Varietal Responses of Cotton to Nitrogen Fertilization

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RESEARCH PROBLEM

Optimizing yield and earliness of cotton (*Gossypium hirsutum* L.) varieties with nitrogen (N) fertilization is an ongoing concern of cotton producers in Arkansas (Maples and Frizzell, 1985; McConnell et al., 1993). Genetically engineered cotton varieties are currently being used in increasingly larger portions of the cotton-producing acreage of Arkansas and the Cotton Belt. Producers have been quick to utilize 'Bollgard' and Roundup Ready® varieties, as well as stacked-gene varieties that combine these two technologies into one cotton variety. 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 in Delta production systems, N requirements of the new varieties are often questioned by producers.

The objective of this study was to determine various responses of new, genetically engineered cotton varieties to N-fertilization, particularly in yield, earliness, and fiber quality.

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 management practices such as fertilization, required to achieve optimum yields, and earliness might differ from older varieties. Optimizing N fertilization for individual cotton varieties is one 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 have been introduced to the Delta region. Varieties currently under evaluation are: Stoneville 4892 BR (ST 4892BR), FiberMax 960 BR (FM 960BR), Pay Master (PM 1281BR), and Deltapine 555 BR (DP 555BR). All varieties tested are genetically engineered to tolerate early-season applications of Roundup® herbicide and to resist damage from heliothis species insect pests. This is the first year of results from tests including these new varieties.

Fertilizer treatments 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. Plot integrity has been maintained with respect to N rates. The same N treatments have been applied to the same plots since the inception of testing. Phosphorus and potassium fertilizer were annually applied as a pre-plant blanket treatment to all plots at rates of 46 lb P_2O_5/acre and 60 lb K_2O/acre. The test was furrow-irrigated using tensiometers to trigger irrigation. The varieties were planted on 12 May 2003. 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 seedcotton yield, plant height, plant population, and node-development information. All data were analyzed using the Statistical Analysis System

(SAS). The experimental design was a randomized complete block. F-tests and least significant differences (LSD) were calculated at the P=0.05 level of probability. Only yield responses of cotton to N fertilization are presented in this report.

RESULTS AND DISCUSSION

The 2003 growing season was marred by abnormally wet and cool growing conditions in May and most of June. These inclement conditions were responsible for substantial delays in maturity in the 2003 crop. Yields were lower than expected and lower than other years of similar testing (McConnell et al., 2003).

No significant differences in the yield of cotton occurred as a function of the interaction between cotton variety and N-fertilizer rate (Table 2). Seed-cotton yields among varieties, averaged across N rates, were not statistically different. The mean yield of PM 1281BR, the numerically greatest-yielding variety, was only 233 lb/acre greater than the yield of ST 4892BR, the numerically lowest-yielding variety.

Although yields were lower in 2003 than in preceding years, significant differences in cotton yield were observed among N rates, averaged across varieties. The 50-lb N/acre rate produced a 73% increase in yield from the untreated control. The 100-lb N/acre rate produced a 24% increase in yield above 50 lb N/acre. The 150-lb N/acre rate produced the maximum yields and was 12% greater than the mean cotton yield from 100 lb N/acre. All differences among the N-treatment means were statistically significant.

PRACTICAL APPLICATIONS

Nitrogen fertilization rate was the only factor that affected seedcotton yield in 2003. These first-year results suggest that genetically engineered cotton varieties have similar N-fertilizer requirements and do not likely require different N-fertilizer management strategies than conventional cotton varieties.

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. Fayetteville, Ark.

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.

McConnell, J.S., B.A. Meyers, and M. Mozafarri. 2003. Varietal response of cotton to nitrogen fertilization. *In:* N.A. Slaton (ed.) Wayne E. Sabbe Soil Fertility Studies 2002. University of Arkansas Agricultural Experiment Station Research Series 502:44-46. Fayetteville, Ark.

Table 1. Residual nitrate-nitrogen (NO_3-N), phosphorus (P), potassium (K), soil pH, 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[z]	K[z]	pH[y]	EC[y]
(in.)	---------- (lb/acre) ----------				(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

[z] Mehlich-3 extractable (1:7 extraction ratio)

[y] Soil pH and EC measured in a 1:2 soil:water mixture.

Table 2. Seed-cotton yields of four genetically engineered cotton varieties as affected by N-fertilizer rate at the Southeast Branch Experiment Station near Rohwer, Ark., during 2003.

	Cotton variety				N-rate
N rate	ST 4892BR	FM 960BR	PM 1281BR	DP 555BR	mean
(lb/acre)	------------------- (lb seed cotton yield/acre[z]) --------------------				
150	3590	4219	3903	3805	3869
100	3514	3570	3476	3246	3467
50	2616	2788	3095	2648	2787
0	1820	1721	1428	1479	1612
$LSD_{(0.05)}$ to compare N-rate means = 67 lb/acre					
Cultivar means[y]	2807	2980	3040	2869	–

[z] Lint yield may be estimated by dividing seedcotton yield by 3.

[y] Mean yields of varieties, averaged across N rates, were not different.