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RESPONSE OF WHEAT TO SUBOPTIMAL NITROGEN UNDER SALINE WATER IRRIGATION

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ABSTRACT

A micro-plot study on HD 1593 wheat was carried out during 1978-80, in a single-strip plot design with 2 levels of N and 4 levels of water salinity on a sandy loam soil. Adverse effect of salinity was greatly manifested on grain and dry matter yield during rainfall deficit year 1979-80. Normal level of N (120 kg) proved optimum at ECi 8 and 12 dS m^{-1} whilst suboptimal N (72 kg) was significantly superior at ECi 16 dS m^{-1}.

INTRODUCTION

Poor plant stand is a matter of prime concern in augmenting yield production in saline areas of arid and semi-arid tracts. Furthermore, limited growth and decreased tillering potential on saline soils may perhaps decrease total nitrogen requirement of the plants compared to the normal soils. Usual or optimal level of fertility may thus, prove excessive in abrupt saline conditions (Dhir et al., 1977) and sometimes even prove harmful and contribute to the factors of salinity (Bernstein et al , 1974; Jadav et al., 1975). Present experiment was therefore, designed to ascertain the effect of optimal and sub-optimal levels of nitrogen on growth and yield of wheat grown with varied quality of saline irrigation waters.

MATERIALS AND METHODS

A micro-plot experiment on common wheat cv HD 1593 was carried out on sandy loam soils for two consecutive rabi seasons of 1978-80. A single-strip plot design with 3 repeats was adopted. Main plots consisted of four salinity levels of irrigation water 2.2 (control), 8, 12 and 16 dS m^{-1} and sub-plot two nitrogen levels-optimal (120 kg/ha) and suboptimal (72 kg/ha). Saline waters were synthesized keeping ratio of Na : Ca : Mg. as 60 : 25 : 15 and of Cl : SO_4 : HCO_3 as 4 : 1 : 1, respectively. Grain and dry matter yields were recorded on individual plants and per hectare basis. Electrical conductivity CEe of the soil was determined at 0-15 and 15-30cm depth at the crop sowing and at harvest.

Five irrigations of 6 cm each were given during each cropping period. The crop sown on 11 Nov 1978 and 16 Nov 1979 was harvested on 4 Apr 1979 and 29 Mar 1980, respectively.

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RESULTS AND DISCUSSION

Salinity of the soil extract at the crop sown in rabi 1978 was quite low in all the treatments, possibly due to heavy downpour (969 mm) in the rainy season (Table 1). However, by the harvest time, salinity build-up due to the addition of salts through 5 irrigations rose nearly three to five fold depending upon the quality of irrigation water. The maximum build-up was ECe 14.8 in 16 ECi treatment against initial status of ECe 2.3 dS m^{-1}

Table 1. Salinity status (ECe of 0-15 and 15-30 cm depth) of experimental soil at sowing and at harvest of wheat crop.

Salinity of irrigation water (dS m^{-1})	N level (kg/ha)	1978-79		1979-80	
		At sowing	At harvest	At sowing	At harvest
2.2 (Control)	120	1.9	3.9	11.1	6-6
	72	2.1	4.3	12.0	6-5
8	120	2.4	7.2	12.9	14.1
	72	2.5	6.8	13.2	13.9
12	120	2.4	12.0	16.5	18.5
	72	2.8	13.7	17.4	19.8
16	120	2.3	14.8	30.1	29.4
	72	2.7	13.9	28.7	28.0

Due to scarce rainfall (185 mm) in the rainy season of 1979, the salinity status of soil further swelled due to upward moment of salts during lone months of water scarcity i.e. mid-July to October. As a result, salinity before sowing of wheat was of sizable magnitude ranging from ECe 11.1 in the control to ECe 29.4 dSm^{-1} in 16 ECi treatment. Irrigation through the crop growth showed amazing effect on the salinity status of soil at harvest. In the control (ECi 2.2) salinity was brought down to nearly half (i.e. 6.6) of the initial status due to leaching. In ECi 8 and 12 treatments, salinity marginally increased, and in 16 ECi, marginally decreased. In these cases, irrigation waters probably acted both for leaching as well as for building up of salt status resulting in almost a status que. The pH of soil did not show much changes hence not reported.

It may be elicited from Table 2 that adverse effect of salinity was of far higher magnitude during 1979-80 than in 1978-79. Means for all the traits in the former season declined dramatically. For instance, decrease by 52.9 and 51.8 % in grain yield/ha and dry matter yield/ha, respectively, was realized at ECi 12 dS m^{-1} over control during stress year (1979-80); whereas the corresponding values in preceding season (less stressed year) were 9.1 and 1.2 %, respectively. Effect of salinity on crop growth and yield is too well established to discuss further.

Table 2 : Effect on saline waters and nitrogen on grain and dry matter yield of HD 1593 wheat

Salinity levels (dS-m^{-1})	N level (kg/ha)	Yield/plant (g) Grain 1978-79	Yield/plant (g) Grain 1979-80	Yield/plant (g) Dry matter 1978-79	Yield/plant (g) Dry matter 1979-80	Yield/ha (q) Grain 1978-79	Yield/ha (q) Grain 1979-80	Yield/ha (q) Dry matter 1978-79	Yield/ha (q) Dry matter 1979-80
Control	120	3.5	3.2	6.0	9.8	42.1	38.5	106.7	103.5
(2.1)	72	1.7	3.9	5.0	11.6	34.7	35.3	89.1	100.3
	Mean	2.1	3.5	5.5	10.4	38.4	34.4	97.9	101.9
8	120	3.1	2.7	9.4	8.7	42.0	39.3	102.5	103.8
	72	1.5	3.6	4.7	10.4	33.4	28.0	88.3	88.7
	Mean	2.3	3.1	7.0	9.5	37.7	33.6	95.4	96.2
12	1.0	1.8	2.6	5.4	10.0	39.0	24.0	117.5	63.0
	72	3.6	3.8	5.0	11.5	30.8	8.4	80.8	35.2
	Mean	2.7	3.2	5.2	10.2	34.9	16.2	99.1	49.1
16	120	2.3	1.5	6.6	5.5	36.9	2.0	109.2	7.5
	72	3.7	2.7	11.0	7.9	37.8	6.0	94.2	19.6
	Mean	3.0	2.1	8.8	6.7	37.3	4.0	101.7	10.5
Salinity	S Em ±	0.3	0.3	0.7	0.6	1.0	2.1	2.8	3.8
	CD (5 %)	0.8	0.8	2.1	1.6	ns	6.2	ns	11.5
N levels	S Em ±	0.2	0.2	0.5	0.4	0.8	1.5	2.0	2.7
	CD (5 %)	ns	ns	ns	ns	2.3	4.4	5.8	8.1
Interaction	S Em ±	0.4	0.4	1.0	0.8	1.5	2.9	3.8	5.4
	CD (5 %)	1.2	1.1	3.0	2.3	ns	8.8	11.5	16.3

The overall effect of N was significant on grain and dry matter yield per hectare with 72 kg N being poor yielder. However, interaction between levels of N and salinity revealed that grain yield/plant was significantly higher at 72 kg N compared to that at 120 kg N with ECi 12 and 16 dS m^{-1} of irrigation water over the years. Such effect on dry matter/plant was however significant only with 16 EC of irrigation water.

It may well be clinched from the data that during rainfall deficit year, optimal rate of N was significantly superior upto ECi 12 dS m^{-1}. In fact suboptimal N induced severe nutrient deficit resulting in poor plant stand and growth. Situation at the abrupt water salinity level of ECi 16 dS m^{-1} was however, reversed, to the extent that yield was numerically 3-fold more with suboptimal (6 q/ha) than optimal (2 q/ha) N dose. A better plant stand coupled with higher grain yield per plant in the former contributed the same. Results on dry matter were also similar. The results on grain yield are in agreement with those of Dhir et al. (1977) in Pali, and Kumar and Singh (1980) in Agra conditions. Response of fertilization on saline soils logically depends on the intensity of two inhibitory factors : salinity, and the deficiency of nutrients. Thus, when the ambient salinity is the dominant limiting factor as for wheat (Bernstein et al., 1974), increasing fertility may be ineffective for growth promotion. In general, fertilization to the level required in non-saline condition is likely to yield poor when salinity is high to depress yield by 50 % (Bernstein, 1964). That is why no response of optimal dose of N was observed at the highest salinity level in stress year where yield was depressed to the order of 94.9 %. Conversely, at the moderate salinity (ECi 8 and 12 dS m^{-1}), suboptimal N appeared to have induced nutritional deficiency, thereby greater response of optimal dose of N was obvious (Khalil et al., 1967).

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