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Effect of planting methods and seed rate on growth and yield of wheat (*Triticum aestivum*)

R.K.Kataria and H.L.Sharma[1]
Seed Production Unit
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur – 176 062.

Abstract

A field experiment was conducted during the winter (*Rabi*) seasons of 2000-01 and 2001-02 at Palampur to study the effect of four planting methods (broadcasting, normal sowing in lines 22.5 cm apart, closer sowing in lines 15.0 cm apart, criss-cross sowing 22.5 x 22.5cm) and three seed rates (100, 115 and 130 kg/ha) on growth, yield attributes and yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol). Significantly higher value of leaf area index, plant height, effective tillers, spike length, spikelets/spike, grains/spike and 1000-grain weight under cross-row planting (22.5cm x 22.5cm) resulted in increase in grain yield by 20.1, 9.8 and 5.4 % over broadcast, normal (22.5cm) and closer rows (15cm) methods of sowing respectively. Increasing seed rates resulted in significant increase in LAI, plant height and effective tillers that ultimately produced significantly higher grain yield with 130 kg seed/ ha. Contrary to this 1000-grain weight was significantly higher with lower seed rate (100 kg/ha).

Introduction

Wheat is the most important crop of Himachal Pradesh during winter season in low and mid Shivalik hills of the State. Most of the farmers sow wheat crop by broadcast method, due to which the plant population, in general, is sub-optimal. Appropriate planting arrangement with suitable plant population is vital for efficient use of available resources like solar radiation, soil moisture, nutrients and better weed management. Uniform distribution of plants over cropped area and bi-directional orientation of plants to harvest maximum radiation through its greater penetration in crop canopy result in higher productivity (Kler and Bains, 1992). Bi-directional sowing showed higher photosynthetically active radiation interception (PARI) and yielding ability at recommended inputs. The beneficial effect of line and cross sowing has been reported by several researchers (Singh *et al.* 1993). Manipulation of agronomic practices such as planting pattern/geometry and seed rate are considered to be foremost step to achieve proper distribution of plants over cultivated area, thereby better utilization of above and below-ground natural resources towards increasing yield (Jat and Singhi, 2004). Keeping in view these factors the present investigation was carried out to work out the seed rate for different planting methods for increased productivity of wheat.

Material and Methods

The experiment was conducted during the winter (*Rabi*) seasons of 2000-01 and 2001-02 at the experimental farm of Seed Production Unit, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur situated 32.6° N and 76.3° E at an elevation of 1291.0 m above mean sea level. The soil of the experimental site was silty clay loam in texture and acidic in reaction (pH 5.9) having 0.61% organic carbon, medium in available nitrogen (294.0 kg/ha) and phosphorus (14.6 kg/ha) and high in available potash (314.0 kg/ha).The experiment was laid out in randomized block design with twelve treatment combinations comprising of four planting methods (broadcast, normal sowing in lines 22.5 cm apart, closer row sowing in lines 15.0 cm apart, criss-cross sowing 22.5 x 22.5cm) and three seed rates (100,115 and 130 kg/ha). 'HPW 89' wheat was sown on November 5 and 7 during 2000 and 2001 respectively. A rainfall of 200.6 and 185.4mm was received during two years of experimentation whereas mean monthly minimum and maximum temperature ranged from 5.2 to 18.2 °C and 16.1to 30.1 °C during 2000-01 and 4.6 to 19.0 °C and 16.3 to 32.4 °C - during 2001-2002. Rainfall was well distributed during both

[1] *Department of Agronomy, CSK HPKV, Palampur*

the years. The crop was fertilized uniformly with 120 kg N, 60kg P_2O_5 and 30kg K_2O/ha. Nitrogen was applied in two splits, half at the time of sowing and half at CRI stage. One manual hoeing and weeding was done at CRI stage of the crop. The crop was harvested on 28th and 24th May during 1st and 2nd year of experimentation respectively and five irrigations were given to the crop in each years. The data was analyzed using analysis of variance technique.

Results and Discussion

Growth parameters

Significantly higher leaf area index (LAI) and plant height was recorded in cross sown crop over all other methods of sowing. Normal method of sowing in lines 22.5 cm apart though produced significantly higher LAI and taller plants over broadcast but remained at par with closer row planting (Table 1). Significant improvement in LAI under cross row sowing could be ascribed for its effectiveness to modify environmental conditions of plants by proper distribution of plants over ground area, resulting in increased interception, absorption and utilization of photosynthetically active radiation (PAR) thereby resulting in higher photosynthesis and finally plant height. These results are in close conformity with the findings of Jat and Singhi (2004) who have also reported higher LAI under cross row and conventional method of sowing over broadcasting.

Significant increase in LAI was observed with increase in seed rate. Crop sown with seed rates of 115 and 130 kg per hectare resulted in more LAI over 100 kg seed per hectare which could be due to higher plant population. Increasing seed rate up to 130 kg / ha did not affect the plant height.

Yield attributes

Planting methods *viz* cross rows, closer rows and normal sowing resulted in significant improvement in yield attributes over broadcast method (Table 1). Cross sowing recorded 36.6, 12.1, 3.4, 11.1 and 2.8 percent increase in effective tillers, spike length, spikelets/spike, grains/spike and 1000-grain weight respectively over broadcast method of sowing. Superiority of cross row sowing was also observed

Table 1. Effect of planting methods and seed rate on growth and yield attributes of wheat crop (pooled data of 2 years)

Treatment	Growth parameters		Yield attributes				
	LAI at heading	Plant height (cm)	Effective tillers/m^2	Spike length (cm)	Spikelets/ spike	Grains/ spike	1000-grain weight (g)
Planting methods							
Broadcast	3.13	81.9	232.6	9.1	14.6	39.7	39.2
Closer rows (15.0 cm)	4.41	87.9	295.9	9.7	14.7	41.7	40.1
Normal rows (22.5 cm)	4.08	83.8	269.2	9.7	14.7	41.8	40.0
Cross rows (22.5 x 22.5 cm)	4.70	89.3	317.6	10.2	15.1	44.1	40.3
CD (P=0.05)	0.08	0.5	4.4	0.1	0.1	0.4	0.3
Seed rate (kg/ha)							
100	3.97	85.4	248.2	9.7	14.8	41.8	40.0
115	4.08	85.9	279.8	9.7	14.8	41.8	39.9
130	4.20	85.9	308.5	9.7	14.8	41.9	39.8
CD (P=0.05)	0.07	NS	3.8	NS	NS	NS	NS

over normal and closer planting of wheat with the significant increase in all yield attributes except 1000-grain weight. Though closer row planting produced significantly higher number of effective tillers over normal planting but these two methods remained at par in respect of all other yield attributes. An improvement in effective tillers and other yield attributes under cross sowing could be on account of vigorous growth of plants due to more uniform distribution of plants per unit area and LAI which resulted in efficient utilization of space, nutrients, water, air and solar radiation. Higher LAI must have intercepted more photosynthetically active radiation thereby increasing photosynthesis and accumulation of more synthates in yield contributing characters. Closer row planting of wheat though produced significantly higher number of tillers but it did not prove to be better in respect of spike length, spikelets/spike, grains /spike and 1000-grain weight over normal method of planting. Similar results were reported by Kler and Bains (1992), Singh *et al.* (1993) and Jat and Singhi (2004) in which cross sowing method was shown to be superior over all other methods of wheat planting.

Effect of seed rate was observed to be significant only on tillers/m^2. There was significant increase of 24.3 and 10.3% in effective tillers with 130 kg seed per hectare over 100 and 115 kg seed rate per hectare respectively. This could very well be attributed to higher plant population and LAI with increase in seed rate.

Yield and economics

Crop sown by cross rows method gave the significantly higher grain yield (34.83 q/ha), showing 20.1, 9.8 and 5.4 % increase over broadcast, normal and closer row methods of planting respectively. Closer and normal planting also produced significantly higher yield than broadcast. Similar trend was observed in case of straw yield (Table 2). The increase in straw yield under cross row sowing was 43.9, 18.1 and 10.0 percent over broadcast, normal and closer planting of wheat. Net profit and benefit: cost ratio were highest in cross row planting (Rs 16312/ha and 1.25) followed by closer, normal and broadcasting methods of planting. The higher productivity and profit realized under cross row sowing method might be due to reduced competition for resources (both above and below ground) thereby improvement in

Table 2. Effect of planting methods and seed rate on yield, harvest index and economics of wheat crop (pooled data of 2 years)

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Net returns (Rs/ha)	Benefit : Cost ratio
Planting methods				
Broadcast	28.99	39.17	10468	0.82
Closer rows (15.0 cm)	33.06	51.24	14922	1.18
Normal rows (22.5 cm)	31.72	47.71	13590	1.08
Cross rows (22.5 x 22.5 cm)	34.83	56.36	16312	1.25
CD (P=0.05)	0.74	1.60	656	0.05
Seed rate (kg/ha)				
100	30.51	46.17	12598	1.00
115	32.31	48.93	13900	1.08
130	33.63	51.12	14823	1.14
CD (P=0.05)	0.64	1.39	568	0.04

growth and development of yield attributes and finally grain yield and net profit. These results are in close agreement with the findings of Jat and Singhi (2004), Ranjit Singh *et al.* (2001) and Singh *et al.* (1993).

The significant increase in grain and straw yield to the tune of 10 percent was observed due to increase in seed rate from 100 to 130 kg/ha which resulted in highest net profit and benefit cost ratio.

Significant interaction of planting methods and seed rate was recorded on grain yield (Table 3). Sowing wheat by broadcast method with 130kg seed/ ha proved to be at par with all other methods of planting with 100 kg seed/ha. Cross sowing with higher seed rate of 130 kg/ha proved to be significantly superior to all other combinations with highest grain yield of 36.8 kg/ha. At lower seed rate of 100 kg per hectare, grain yield obtained under normal, closer and cross sowing methods did not differ significantly. Similarly under normal sowing there was no increase in the yield with the increase in seed rate.

Therefore it can be concluded from the present investigation that for higher production and profit, wheat should be sown by cross row method using 130 kg seed per hectare under mid hill conditions of Himachal Pradesh. For increasing the productivity of broadcast sown crop, higher seed rate of 130 kg/ha can be recommended.

Table 3. Interaction effect of planting methods and seed rate on grain yield of wheat

Planting methods	Seed rate (kg/ha)		
	100	115	130
Broadcast	26.46	28.57	31.93
Closer rows (15.0 cm)	32.20	33.20	33.77
Normal rows (22.5 cm)	31.10	32.07	32.00
Cross rows (22.5 x 22.5 cm)	32.27	35.40	36.80
CD (P=0.05)		1.29	

VIR SOFTECH

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