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Effect of irrigation and fertilizers on growth, yield and nutrient uptake by wheat (*Triticum aestivum*)

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ABSTRACT

In a study conducted on sandy-loam (Fluvent) soil during 1988–90, the irrigation levels showed significant effect on dry matter, 1,000-kernel weight and grain yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol.). The fertility levels showed significant effect on yield and yield attributes and uptake of nutrient, while irrigation level did not show significant effect on nutrient uptake except nitrogen and potassium by grain. The IW : CPE ratio of 0.9 and fertility level of 120 kg N/ha + 0 kg P_2O_5/ha + 30 kg K_2O/ha were found the best irrigation and fertility levels respectively.

Crop and their varieties differ in need for water and nutrient management under different agro-climatic conditions. Irrigation increases the availability of applied water and nutrient through the establishment of relatively favourable moisture conditions around root zone of crops. In particular agro-climatic region, i.e. sub-montane low hill sub-tropical zone of Himachal Pradesh, very scanty information is available regarding irrigation and judicious fertilizer need of wheat (*Triticum aestivum* L. emend. Fiori & Paol.), which is generally grown in sandy-loam with poor soil depth. Present study was therefore conducted to find out the effect of irrigation and fertility levels on growth, yield, and nutrient uptake in wheat.

MATERIALS AND METHODS

The experiment was conducted during 1988–89 and 1989–90 in sandy-loam (fluvent) soil of Regional Research Station, HPKV, Dhaulakuan (456 above mean sea-level, 30°5'N and 77°5'E), in winter (*rabi*) season. Two irrigation levels (based on IW : CPE ratio I_1, 0.9 and I_2, 0.6 in combination with 6 fertility levels comprising T_1, 120 kg N/ha; T_2, 120 kg N/ha + 30 kg P_2O_5/ha; T_3, 120 kg N/ha + 60 kg P_2O_5/ha; T_4, 120 kg N/ha + 15 kg K_2O/ha; T_5, 120 kg N/ha + 30 kg K_2O/ha; and T_6, 120 kg N/ha + 60 kg P_2O_5/ha + 30 kg K_2O/ha. The experiment was conducted in randomized block design with 3 replications. The soil was sandy loam in texture with 14% clay, 23.3% silt and 62.5% sand and had pH 6.8 (1 : 2.5 soil water), the available N (alkaline $KMnO_4$ method), Olsen's P_2O_5-exchangeable K and organic matter in top 15 cm soil were 250, 42.3 and 185.2 kg/ha and 0.52% respectively. Soil profile was 45 cm deep, underlain with a thick layer of gravel and boulders. The available soil water was 34.65 mm in top 15 cm soil. The bulk density and hydraulic

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conductivity were 1.54 g/cm^3 and 1.0 cm/hr respectively. The wheat cv. 'Sonalika' was sown on 28 November 1988 and 23 November 1989 and harvested on 28 April 1989 and 18 April 1990 in 7 m x 3.5 m plots. Depth of irrigation was kept 5 cm in all the ratios. The nitrogen, phosphorus and potassium concentration of grain and straw were determined and uptake of nutrient was calculated. The total rainfall received during the crop season in 1988–89 and 1989–90 was 303.4 and 280.3 mm respectively.

RESULTS AND DISCUSSION

Effect of irrigation on yield and yield attributes

Effect of irrigation treatment on yield-contributing characters of wheat was inconsistent (Table 1). Dry-matter yield, 1,000-kernel weight and grain yield were significantly higher with IW : CPE of 0.9 ratio than 0.6. However, spikelets/ear, kernels/ear and straw yield were not significantly influenced by irrigation levels. Numerically the values were higher at ratio of 9 than at 0.6 IW : CPE. Majumdar and Mandal (1984) reported that wheat crop irrigated at an IW : CPE ratio of 0.9 to harvest an optimum yield with an optimum water-use efficiency.

Effect of fertility levels on growth and yield:

The yield and yield attributes varied significantly among different fertility levels (Table 1). Yield and yield attributes were highest in T_6 and lowest in T_1. Treatment T_5 (without phosphorus) was at par with T_6. Yield and yield attributes did not differ significantly when half and full doses of phosphorus (T_2 and T_3) and potassium (T_4 and T_5) were separately along with nitrogen. The phosphorus status in experimental field was high and potassium status was medium.

Interaction effect of irrigation and fertility levels were not found significant.

Nutrient uptake

N uptake: Nitrogen uptake by grain differed significantly between irrigation treatments (Table 2), while the nitrogen uptake by straw did not differ significantly. Nitro-

Table 1. Effect of irrigation and fertility levels on yield attributes and yield of wheat (pooled data of 2 years)

Treatment	Dry matter (g/m)	Spikelets/ ear	Kernels/ ear	1,000-kernel weight (g)	Grain yield (Mg/ha)	Straw yield (Mg/ha)
Irrigation schedule						
I_1, IW : CPE = 0.9	131.26	15.16	43.67	42.72	2.63	5.91
I_2, IW : CPE = 0.6	124.45	15.11	41.96	39.81	2.40	5.57
CD (P = 0.05)	3.84	NS	NS	1.84	0.40	NS
$N + P_2O_5 + K_2O$ (kg/ha)						
T_1 120, 0, 0	98.30	14.26	38.80	37.00	2.18	5.46
T_2 120, 30, 0	110.82	14.96	41.85	38.40	2.42	5.64
T_3 120, 60, 0	118.59	15.86	42.42	39.55	2.48	5.98
T_4 120, 0, 15	137.50	15.18	42.84	42.30	2.58	5.78
T_5 120, 0, 30	145.50	15.38	44.42	43.60	2.73	6.01
T_6 120, 60, 30	156.53	15.75	47.50	44.93	2.96	6.34
CD (P = 0.05)	12.84	0.92	3.96	4.82	0.35	6.32

Table 2. Effect of irrigation and fertility levels on nutrient uptake (kg/ha) in wheat (pooled data of 2 years)

Treatment	Nitrogen		Phosphorus		Potassium	
	Grain	Straw	Grain	Straw	Grain	Straw
Irrigation schedule						
I_1	58.95	55.35	15.02	17.88	21.31	60.78
I_2	53.75	52.10	13.68	16.70	19.03	53.74
CD (P = 0.05)	3.42	NS	NS	NS	1.23	NS
$N + P_2O_5 + K_2O$ (kg/ha)						
T_1	48.95	46.40	12.40	14.63	20.66	48.59
T_2	54.00	54.62	14.49	16.37	22.80	55.72
T_3	56.05	56.37	15.50	17.93	23.22	57.64
T_4	57.80	53.95	16.40	16.79	24.63	57.77
T_5	61.15	58.21	15.98	17.73	26.78	64.90
T_6	66.25	61.52	19.93	19.31	28.83	68.36
CD (P = 0.05)	9.72	6.52	3.52	4.20	4.68	10.19

Details of treatments are given in Table 1

gen uptake by grain and straw was more under I_1 due to more grain and straw yields. Nitrogen content by grain and straw did not differ significantly due to irrigation treatments.

Nitrogen uptake by different levels of fertility varied significantly (Table 2). The total nitrogen uptake was highest in T_6 and lowest in T_1. The total nitrogen uptake did not differ significantly in those treatments where half and full doses of phosphorus (T_2 and T_3) and potassium (T_4 and T_5) were applied along with recommended nitrogen.

Phosphorus uptake

Phosphorus uptake by grain and straw did not vary significantly (Table 2). However, it was higher by grain and straw in I_1 than that in I_2.

Uptake of phosphorus among different fertility levels varied significantly by grain and straw (Table 2). The total phosphorus uptake was higer in T_6 and lowest in T_3 in both grain and straw. Phosphorus uptake in treatment T_2 and T_3 did not differ significantly with T_1 by grain and straw, while phosphorus uptake by grain in treatment T_4 and T_5 varied significantly from T_1.

Potassium uptake: Potassium uptake by grain differed significantly; however, uptake by straw did not vary significantly between irrigation treatment (Table 2). Potassiu uptake by grain and straw was more in I_1 treatment than I_2 treatment. It was due to more grain and straw yields in I_1 treatment.

Potassium uptake by grain and straw varied significantly among the different treatments (Table 2). Treatments T_5 and T_6 recorded significantly more potassium uptake by grain and straw with I_1. Treatment T_6 gave highest uptake and treatment T_1 gave lowest uptake. The total uptake by straw was more than grain.

Irrigation and fertility levels interaction was not found significant in nutrient uptake.

REFERENCE

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