LONG-TERM IRRIGATION METHODS AND NITROGEN FERTILIZATION RATES IN COTTON PRODUCTION: THE LAST FIVE YEARS[1]

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RESEARCH PROBLEM

Management of nitrogen (N) and irrigation are two very important aspects of successful cotton (*Gossypium hirsutum* L.) production. The interactions of N fertilizer and irrigation are not well documented under the humid production conditions of Southeast Arkansas (McConnell *et al.*, 1988). The objective of these studies was to evaluate the development and yield of intensively managed cotton soil treated with soil-applied N fertilizer under several irrigation methods.

BACKGROUND INFORMATION

Over- and under-fertilization may result in delayed maturity and reduced yield, respectively (Maples and Keogh, 1971). Adequate soil moisture is also necessary for cotton to achieve optimum yields. If the soil becomes either too wet or too dry, cotton plants will undergo stress and begin to shed fruit (Guinn *et al.*, 1981).

RESEARCH DESCRIPTION

This study was conducted at the Southeast Branch Experiment Station on an Hebert silt loam soil. The experimental design was a split block with irrigation methods as the main blocks. Nitrogen rates were tested within each irrigation method. Five irrigation methods were used from 1988 to 1993 (Table 1), but only three since. Six N rates (0, 30, 60, 90, 120, and 150 lb urea-N/acre) were tested with different application timings used for the higher (90 to 150 lb N/acre) N rates.

RESULTS

During the last 5 years, irrigation generally increased cotton yields except during a season when early-season rainfall resulted in standing water that delayed the irrigated plants or when verticillium wilt was prevalent (Table 2). The method of irrigation to

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maximize lint yield varied year to year and, therefore, appeared to be less important than irrigation usage. Generally, lint yield was found to increase with increasing N fertilization (Table 3). The N treatments that usually resulted in the greatest lint yields were applications of 60 to 150 lb N/acre, depending upon the irrigation treatment and year. Exceptions were found for the 150 lb N/acre treatment (75 lb N/acre PP and 75 lb N/acre FS), which was found to decrease lint yield in some irrigation blocks. The yields of the high-frequency irrigation block during some years were significantly influenced by verticillium wilt. The disease was more virulent in the plots receiving higher N rates, thereby reducing yields with increasing N.

PRACTICAL APPLICATIONS

Irrigated cotton was generally found to be higher yielding than cotton grown under dryland conditions unless verticillium wilt affected the crop. Fertilizer N requirements of cotton for maximum yield tended to be greater under irrigated production conditions than under dryland production conditions. Fertilizer N requirements of cotton for maximum yield tended to be greater for furrow irrigated cotton than for center pivot irrigated cotton.

ACKNOWLEDGMENTS

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LITERATURE CITED

Guinn, G., J.R. Mauney, and K.E. Fry. 1981. Irrigation scheduling effects on growth, bloom rates, boll abscission and yield of cotton. Agron. J. 73:529-534.

Maples, R. and J.G. Keogh. 1971. Cotton fertilization studies on loessial plains soils of eastern Arkansas. University of Arkansas Agricultural Experiment Station Bulletin 825.

McConnell, J.S., B.S. Frizzell, R.L. Maples, and G.A. Mitchell. 1988. Relationships of irrigation methods and nitrogen fertilization rates in cotton production. University of Arkansas Agricultural Experiment Station Report Series 310.

Table 1. Duration, tensiometer thresholds and depths, and water application rates for three irrigation methods.

Irrigation method	Duration	Tensiometer threshold	Tensiometer depth	Water applied
		— cbar -----	— in -----	— in -----
High Frequency Center Pivot	Planting to P.B.[z]	35	6	0.75
	P.B. to Aug. 15	35	6	1.00
Furrow Flow	Until Aug. 15	55	12	Not precise
Dryland	Not Irrigated	----	----	----

[z] P.B. = Peak Bloom

Table 2. Lint yield response of cotton to three irrigation methods from 1994 to 1998.

Method	1994	1995	1996	1997	1998
	----------	----------	lb/acre ----------	----------	----------
High Frequency Center Pivot	1317	1113	1344	1400	1211
Furrow Flow	1478	1217	1463	1458	1341
Dryland	1353	892	1057	1521	750
$LSD_{(0.05)}$	83	59	108	99	129

Table 3. Lint yield response of cotton to 10 nitrogen (N) fertilization rates and splits under three irrigation methods from 1994 to 1998.

N rate					
PP[z]	FS	FF	HF[y]	FI	DI
lb N/acre					
1994					
75	75	0	1264 c	1600 a-c	1328 a-c
50	50	50	1256 c	1643 ab	1513 ab
30	60	60	1283 c	1633 ab	1501 ab
60	60	0	1312 bc	1602 a-c	1643 a
40	40	40	1467 a	1695 a	1559 a
45	45	0	1441 ab	1492 c	1359 a-c
30	30	30	1384 a-c	1549 bc	1381 a-c
30	30	0	1515 a	1482 c	1226 b-d
15	15	0	1313 bc	1215 d	1085 cd
0	0	0	1073 e	873 e	931 d
LSD (0.05)			132	137	322
1995					
75	75	0	1127 a	1393 a	954 a-c
50	50	50	1166 a	1373 ab	1039 a
30	60	60	1193 a	1369 ab	971 ab
60	60	0	1162 a	1376 ab	879 b-d
40	40	40	1213 a	1360 ab	1032 a
45	45	0	1107 a	1236 bc	946 a-c
30	30	30	1149 a	1280 ab	947 a-c
30	30	0	1198 a	1098 cd	852 cd
15	15	0	964 b	980 d	781 d
0	0	0	838 c	704 e	532 e
LSD (0.05)			106	146	114
1996					
75	75	0	1315 c	1630 a	1067 a
50	50	50	1411 a-c	1543 a	1116 a
30	60	60	1331 bc	1572 a	1078 a
60	60	0	1383 a-c	1522 a	1035 a
40	40	40	1431 ab	1576 a	1174 a
45	45	0	1382 a-c	1495 a	1050 a
30	30	30	1440 ab	1527 a	1059 a
30	30	0	1461 a	1633 a	1059 a
15	15	0	1309 c	1167 d	1048 a
0	0	0	979 d	868 c	752 b
LSD (0.05)			114	251	155

continued

Table 3. Continued.

N rate					
PP[z]	FS	FF	HF[y]	FI	DL
-------- lb N/acre --------					
1997					
75	75	0	1491 a	1739 a	1682 ab
50	50	50	1491 a	1679 a	1777 ab
30	60	60	1384 a	1576 ab	1867 a
60	60	0	1528 a	1547 a-c	1629 b
40	40	40	1491 a	1751 a	1799 ab
45	45	0	1507 a	1582 ab	1615 b
30	30	30	1420 a	1368 c	1754 ab
30	30	0	1477 a	1457 bc	1338 c
15	15	0	1157 a	1102 d	1067 d
0	0	0	1086 b	764 e	683 e
LSD (0.05)			159 b	207	217
1998					
75	75	0	1230 bc	1519 a	767 ab
50	50	50	1154 bc	1495 ab	721 a-c
30	60	60	1096 c	1520 a	777 ab
60	60	0	1185 bc	1281 bc	641 bc
40	40	40	1237 bc	1490 ab	816 a
45	45	0	1259 ab	1410 ab	837 a
30	30	30	1413 a	1437 ab	883 a
30	30	0	1226 bc	1331 ab	779 ab
15	15	0	1195 bc	1107 c	712 a-c
0	0	0	1116 bc	817 d	589 c
LSD (0.05)			161	220	171

[z] Preplant (PP), first square (FS) and first flower (FF).
[y] High frequency (HF), furrow irrigated (FI), dryland (DL).