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Response of wheat (*Triticum aestivum*) to planting method, seed rate and fertility in late-sown condition

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ABSTRACT

A field experiment was conducted during the winter reasons of 1989–90 and 1990–91 to study the response of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) to planting method, seed rate and fertilizer. Cross-row (22.5 cm × 22.5 cm) planting method gave significantly higher yields (grain + straw), yield attributes and benefit : cost ratio than other planting methods. Cross and close row (15.0 cm) plantings had smothering effect on weed density and dry weight. Increasing seed rate from 100 to 150 kg/ha increased the grain and straw yields, however benefit : cost ratio was the highest with 125 kg seed/ha seed rate. Application of recommended fertilizers (125 kg N + 60 kg P + 50 K kg/ha) increased the yield and yield attributes. However, benefit : cost ratio was highest with 50% of the recommended fertilizer (60 kg N + 30 kg P +25 kg K/ha).

Of the various factors responsible for low productivity, suboptimum plant population per unit area and poor fertilizer management are of paramount importance in wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Dhillon and Kler (1981), Grewal (1982) and Prasad *et al.* (1991) reported superiority of planting methods, i.e. cross or bi-directional, over unidirectional (normal). Similarly, closer planting (15 cm) enhances wheat yield (Grewal, 1982). To realize maximum yield potential in wheat, the balanced and optimum use of fertilizer is, however, another factor of importance (Rana *et al.*, 1982; Singh *et al.*, 1985). The magnitude of the reduction in wheat yield and economics by using suboptimum level of fertilizer is to be identified in fertilizer-constraint condition. Information regarding the effects of planting methods, seed rates and fertility management on wheat are lacking in flood-prone area of north-eastern plains zone of Uttar Pradesh in late-sown conditions, an attempt was made on this aspects.

MATERIALS AND METHODS

A field study was conducted during the winter (*rabi*) seasons of 1989–90 and 1990–91 at Ghaghraghat (Bahraich). The experiment was laid out in split-plot design keeping 4 planting methods and 3 seed rates in main plot and 3 fertility levels in subplot, replicated 3 times. The soil was sandy loam with pH 8.2, 0.39% organic carbon, 25.6 kg P_2O_5 and 298 kg available K_2O/ha. Wheat 'HUW 234' was sown on 27 December 1989 and 28 December 1990 and harvested on 20 April 1990 and 24 April 1991. The weeds were not removed during the crop season. The dry weight of weeds was taken at

harvest on randomly selected 2 places by throwing 0.5 m × 0.5 m quadrat. Yield attributes (spike length, grains/spike and 1,000-grain weight) were recorded on 10 random spikes from each plot. The crop was irrigated 4 times in each year. The total rainfall received during the first and second year was 50.2 mm and 58.7 mm respectively.

RESULTS AND DISCUSSION

Planting method

Plants were taller in cross-row planting method than those in other planting methods. The grain yield in cross-row planting was 4.9, 14.5 and 21.6% higher than that of closer, normal and broadcast method of planting respectively. Closer and normal planting also gave higher yield than broadcast method of planting. Cheema *et al.* (1986) and Singh *et al.* (1988) also reported similar results. The effect of cross-sowing on yields could be seen through superior yield attributes, viz. tillers/m^2, spike length, plant height, and grains/spike (Table 1).

The weed-dry weight and density were significantly less in cross-row planting in both the seasons. The results suggest that the crop competition mediated by cross-row planting assists in reducing the weed growth which results in higher yield of wheat. Similarly, Bhardwaj and Gupta (1993) reported that cross-row planting left little space for emergence of weeds and hence reduced the population of weeds considerably. Net profit was the highest in cross-row planting, followed by close normal and broadcast methods of planting. Benefit : cost ratio also followed the similar trend.

Seed rate

Sowing with higher seed rate of 150 kg/ha recorded taller plants and grain yield than of 100 kg/ha in both the seasons (Tables 1, 2). Dry weight of weeds reduced with every increase in seed rate but the differences were not significant between seed rates 125 and 150 kg/ha. Increase in plant height and tillers/m^2 was recorded under higher seed rate (150 kg/ha), which adversely affected the yield- attributing characters because of increased competition for soil moisture by the higher plant population. However, lower weed-dry weight and density had favourable effect on yield and yield attributes with 125 and 150 kg/ha seed rates. Radford *et al.* (1980) observed lesser dry weight of grassy weed under higher seed rates. Net profit and benefit : cost ratio were highest with seed rate of 125 kg/ha, because of 2.2% higher cost in seed rate of 150 kg/ha.

Fertility

Crop fertilized with 100% of the recommended fertilizer improved the yields and yield attributes and reduced the weed density and dry weight significantly than that of 50% of the recommended fertilizer and the control. The findings are in accordance with those of Rana *et al.* (1980) and Singh *et al.* (1985). Application of suboptimum level of fertilizer (60 kg N + 30 kg P + 25 kg K/ha) significantly reduced the tillers/m^2 and caused poor growth of crop and provided more space for weeds to grow. This might have caused a significant reduction in yield attributes in both the years.

On an average, optimum level of fertilizer increased the grain yield by 5.7% than suboptimum level. However, benefit : cost ratio was the highest (0.98) in suboptimum level of fertilizer due to 12.6% higher cost involved in optimum level of fertilizer (Table 2).

Table 1. Yield attributes of wheat and weed-dry weight as affected by planting method, seed rate and fertilizer

Treatment	Plant height (cm)		Spike length (cm)		Tillers/ m^2		Grains/ spike		1,000-grain weight (g)		Weed-dry weight (g/m^2)	
	1989–90	1990–91	1989–90	1990–91	1989–90	1990–91	1989–90	1990–91	1989–90	1990–91	1989–90	1990–91
Planting method												
Broadcasting	64.7	65.9	8.9	8.8	168	175	23.3	24.7	41.0	41.8	105.4	101.0
Normal (22.5 cm)	67.5	68.8	10.2	10.3	194	204	24.4	27.8	41.1	41.2	80.3	78.1
Closer (15 cm)	71.0	72.4	10.2	10.4	226	232	25.6	28.9	41.3	41.2	68.9	65.4
Cross planting (cm) (22.5 ×22.5 cm)	73.6	74.8	10.4	10.5	253	258	27.8	30.9	42.2	41.3	62.7	60.7
CD (P = 0.05)	1.6	1.3	0.5	0.4	20	18	1.1	0.9	NS	NS	5.1	4.2
Seed (kg/ha)												
100	69.8	69.5	9.6	9.5	232	230	26.5	26.2	41.5	41.4	92.5	94.6
125	71.4	72.6	10.2	10.3	267	261	28.6	27.9	41.6	41.5	67.8	65.7
150	72.7	72.9	10.1	10.0	270	264	27.5	26.8	41.3	41.1	64.9	62.8
CD (P = 0.05)	1.1	1.1	0.5	0.3	13	14	1.2	1.0	0.4	0.3	4.3	3.3
Fertility (N + P + K kg/ha)												
Control (no NPK)	66.5	65.9	8.9	8.8	158	160	23.4	24.4	40.6	40.4	90.6	89.7
60 + 30 + 20	69.9	70.2	9.6	9.5	255	267	27.5	27.9	41.5	41.9	82.8	81.6
120 + 60 + 40	71.5	71.1	10.4	10.2	270	282	28.4	29.9	42.2	42.8	65.6	65.4
CD (P = 0.05)	1.2	0.9	0.4	0.3	13	14	1.4	1.2	0.6	0.7	5.1	4.8

Table 2. Grain yield, straw yield and net income (Rs/ha) of wheat as affected by planting method, seed rate and fertilizer

Treatment	Grain yield (q/ha)			Straw yield (q/ha)			Net return (Rs/ha)	Benefit : cost ratio	Cost (Rs/ha)
	1989–90	1990–91	Pooled	1989–90	1990–91	Pooled			
Planting method									
Broadcasting	24.68	25.59	25.13	38.50	39.98	39.24	2,587	0.37	4,244
Normal (22.5 cm)	26.69	27.19	26.94	42.54	43.86	43.19	3,046	0.71	4,311
Closer (15 cm)	28.61	29.67	29.14	43.64	44.73	44.18	3,478	0.79	4,404
Cross planting (cm) (25 × 22.5)	30.28	31.14	30.71	46.96	47.35	47.65	3,862	0.86	4,477
CD (P = 0.05)	1.70	1.81	1.75	1.41	1.21	1.31			
Seed (kg/ha)									
100	27.82	26.59	27.20	39.59	39.98	39.78	3,065	0.72	4,248
125	28.92	29.53	29.22	44.53	43.68	44.10	3,638	0.83	4,360
150	29.19	29.97	29.58	45.57	44.27	44.92	3,543	0.79	4,460
CD (P = 0.05)	0.97	1.11	1.04	1.07	1.01	1.04			
Fertility (N + P + K kg/ha)									
Control	23.54	22.91	23.22	33.14	33.61	33.37	2,401	0.62	3,825
60 + 30 + 20	32.50	31.54	32.02	48.43	46.22	47.32	4,268	0.98	4,356
120 + 60 + 40	34.11	33.62	33.86	51.45	49.84	50.64	4,233	0.86	4,905

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