Varietal Responses of Cotton to Nitrogen Fertilization

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RESEARCH PROBLEM

Optimizing yield and earliness of cotton (*Gossypium hirsutum* L.) with nitrogen fertilization is an ongoing concern of cotton producers in Arkansas (Maples and Frizzell, 1985). Genetically engineered cotton varieties are currently being used in large portions of the cotton-producing acreage, particularly 'Bollgard' and Roundup® Ready varieties. New cotton varieties developed using traditional plant-breeding techniques are also being utilized by producers. Advantages of these new varieties include higher yield potential, enhanced pest resistance, resistance to herbicides, superior lint quality, faster maturity, and other new characteristics. With the increase in new cotton varieties into Delta production systems, N requirements of the new varieties are questioned by producers. The objective of this study was to determine the response of new cotton varieties to N-fertilization; particularly yield, earliness, and fiber quality response.

BACKGROUND INFORMATION

New cotton cultivars have increased the genetic diversity of cotton grown in the Delta. The genetic variability of currently available varieties indicates that crop growing practices, such as fertilization, might differ from older varieties to achieve optimal yields and earliness. Optimizing N fertilization for individual cotton varieties is a possible way of tailoring production practices to achieve optimal economic returns.

PROCEDURES

Studies of the responses of cotton varieties to N-fertilization were begun at the Southeast Branch Experiment Station in 1989 (McConnell et al., 1993). Tested varieties have changed as new varieties were introduced into the Delta region. Three years of data, 2000 through 2002, are available from the current test. Varieties currently under evaluation are: Deltapine 747 (DP 747), a rapid maturing variety; Stoneville 474 (ST 474), a moderate-maturing variety; Deltapine 5415 (DP 5415), a full-season variety and the parent line of Nucot 32B; and Nucot 32B (NU32B), a full-season variety with genetic resistance to heliothis species.

Nitrogen fertilizer rates were 0, 50, 100, and 150 lb N/acre. The source of the N was urea. The N-fertilizer treatments were split applied with half the total N-rate applied after emergence and half when the crop reached the first-square stage. The urea-N was incorporated with shallow plowing after each application. The test was furrow-irrigated using tensiometers to trigger irrigation. The studies were planted on 18 May 2000, 5 June 2001, and 23 April 2002. In 2001, the initial stand was destroyed by an early June hailstorm. The study was replanted on 5 June 2001. Cotton planted this late frequently exhibits aberrant growth from normal, yet the 2001 yields were acceptable and the trends in yield due to the treatments were similar to other years. The soil (Hebert silt loam) at the test site was sampled and analyzed for nutrient content in 1999 (Table 1).

The measurements taken on the cotton varieties included seed-cotton yield, plant-height, plant-population, and node-development information. All data were analyzed using the Statistical Analysis System (SAS). The experimental design was randomized complete block. F-tests and least significant differences (LSD) were calculated at the α=0.05 level of probability. Only yield responses of cotton to N-fertilization are presented in this report.

RESULTS AND DISCUSSION

The yield of cotton varieties was not found to significantly interact with differing N-fertilization rates in any year of the current test (Table 2). The main effect of N-fertilizer rate significantly affected cotton yield each year with 100 lb N/acre producing maximal yield for all four varieties. Non-significant, numerical yield increases occurred between the 100 and 150-lb N/acre rates in 2000 and 2002.

Yields of varieties were different two out of three years (2001 and 2002). The highest yielding variety was ST474 in 2001, while DP747 and NU32B had the greatest yields in 2002. No significant difference in yield of the varieties occurred in 2000. No pattern was discerned that would indicate a substantial yield advantage of one variety over the others tested.

Although the interaction of varieties and N-rates was not significant, a trend of increasing yield with increasing N rate was observed for ST474 through the 150 lb N/acre treatment all three years of the test. Other varieties appeared to respond to the 150 lb N/acre with increased yields occasionally, but not with the same frequency as ST474.

PRACTICAL APPLICATION

The yields of all the cotton varieties tested were maximized with N fertilization rates of 100 lb N/acre. Interactions between cotton varieties and N-fertilization were not found to influence cotton yields. Occasionally, yields were increased in some varieties with N-rates above 100 lb N/acre, especially ST474, but not significantly.

ACKNOWLEDGMENTS

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LITERATURE CITED

Maples, R., and M. Frizzell. 1985. Cotton fertilization studies on loessial plains soils of eastern Arkansas. University of Arkansas Agricultural Experiment Station Bulletin 825.

McConnell, J.S., W.H. Baker, D.M. Miller, B.S. Frizzell, and J.J. Varvil. 1993. Nitrogen fertilization of cotton cultivars of differing maturity. Agron. J. 85:1151-1156.

Table 1. Residual nitrate-nitrogen (NO_3^-N), phosphorus (P), potassium (K), and electrical conductivity (EC) to a depth of two feet in six-inch increments from the variety by N-fertilization rate in test site in 1999.

Depth	NO_3^-N	P	K	pH	EC
(in.)	(lb/acre)	(lb/acre)	(lb/acre)	(pH units)	(µS/m)
0 - 6	1.8	70	260	6.3	26
6 - 12	1.7	30	125	6.4	20
12 - 18	1.7	29	149	6.1	21
18 - 24	2.4	22	243	6.0	44
LSD(0.05)	0.4	6	18	0.1	3

Table 2. Seedcotton yields (lint yield may be estimated by dividing by 3) of four cotton varieties [Deltapine 747 (DP 747), Stoneville 474 (ST474), Deltapine 5415 (DP5415), and Nucot 32B (NU32B)] as affected by 0, 50, 100, and 150 lb urea-N/acre at the Southeast Branch Experiment Station near Rohwer, AR, from 2000 to 2002.

N fertilizer	Cotton variety				
rate	DP747	ST474	DP5415	NU32B	N rate mean
	(lb seedcotton/acre)				
2000					
150	4051	4353	4090	4255	4185
100	3899	4291	3821	3915	3995
50	3400	3173	3103	3483	3300
0	2287	1636	1611	1878	1853
Variety mean	3347	3311	3123	3383	--
LSD(0.05)Variety[z] and N rate by variety interaction[y] were NS					195[x]
2001					
150	4012	4511	3456	3876	3902
100	3915	4123	3723	3978	3945
50	3381	3769	3439	3425	3496
0	2780	2624	2702	2789	2718
Variety mean	3514	3729	3310	3485	--
LSD(0.05)Variety[z] = 182 lb/acre; N rate by variety interaction[y] was NS					214[x]
2002					
150	5392	5554	3877	5503	5057
100	5242	4788	4181	5063	4849
50	4124	3896	3814	4163	3999
0	2638	2314	1912	2454	2293
Variety mean	4439	4100	3333	4296	--
LSD(0.05)Variety[z] = 288 lb/acre; N rate by variety interaction[y] was NS					404[x]

[z] LSD(0.05) for variety main effects.
[y] No significant difference observed between variety and N rate.
[x] LSD(0.05) for N-rate main effects.