

Response of wheat (*Triticum aestivum*) cultivars to levels of fertilizers under limited irrigation

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ABSTRACT

A field experiment was conducted with 3 varieties ('Sonalika', 'OW 6' and 'UP 262' of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) and 2 levels of irrigations [2 irrigations (crown-root initiation + flowering stage), 3 irrigations, crown-root initiation + jointing + flowering stage] and 3 levels of fertilizers (80, 40 and 20 kg; 60, 30, 15 kg and 40, 20, 10 kg N, P and K/ha). With 3 irrigations and 80, 40 and 20 kg N, P and K/ha 'OW 6' wheat gave the highest yield of 27.63 q/ha, followed by 'UP 262' (25.86 q/ha). With 2 irrigations 'OW 6' recorded the highest yield with 80, 40 and 20 kg N, P and K/ha (23.19 q/ha). The benefit : cost ratio was the highest (1.98) for 'OW 6' with 3 irrigations and 80, 40 and 20 kg N, P and K/ha. But with 2 irrigations, maximum net returns/rupee invested (Rs 1.78) were realized from 'OW 6' with 60, 30 and 15 kg N, P and K/ha.

Key words : Wheat cultivars, Nutrient management, Limited irrigation

Wheat is coming up as a major winter-season crop in the western undulating zone of Orissa due to its low water requirement and suitability for the agro-ecological situation. However, use of conventional varieties, very low dose (20, 10 and 10 kg N, P and K/ha) of chemical fertilizer and availability of limited irrigation are the varying agronomic practices followed by the wheat growers of the region, which influence the crop yield and economics of such wheat cultivation. Thus to economize these scarce and costly inputs, it is essential to optimize its manifestation through agronomic manipulations for higher production of

wheat (Deshmukh *et al.*, 1992). Hence the present investigation was undertaken to determine productivity and profitability of wheat cultivars with levels of fertilizer under the use of limited irrigation.

MATERIALS AND METHODS

A field experiment was conducted during the winter season of 1998–99 and 1999–2000 at Regional Research and Technology Transfer Station, Bhawanipatna, Kalahandi, Orissa. The soil was shallow black with pH 7.1 and was low in organic carbon (0.46%), low in available P (8.5 kg/ha) and medium in available K (328 kg/ha). Treatments

consisting of 3 wheat cultivars ('Sonalika', 'OW 6' and 'UP 262') and 2 levels of irrigation (2 irrigations, viz. at crown-root initiation + flowering stages and 3 irrigations at crown-root initiation + jointing + flowering stages) as main plot treatment and 3 levels of fertilizers (80, 40 and 20 kg N, P and K/ha; 60, 30 and 15 kg N, P and K/ha; and 40, 20, 10 kg N, P and K/ha) as subplot treatments were tested in split-plot design with 3 replications. Wheat was sown on 25 and 28 November in respective years with a common pre-sowing irrigation to all treatments. Normal plant-protection practices were adopted as and when required. The precipitation received in 2 growing seasons were 0 and 98.1 mm respectively.

RESULTS AND DISCUSSION

Variety

The plant height was maximum with 'Sonalika', followed by 'OW 6'. The 'OW 6' showed the maximum ears/m² and grains/ear. During 1998–99, 'UP 262' showed the highest 1,000-seed weight, whereas during 1999–2000 'OW 6' recorded the highest 1,000-seed weight. However, these were statistically at par with 'OW 6' and 'Sonalika' in respective years. However, the mean grain yield of 'OW 6' statistically out-yielded the other 2 varieties. The harvest index of 'OW 6' was also the highest (42.39%) which explained better source-sink conversion capability of the variety.

Irrigation

Plant height and ears/m² did not have much variation due to level of irrigations and were not significant (Table 1). But 3 irrigations at crown-root initiation, jointing

and milking stages produced significantly higher number of grains/ear and weight of grains in comparison to 2 irrigations at crown-root initiation and flowering stage. Grain yield and straw yields also followed the same trend with highest mean grain and straw yields for 3 irrigation schedules. The harvest index was 42.17% for 3 irrigations compared with 40.40% for 2 irrigations.

Fertilizer application

The plant characters, yield attributes, grain and straw yields significantly increased with the increase in fertilizer dose (Table 1). The highest grain yield and straw yield were recorded for 80, 40 and 20 kg N, P and K/ha. The harvest index also exhibited similar trend. This higher yield could be attributed to increased growth and yield parameters owing to accumulation of more photosynthates in sink. The finding is in consonance with Kattimani *et al.* (1989). However, 1,000-grain weight did not increase significantly due to increase in fertilizer application from 60, 30 and 15 kg to 80, 40 and 20 kg N, P and K/ha. Thakur *et al.* (1997) also opined that test weight was not influenced by higher fertilizer doses.

Interaction effect

The interaction effect revealed that with 3 irrigations and 80, 40 and 20 kg N, P and K/ha, the highest yield of 27.63 q/ha was obtained from 'OW 6', followed by 'UP 262'. Singh and Uttam (1993) also reported that 3 irrigations are better than 2 for grain and straw yields under higher fertilizer application. However, when irrigation is a limiting factor, i.e. the crop was irrigated

Table 1. Effect of varieties, levels of irrigation and fertilizer on growth, yield attributes and yield of wheat

Treatment	Plant height (cm)		Ears/m ²		Grains/ear		1,000-grain weight (g)		Grain yield (q/ha)			Straw yield (q/ha)			Harvest index (%)
	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Y ₁	Y ₂	Mean	Y ₁	Y ₂	Mean	Mean
<i>Variety</i>															
V ₁ , 'Sonalika'	86.3	84.7	282	291	27.9	29.6	39.2	42.4	18.95	21.11	20.03	28.72	29.12	28.92	40.92
V ₂ , 'OW 6'	85.0	82.2	294	326	30.2	32.4	40.6	43.2	20.80	24.81	22.81	29.26	32.73	31.00	42.39
V ₃ , 'UP 262'	82.2	80.6	276	312	29.2	30.4	40.7	40.8	19.32	22.52	20.92	29.54	31.66	30.60	40.61
CD (P=0.05)	2.8		2.4	13	22	1.2	1.6	1.1	1.7	1.82	1.72	1.36	1.24	2.32	1.12
<i>Irrigation</i>															
I ₁ , (CRI+F)	84.8	82.4	290	301	28.2	29.7	39.1	41.3	18.21	21.37	19.79	28.14	30.24	29.19	40.40
I ₂ , (CRI+J+M)	84.2	82.6	299	318	30.00	31.9	41.2	43.0	21.17	24.26	22.72	30.21	23.10	31.16	42.17
CD (P=0.05)	NS	NS	NS	NS	1.0	1.3	0.9	1.4	1.49	1.40	0.91	1.00	1.89	0.75	
<i>Fertilizer (N:P₂O₅:K₂O kg/ha)</i>															
F ₁ , 80:40:20	87.2	86.0	332	338	31.8	34.1	41.4	43.3	22.12	25.43	23.78	30.84	22.76	32.30	42.40
F ₂ , 60:30:15	84.8	84.0	294	316	29.5	30.8	40.6	42.2	20.22	23.32	21.77	30.12	32.24	31.18	41.11
F ₃ , 40:20:10	81.5	77.1	356	275	26.0	27.5	38.5	10.9	16.73	19.69	18.21	26.56	27.51	27.04	40.24
CD (P=0.05)	1.9	1.7	9	16	0.9	1.1	0.8	1.2	1.40	1.24	0.86	0.88	1.66	0.71	

Y₁, 1998-99; Y₂, 1999-2000; CRI, crown-root initiation stage; F, flowering stage; J, jointing stage; M, milking stage

Table 2. Interaction effect of variety, fertilizer and irrigation on grain yield and economics of wheat

Treatment	V ₁		V ₂		V ₃	
	I ₁	I ₂	I ₁	I ₂	I ₁	I ₂
F ₁	19.49 (1.46)	25.43 (1.82)	23.19 (1.74)	27.63 (1.98)	21.04 (1.57)	25.86 (1.85)
F ₂	18.89 (1.46)	22.03 (1.62)	23.04 (1.78)	24.24 (1.78)	20.42 (1.57)	22.02 (1.62)
F ₃	16.72 (1.33)	17.61 (1.33)	18.23 (1.45)	20.52 (1.55)	17.09 (1.36)	19.08 (1.44)
CD (P=0.05)	V × I 1.70	V × F 1.47	I × F 1.23	V × I × F 2.09		

Details of treatments are given in Table 1

Figures in parentheses indicate net return (Rs)/rupee invested; market price of wheat, Rs 800/q

twice, 'OW 6' with 80, 40 and 20 kg N, P and K/ha gave the highest grain yield which was at par with that of 60, 30 and 15 kg N, P and K/ha (23.04 q/ha). This result is in close conformity with that of Singh and Uttam (1993).

Economics

The highest benefit : cost ratio was obtained from 'OW 6' with 3 irrigations and 80, 40 and 20 kg N, P and K/ha. However, with 2 irrigations, the highest net return/rupee invested (RS 1.78) could be realized from 'OW 6' with 60, 30 and 15 kg N, P and K/ha.

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