Irrigation

Nitrogen and Water Effects in Drip Irrigated Cotton

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Summary

Nitrogen at five rates and water at three levels (0.6, 1.0, and 1.3 CU) were studied in a buried drip irrigation system on a Casa Grande sandy loam soil at the Maricopa Agricultural Center in 1985. Yield was increased by N at 50 lbs/Ac on the 1.0 and 1.3 CU water levels but not at the 0.6 CU water treatment. Yields were higher with increasing water application, 28.6" < 40.4" < 48.9". Soil nitrate-N was lower in 1985 than 1984 resulting in a greater fruiting and yield response to applied N fertilizer.

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Efficient use of N fertilizer and water is essential for the cotton grower's economic status with the high cost of production inputs and unfavorable market conditions. This study is part of the continuing effort to provide information to help the grower improve efficiency of fertilizer and water use on cotton.

Methods

Six nitrogen treatments and three irrigation levels (0.6 CU, 1.0 CU, 1.3 CU) were studied using the same plots as the 1984 study. The N fertilizer was N-PHURIC 28-0-0-9, and the amount of N applied weekly was varied with the growth stage of the plant. In four of the treatments, the amount of N applied was the same each week for nine weeks during the growing season, while in one treatment, the fertilizer was applied during the first six weeks only. The six treatments are shown in Table 1.

Each N treated plot consisted of six rows, 40" oc. by 58' gross length. Six of these plots were randomized within each of the three (3) water treatments which were replicated three times resulting in a total of 54 plots. The drip tubing was Chapin Twin Wall III 14 mil drip tubing buried approximately 8" below the row surface.

Initial (8 ppm) and final soil nitrate levels were measured and irrigation water nitrate levels were monitored during the entire season. Petiole and whole plant samples were taken at regular

intervals in order to measure nitrate and total nitrogen uptake, respectively.

Table 1. Nitrogen Treatment for Each Three-Week Period

Plant Growth Stage	Treatment (amount N applied, lbs/A)					
	1	2	3	4	5	6
Late vegetative to first flower (June 10-24)	16.6	33.3	33.5	66.6	100	0
First flower to heavy flowering (July 1-15)	16.6	33.3	33.5	66.6	100	0
Peak flower to late flower (July 22-Aug 5)	16.7	33.4	0	66.7	100	0
Total N APPLIED PER ACRE	50	100	67	200	300	0

Water application was on a four day a week schedule with difference only in the amount applied. The N was injected into the water at the manifold entry to each individual plot.

Flowers were tagged in a 2-m sub-plot with coded plastic tags three days a week from first flower until mid-September. Bolls were harvested when open and the tags collected for determination of fruiting behavior.

The cotton (DPL-62) was planted on April 12,1985 in dry soil and irrigated for germination. Deep planting and a week of cold weather with soil temperatures below 50 F resulted in poor stand establishment. The field was replanted on May 6 with application of additional preirrigation. Equal amounts of water were applied to all water treatments prior to June 10. The treatments were based on consumptive use curves (CU) and ET calculations.

Results

After harvest of the 1984 crop, barley was planted on the entire field to remove as much of the residual N as possible. The plot areas were evident in the barley growth and reflected the residual N differences from the 1984 treatments. The barley was mowed and removed before land preparation for seeding the 1984 cotton crop.

The seed cotton yields in Table 2 show differences due to increasing water levels. Contrary to the 1984 results, a nitrogen yield response was evident on the higher water levels, 1.0 CU and 1.3 CU. On the dry treatment, N application did not affect yield.

Since there appeared to be sufficient residual soil N for a yield of about 2.5 bales per acre, an application of 50 lbs/acre was adequate to achieve the maximum yield of approximately 3 to 3.25 bales/acre. The lower yield attainable in 1985 compared with 1984 was probably due to late planting. Planting a month earlier should result in a higher yield of as much as one bale.

Table 2. Seed Cotton Yields

Water level	Rep	N rate, lbs/acre 0	50	67	100	200	300
0.6 CU	1	2300	2700	1960	2700	2360	2360
	2	2950	2270	2560	2630	2260	2590
	3	2720	2550	3110	2710	2660	2520
	mean	2570	2510	2540	2680	2430	2470
1.0 CU	1	3490	4200	3830	4330	3290	4160
	2	3580	4190	4320	4200	3745	4370
	3	3650	3390	3990	3680	4000	4200
	mean	3570	3920	4050	4070	3680	4250
1.3 CU	1	3770	4370	4600	4400	4200	4910
	2	4350	4470	4620	4480	4700	4780
	3	3490	5210	4710	4340	4040	4330
	mean	3870	4680	4650	4410	4310	4670

Irrigation water use was greater in 1985 than 1984 largely because of the lack of effective rainfall. However, total water use was almost the same in both years. The N fertilizer and water use efficiency was very high. The water use was approximately 30 inches less than with the normal practice of furrow irrigation and N fertilizer response for the low rate of application indicated an increase in growth and probable increase in in N content of the crop equal to the N applied. Since all tissue analyses are not complete at this time, calculations can not be made to evaluate this projection.

Plant height at the end of the season (Table 3) was well related to yield at each water level and at low rates of N application. Total N uptake data are not available as N analyses are not complete.

Flower and boll production data for the season (Table 4) were affected by water and by N at the two higher water levels. Only the lower rates of N increased flowers and bolls. The percent boll retention was lower than in 1984 and less tendency was shown for increased boll loss at the higher rates of N application.

Table 3. Cotton Plant Height at Harvest

N Rate lbs/Ac	Water level, CU 0.6	1.0	1.3	means
	height, inches			
0	24.4	31.0	35.1	30.2
50	25.2	32.7	39.3	32.4
67	25.0	35.8	40.6	33.8
100	25.4	37.1	40.3	34.3
200	24.9	39.8	44.8	36.5
300	25.1	39.3	47.8	37.3
means	25.0	35.9	41.3	

Table 4. Total Seasonal Flower and Boll Production for Three Water Levels at Each N Treatment

N Rate	Water Level 0.6 flowers	0.6 bolls	0.6 % set	1.0 flowers	1.0 bolls	1.0 % set	1.3 flowers	1.3 bolls	1.3 % set
0	325	136	42	386	171	44	451	199	44
50	370	154	42	427	182	43	539	231	43
67	321	131	41	437	200	46	520	211	41
100	361	154	43	525	212	40	517	210	41
200	343	153	45	555	217	39	510	206	40
300	387	156	40	528	188	36	585	210	36

Conclusions

The soil level of N was lower in 1985 than the previous year, resulting in a greater fruiting and yield response to applied N fertilizer. The amount of N response was dependent upon the amount of irrigation water applied. No response resulted at the 0.6 CU water level.

Residual soil N continued to provide a large part of the N requirements for the crop and response only to the low rate of N application indicated a high degree of fertilizer use efficiency at the 50 lb/acre rate. Water use efficiency with the drip system was also very good with an estimated savings of water by at least 40 percent.

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Response of Surface Drip Irrigated Cotton to Fertilizer Application

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Summary

Fertilizer nitrogen rates and the addition of phosphorus, potassium and zinc were studied in a drip irrigated field at Eloy. Response to nitrogen was found with the optimum rate being about 170 lbs/acre although higher rates tended to increase yields. Significant response to P and K were not found, but there appeared to be a response to zinc. Yields were below desired levels because of problems with obtaining a good stand and infestations of cotton rust and root rot.

Methods

The study was located at Regal Farms near Eloy, AZ. A pump, controllers, and filter system suitable for plot research were constructed and mounted on a trailer which was located near the well and sump. The filtered water was piped to the 20 acre study site. Part of the field received various fertilizer treatments at the recommended irrigation rate; another part received various water rates with the best estimated fertilizer rate.