 Sep	1 Oct and 20 Oct
Standard	1073	15 Sep	20 Oct

[1] Actual heat units from cutout at time of defoliation.
[2] Dates of initial defoliation. Plots at Bryant location received a second defoliation approximately one week following the initial treatment.

Table 2. Percentage of open bolls and seedcotton yield for plots at Miller location in 1999 Arkansas defoliation study.

Treatment	% Open bolls[1]	Seedcotton Yield
		lb/a
850 HU's	19.7	3457
standard	37.7	2977
Mean	28.7	3217
R Square (x 100)	92.0	68
C.V. (%)	16.4	12
LSD (0.05)	9.6	NS

[1] % open bolls determined by (open bolls/total bolls) * 100 in a three foot section from each plot.

Table 3. Percentage of open bolls and seedcotton yield for plots at Wildy location in 1999 Arkansas defoliation study.

Tteatment	% Open bolls[1]	Seedcotton yield 1st pick	2nd pick	Total
		lb/a		
850 HU's	30.9	1833	395	2228
standard	51.0	2280	172	2453
Mean	41.0	2057	284	2340
R Square (x 100)	NA[2]	98	100	94
C.V. (%)	NA	3	1	3
LSD (0.05)	NA	213	8	218

[1] % open bolls based on visual estimates of 24 random locations (per treatment) prior to defoliation application.
[2] Data for % open bolls not analyzed.

Table 4. Percentage of open bolls and seedcotton yield for plots at Bryant location in 1999 Arkansas defoliation study.

Treatment	% Open bolls[1]	Seedcotton yield
		lb/a
850 HU's	28.0	2646
Standard	No Data	2634
Mean	No Data	2640
R square (x 100)	NA[2]	86
C.V. (%)	NA	1
LSD (0.05)	NA	NS

[1] % open bolls determined by (open bolls/total bolls) * 100 in sample counted from plots prior to defoliation treatments.
[2] Data for % open bolls not analyzed.