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Effect of irrigation and nitrogen regime on yield and yield-contributing characters of upland cotton (*Gossypium hirsutum*)

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) seasons of 1990 and 1991 to study the effect of irrigation and nitrogen regime on yield and its attributes of American or upland cotton (*Gossypium hirsutum* L.) at Ludhiana. Normal and heavy pre-sowing irrigations gave statistically similar seed-cotton yield. Various yield-contributing and quality characters (picked bolls/plant, boll weight, seed index, ginning outturn) were not affected by levels of pre-sowing irrigation. However, delay in the first irrigation from 4 to 5 or 6 weeks after sowing decreased the seed-cotton yield significantly. Nitrogen @ 60 kg/ha increased the seed-cotton yield and yield-contributing characters significantly compared with those under 0, 30 or 90 kg N/ha.

Water requirement of cotton (*Gossypium* sp.) crop varies with the species grown and growing conditions. In Punjab, the farmers sow upland or American cotton (*G. hirsutum* L.) after heavy pre-sowing irrigation to ensure good crop stand. First irrigation 4 weeks after sowing is found beneficial in most cases (Singh, 1986), but there may be a need of delaying post-sowing irrigation under heavy pre-sowing irrigation (Dhankar *et al.*, 1980). The increase in interval between sowing and first irrigation to 35 or 45 days results in significant reduction in seed-cotton yield (Yaseen *et al.*, 1990). Response to applied N may vary with the moisture availability in soil. Therefore an experiment was carried out to study the effect of irrigation and N regime on yield and its attributes in this crop.

MATERIALS AND METHODS

The field experiment was conducted during the rainy seasons of 1990 and 1991 at Ludhiana, with 'LH 886' American cotton on loamy-sand soil. The soil was low in organic carbon (0.14%) and available nitrogen (108 kg/ha), medium in available phosphorus (P_2O_5, 17 kg/ha) and high in potash (K_2O, 495 kg/ha). The experiment was laid out in split-plot design with irrigation levels in the main plots and N levels in subplots. Irrigation treatments included pre-sowing irrigation levels (normal 100 mm and heavy 100 mm + 75 mm) + post-sowing irrigation 4, 5 or 6 weeks after sowing. Nitrogen doses of 0, 30, 60 and 90 kg/ha (N_0, N_{30}, N_{60} and N_{90} respectively) were applied to the crop, half at sowing and half at flowering. The sowing of the crop was done in end of April during both the years.

RESULTS AND DISCUSSION

Pre-sowing irrigation

Normal and heavy pre-sowing irrigation did not influence the seed-cotton yield

Table 1. Seed-cotton yield, yield-contributing and quality characters of American cotton as affected by various treatments

Treatment	Seed-cotton yield (q/ha)		Picked bolls/ plant		Unopended bolls/ plant		Boll weight (g)		Harvest index (%)		Seed index (g)		Ginning out-turn (%)	
	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991	1990	1991
Pre-sowing irrigation														
Normal	22.2	22.7	20.7	20.1	3.2	7.8	1.8	1.9	22.7	23.1	8.4	6.8	37.1	36.8
Heavy	22.1	22.6	20.8	18.6	2.9	6.5	1.8	1.8	25.3	24.4	8.2	6.7	36.7	36.9
CD (P = 0.05)	NS	NS	NS	NS	0.2	0.5	NS	NS	NS	NS	NS	NS	NS	NS
Post-sowing irrigation														
4 WAS	22.9	23.5	22.6	20.8	3.2	7.7	1.8	1.9	23.9	24.9	8.2	6.8	37.0	37.1
5 WAS	21.8	22.5	20.4	18.7	3.1	7.2	1.8	1.9	23.6	24.0	8.4	7.0	36.8	36.9
6 WAS	21.8	22.0	19.3	18.5	2.9	6.7	1.6	1.8	24.6	22.5	8.3	6.6	37.0	36.5
CD (P = 0.05)	0.5	0.5	0.8	2.1	0.2	0.9	0.1	NS	NS	0.8	NS	NS	NS	NS
N (kg/ha)														
Control	21.4	21.2	19.6	18.5	2.7	6.8	1.7	1.7	26.4	24.3	8.3	6.9	36.9	36.5
30	22.3	22.7	22.1	20.0	2.7	7.0	1.9	1.9	24.6	24.1	8.2	6.9	36.8	36.6
60	23.0	24.3	22.8	20.9	3.4	7.3	1.8	1.9	22.9	24.0	8.3	6.7	36.9	36.9
90	21.9	22.6	18.7	18.1	3.4	7.6	1.7	1.9	22.1	22.6	8.4	6.6	37.0	37.4
CD (P = 0.05)	0.4	0.3	0.7	0.8	0.4	0.5	0.1	0.1	1.7	1.6	NS	NS	NS	NS

WAS, Weeks after sowing

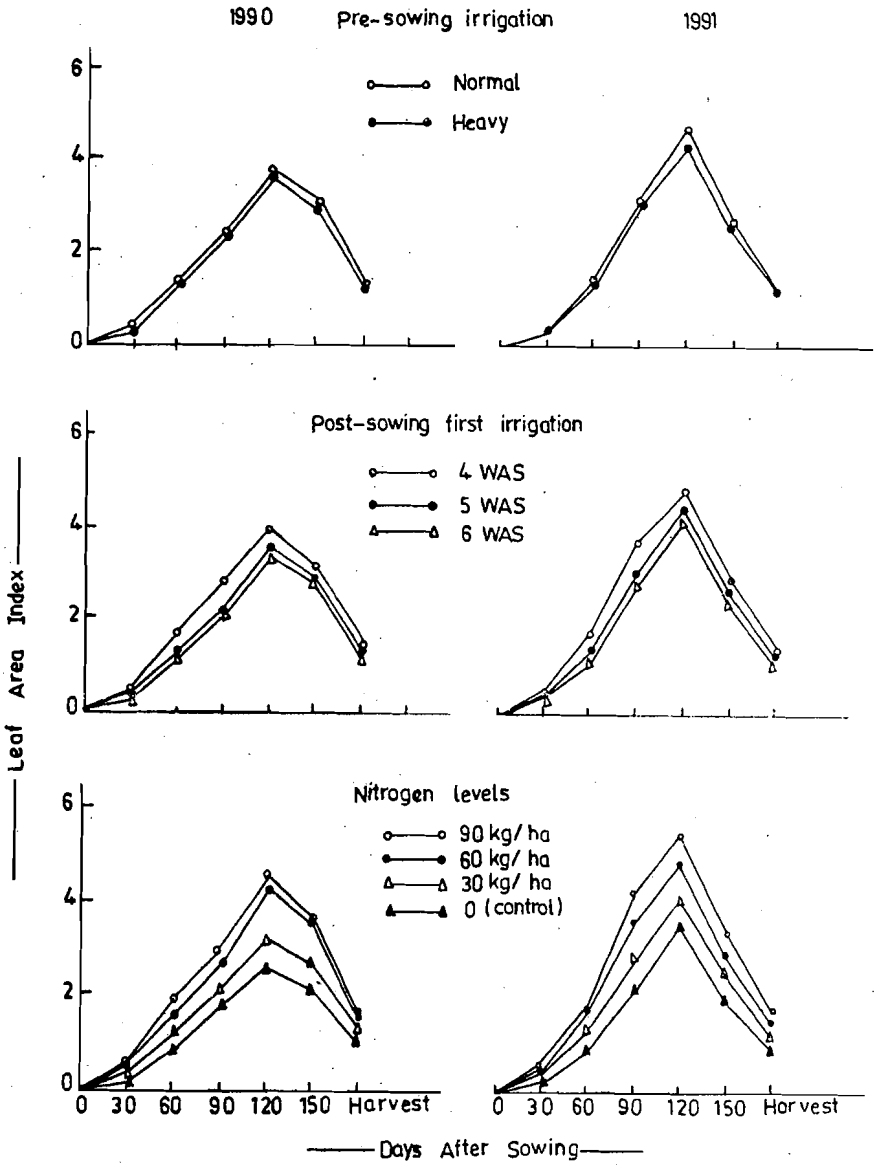

Fig. 1. Leaf-area index of upland cotton under different irrigation and nitrogen levels

significantly (Table 1) during both the years. The response of both irrigation levels to yield-contributing and quality characters were non-significant during both the years. The better soil physical conditions (better soil aeration and optimum soil moisture) under normal pre-sowing irrigation yielded a better canopy cover (Fig. 1) throughout the

crop growth irrespective of rainfall pattern.

Post-sowing irrigation

Significant yield reduction was observed during both the years with delay in the post-sowing irrigation (Table 1). Application of the first irrigation 4 weeks after sowing gave significantly higher yield than when the first irrigation was applied at 5 or 6 weeks after sowing. It may be because of more development of photosynthetic area early in the growing season (Fig. 1), and also the plants produced more number of picked bolls and heavier bolls during both the years under this treatment. Harvest index was significant during 1991 and it decreased with the delay in the first irrigation from 4 to 6 weeks after sowing. These results are in conformity with those reported by Yassen *et al.* (1990).

Nitrogen

The seed-cotton yield increased significantly up to 60 kg N/ha during both the years. Under N_0 and N_{30} treatments, the leaf-area index was less. It shows reduced crop development which affected the yield significantly. However, N level beyond 60 kg/ha (i.e. N_{90}) led to increase in vegetative growth at the cost of economic yield during both the years of study. Yield enhancement under N_{60} was actually the result of cumulative effect of yield-contributing factors. The seed index and ginning outturn were not affected by various N doses. Lower dry matter produced under N_0 level caused higher harvest index than the other N levels in this indeterminate crop. The economic optimum dose found out by a quadratic equation was about 50 kg N/ha (47.6 kg N/ha in 1990 and 49.8 kg/ha in 1991) in loamy-sand soil for both the years.

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