

Drip Irrigated Cotton Responses to Fertilizer Levels, Varieties and Plant Populations

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ABSTRACT

Three cotton cultivars (DPL 41, 90 and 775) were planted at 3 seeding rates (5, 10 and 20 lbs/A). These variables were evaluated under 5 fertilizer treatments which included increasing nitrogen levels and one treatment with nitrogen (N), phosphorus (P), potassium (K) and zinc (Zn). Residual soil N was high and variable and no clear response to applied N was found, although generally higher yields were found with the high N rate. The plots receiving P, K and Zn yielded less than plots receiving an equal amount of N. Increased seeding rates significantly increased yields which was probably an effect of early weed competition. Delta Pine 90 produced significantly more than 41 which was greater than 775. Petiole and soil nitrate values reflected the high and variable available soil N.

INTRODUCTION

This is the third year of study of nutrient requirements of drip irrigated cotton under field conditions. These studies were undertaken to study the hypothesis that high yields of cotton could be obtained using drip irrigation while using less water than with conventional furrow irrigation. If higher yield potentials exist with drip irrigation due to regular uniform applications of water and other factors, then more nutrients would be required. These additional nutrients would include N and possibly potassium (K) and zinc (Zn).

METHODS AND MATERIALS

The experiment was located at Regal Farms near Eloy. The irrigation system and experimental design were essentially the same as those used the previous year for the irrigation and fertilizer studies (see Report on Cotton, P-63, 1986.). The system provided water and fertilizer to both the fertilizer and irrigation studies (see Drip Irrigated Cotton Responses to Water Level, Varieties and Plant Population elsewhere in this Report), and several bulk rows in the rest of the field. A different field was used because of root rot infestation in the 1985 study field. The soil was a Mohall sandy loam.

The experimental design was a randomized complete block with four replications. The main plots were the five fertilizer treatments shown below with subplots being variety (DPL 41, DPL-90, and DPL 775) and seeding rates (5, 10, and 20 lb per acre).

The fertilizer treatments were as follows: 1. Low N; 2. N according to predicted uptake, although this turned out not to be possible because of the high available soil N; 3. N as predicted by soil and petiole levels (this rate was supplied to the irrigation study); 4. High N or about 150% of the amount predicted by treatment 3; and 5. High N plus P, K and Zn. All fertilizer was applied through the above-ground drip system according to the schedule shown in Table 1. Each drip line supplied two rows of cotton and the emitters were 3.3 feet apart.

Fertilizer materials were urea-ammonium nitrate solution (Solution 32), orthophosphoric acid, potassium chloride (0-0-60) made into solution, and Zn-EDTA. NpHuric solution (10-0-0-18) was used on occasion to remove any possible emitter plugging by lime. The water application schedule was the

same as for the 100% treatment of the adjacent irrigation study and 29.8 inches of water were applied. Rainfall during the season was 3 inches.

Table 1. Fertilizer schedule, Eloy, 1986.

Date	Treatment					Material
	1	2	3	4	5	
May 13	-	-	-	-	45 P ₂ O ₅	H ₃ PO ₄
	-	-	-	-	50 K ₂ O	KCl
	-	-	-	-	1.1 Zn	Zn-EDTA
22	11.7	11.7	1.2	11.7	11.7 N	NpHuric
	-	-	1.0	24.2	24.2 N	Soln-32
30	-	-	7.1	-	-	"
June 5	-	-	-	-	1.1 Zn	Zn-EDTA
18	5.9	5.9	7.1	2.9	2.9 N	NpHuric
	-	-	7.1	16.1	16.1 N	Soln-32
26	-	7.9	-	16.1	16.1 N	"
	-	-	-	-	45 P ₂ O ₅	H ₃ PO ₄
	-	-	-	-	1.1 Zn	Zn-EDTA
July 1	-	-	5.4	-	-	Soln-32
15	3.2	9.7	-	19.4	19.4 N	"
22	-	6.4	-	19.4	19.4 N	"
24	-	-	1.4	-	-	"
29	-	9.7	-	12.9	12.9 N	"
31	-	-	1.4	-	-	"
Aug 7	-	-	1.4	-	-	"
9	-	-	1.4	-	-	"
18	-	-	0.5	-	-	NpHuric
Totals						
N	20.8	53.1	35.0	122.7	122.7	
P ₂ O ₅	-	-	-	-	90	
K ₂ O	-	-	-	-	50	
Zn	-	-	-	-	3.3	

Soil samples were collected at planting time. Nitrate-nitrogen was high and variable, ranging from 10.5 to 38.5 ppm in the surface six inches, 14 to 42 ppm in the 6-to-12 inch layer, and 14 to 37 ppm in the 12-to-18 inch layer. The high N availability was due in part to the fact that the field had been fallow.

When fallow, mineralization takes place during moist periods and the rainfall is insufficient to leach away the nitrate. Soil pH values of all samples ranged between 7.7 and 8.0 and electrical conductivities ranged from 0.40 to 1.8 (270 to 1225 ppm soluble salts, respectively), indicating low sodium and salinity hazards. Irrigation water samples during the season indicated a low salt content (EC_w of 0.40 to 0.50) and low nitrate content (1.04 to 1.46 ppm N).

Planting date was 23 April and first flowers were observed on 2 July. Petioles were sampled weekly from 26 June through 16 September for nitrate analysis (Table 2). Petiole samples from some dates were analyzed for soluble phosphate content (Table 2).

Cotton was machine picked from the center two rows from each plot on 19 October. Random samples were taken for determining the lint percentage. A gin turnout of 34.4% was used for calculating yields for all plots and these values were converted to bales per acre using 480 pounds per bale. Yields were relatively low, partly due to the fact that only one picking was possible.

Table 2. Selected petiole nitrate (ppm NO₃-N) and soluble phosphate (ppm P) values, Eloy, 1986.

Treatment	Date				
	July 8	23	August 5	19	Sept 16
DPL 41			petiole nitrates		
1	13220	11660	8670	4610	2260
2	11290	11220	12070	5580	2680
3	17140	9620	10280	5590	3980
4	16710	16010	13480	7180	4740
5(+PKZn)	13490	10970	11950	5400	2530
DPL 90					
1	15190	11400	10630	4890	2650
2	9270	10730	9780	5960	2970
3	19350	12530	1056	8360	2860
4	17590	17770	15120	9190	3450
5(+PKZn)	16950	16440	13530	8860	4920
DPL 775					
1	14510	1050	8270	6440	1200
2	7340	9890	10020	8300	3810
3	14220	5840	9640	4870	2120
4	14580	15680	13210	7640	2730
5(+PKZn)	16880	15190	14520	7490	3440
DPL 90			petiole phosphates		
1		1190	1495	1190	
2		1330	1590	1260	
3		1310	1300	1340	
4		1230	1320	980	
5(+PKZn)		1280	1455	1055	

OBSERVATIONS AND RESULTS

Growth was highly variable and not always related to treatment. Rank growth with few bolls set was found on many plots, especially those with the high N treatment, by mid-July. These growth patterns generally were related to the variable soil conditions which reflected the past history of the field. Severe weed competition during the early part of the season affected early growth and development.

Petiole samples (Table 2) bore out the observations of soil variability and high available soil N. Some individual plots tended to remain high and others tended to remain low throughout the season, regardless of treatment. Petioles generally showed adequate N levels throughout the season, although there was an unexplained drop around 15 July, but all treatments recovered by 29 July. The higher N treatments were beginning to show by the second week of August.

The soil test values indicated that petiole nitrates would remain high during the season and that adequate available N was present for the production of two to three bales of cotton without the addition of N fertilizer. Soluble phosphate in petioles did not increase with phosphorus fertilizer treatment (Table 2).

Yields (Table 3) were generally low for the first picking. Since a second picking was not possible, it is not known how much cotton remained in the field, nor is it known if the amount remaining was proportional to any of the treatments. A large number of green bolls remained in the field, but no attempt was made to estimate the amount or location since a second pick was anticipated.

Yields of plots from the adjacent experimental field which received essentially the same fertilizer schedule as treatment 3 were one bale or more higher than from the fertilizer study. This points out that the fertilizer program was adequate and that the variation in yield was due to other factors.

Table 3. Cotton lint yields in bales per acre, Eloy, 1986.

Treatment	----- Variety/Seed Rate -----								
	-----DPL41-----			-----DPL90-----			-----DPL775-----		
	5	10	20	5	10	20	5	10	20
1	1.81	2.30	2.40	2.44	2.71	2.64	1.75	1.68	2.05
2	2.19	2.18	2.40	2.50	2.51	2.76	1.56	1.84	1.92
3	1.80	2.19	2.28	2.26	2.33	2.66	1.50	1.70	1.76
4	2.25	2.68	3.29	3.00	3.00	2.89	1.82	2.27	2.67
5	2.12	2.67	2.56	2.37	2.68	2.69	1.81	2.33	2.29

Overall yields increased with increased seeding rates. This may be somewhat unexpected since cotton can compensate for poor stands under normal circumstances. In this case the response to seeding rate may be due to the suppressed growth by the early weed competition. When the weeds were controlled the growing season remaining was insufficient to allow compensation for the lower stands.

Delta Pine 90 yielded significantly more than DPL 41, which yielded significantly more than DPL 775. It should be pointed out that DPL 90 has more yield potential than DPL41, as well as the fact that the field was managed in favor of DPL 90.

The influence of N on yields is not clear. Yields tended to decrease as N increased from 21 to 53 lbs per acre. Higher yields were found with the higher N (123 lb) rate. Thus, there is no good correlation between N applied and yields.

The main difference between the plots receiving 45 and 53 lb of N per acre was in the time of application, rather than the quantities applied. Timing, possibly in combination with the weed problem, could have influenced yields between the two treatments. The plots which received P, K and Zn yielded less than those which did not with the same N (123 lb) rate.