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Effect of Nitrogen and Spacing on Yield and Quality of 'Hybrid-4' Cotton under Rainfed Condition

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ABSTRACT

A field experiment to evaluate the effect of three levels of nitrogen and nine spacing on 'Hybrid-4-' cotton was conducted for three years from 1975-76 to 1977-78 on loamy sand (*Goradu*) soil of middle Gujarat under rainfed condition. The results indicated that the 50 kg N/ha with spacing 120 x 50 cm² was conducive for higher yield. The moisture use efficiency (kg/mm/ha) was higher under 120 x 50 cm² spacing.

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INTRODUCTION

According to Sawhney and Sikka (1960), the rainfed crop of cotton in India on an average removes 25.8 kg N, 20.2 kg P_2O_5 and 87.4 kg K_2O/ha. Beneficial effect of nitrogen application to cotton has been reported by almost all workers. But there have been variable responses of the crop to different doses of nitrogen varying from 33.6 to 67.2 kg/ha under different sets of conditions (Sharma, 1961 and Garg, 1964).

Optimum spacing between and within rows is an essential pre-requisite for obtaining good yield of cotton crop. Swaminathan (1971) reported that the low plant population is one of the major reasons of low yields of cotton in India. Bederker *et al.* (1956) did not observe any beneficial effect of close spacing on final yield.

Under present day fertilizer constraint and increased price of nitrogenous fertilizers, it was thought worth while to find out the optimum levels of nitrogen and spacing for increased yield of rainfed cotton 'Hybrid-4' under Anand condition.

MATERIALS AND METHODS

This investigation was undertaken at the Gujarat Agricultural University, Anand Campus, Anand during *Kharif* of 1975-76, 1976-77 and 1977-78. Soil of the experimental plot was loamy sand (*goradu* soil). The experiment was conducted on different fields during different years. The fertility status of the experimental site during each year in respect of available nitrogen was 325.2, 340.5 and 380.0 kg/ha during 1975-76, 1976-77 and 1977-78 years, respectively while available phosphorous was 52.8, 58.4 and 107.5 kg/ha and available potassium was 369.6, 336.0 and 322.6 kg/ha, respectively. No phosphorous and potassium was applied as soils are under high group for both the nutrients. The experiment was laid out in a randomized block design with 27 treatments formed by combining three levels of nitrogen (50, 100 and 150 kg/ha) and nine levels of spacing viz. 90 x 45,

90 x 60, 90 x 75, 120 x 35, 120 x 50, 120 x 65, 150 x 75, 150 x 65 and 150 x 35 cm^2 representing a plant population ranging from 9000 to 25000, replicated thrice. The sowing was done in June by dibbling. Gap filling was done by transplanting the seedlings raised in polyethylene bags. Half the quantity of nitrogen was applied as a basal dressing in furrows and the remaining half was top-dressed when the plants were 45 days old.

The pests like aphids, jassids and boll worm were observed during all the three years while the incidence of leaf roller was observed during 1976-77 only. Dimethoate 0.03%, phosphamidon 0.03% were sprayed to control aphids and jassids while endosulfan 0.075%, parathion 0.03% and carbaryl 0.2% were sprayed to check bollworm. The different chemicals were used in different sprayings. In all, six sprayings were carried out.

The cotton seed (after delinting) as well as dry stalks were collected during the year 1977-78 only and composite samples were made for each treatment after mixing all replications. These were analysed for nitrogen, phsophorous and potassium content by standard methods as described by Jackson (1958). The oil content in seed was analysed by Soxhlet's method.

The seed cotton samples were taken from each treatment and replication at the time of final harvest after thorough mixing of seed cotton from each picking and also after cleaning the seed cotton. These were analysed for fibre length, ginning percentage, staple length, uniformity ratio, fineness, maturity coefficient and tenacity for the year 1976-77 and 1977-78.

Total rainfall amounted to 909.9, 1687.1 and 1282.0 mm in 54, 52 and 62 rainy days for the years 1975-76, 1976-77 and 1977-78, respectively against an average annual rainfall of 815 mm of the tract. The rain received during 1975-76, was well distributed up to October without severe drought and incidence of disease or pest. However, during 1976-77, the rain received was double than the average annual rainfall. The higher intensity of rainfall during July and August (28th to 38th standard week) as per fig. 1 favoured the attack of pests as well as adversely affected the vegetative growth. The rain received during November favoured the crop growth. During 1977-78, the rain received was higher than the average annual rainfall but the distribution was erratic. The continuous rain from June to middle of August (24th to 33rd standard week) favoured the occurrence of diseases and pests posing difficulties in their control. The monsoon ceased early.

RESULTS AND DISCUSSION

Yield and yield attributes:

Data on the average yield of seed cotton, dry stalk, number of bolls per plant are presented in Table 1.

The differences in yield of seed cotton in different years are attributed to seasonal variations which modified the growth development and ultimately the yield of the crop. The season during 1976-77 and 1977-78 were favourable up to the month of July with normal growth of the crop. But excessive rains, received

TABLE 1

Effect of nitrogen and spacing levels on yield and yield attributes of cotton.

Treatments	Seed Cotton (q/ha)				Dry Stalk (q/ha)				No. of bolls/plant			
	1975-76	1976-77	1977-78	Mean	1975-76	1976-77	1977-78	Mean	1975-76	1976-77	1977-78	Mean
N-Levels, kg/ha												
50	14.21	12.96	8.74	11.97	30.9	24.6	15.8	23.79	15.9	49.2	21.1	28.75
100	15.91	10.34	10.47	12.24	31.2	20.4	19.2	23.60	18.6	50.5	21.8	30.32
150	15.93	9.00	11.48	12.16	32.9	16.7	22.5	24.03	21.3	47.7	24.7	31.26
SEm ±	0.61	0.86	0.52	0.55	2.2	1.13	0.83	2.16	1.93	3.35	1.09	1.2
CD at 5%	NS	2.44	1.49	NS	NS	3.19	2.36	NS	2.64	NS	3.10	NS
Spacings, cm²												
90 x 45	17.50	13.45	10.87	13.49	39.9	22.5	19.4	27.27	12.8	45.5	16.7	24.99
90 x 60	16.11	11.95	11.00	13.02	34.7	20.9	19.7	25.11	17.1	61.0	21.7	33.27
90 x 75	16.16	10.58	10.19	12.32	30.9	20.7	18.1	23.21	21.1	53.8	24.0	32.99
120 x 35	16.67	10.24	9.78	12.23	34.1	21.6	17.3	24.33	14.1	38.2	16.3	22.87
120 x 50	17.53	13.61	12.10	14.41	40.6	23.9	22.1	28.85	17.8	43.9	24.4	28.10
120 x 65	17.29	10.87	9.97	12.78	37.1	22.1	18.7	25.93	20.3	57.7	24.4	34.17
150 x 75	13.06	8.81	9.03	10.30	22.4	17.5	17.6	19.16	25.8	50.9	29.6	35.43
150 x 65	11.64	6.80	8.54	8.99	20.2	14.6	15.7	16.83	21.9	49.0	26.1	32.31
150 x 35	12.19	10.63	10.63	11.15	25.6	21.3	23.9	23.58	16.8	42.1	19.9	26.27
SEm±	1.07	0.50	0.90	0.95	3.7	1.9	1.4	2.14	1.61	5.81	1.89	2.12
C.D. at 5%	3.04	1.41	NS	2.63	10.6	NS	4.1	6.42	4.57	NS	NS	5.91
N x Spacing												
SEm ±	1.87	1.49	2.46	0.96	6.44	3.38	2.49	2.50	2.79	10.06	3.28	3.74
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

during August in 1976-77 and early cessation of rain during 1976-77 and 1977-78 when the crop was in flowering and fruiting stage, caused severe set back to the crop.

The differences due to application of nitrogen were significant for seed cotton and dry stalk yields for 1976-77 and and 1977-78 only. During the 1976-77 the application of 50 kg N/ha gave higher seed cotton yield over 100 and 150 kg N/ha. But in 1977-78, the application of 150 kg N/ha gave higher yield over 50 kg N/ha while it was at par with 100 kg N/ha. The dry stalk yield was increased with the increase in nitrogen levels in 1977-78 while reverse trend was observed in 1976-77. The pooled analysis showed that the application of nitrogen has no significant effect on seed cotton and stalk yields. This shows that the application of 50 kg N/ha is sufficient for cotton 'Hybrid-4' under rainfed condition. The result is in agreement with Garg (1964) and Sanap et al. (1978). The number of bolls per plant differed significantly during 1975-76 and 1977-78. The pooled analysis showed that the nitrogen application had no significant effect on the boll number per plant.

The data on the effect of spacing revealed that the differences in seed cotton yield were significant during first and second year only. The pooled analysis indicated that the spacing of 120 x 50 cm² was at par with 90 x 45, 90 x 60, 90 x 75, 120 x 35 and 120 x65 cm² spacings, but it was significantly superier to rest of the spacings. The spacings of 90 x 45, 90 x 60, 90 x 75, 120 x 35 and 120 x 65 cm² were superior to 150 x 65 cm², while 90 x 45 and 90 x 60 cm² were superior over 150 x 75 cm². The spacing 120 x 50 cm² was better as compared to other spacings although they were at par statistically. It is also relatively more convenient for cultural operations requiring less seed rate of 'Hybrid-4' which is quite costly. The dry stalk yield showed significant differences during the first and third years and remained unaffected during the second year. The pooled analysis indicated that the spacing of 120 x 50 cm² gave higher dry stalk yield and was superior over 150 x 75 and 150 x 65 cm². The number of bolls per plant was significant in the first year but non-significant during 1976-77 and 1977-78.

The interaction of nitrogen x spacing and other interaction viz., year x spacing, year x nitrogen and year x nitrogen x spacing were not significant for seed cotton and stalk yields as well as number of bolls per plant.

Quality:

It was observed that the ginning percentage, fineness and maturity coefficient decreased with the increase in level of nitrogen while other characters did not show any definite trend (Table 2). Practically the qualitative characters remained unaffected due to different spacings. The reduction in ginning percentage with the increase in nitrogen application may be due to increase in the seed weight and addi-

TABLE 2

Effect of nitrogen and spacing levels on the quality characters of cotton (Mean of (1976-77 and 1977-78).

Treatments	*Mean fibre length, mm*	*Ginning, %*	*Staple length, mm*	*Uniformity ratio, %*	*Fineness, micronaire*	*Maturity Coefficient*	*Tenacity, g/tex.*
N-Levels, kg/ha							
50	27.9	32.7	31.1	47	3.7	0.80	46.6
100	27.8	31.8	31.0	48	3.5	0.78	46.1
150	28.0	31.7	31.1	47	3.5	0.78	46.4
Spacing, cm²							
90 x 45	27.0	32.1	31.1	48	3.6	0.79	46.1
90 x 60	27.8	32.2	31.0	48	3.6	0.79	46.3
90 x 75	28.0	32.4	31.2	47	3.6	0.79	46.5
120 x 35	27.8	31.3	30.9	48	3.4	0.77	46.5
120 x 50	27.8	32.3	31.0	48	3.7	0.80	45.7
120 x 65	27.7	31.8	30.8	48	3.6	0.79	46.0
150 x 75	27.8	32.3	31.0	48	3.6	0.79	46.5
150 x 65	28.0	32.5	31.1	47	3.4	0.77	46.9
150 x 35	28.2	31.8	30.9	48	3.6	0.79	46.8

TABLE 3

Effect of nitrogen and spacing levels on the nutrient content of seed and dry stalk and oil percentage in cotton seed.

Treatments	Cotton seed			Oil Content, %	Dry Stalk		
	N%	P%	K%		N%	P%	K%
N-Levels, kg/ha							
50	3.31	1.24	3.10	22.89	0.72	0.262	2.51
100	3.40	1.20	3.10	22.20	0.92	0.247	1.33
150	3.49	1.17	3.04	21.20	1.03	0.219	1.13
Spacings, cm^2							
90 x 45	3.51	1.24	3.13	22.13	0.92	0.215	0.25
90 x 60	3.48	1.20	3.13	23.05	0.82	0.223	1.25
90 x 75	3.22	1.23	2.98	22.18	0.90	0.234	1.28
120 x 35	3.49	1.18	3.03	22.33	0.98	0.266	1.32
120 x 50	3.52	1.28	3.15	22.01	0.99	0.269	1.32
120 x 65	3.27	1.23	3.06	23.36	0.91	0.255	1.28
150 x 75	3.16	1.14	3.10	22.26	0.91	0.247	1.20
150 x 65	3.24	1.25	3.05	22.50	0.88	0.225	1.23
150 x 35	3.25	1.19	2.93	22.96	0.86	0.253	1.13

tional nitrogen might have been utilized in the synthesis of seed material as observed by Verma *et al.* (1965). Iyengar (1941) also observed lack of definite relation between fibre length and nitrogen application.

Nutrients content:

The application of nitrogen increased the nitrogen content in cotton seed as well as in dry stalk, while phosphorus and potassium content decreased (Table 3). No definite trend was observed with the different spacings. The increase in nitrogen application decreased the oil percentage. However, no definite trend was observed with the different spacing. Similar results in other oil-seed crops were also reported by Bhan and Singh (1973) and Mitchell *et al.* (1974).

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