Nitrogen Fertilization of Ultra-Narrow-Row Cotton: Final Report

J.S. McConnell, M. Mozaffari, B.A. Meyers, R.E. Glover, and R. Benson

RESEARCH PROBLEM

Recent developments in cotton (*Gossypium hirsutum* L.) production technology in the Delta include drill planting cotton in an ultra-narrow-row (UNR) production system. Ultra-narrow-row cotton is a low-input production system designed to maximize economic returns. The premise is that UNR cotton will be lower yielding, but the reduction in input costs will result in a larger profit margin. Research that provides information on production parameters is scant. Nitrogen (N) fertilization rates required to optimize yields and earliness for UNR cotton are unknown. The objectives of these studies were to determine optimal N fertilization for UNR cotton.

BACKGROUND INFORMATION

Crops grown in very narrow rows intercept and utilize sunlight more efficiently, but equipment, particularly for harvesting high-quality cotton, has always required wide rows. Technology development for UNR cotton production, including harvest equipment, has increased recently. Potential benefits of UNR cotton production include: reduced production costs, utilization of soils not ordinarily suited to cotton production, decreased soil erosion, and utilization of the same equipment for cotton, soybean, and cereal crops. Potential drawbacks of UNR cotton include: increased weed pressure in low-stand areas; different equipment is required from conventionally row-spaced cotton (precision drill planter, finger stripper harvester); and lint quality may decline. Variety differences, fertility requirements, effect of planting date, and other parameters for optimal growth and yield of UNR cotton are unknown.

PROCEDURES

A pilot study of the responses of UNR cotton to N-fertilization was conducted in 1997 at the Southeast Branch Experiment Station (SEBES) near Rohwer, Arkansas. The current test was begun in 1998 with N-rates of 0-, 25-, 50-, 75-, 100-, and 125-lb urea-N/acre at SEBES. The experimental design was a randomized complete block. N-treatments were applied to the soil surface without incorporation when the crop reached the two true leaf stage. The test was expanded for the 1999 growing season to include a second study site at the Northeast Research and Extension Center (NEREC) near Keiser, Arkansas. The test was planted on 26 May 1999 (SEBES), 23 May 1999 (NEREC), 16 May 2000, and 17 May 2001. The soil (Hebert silt loam) at the test site was sampled and analyzed for nutrient content at the SEBES site (Table 1).

Measurements taken on the UNR cotton included seed-cotton yield, plant height, plant population, boll load, and boll weight. All data were analyzed using the Statistical Analysis System (SAS). F-tests and least significant differences (LSD) were calculated at the α=0.05 level of probability.

RESULTS AND DISCUSSION

The results of the pilot study and the first year of the current experiment correlated well. The N- fertilization rate necessary to produce maximal yield, boll load and boll weight was 50 lb N/acre. Although trends of higher values were observed with greater N rates, the differences were not always significant from the 50 lb N/acre treatment. Plant height increased with increasing N fertilization up to 100 lb N/acre.

Drought conditions masked the impact of N fertilization of the UNR cotton at SEBES in 1999 (Table 2). Nitrogen fertilization of conventionally row-spaced cotton has been shown to be ineffective under severe water deficit (McConnell et al., 1998). The N treatments were not found to significantly affect any of the measured parameters. Results from the 2000 growing season at SEBES showed increased yields with N treatments up to 100 lb N/acre. Plant height and boll load increased throughout the range of N treatments. The 2001 growing season was marked by a prolonged period of water-saturated soil conditions and occasional plant submergence early in the growing season. These conditions retarded the growth, development and yield of the cotton. Because of these adverse growing conditions, no significant differences were observed in 2001.

Results from NEREC were similar to the first year's at SEBES (Table 3). Maximal yields were achieved with only 25 lb N/acre. Plant height was found to significantly increase up to 75 lb N/acre. No significant differences were observed in either the plant populations or boll loads at NEREC.

PRACTICAL APPLICATION

Current University of Arkansas N fertilizer recommendations for cotton use a base value of 100 lb N/acre. Subtractions from this base value are recommended with differences in soil texture, soil calcium content, and crop history of the field (Chapman, 2000). The N-fertilizer recommendation for the SEBES study site would be 90 lb N/acre to optimize cotton yield. The responses of UNR cotton to N fertilization treatments indicate that the N required for maximal yield will be less than the 90 lb N/acre recommended for cotton grown in conventionally spaced rows. Yields of UNR cotton were not often found to significantly increase with N rates above 50 lb N/acre. Additionally, the 50 lb N/acre treatment was usually found to maximize both the boll load and boll weight. The parameters measured in these studies suggest that the N fertilization to optimize UNR cotton is substantially different from the recommended N-rates for conventionally grown cotton.

ACKNOWLEDGMENTS

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LITERATURE CITED

McConnell, J.S., W.H. Baker, and R.C. Kirst, Jr. 1998. Yield and petiole nitrate concentrations of cotton treated with soil-applied and foliar-applied nitrogen. J. Cotton Sci. 2:143-152.

Chapman, S.L. 2000. Soil test recommendation guide. Pp. 39.University of Arkansas Cooperative Extension Service.

Table 1. Initial soil analyses by depth for nitrate-nitrogen (NO_3^-N), phosphorus (P), potassium (K), and electrical conductivity (EC) at the ultra-narrow-row nitrogen fertility study site at the Southeast Branch Experiment Station near Rohwer, AR, from 1997 to 2001.

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	5.9	34
LSD (0.05)	0.4	6	18	0.2	3

Table 2. Lint yield, plant height, plant population, boll load, and boll weight of cotton grown in ultra-narrow rows with 0, 25, 50, 75, 100, 125 lb urea-N/acre at the Southeast Branch Experiment Station near Rohwer, AR, from 1999 to 2001.

N-rate	Lint yield	Plant height	Plant population	Boll load	Boll weight
(lb N/acre)	(lb/acre)	(in.)	(plt/acre)	(boll/acre)	(g/boll)
1999					
125	700	10.6	130,687	264,400	2.70
100	638	11.4	139,763	253,077	2.55
75	598	12.8	157,914	223,863	2.76
50	548	12.1	148,233	230,950	2.45
25	547	11.4	140,368	233,863	2.41
0	474	12.2	150,048	191,796	2.49
LSD (0.05)	NS	NS	NS	NS	NS
2000					
125	648	25.5	107,091	271,055	2.67
100	527	23.7	104,671	232,333	2.46
75	482	22.8	113,326	218,417	2.41
50	384	18.9	98,621	182,115	2.34
25	335	18.8	114,784	183,239	1.98
0	310	17.6	117,982	147,628	2.22
LSD (0.05)	110	2.9	NS	40,124	2.94
2001					
125	231	7.9	246,854	75,024	3.00
100	246	9.4	284,608	88,093	3.05
75	247	9.4	198,451	88,738	2.74
50	212	9.5	231,123	101,646	2.42
25	170	8.4	189,981	87,125	3.36
0	156	8.2	191,191	85,915	3.02
LSD (0.05)	NS	NS	NS	NS	NS

Table 3. Lint yield, plant height, plant population, boll load, and boll weight of cotton grown in ultra-narrow rows with 0, 25, 50, 75, 100, 125 lb urea-N/acre at the Northeast Research and Extension Center near Keiser, AR, in 1999.

N-Rate	Lint yield	Plant height	Plant population	Boll load
(lb N/acre)	(lb/acre)	(in.)	(plt/acre)	(boll/acre)
125	989	20.7	212488	341499
100	1004	20.4	261816	333910
75	958	23.7	239049	314938
50	965	20.4	292171	417387
25	883	17.5	250432	394621
0	608	16.7	250432	318732
LSD (0.05)	267	2.7	NS	NS