Interactions of Nitrogen Supply, Irrigation, and Plant Population on Flowering, Boll Retention, Boll Size, Earliness, and Yield

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Summary

Plant populations of 20, 40, and 80 thousand plants per acre were tested with normal and 2/3 normal irrigation, and with different amounts of fertilizer N. Water and N deficits caused early cutout, decreased total flower production, and caused bolls to be smaller. High population also caused bolls to be smaller. High population increased early flowering and decreased early boll retention, but neither effect continued through the season. Earliness was not enhanced by high plant population nor by 2/3 normal irrigation. Earliness (as a percentage of total yield) was increased by extreme N deficiency only because N deficit depressed yield late in the season. The highest yield was obtained with 138 lbs of N/ac, normal irrigation (5 to 6" every 2 weeks), and normal plant population (20 to 40 thousand plants/ac). Except with no added N, yield was proportional to the amount of water added. Extreme N deficiency decreased yield more than it decreased water used. Nevertheless, the plants produced over 3,000 lbs of seed cotton (1200 lbs of lint)/ac with no fertilizer and 2/3 normal irrigation.

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Our earlier results indicated that water deficit limits plant growth, decreases flowering, increases boll shedding, and causes early cutout. Nitrogen deficit may have some of the same effects. Because of the earlier cutout, however, less N and water may be desirable for short-season production. Increasing the plant population may be desirable because of the smaller plant size when N and water are limiting. We conducted a test in 1982 to investigate the interactions of water, N, and plant spacing.

Deltapine 70 was planted April 7. Seedlings were thinned by hand to give populations of 20, 40, and 80 thousand plants per acre in each plot. A preplant irrigation was applied March 10. The first post-planting irrigation was applied to all plots on May 27. Thereafter, 12 to 15 cm were applied to the normal and 8 to 10 cm were applied to the stressed plots every two weeks. Nitrogen was applied at rates of 0, 138, and 203 lbs per acre in normally irrigated plots, and at 0, 69, and 134 lbs per acre in the stressed plots. Twenty pounds of N were given in two foliar applications in the high-N treatments. Nitrogen, irrigation, and spacing were tested in all possible combinations with six replications. Flowers were tagged daily in four reps through the season.

Results and Discussion

Flowering. Water and N deficits had little effect on early flowering, but caused early and prolonged cutout. Water and N deficits caused flowering to stop about the end of July, and it did not start again until about the end of August. Although flowering slowed in August in plots with adequate water and N, it never completely stopped. Early flowering was increased somewhat by increasing the plant population. However, in plots that were deficient in water or N, flowering rate slowed sooner at higher plant populations so that the cumulative number of flowers produced was virtually the same in all populations by July 23.

Boll retention. We suspected that the combination of adequate water and N and 80,000 plants per acre would cause excessive competition for light and, thereby, decrease boll retention. There was a tendency for this to occur in late June and early July, but not during the remainder of the season. The high population retained a lower percentage of bolls in all N and irrigation treatments during the first week of July. Percentage boll retention for the entire season, however, was similar in all treatments. This can be explained by our earlier results which indicated that active boll load (number of bolls up to 45 days old) has a powerful effect on boll retention. A heavy boll load causes low boll retention regardless of other conditions. This type of feedback tends to force all treatments into similar boll retention behavior as the season progresses.

Boll size. High population, N deficiency, and inadequate water all decreased boll size (wt. of seed cotton per boll). Nitrogen deficiency decreased lint weight per seed, seed weight, and the number of seed per boll.

Yield. Plant population had no consistent effect on yield when either water or N was deficient, but the highest population depressed yield somewhat when both water and N were adequate (Table 1). These results are consistent with the hypothesis that population should be limited when conditions favor vigorous growth. Yields were higher than we expected in the unfertilized plots. We estimate that the irrigation water applied contained 30 to 40 lbs of N per acre as impurities. Severely N

deficient plants did not respond to irrigation above 2/3 normal. Likewise, plants with limited irrigation gave a relatively small yield increase when N was applied. Normal irrigation (about 5" to 6" every two weeks), 20 or 40 thousand plants per acre, and 138 lbs of N/acre gave the highest yield.

Earliness. To estimate earliness, we calculated yield from flowers that appeared through July 28 and compared that with total yield in each treatment (Table 2). Increasing the plant population within 38" rows did not increase earliness. (We have no data for narrow rows.) The lowest N level increased earliness with normal irrigation, but also decreased yield. Early yield tended to be proportional to total yield in all other treatments.

Water use efficiency. The water use efficiency (WUE) was significantly affected by N only in the normally irrigated plots (Table 3). Because yield was reduced more than water use by the N shortage, the zero N treatment gave the lowest WUE. With added N, yield (and thus WUE) tended to be proportional to the amount of water added.

Table 1. Seed cotton yield (pounds per acre) in 1982 as influenced by population, N supply, and irrigation.

	Plant population		
	20,000	40,000	80,000
Lbs. N/ac.*		Normal irrigation	
0	3134	3094	3222
138	4822	4820	4250
203	4302	4331	4172
		2/3 normal irrigation	
0	3030	3235	3296
69	3858	4036	3902
134	3619	3699	3855

*Does not include N present in the irrigation water

Table 2. Yield produced from flowers that appeared through July 28 as a percentage of total yield in each treatment.

	Plant population		
	20,000	40,000	80,000
Lbs. N/ac.		Normal irrigation	
0	93.3	91.0	89.4
138	78.7	75.6	75.0
203	82.0	82.1	73.5
		2/3 normal irrigation	
0	79.5	78.4	76.6
69	73.3	77.7	77.3
134	80.0	79.6	77.3

Table 3. Lint yield and water use efficiency (WUE) of 40,000 plants per acre

Lbs. N/ac.	Yield* lbs/ac	WUE* lbs/in. H_{20}
	Normal irrigation	
0	1213 a	28.5 a
138	1780 c	38.1 b
203	1644 bc	33.7 ab
	2/3 normal irrigation	
0	1283 a	34.9 b
69	1511 b	39.4 b
134	1475 ab	36.8 b

*Entries followed by the same letter are not statistically different at the 5% level.

Use of Growth Regulator PIX®

Jim Armstrong, Pima County Extension Agent

This material has now been available for several years but test results had failed to pinpoint the best application time, condition or whatever for maximum benefit. Three years experience prior to 1982 had provided economic returns in all tests conducted in Pima County excepting one short staple test. However, there was considerable variance as to appropriate application timing.

The effort in cooperation with BASF in 1982 was designed to add insight into what conditions contributed to the best results. Four different treatments along with a check replicated four times were applied on Pima S-5 cotton. The first treatment was one pint of PIX® applied at early bloom (10-12 blooms per foot of row) and a second application of 1 pint at peak bloom (about 25 days after first application). Treatment two was one pint of PIX® at early bloom and ½ pint at peak bloom. Treatment three was one pint PIX® at early bloom. Treatment four was one pint of PIX® at peak bloom and treatment five was the check.

All applications were aerially applied in 14 row swaths with each swath being one replication of a treatment.

The following results were obtained from this effort.