

Effect of fertilizer levels and seed rates on growth and yield of surface-seeded wheat (*Triticum aestivum*) under lowland rice ecosystem of north Bihar

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ABSTRACT

An experiment was conducted during the winter (*rabi*) seasons of 1997–98 and 1998–99 to study the effect of fertilizer levels and seed rates on growth and yield of surface-seeded wheat (*Triticum aestivum* L. emend. Fiori & Paol.) under lowland rice ecosystem of north Bihar. Application of 150, 75 and 50 kg N, P and K/ha recorded significantly higher values of yield-attributing characters, grain and straw yield, net return and NPK uptake by the crop than the lower levels of fertilizer but net return/rupee of investment and protein content in grains increased significantly only up to 120, 60 and 40 kg N, P and K/ha. Among the seed rates, 175 kg seed/ha resulted maximum number of ears/m², grain and straw yield, net return, net return/rupee of investment and NPK uptake than 150 and 125 kg/ha seed rates. Protein content in grains was unaffected by seed rates. Application of 150, 75 and 50 kg N, P and K/ha together with 175 kg seed/ha was found to be the best for obtaining higher grain yield of surface-seeded wheat.

Key words : Surface seeding, Wheat, Ecosystem, Seed rate, Fertilizer levels

In lowland rice ecosystem of north Bihar, the water cannot be drained out in time to facilitate land preparation and ensure the timely sowing of wheat. Having no choice for alternate winter (*rabi*) crops, a vast area is being put to late or very late sown wheat with low productivity (Randhawa *et al.*, 1976). This is because of the fact that excess soil moisture does not permit timely tillage operations and wheat sowing. In such conditions, wheat sowing may be advanced by 15–20 days by adopting the technique of surface seeding. Fertilizer plays a key role in accelerating agricultural production. There are two schools of thoughts regarding the fertilizer use in late seeding of wheat. One emphasizes that low productivity of late sown wheat can be increased up to certain extent by supplementing with high dose of fertilizer, whereas other argues that poor growth of late-seeded wheat under adverse thermal regime cannot utilize high dose of fertilizer for improving its low productivity (Verma *et al.*, 2000). Similarly, poor plant stand and lower tillering per unit area are the major problem in realizing the potential yield of wheat under such condition (Sinha, 1999). The fertilizer use-efficiency can be maximized only when plant population is optimum for harnessing the available cultural and solar energy regimes which can be achieved by the use of appropriate quantity of seeds per unit of land area. Hence the present experiment was undertaken to find out suitable

rates of fertilizer and seeds for surface-seeded wheat.

MATERIALS AND METHODS

A field experiment was conducted at research farm of Rajendra Agricultural University, Pusa, Bihar, during the winter seasons of 1997–98 and 1998–99. The soil was clay loam and calcareous, medium in organic carbon (0.56%), low in available N (136.8 kg/ha), P₂O₅ (18.4 kg/ha) and K₂O (117.9 kg/ha) contents, with pH 8.1. The experiment was laid out in randomized block design comprising 5 fertilizer levels (0:0:0, 60:30:20, 90:45:30, 120:60:40 and 150:75:50 kg N:P:K/ha) and 3 seed rates (125, 150 and 175 kg/ha). The treatments were replicated thrice. Pre-soaked seeds (for 8–10 hr) of wheat 'HP 1744' was uniformly broadcast on un-tilled wet soil surface after rice harvest on 20 and 24 December, respectively, in first and second year after treating the seed with vitavax @ 2.5 g/kg seed and then mixed with fresh cowdung in 2:1 ratio to protect the seed from picking by birds. Full dose of phosphorus, potassium and one-third of nitrogen as per treatment were applied through urea, diammonium phosphate and muriate of potash 15 days after sowing. Remaining two-thirds of nitrogen was applied in 2 equal splits, i.e. one third at tillering and one-third at boot stage. The crop received 2 uniform irrigations at tillering and boot stages and was harvested on 15 and

17 April, respectively, in first and second year of experimentation.

RESULTS AND DISCUSSION

Growth and yield attributes

Plant height increased with subsequent increase in fertilizer level and recorded maximum value at 150:75:50 kg N:P:K/ha, but decreased non-significantly with increase in seed rate (Table 1). All the yield-attributing characters except effective tillers/m² and grains/ear increased significantly only up to 120:60:40 kg N:P:K/ha and further increase in fertilizer level had not any significant effect on these yield attributes. However, effective tillers/m² and grains/ear increased significantly up to 150:75:50 kg N:P:K/ha. Seed rate of 175 kg/ha recorded significantly higher effective tillers/m² and leaf-area index than 150 and 125 kg seed rates/ha. Other yield attributes were unaffected by seed rates.

Grain and straw yields

Grain and straw yields differed significantly under varying fertilizer levels (Table 1) and maximum yields were recorded at 150:75:50 kg N:P:K/ha. Since yield is the result of additive and complementary effect of plant growth and yield-attributing parameters and the yield-attributing characters had better expression at higher fertility level due to adequate quantity and balanced proportion of plant nutrient supply during the crop growth period which ultimately led towards an increase in grain yield. Use of 175 kg seed/ha resulted in the highest grain and straw yields. The increase in effective tillers per unit area was responsible for higher yield under high seeding rate. This finding confirms the result of Singh *et al.* (1999).

Interaction between seed rates and fertilizer levels for grain yield was significant (Table 2). Combined application of 150:75:50 kg N:P:K/ha together with 175 kg seed/ha resulted highest grain yield. This was due to proper utilization of applied plant nutrients by optimum plant stand which helped in the realization of potential yield of the crop. However, application of 150:75:50 kg N:P:K/ha together with 150 kg seed/ha gave similar grain yield to that of 120:60:40 kg N:P:K/ha with the seed rate of 175 kg/ha. This might be due to complementary effects of growth factors with each other which cumulatively enhanced the yield in surface-seeded wheat. Harvest index increased significantly up to 120:60:40 kg N:P:K/ha only and was unaffected by seed rates.

Protein content

Protein content in grain increased significantly up to 120:60:40 kg N:P:K/ha only. High protein content at higher fertilizer levels was due to higher N-content in grains and N uptake by the crop, resulting from balanced application of fertilizers. Seed rates had no significant influence on protein content in grain. Similar result was also obtained by Thakur *et al.* (1999).

Economics

Use of no fertilizer was found to be uneconomical and recorded negative values of net return and net return/rupee of investment (Table 1). Among the fertilizer levels, the maximum net return was obtained at 150:75:50 kg N:P:K/ha which was significantly higher than lower fertilizer levels. However, net return/rupee of investment increased significantly up to 120:60:40 kg N:P:K/ha only. Further increase in fertilizer level had no effect on net re-

Table 1. Effect of fertilizer levels and seed rates on growth, yield, economics and nutrient uptake by the crop (pooled data of 2 years)

Treatment	Plant height (cm)	Effective tillers/m ²	Leaf-area index (60 DAS)	Ear length (cm)	Grains/ear	1,000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Protein content in grain (%)	Net return (Rs/ha)	Net return/rupee of investment	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
<i>Fertilizer (NPK kg/ha)</i>															
0:0:0	60.3	228.8	3.0	6.5	26.5	36.0	7.1	11.2	39.0	11.1	-808.6	-0.2	15.1	3.7	12.3
60:30:20	73.3	269.2	3.3	8.1	36.3	37.1	15.6	23.5	39.8	11.3	3,828.5	0.5	35.6	9.6	28.4
90:45:30	78.3	307.8	3.4	8.6	40.9	37.6	21.0	31.3	40.3	11.5	7,240.6	0.9	49.2	13.3	39.5
120:60:40	83.1	328.0	3.6	9.0	45.2	38.0	25.3	36.9	40.6	11.6	9,477.4	1.1	59.6	16.1	47.3
150:75:50	87.1	338.7	3.7	9.3	49.4	38.3	27.1	39.4	40.8	11.7	10,332.2	1.1	65.5	17.4	51.2
CD (P=0.05)	3.5	9.6	0.12	0.3	4.0	0.3	1.0	1.5	0.2	0.1	699.8	0.1	2.6	0.7	1.9
<i>Seed rate (kg/ha)</i>															
125	77.2	267.1	3.2	8.3	40.6	37.4	16.4	24.2	40.2	11.4	4,226.6	0.5	38.3	10.3	31.1
150	76.3	300.2	3.4	8.3	39.5	37.4	19.6	29.1	40.1	11.4	6,271.8	0.7	45.7	12.3	36.4
175	75.6	316.4	3.6	8.2	38.8	37.3	21.6	32.1	40.1	11.4	7,543.7	0.9	50.3	13.4	39.8
CD (P=0.05)	NS	8.2	0.1	NS	NS	NS	0.8	1.2	NS	NS	5,43.6	0.1	2.0	0.5	1.5

DAS, Days after sowing

Table 2. Interaction between fertilizer levels and seed rates for grain yield (q/ha) (pooled data of 2 years)

Treatment	Seed rate (kg/ha)			Mean
	125	150	175	
<i>Fertilizer (NPK kg/ha)</i>				
0:0:0	6.2	7.2	7.8	7.1
60:30:20	12.0	16.0	18.7	15.5
90:45:30	8.3	21.3	23.5	21.0
120:60:40	21.6	26.1	28.0	25.3
150:75:50	23.6	27.6	30.0	27.1
Mean	16.4	19.6	21.6	
CD (P=0.05)		1.7		

turn/rupee of investment. Net return and net return/rupee of investment were also significantly influenced by the seed rates. Seed rate of 175 kg/ha recorded higher net return and net return/rupee of investment than seed rates of 150 and 125 kg/ha.

Nutrients uptake

The uptake of N, P and K by the crop increased significantly with subsequent increase in the fertilizer levels, maximum being at 150:75:50 kg N:P:K/ha. This was because of higher availability of these nutrients which resulted in enhanced nutrient content in plant tissues and higher biomass production at high fertilizer levels. Similar result was also obtained by Pandey and Agarwal (1991).

Increasing seed rates also enhanced the uptake of these nutrients by the crop and 175 kg seed/ha recorded the highest uptake which was significantly higher than the seed rates of 150 and 125 kg/ha. The higher nutrients uptake was due to enhanced biomass production at higher seed rates.

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