Response of Cotton to Various Fertilization Histories

W.C. Hofmann and P.T. Else

ABSTRACT

Effects of various fertilization histories on cotton yield were investigated for the fourth consecutive year in the same field at the Maricopa Agricultural Center. Treatments included: 1) no fertilizers added for the past 4 seasons, 2) aggressive nitrogen fertilization in the 1988 season, no fertilization for the previous 3 seasons, 3) standard nitrogen fertilization in 1988, similar treatment for the previous 3 seasons, 4) aggressive nitrogen fertilization in 1988, same history as treatment #3 for previous 3 seasons, and 5) a commercial alternative fertilization program (BioHumaNetics, Inc.). Yields in 1988 were significantly different with treatment 2 having the highest yield, followed by treatments 3 and 4, followed by treatment 5; treatment 1 had the lowest yield.

INTRODUCTION

Upland cotton was grown in the same field for 4 consecutive seasons. Various fertilization strategies (Table 1) were employed in order to assess the short-term effects of 5 regimes on yield each season, and to investigate the longer-term effects of continuous cotton cultivation on nutrient availability.

Table 1. Treatment schedule.

Tmt 1 Control: no fertilizers added for the past 4 years
Tmt 2- No fertilizers added for previous 3 seasons, aggressive nitrogen fertilization in 1988, and
Tmt 4- Preplant and sidedress nitrogen treatment for the previous 3 seasons, aggressive nitrogen fertilization in 1988:
3/16- 46% urea at 225 lbs/A (104 lbs N/A), broadcast
6/24- 21% ammonium sulfate at 317 lbs/A (67 lbs N/A), sidedress
7/15- UAN-32 at 30 lbs N/A), broadcast
8/11- UAN-32 at 30 lbs N/A, water-run
(total N application was 231 lbs/A)

Tmt 3- Standard (preplant and sidedress) nitrogen fertilization for the last 4 years. 1988 program:
3/16- 46% urea at 225 lbs/A (104 lbs N/A), broadcast
6/24- 21% ammonium sulfate at 317 lbs/A (67 lbs N/A),sidedress
(total N application was 171 lbs/A)

Tmt 5- BioHumaNetics (BHN) program for the past 4 years.
1988 program:
1/26- Soil application of PEK and Lase
4/20- Foliar application of 13-7-5 (with Co, Si, S, and Cu in trace amounts) at 1.96 gal/A (2.4 lbs N/A)
5/6 - Soil application of 30-0-0 Huma-N concentrate (urea and ammonium nitrate) at 9 gal/A (25.4 lbs N/A)
5/27- Foliar application of a blend containing 6-10-5 and trace amounts of Fe, Zn, Mn, S at 2 gal/A (1.1 lbs N/A)
6/24- Soil application of 10-20-0 at 10 gal/A (9.4 lbs N/A)
7/15- Soil application of 30-0-0 at 10 gal/A (28.2 lbs N/A)

7/22- Foliar application of a blend containing 9-11-4 at .5 gal/A (.5 lbs N/A)
8/11- Foliar application of a blend containing N (.4 lb/A), P, K, Ca
8/11- Soil application of 20-2-.5 at 15 gal/A (28.2 lbs N/A)
8/31- Foliar application of a blend containing N (1 lb/A), P, K, Zn, and Cu
10/4- Foliar application of a blend containing Jackpot A, Nip, Breakout, and cobalt (5-7-9 at .5 gal/A, .24 lbs N/A)
(total N application was 97 lbs/A)

METHODS AND MATERIALS

The 5 treatments (Table 1) were arranged in a randomized complete block design with 8 replications. Each experimental unit was 4 rows wide (40 inch spacing) by 600 feet in length. DPL 77 seed was planted on 28 March. Preseason soil samples (for nitrate analysis) were taken on 11 March at 1-foot increments to a depth of 3 feet. Plant height measurements were made on 15 July and on 17 August. Petiole samples were taken on 8 July and 18 August for nitrate analysis. The field was defoliated on 25 October (rep 3) and on 8 November (reps 1-2 and 4-8). The 2 center rows of each plot were machine picked on 1 November (rep 3), 15 November (reps 4-8), and 22 November (reps 1-2).

RESULTS

Results in 1988 (Table 2) show that treatment 2, the treatment aggressively fertilized with nitrogen in 1988 but that had not been fertilized for the previous 3 years, had a significantly higher yield than the other 4 treatments. Treatments 3 and 4 (Table 1) had higher yields than the BHN treatment (treatment 5), which in turn had a greater yield than the unfertilized treatment (treatment 1). Differences in growth rates were visually apparent by early July, and that was reflected in the mid-season and late-season plant height measurements (Table 2).

Nitrate analysis of petioles sampled at mid-season (8 July) indicated that there was more nitrate in the 3 treatments that were fertilized by conventional means (treatments 2, 3, and 4), than in the BHN treatment and the unfertilized treatment (Table 3). By 18 August, nitrate values for all 5 treatments were very low, but nitrate levels were higher in the 2 treatments that received aggressive nitrogen fertilization (treatments 2 and 4) than in the other 3 treatments.

Table 2. Plant Response Data Summary, Maricopa Ag Center, 1988
(Treatments are ranked in ascending order of yield)

	Plant height 15 July (cm)	Plant height 17 Aug. (cm)	Yield (lint in bales/A)
Tmt 1	66.6 A[1]	63.8 A	2.02 A
Tmt 5	67.2 A	86.3 B	3.04 B
Tmt 3	81.8 B	92.6 BC	3.35 C
Tmt 4	75.9 AB	95.5 C	3.42 C
Tmt 2	74.3 AB	100.7 C	3.71 D
Std. error	5.50	4.20	.131

[1]/Within each column, means followed by the same letter are not significantly different using the LSD method at the .05 significance level.

Table 3. Nutrient Data Summary

	Preseason soil samples, nitrate-N level (mg/Kg) -----sample depth--------- 0-1 foot	1-2 feet	2-3 feet	Petiole nitrate-N level 8 July (mg/Kg)	Petiole nitrate-N level 18 Aug. (mg/Kg)
Tmt 1	5.3 A[1]	1.5 A	1.0 A	3665 A	76 A
Tmt 2	-	-	-	10860 B	739 C
Tmt 3	4.7 A	1.9 A	0.8 A	9395 B	192 AB
Tmt 4	-	-	-	10070 B	775 C
Tmt 5	5.9 A	4.3 A	3.1 A	2720 A	235 B
Std. Error	1.16	1.38	1.11	884	65

[1]/Within each column, means followed by the same letter are not significantly different using the LSD method at the .05 significance level.

DISCUSSION

Four years of the experiment's results seem to indicate that timely nitrogen fertilization during the first half of the growing season was the most critical factor in plant growth and yield. It seemed apparent in the fourth year of study that the BHN program was still quite dependent upon timely and substantial in-season applications of nitrogenous fertilizer. In 1988, due to an oversight in the BHN program, the sidedress application made on the Treatment 5 plots on 24 June (Table 1) did not deliver sufficient nitrogen during the critical boll production period. That probably accounted for the depressed petiole nitrate-nitrogen levels on 8 July (Table 3), and for resultant reductions in yield.

The fact that Treatment 2 (aggressive nitrogen fertilization in 1988, no fertilizers for the previous 3 years) produced yields that were superior to Treatment 4 (aggressive fertilization in 1988, standard nitrogen fertilization for the previous 3 seasons) suggests that nitrogen fertilization was not the only critical factor during the study. Apparently the Treatment 2 plots had benefitted in some way from the 3-year slack period of reduced cotton growth due to withholding fertilizers. The superiority of treatment 2 may have implications related to the availability of nutrients in a program where cotton is grown on the same field year after year.