FERTILIZER MANAGEMENT STUDIES,. WHEAT GROWN HYDROPONICALLY UNDER S•.••.e CONDITIONS

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A solution culture study was conducted for two years to investigate the performance of two wheat varieties (LU-26s and Pak-81) grown under varying salinity (Eee 0, 7.5 and 15 d'Srn') and given different fertilizers (Control, N, NP and NPK). A standard rate of 100, 75 and 60 kg ha' of N, P and K, respectively was used. The averag.e of two years results showed that LU-26s performed better even at ECe of 15 dSm-1 than Pak-81 and produced significantly h'Oher number of tillers/plant, 100-grain weight and grain yield/plant. Of different fertilizers, combined appUcation of the three macro elements (NPK) increased tillering, delayed earing with well Q-ev.etaped spikes and' heavier seeds resulting in higher grain yield.

Key words: fertilizer management, saline conditions, wheat grown hydroponically

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Wheat *(Triticum aestivum* L.) is an important cereal crop used as a staple food in many countries of the world. In Pakistan the area under all the food grain crops was 12 x 10^6 hectares. Of this, 8.1 x 10^6 hectares were occupied by wheat. The total wheat grain production was 16.6 x 10^6 metric tonnes {Anonymous, 19971. The present trend in population increase predicts that there will be about 140 million people in Pakistan in the year 2000. To meet the food requirements for the increased population, wheat production, 'W,ill have to be doubled by that time (Saleem and Ahrnao,"; 1988). Wheat production potential in Pakistan on the other hand is not being exploited fully due to many factors, among which environmental stresses like soil salinity, drought and waterlogging are the most important (Vaadia. 1985). Salinity is a serious constraint to increasing crop yields and is one of the most important problems affecting irrigated agriculture in the world. Millions of hectares of potentially irrigable land lie idle because of excessive salinity. The problem is further aggravated as marginal land is brought under cultivation to meet the ever increasing demand of food, fibre and fuel.

In Pakistan, of 16.13 x 10^6 hectares irrigated land about 6.3 x 10^6 hectares are in the grip of salinity and sodicity (Khan, 1993). This alarming situation calls for adequate agronomic and cultural practices to prevent the continuous degradation of soils and to facilitate good crop production in salt-affected soils. Little work has been done on the agronomic aspects namely, water requirements, cultural practices, fertilizer management, etc. of various crop species under saline/sodic conditions (Qureshi and Rashid, 1988). However, some researchers have opined that fertilizer management could be a practical approach to alleviate the effects of salinity on agricultural crops (Feigin, 1985 and Akhtar, 19871. The present studies were, therefore, undertaken to determine the fertilizer requirement of wheat in terms of three macro nutrients (N, P and K) grown under saline conditions.

MATERIALS AND ME:rHODS

Treatments

a) Varieties	b) Salinity levels
V_1 = LU-26s	S_0 = Control
V_2 = Pak-81	S_1 = ECe 7.5 dSm^{-1}
	S_2 = ECe 15 dSm^{-1}

c) Fertilizers
i. Control
ii. Nitrogen (N)
iii. Nitrogen + phosphorus (NP)
iv. Nitrogen + phosphorus + potash (NPK)

Fertilizer rate	:	100-75-50 kg ha^{-1} of NPK
Fertilizer source	:	Amm. sulphate, single super-phosphate, potassium sulphate.
Degign	:	Split - split plot
Replications	:	Three
Growth medium	:	Solution culture

Half N with full P and K were applied as per treatment at the time of transfer of seedlings and remaining N after 15 days of first application.

Experimental Procedure: Seedlings of two wheat varieties (LU-26s and Pak-81) were raised on sandbed in a net house. Ten days old seedlings. were transferred in the first week of December to foam plugged holes in the polystyrene sheets placed on brick and cement made tanks filled with water. There were 32 seedlings i.e. sixteen for LU-26s and sixteen for Pak-81 ili each tank arranged in four rows of eight plants each. Then half strength Hoagland medium was added to each tank and the seedlings were kept for seven days in aerated growth medium. An electric pump was used for aeration of the growth medium throughout the crop growth period.

Seven days after seedling transfer, the solution was changed and the tanks were refilled with fresh water + half strength Hoagland medium. To these tanks salt solution (NaCl: $CaCl_Z$ = 20: 1 on molecular weight basis) with a daily increment of 25 mol m" was added till the desired salinity levels were achieved in different treatments except control.. Then half of N along with full P and K were added in tanks as per treatment. The remaining N was applied 15 days after this application. Later on the solution in the tanks was changed at an interval of 15 days and with each change full salinity level was created in one single dose (except control). Full strength Hoagland nutrient solution was applied after each two weeks interval until harvest of crop.

After 60 days of seedlings transfer, fully expanded and disease free penultimate leaves were removed from three randomly seiected plants in each treatment for determining foliar ionic composition. At maturity, when the crop was harvested, the data on different growth and yield contributing parameters were recorded. The data were analysed using analysis of variance and LSD test at 5% probability was applied to test the significance of treatment means (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Data (Table 1) showed that LU-26s produced significantly more number of tillers per plant than that of Pak-81. Salinity x fertilizer interactions were significant. Salinity decreased number of tillers/plant and the effect was more pronounced when plants were grown at the highest level of salinity (150 mol m' NaCl) without fertilizer. Generally, fertilizer application increased tillering but particularly NPK application produced relatively more number of tillers per plant. Similar results were also reported by other researchers (Joshi, 1976 and Zahid et al., 1986). The data further indicated thatthe variety Pa,k-S1required significantly more time (100.72 days) to earing than LU-26s (94.89 days). Various salinity x fertilizer interactions differed significantly from one another. Increased salinity induced early earing. Fertilizer application particularly NPK caused a significant delay in e~Maximum time (101 days) for earing was recordedinent where plants were grown at 75 mol m'3';NaCl ion and were applied with NPK fertilizers, while)he minimum time (94 days) for earing was taken by plants grown at 150 mol m^{-3} Nael salt solution without fertilizer. These results are supported bythefi. ndings of Ali (1988).

The data regarding Spike length showed that though the effect was not significa,?t, but generally, salinity caused decrease in Spi~.:~~ngth, while fertilizer application particularly com~i~j.on of all three macro elements (NPK) increased splk\ lengtheven at higher salinity level. The varietY:s?LU produced significantly higher weight per 100 grains than Pak: 81. Salinity caused- a progressive dec::i:~!3sein 100-grain weight but fertilizer application pa:rtjc;;ularlyNP or NPK increased it progressively. Maxiffl~IT) 100-grain weight (4.11 g) was recorded intriotafment where plants were grown under normal conditions (without salinity) and fertilized with NPK, whereas the minimum weight/IOO-grain (1.57 g) was observedjri, treatment where plants were grown at the higher salinity level (150 mol m^{-3}) without fertilizer. Similar results were also reported earlier by Asana and Kar~ (1965) and Haqqani *et al.* (1984).

Data in Table I further indicated that LU-26s gave significantly more grain yield per plant (2.43 g) than Pak-81 (1.45 g). Increasing salinity caused a decrease in grain yield per plant but fertilizer application particularly NPK application relatively improved the situation. However, the salinity x fertilizer interaction was found to be non-significant.

Though both the varieties differed non-significantly from each other but Pak-81 had relatively higher level of Na' (96.74m mol kg") than that of LU-26s (88.41m mol kg"). Leaf Na' contents increased with increasing salinity. However,fertilizer applications, in general, and NPK application in particular caused a decrease in leaf Na' contents. The variety LU-26s showed relatively higher K^+ contents than Pak-81. Salinity decreased leaf K^+ contents, whereas fertilizer application particularly NPK application increased leaf K^+ contents. However, the varieties or the salinity x fertilizer combinations differed non-significantly from one another.

Wheat [illegible]

Table 1. [illegible] varieties in [illegible] fertilize[illegible] [illegible]

Treatments		Tillers plant-1	[illegible]	Spike length (cm)	100-grain weight (g)	[illegible] (g)	Leaf contents (m mol kg-1)	
							[illegible] +	[illegible] +
A) V[illegible]								
[illegible]		* [illegible]	[illegible]	9.19	[illegible]	[illegible]	[illegible]	76.39
[illegible] 81		[illegible]	[illegible]	7.94	[illegible]	1.45 b	96.74	[illegible]
[illegible] 0.05		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B) Salinity x fertilizer								
[illegible]	[illegible]	[illegible]	[illegible].17 c	[illegible].17	[illegible] f	2.64	[illegible] f	45.31
	N	4.1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] f	[illegible]
	NP	4.66 b	100.00 [illegible]	[illegible].00	[illegible]	[illegible]	[illegible] f	[illegible]
	NPK	[illegible]	[illegible]	10.00	4.[illegible]	[illegible]	[illegible] f	114.51
S_1	[illegible]	[illegible]	[illegible].00 [illegible]	7.17	[illegible]	1.[illegible]	[illegible]	[illegible]
	N	[illegible]	[illegible].17 [illegible]	7.83	[illegible]	1.[illegible]	[illegible]	[illegible]
	N[illegible]	[illegible] d	[illegible]	8.67	3.1[illegible]	1.84	[illegible]	67.07
	NPK	[illegible]	[illegible].00 [illegible]	[illegible]	[illegible]	[illegible].16	[illegible]	[illegible]
S_2	[illegible]	2.44 i	[illegible].00 [illegible]	7.13	1.57 h	1.0[illegible]	[illegible]	[illegible]
	N	2.62 hi	[illegible].00 f	7.53	[illegible]	1.0[illegible]	[illegible]	[illegible]
	NP	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	100.1[illegible]	[illegible]
	NPK	[illegible]	97.50 d	[illegible]	[illegible]	1.44	[illegible]	73.04
[illegible] 0.05		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* = [illegible] (s) [illegible]; [illegible] = Non[illegible]

Keeping in view the overall performance' of varieties, LU-26s was found to be mote salt tolerant. Similarly, of different fertilizer combinations of the three macro-nutrients, ***NPK*** emerged to be more efficient/useful in alleviating the effects of salinity leading to improved growth and yield performance of plants.

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