EFFECT OF N RATE AND TIMING, ROW SPACING AND MESSENGER ON HARD LOCK AND YIELD OF COTTON

Drs. David L. Wright, Jim Marois and Pawel Wiatrak
University of Florida
NFREC
Quincy, FL

Abstract

Florida's environment is often hot and humid when cotton is defoliated in the fall. This may result in high levels of hard locked bolls that can not be harvested. Nitrogen is often implicated in creating conditions that result in high levels of hard locked bolls and boll rot. Four rates of N (0, 60,120,and 180 lbs./A) were applied at three different timings (all at plant, or 1st square, or 3rd week of bloom). Studies were conducted in 1999 and 2000 at the University of Florida, NFREC in Quincy, FL. Yields were typically lower with the 180lbs. of N, and when applied the 3rd week of bloom for all rates of N in treatments harvested with a spindle picker. Yield, plant height and boll number were usually highest when N was applied at first square. Yield from plots with 180lbs. of N applied at third week of bloom was similar to no N in both years of study. In both years, 0 N gave a similar yield as any N treatment applied at any time. Highest N rate applied late and at planting in another year resulted in lowest yield. Soil test of nitrates showed that as much as 60 lbs./A of residual N was available to the cotton crop and was probably adequate for top yields under environmental conditions present at boll opening. Most hard locked bolls did occur under highest N rates applied the third week of bloom. These data indicate that knowledge of residual soil N and moderate rates of N applied at squaring is best for top yield and reduced hard lock. Messenger, a plant health material, applied 4 times after squaring reduced hard lock by 41% while increasing boll number by about 15%. Because hard lock has often reduced yield by more than 50%, research needs to be done to determine management to further reduce it's incidence.

Introduction

Cotton production in the Southeast is difficult due to environmental conditions. Well-managed fields often experience yield loss from hurricanes or hard lock during boll opening period. There a appear to be several factors associated with hard lock, including high temperature and humidity as well as excessive growth caused by high fertility, and especially N. Several studies show that N applied after the 3rd week of bloom has no influence on yield and in many cases results in a yield less than if no N were applied, even if the crop was N deficient during the entire season (Wright et.al., unpublished data). Nitrogen costs are high and the affect on yield may be negative in many cases. However, N is the most common nutrient applied if growth is not rapid enough or if boll number is less than expected. If insecticides or growth regulators need to be applied late in the season, recommendations may be made to add urea to boost yield or boll set. This study was conducted to look at affects of N and time of application on hard lock as well as boll set and yield. Previous studies showed that Messenger, a plant health material, may reduce hard lock incidence and applications were made late in the season combined with different N timing and rates.

Materials and Methods

The study was conducted on a Dothan sandy loam (fine loamy siliceous, thermic Plinthic Kandiudult), at the North Florida Research and Education Center, Quincy, Fl, in 1999 and 2000.

The treatments were as follows:

I. Row spacing
7 inch (UNR cotton)
2. 36 inch

II.	N rates (lbs a.i./A)	Time of application
1.	0	-
2.	60	at plant
3.	60	1st square (42 days after planting)
4.	60	3rd week of bloom
5.	120	at plant
6.	120	1st square (42 days after planting)
7.	120	3rd week of bloom
8.	180	at plant
9.	180	1st square (42 days after planting)
10.	180	3rd week of bloom

One day prior planting 100 lbs/A of 0-0-60 N-P_2O_5-K_2O fetilizer was broadcast applied on the entire study. Deltapine DP 458 BRR cotton was planted in UNR (7" row spacing) at 120,000 seeds/A with a Great Plains No-till Drill and conventional rows (36" row spacing) strip tilled at 4 seeds/ft of row with a Brown Ro-till implement and KMC planters on late May to early June each year.

Cotton was broadcast sprayed with Cotoran @ 1 qt/A + Prowl @ 1 qt/A + Gramoxone @ 1.5 pt/A + Induce @ 1pt/100 gal immediately after planting each year, Roundup Ultra @ 1 pt/A was applied each year at 2nd and 4th node stage on cotton and, and Staple @ 1 oz/A + Induce @ 1 qt/100 gal. was applied about 6 weeks later.

All nitrogen treatments were applied according to the schedule (at plant, 1st square, and 3rd wek of bloom). Cotton was irrigated on an as need basis each year and each of the three years were dry years.

The studies were defoliated with Finish @ 1 qt/A + Dropp @ 0.2 lb/A when 60% of the crop was open. Cotton was picked by hand or with a modified cotton picker to determine amount of hard lock or unpickable cotton. At defoliation 5 plants were selected from each plot and the height and boll number was determined to determine if the treatments affected boll positioning within the plant canopy.

The study was Two Factor Completely Randomized Block Design with four replications. Analysis of Variance and the Least Significant Difference Test were calculated at 5% probability level.

Results

Plant height was influenced by row width and fertilizer treatment (Table 1). Significantly higher plants were obtained from cotton grown in 36 inch row spacing than 7 inch row spacing. Higher nitrogen rates (180 lb N/A) significantly increased the plant height of cotton as compared to lower nitrogen rates.

The seed cotton yields were statistically different for row spacing only (Tab. 2 and 3). Yields were significantly higher from 7 inch row spacing as compared to 36 inch row spacing. Generally there was a tendency to get higher yields at low nitrogen rate applied at planting.

There was not a significant difference between fertilizer treatments for cotton yields, which were generally lower than picked by hand due to the high amount of hardlocked bolls (Table3).

There were no significant grade differences between UNR and Strip-till cotton or between nitrogen treatments.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:596-598 (2001)
National Cotton Council, Memphis TN

In general, row spacing had no effect on boll height, however there was an effect on the number of bolls per plant (Table 4). The timing of fertilizer application had a significant effect on the number of bolls on the plant at harvest, with the late 3rd week after bloom application reducing the number of bolls and the at plant application increasing the number of bolls per plant. The rate of N also affected the number of bolls per plant, with the 0 and 180 lb rates reducing the number of bolls and the 60 and 120 increasing the number of bolls.

In 2000 number of squares were increased with highest N rate as compared to the control and nodes above last flower was highest at 120 lb. Rate of N at all times of application (Table 5). Table 6 shows petiole nitrate-N at two dates with highest nitrates showing up at all rates soon after N application. There was adequate soil N available even in the control plots to keep nitrates in a low but sufficient range.

Growth was stimulated more by the low rate of N applied at first square than high rates of N applied at planting (Table 7). Nitrogen had not been applied for the third week of bloom and there was no difference from the control.

Messenger had a definite reducing influence on amount of hardlock cotton (Table 8). Most hardlock occurred at the highest rate of N applied at the latest date of application, as well as the highest average for all three treatments. Messenger reduced hardlock by 41% as compared to no messenger application. No N plots in those plots not treated with Messenger had the least amount of hardlock. Yield was not significantly influenced by N application or timing but tended to have lowest average yield when high rates of N were applied either at planting or when it was applied late, third week of bloom (Table 9). This data supports other data that indicates that late applications of N does not increase yield and in many cases causes yield decreases. Cause of hardlock cotton is not fully understood, but time and amount of N does have some influence its occurrence. Messenger made be a management tool that can be used to reduce the incidence of hardlock, but more research needs to be conducted to determine its timing and applications needed.

Table 1. Plant height in 1999 (ft)

Fertilizer treatment (lb/A)	Application	Row width (inch) 7"	36"	Mean
1. 0	-	3.4	4.07	**3.73**
2. 60	At plant	4.4	4.76	**4.56**
3. 60	1st square	4.7	5.27	**4.98**
4. 60	3rd week of bloom	4.4	4.99	**4.71**
5. 120	At plant	5.1	5.31	**5.19**
6. 120	1st square	5.3	5.68	**5.5**
7. 120	3rd week of bloom	5.2	5.29	**5.25**
8. 180	At plant	5.6	5.70	**5.63**
9. 180	1st square	5.8	5.82	**5.8**
10. 180	3rd week of bloom	5.5	5.62	**5.55**
	Mean	**4.9**	**5.25**	***5.09***

$LSD_{(0.05)}$ for row width 0.173
$LSD_{(0.05)}$ for fertilizer treatment 0.381
$LSD_{(0.05)}$ for interaction NS

Table 2. Seed cotton yield from hand pick (lb/A) 1999.

Fertilizer treatment (lb/A)	Application	Row width (inch) 7"	36"	Mean
1. 0	-	1121	1220	**1171**
2. 60	At plant	2127	1449	**1788**
3. 60	1st square	2147	1085	**1616**
4. 60	3rd week of bloom	1962	767	**1365**
5. 120	At plant	1824	888	**1356**
6. 120	1st square	1934	1433	**1684**
7. 120	3rd week of bloom	1746	877	**1312**
8. 180	At plant	1639	1063	**1351**
9. 180	1st square	1658	1293	**1476**
10. 180	3rd week of bloom	1716	854	**1285**
	Mean	**1787**	**1093**	***1440***

$LSD_{(0.05)}$ for row width 334.7
$LSD_{(0.05)}$ for fertilizer treatment NS
$LSD_{(0.05)}$ for interaction NS

Table 3. Seed and lint cotton yields picked with spindle picker (lb/A) 1999.

Fertilizer treatment (lb/A)	Application	Yield (lbs/A) Seed	Lint
1. 0	-	507	193
2. 60	At plant	596	226
3. 60	1st square	634	241
4. 60	3rd week of bloom	529	201
5. 120	At plant	627	238
6. 120	1st square	754	286
7. 120	3rd week of bloom	530	201
8. 180	At plant	712	271
9. 180	1st square	394	150
10. 180	3rd week of bloom	316	120
	Mean	**560**	**213**

$LSD_{(0.05)}$ for fertilizer treatmentNS

Table 4. Number of bolls per plant, 1999.

Fertilizer treatment (lb/A)	Application	Row width (inch) 7"	36"	Mean
1. 0	-	5.6	7.60	**6.6**
2. 60	At plant	7.8	12.00	**9.9**
3. 60	1st square	7.2	8.50	**7.85**
4. 60	3rd week of bloom	6.25	7.20	**6.73**
5. 120	At plant	9.4	11.60	**10.5**
6. 120	1st square	8.15	11.35	**9.75**
7. 120	3rd week of bloom	2.45	7.10	**4.78**
8. 180	At plant	6.85	9.75	**8.3**
9. 180	1st square	5.25	5.90	**5.58**
10. 180	3rd week of bloom	3.25	5.00	**4.13**
	Mean	**6.22**	**8.60**	***7.41***

$LSD_{(0.05)}$ = 5.34

Table 5. Influence of N rate and timing on number of bolls and squares per plant, flower position, and number of nodes above flower at 3 weeks after first bloom in 2000.

N Application (lb/A)	Application timing	Boll number per plant	Square number per plant	Nodes above flower
1) 60	At plant	3.3	4.0	3.3
2) 120	At plant	3.7	4.3	3.8
3) 180	At plant	3.1	4.5	3.7
4) 60	1st square	3.9	3.4	3.1
5) 120	1st square	3.8	4.1	3.8
6) 180	1st square	3.6	4.2	3.5
7) 60	3rd week bloom	3.3	3.4	2.9
8) 120	3rd week bloom	3.5	3.8	3.5
9) 180	3rd week bloom	3.5	3.5	2.9
10) Control		3.9	3.4	2.8
Avg.		3.6	3.8	3.3
$LSD_{(0.05)}$		NS	0.39	0.57

Table 6. Influence of N rate on $N\text{-}NO_3$ concentration in the petioles of cotton at 1st bloom and 3 weeks after first bloom in 2000.

N application (lb/A)	Application timing	Petioles ($N\text{-}NO_3$) 1st bloom	Petioles* ($N\text{-}NO_3$) 3 wks after 1st bloom
1) 60	At plant	4250	7583
2) 120	At plant	7125	6883
3) 180	At plant	8625	9150
4) 60	1st square	9300	5567
5) 120	1st square	9400	8150
6) 180	1st square	9475	8450
7) 60	3rd week bloom	2125	3300
8) 120	3rd week bloom	2150	4250
9) 180	3rd week bloom	3050	4967
10) Control		3050	2483
Avg.		5855	6078
$LSD_{(0.05)}$		1232	1927

Table 7. Influence of N rate and timing on plant ratio (plant height/node number) 90 DAP in 2000.

N application (lb/A)	Application timing	Messenger	
		Yes	No
1) 60	At plant	2.05	2.07
2) 120	At plant	2.07	2.2
3) 180	At plant	2.03	2.08
4) 60	1st square	2.16	2.19
5) 120	1st square	2.17	2.14
6) 180	1st square	2.19	2.1
7) 60	3rd week bloom	1.89	2.08
8) 120	3rd week bloom	1.86	1.92
9) 180	3rd week bloom	1.92	1.95
10) Control		1.88	2.07
Avg.		2.02	2.08
$LSD_{(0.05)}$		0.17	NS

Table 8. Influence of Messenger and N rate and timing on percent of hard-lock in 2000.

N application (lb/A)	Application timing	Messenger		
	At plant	Yes	No	Avg.
1) 60	At plant	22.0	39.3	30.7
2) 120	At plant	23.4	34.0	28.7
3) 180	At plant	16.5	29.6	23.1
4) 60	1st square	16.5	28.0	22.3
5) 120	1st square	13.3	29.6	21.5
6) 180	1st square	20.4	29.3	24.9
7) 60	3rd week bloom	18.8	40.9	29.9
8) 120	3rd week bloom	15.6	33.9	24.8
9) 180	3rd week bloom	29.1	34.8	32
10) Control		18.4	27.4	22.9
Avg.		19.4	32.7	-

$LSD_{(0.05)}$ for Messenger = 3.09
$LSD_{(0.05)}$ for treatment = 6.79
$LSD_{(0.05)}$ for interaction = NS

Table 9. Influence of Messenger and N rate and timing on the seed yield of cotton in 2000.

N application (lb/A)	Application timing	Messenger		
		Yes	No	Avg.
1) 60	At plant	1636	1628	1632
2) 120	At plant	1790	1629	1709
3) 180	At plant	1220	1287	1253
4) 60	1st square	1870	1564	1717
5) 120	1st square	1656	1786	1721
6) 180	1st square	1656	1705	1681
7) 60	3rd week bloom	1732	1717	1725
8) 120	3rd week bloom	1402	1486	1444
9) 180	3rd week bloom	1463	1369	1416
10) Control		1832	1702	1767
Avg.		1667	1615	-

$LSD_{(0.05)}$ for Messenger = NS
$LSD_{(0.05)}$ for treatment = NS
$LSD_{(0.05)}$ for interaction = NS