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

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RESEARCH PROBLEM

Nitrogen (N) management and irrigation management 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 objectives of these studies were to evaluate the growth, development, and yield of intensively-managed cotton grown on soils previously treated with different rates of soil-applied N fertilizer that resulted in different levels of residual soil N 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 optimal 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

Studies were conducted at the Southeast Branch Experiment Station on an Hebert silt loam soil. Five irrigation methods were used from 1988 to 1993, but only three have been used since 1993 (Table 1). Six different total 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

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150 lb N/acre) N rates. Ten total-N treatments were tested within each irrigation method (Table 2). Nitrogen fertilizer was not applied to the 2000 cotton crop to examine the effects of residual soil N on cotton development. From 1996 to 2000 the experimental design was a split block with irrigation methods as the main blocks. Each treatment was replicated five times.

RESULTS

The method of irrigation that maximized cotton lint yield varied among years. Therefore, the method of irrigation appeared to be less important than irrigation usage (Table 3). Generally, lint yield increased with increasing N rate (Table 2). 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 were significantly influenced by verticillium wilt during some years. The disease was more virulent in the plots receiving higher N rates, thereby reducing yields with increasing N rate.

In 2000, cotton response to the residual N seemed to mirror the N-fertilizer rates applied in previous years. Presumably, as the residual N is consumed by subsequent crops, residual soil N will have less impact on cotton development and yield.

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 maximal yield tended to be greater under irrigated production than under dryland production. Fertilizer N requirements of cotton for maximal yield tended to be greater for furrow-irrigated cotton than for center-pivot irrigated cotton. Residual soil N was sufficient the first year to maintain cotton yields when previous years of N-fertilization were above 60 to 120 lb N/acre.

LITERATURE CITED

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

Irrigation methods	Duration	Tensiometer threshold	Tensiometer depth	Water applied
		(cbar)	------- (inches)	------
High frequency center-pivot	Planting to PB[z]	35	6	0.75
High frequency center-pivot	PB to Aug. 15	35	6	1.00
Furrow flow	Until Aug. 15	55	12	Not precise
Dryland	Not irrigated	--	--	--

[z] PB = Peak bloom

Table 2. Cotton lint yield response to ten nitrogen (N) fertilization treatments under three irrigation methods from 1996 to 1999, and seedcotton yield response to residual soil N from previous N treatments in 2000.

N Rate					
PP[z]	FS[z]	FF[z]	HF[y]	FI[y]	DL[y]
--------- (lb/acre) ----------			---------- (lb/acre) ----------		
1996					
75	75	0	1315	1630	1067
50	50	50	1411	1543	1116
30	60	60	1331	1572	1078
60	60	0	1383	1522	1035
40	40	40	1431	1576	1174
45	45	0	1382	1495	1050
30	30	30	1440	1527	1059
30	30	0	1461	1633	1059
15	15	0	1309	1167	1048
0	0	0	979	868	752
$LSD_{(0.05)}$			114	251	155
1997					
75	75	0	1491	1739	1682
50	50	50	1491	1679	1777
30	60	60	1384	1576	1867
60	60	0	1528	1547	1629
40	40	40	1491	1751	1799
45	45	0	1507	1582	1615
30	30	30	1420	1368	1754
30	30	0	1477	1457	1338
15	15	0	1157	1102	1067
0	0	0	1086	764	683
$LSD_{(0.05)}$			156	207	217

continued

Table 2. Continued.

N Rate					
PP[z]	FS[z]	FF[z]	HF[y]	FI[y]	DL[y]
--------- (lb/acre) ----------			---------- (lb/acre) ----------		
1998					
75	75	0	1230	1519	767
50	50	50	1154	1495	721
30	60	60	1096	1520	777
60	60	0	1185	1281	641
40	40	40	1237	1490	816
45	45	0	1259	1410	837
30	30	30	1413	1437	883
30	30	0	1226	1331	779
15	15	0	1195	1107	712
0	0	0	1116	817	589
$LSD_{(0.05)}$			161	220	171
1999					
75	75	0	1595	1533	656
50	50	50	1468	1431	788
30	60	60	1467	1463	706
60	60	0	1552	1405	636
40	40	40	1545	1587	783
45	45	0	1445	1454	756
30	30	30	1406	1203	740
30	30	0	1446	1280	791
15	15	0	1105	847	799
0	0	0	1057	677	605
$LSD_{(0.05)}$			169	257	NS
2000[x]					
75	75	0	2968	2161	1245
50	50	50	3034	2126	1295
30	60	60	3138	2223	1255
60	60	0	2783	1923	1186
40	40	40	2882	1999	1382
45	45	0	2753	1951	1233
30	30	30	2541	2003	1314
30	30	0	2784	1885	1182
15	15	0	2329	1665	1312
0	0	0	2643	1677	1027
$LSD_{(0.05)}$			280	203	157

[z] Pre-plant (PP), first square (FS), and first flower (FF).
[y] High frequency (HF), furrow irrigated (FI), and dryland (DL).
[x] Lint yield may be estimated by dividing the seedcotton yield by 3 (i.e., gin turnout of 33%).

Table 3. Lint yield response of cotton to four irrigation methods from 1996 to 1999, and seedcotton yield in 2000.

Method	1996	1997	1998	1999	2000
	---------- (lb/acre) ----------				
High frequency center-pivot	1344	1400	1211	1401	2801
Furrow-flow	1463	1458	1341	1288	1961
Dryland	1057	1521	750	728	1242
$LSD_{(0.05)}$	108	99	129	120	248