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Research Paper

Effect of early sowing, N levels and seed rates on yield and yield attributes of different wheat (*Triticum aestivum*) varieties

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ABSTRACT

A field experiment was conducted for three consecutive years during 2007 to 2010 at Karnal by using three high yielding disease resistant wheat [*Triticum aestivum* (L.) emend. Fiori & Paol] varieties namely 'PBW 502', 'HD 2687' and 'DBW 17' with two sowing time (last week of October and mid November), two seed rates (100 and 125 kg/ha) and two N rates (150 and 200 kg/ha) and replicated thrice. Pooled analysis revealed that early sowing produced 10.06 % higher grain yield than normal sowing due to higher biomass, spikes/m^2, harvest index and thousand grain weight. This was achieved due to 15 days earlier flowering in early sown, which provided more conducive environment for proper growth and development of wheat grain than timely sowing. Among varieties, 'HD 2687' produced significantly higher grain yield than other varieties. Application of 50 kg more N/ha than recommended dose exhibited significantly higher grain yield, whereas 25 % higher seed rate application showed no significant effect on grain yield. October sowing recorded higher gross returns (9.6%), net returns (19.3%) and benefit cost ratio (2.01) than mid November sowing.

***Key words**:* Nitrogen, Seed rate, Sowing time, Variety, Wheat

Wheat is the second most important crop after rice in India and it occupied approximately 28 million hectare area with a production of 85.93 million metric tons during 2010-11. Country ranks second in wheat production after China. The area, productivity and production of wheat have increased 119, 236 and 634%, respectively by the year 2005 compared with 1965-66 (base year). Weather is cool and dry in early part of wheat growing season (November to February) whereas temperature rises during grain filling period (March- April), more pronounce in eastern part of Indo Gangetic plain, causing reduced length of wheat growing period. Wheat is grown under different agro-climatic conditions having variable productivity levels. In India, wheat is generally grown under three sowing conditions i.e. timely (November sown), late (December sown) and very late sown (January sown) conditions. Timely sown wheat crop is generally preceded by crops like upland rice, soybean, sorghum, bajra and even grown after fallow area. Whereas late sown wheat is generally preceded by crops like basmati rice, low land rice, cotton, pigeonpea *etc.* and very late sown wheat is grown after *toria*, pea, potato and sugarcane ratoon etc. Delaying of wheat sowing (timely to late i.e. mid November to 1st fortnight of December) resulted in decrease in yield by 15.5, 32.0, 27.6, 32.9 and 26.8 kg/ha/day under NHZ, NWPZ, NEPZ, CZ and PZ, respectively for timely sown varieties. For late sown varieties, delay in wheat sowing (late to very late i.e. 1st fortnight of December to 1st fortnight of January) decreased the grain yield by 42.7, 44.8, 51.6 and 44.2 kg/ha/day under NWPZ, NEPZ, CZ and PZ, respectively (Tripathi *et al*., 2005). Even early wheat sowing with normal agronomy decreased the grain yield by about 4 % compared to normal sowing. In a study of 7 dates of sowing, Dhillon and Ortiz Monasterio (1993) reported that yield of *aestivum* wheat starts declining after 25th November and *durum* wheat after 15th November sowing.

Wheat sowing is generally recommended from mid November onward in different wheat growing regions. Weather during wheat growing season is cool and dry in early part (November to February), whereas temperature rises during grain filling period (March–April), resulting reduced length of wheat growing period as well as yield. Decrease in grain yield, generally, is due to shrivelled grain resulting lower thousand grain weight. This happens owing to prevalence of hot and desiccating wind during grain filling period as well as skipping of last irrigation

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due to fear of lodging. To overcome this terminal heat stress, an experiment was planned by selecting a set of recommended varieties with enhanced nitrogen and seed rates for early and timely sown conditions.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* seasons of 2007-08, 2008-09 and 2009-10 at research farm of Directorate of Wheat Research, Karnal (Latitude 29⁰ 43' N, longitude 76⁰ 58' E and altitude 245 m). Three wheat varieties *viz.* 'PBW 502', 'HD 2687' and 'DBW 17' were sown in last week of October (24th–31st) and mid November (12–18) with two seed (100 and 125 kg/ha) and two N rates (150 and 200 kg/ha) and replicated thrice. The experiment was conducted in factorial split plot design. After harvesting rice as previous crop, the field was prepared by cultivator and disc harrow and in each subplot was seeded as per treatment. Fertilizer @ 150 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha was applied to the wheat crop. Full dose of phosphorous in the form of diammonium phosphate and potash in the from of muriate of potash and remaining amount of one third dose of nitrogen in the form of urea was applied as basal i.e before sowing and remaining two third dose of nitrogen was top dressed in two splits at 1st node stage (DC 31) (Zadoks *et al*., 1974) and at boot stage (DC 41). Irrigation was applied as per need of the crop. Weeds were controlled with the application of sulfosulfuron 25 g /ha in 400 liters of water at 30-35 days after sowing. Observations were recorded on biomass, yield and its component characters. Standard statistical methods of analysis were followed for the yield and yield attributing parameters (Gomez and Gomez, 1984). Maximum and minimum temperature for three consecutive years during wheat growing season at Karnal was also depicted in figure 1. In, 2007-2008 the lowest minimum temperature was in month of February, which provided proper growth and development. On contrary to it, 2009-2010 crop year showed the highest maximum temperature continued from mid March to April. Cost of cultivation was calculated by taking into account the prevailing price of inputs like fertilizer, seed, herbicides, irrigations, tillage operations, transportation charges, management charges, rental value of land and depreciation cost of implements. Returns were calculated by taking minimum support price of wheat grain and market price of wheat straw.

RESULTS AND DISCUSSION

Effect of sowing time

On pooled analysis basis, early (last week of October) sowing significantly increased the biomass, grain yield, straw yield, harvest index, thousand grain weight, spikes/m^2 and grain weight/spike than timely sowing (mid November). The grain yield increase was 10.06 % under early sowing as compared with timely sowing (Table 1). This was probably due to significant higher biomass production, thousand grain weight and spikes/m^2 under early sown crop compared to timely sown crop. The increase in thousand grain weight and spikes/m^2 was to the tune of 6.7 and 7.5 % in early sowing than normal sowing, respectively. However, there was no significant difference in grains /spike. These findings are in confirmation with observation of Kamboj *et al.* (2008) who reported that last week of October sowing in Haryana gave the highest wheat grain yield. The higher grain yield in early sowing might be due to escaping of the crop from high heat stress and hot wind prevailing during ripening period i.e. mid March to mid April. Early sown crop extruded its anthers about 15 days earlier than timely sown crop. This is the reason that early sown crop produced higher biomass and thousand grain weight. Among three years of study, 2007-2008 crop year observed the highest grain yield, probably due to the lowest minimum temperature in the month of February, which provided proper growth and development. On contrary to it, 2009-2010 crop year showed the lowest grain yield owing to the highest maximum temperature continued from mid March to April (Fig. 1). Thus, it could be said that the maximum temperature below 30 ^{0}C and the minimum temperature below 15 ^{0}C are conducive for wheat sown in last week of October.

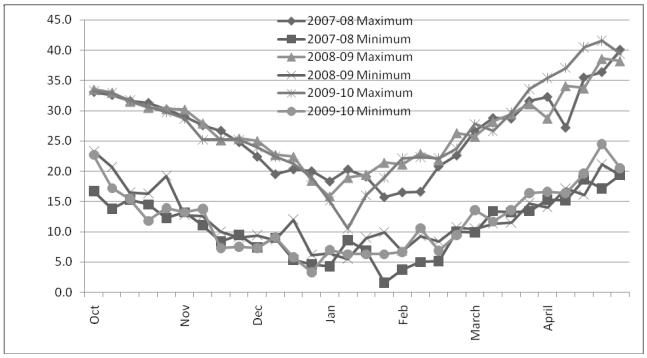

Fig. 1. Maximum and minimum temperature (^{0}C) during wheat growing season at Karnal, Haryana

Effect of varieties

On pooled basis of three year data, 'HD 2687' produced significantly higher biomass (14.16 t/ha), grain yield (6.29 t/ha), straw yield (7.87 t/ha), grain/spike (41.2) and grain weight/spike (2.57 g) as compared to 'PBW 502' and 'DBW 17' (Table 1). However, 'HD 2687' showed lower thousand grain weight and spikes/m^2 than other varieties (Table 1). Harvest index of varieties was at par. Varietal differences, including 'HD 2687', were also reported in the progress report of resource management of all India coordinated wheat improvement project during

Table 1. Effect of early sowing, varieties, nitrogen and seed rates on yield and yield attributes (Pooled basis over 3 years)

Treatment	Biomass (t/ha)	Yield (t/ha)	Straw yield (t/ha)	HI	1,000-grain weight (g)	Spikes/m^2	Grains/ spike	Grain weight/ spike (g)
Sowing time								
Last week of Oct	14.41	6.46	7.95	0.45	40.3	452	36.1	2.55
Mid Nov	13.11	5.81	7.30	0.44	37.6	418	37.9	2.35
SEm±	0.09	0.05	0.11	0.003	0.33	5.9	0.8	0.03
CD (P=0.05)	0.25	0.15	0.29	0.01	0.92	17	NS	0.09
Varieties								
'PBW 502'	13.54	6.07	7.47	0.45	39.5	434	35.8	2.41
'HD 2687'	14.16	6.29	7.87	0.45	37.5	417	41.2	2.57
'DBW 17'	13.56	6.05	7.53	0.45	39.8	454	33.9	2.37
SEm±	0.11	0.06	0.12	0.003	0.39	8.0	0.8	0.03
CD (P=0.05)	0.33	0.17	0.35	NS	1.14	23	2.3	0.11
N levels (kg/ha)								
150	13.37	5.97	7.40	0.45	39.2	428	36.4	2.42
200	14.14	6.29	7.85	0.45	38.6	442	37.6	2.48
SEm±	0.10	0.05	0.06	0.002	0.41	3.8	0.7	0.37
CD (P=0.05)	0.29	0.15	0.19	NS	NS	11	NS	NS
Seed rate (kg/ha)								
100	13.66	6.08	7.57	0.45	39.0	432	37.0	2.46
125	13.85	6.18	7.67	0.45	38.9	438	37.1	2.44
SEm±	0.10	0.05	0.17	0.002	0.37	3.6	0.6	0.38
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

2005-06 (Sharma *et al*., 2006).

Effect of nitrogen and seed rate

Application of 200 kg N/ha produced significantly higher biomass (5.4%), grain yield (5.1 %), straw yield (5.7%) and spikes/m^2 (3.2%) than recommended 150 kg N/ha application on pooled basis of three years data (Table 1). However, harvest index, thousand grain weight, grains/ spike and grain weight /spike were at par between 150 and 200 kg N/ha application. Hussain *et al*. (2006) also reported significant response of wheat genotypes up to 200 kg N/ha application. Application of 25 % higher seed rate (125 kg/ha) produced statistically similar biomass, grain and straw yield, HI, thousand grain weight, spikes/m^2, grains/spike and grain weight/spike with recommended seed rate (100 kg/ha).

Table 2. Effect of different treatment on economics of wheat (mean basis)

Treatment	Gross returns (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	B:C ratio
Sowing time			
Last week of Oct	102.9	51.7	2.01
Mid Nov	92.9	41.7	1.82
Varieties			
'PBW 502'	96.7	45.5	1.89
'HD 2687'	100.5	49.3	1.96
'DBW 17'	96.6	45.4	1.89
N levels (kg/ha)			
150	95.2	44.0	1.86
200	100.4	48.7	1.94
Seed rate (kg/ha)			
100	97.0	45.9	1.90
125	98.6	46.9	1.91

Economics

Last week of October sown crop recorded higher gross returns (9.6%), net returns (19.3%) and benefit cost ratio (2.01) than mid November sown crop despite having similar cost of cultivation in both the sowings. Among varieties, 'HD 2687' brought about higher gross returns, net returns and benefit cost ratio than other varieties (Table 2). Application of 200 kg N/ha also recorded higher gross returns (5.2%), net returns (9.6%) and benefit cost ratio than recommended nitrogen, whereas there was not much difference between two seed rates.

On the basis of three years study, it could be said that last week of October sowing in north Haryana produced 10.06% higher grain yield than timely sowing (mid November). Generally timely sown crop suffers due to high heat and hot wind stress during grain filling stage in the month of mid March and April. If farmers irrigate the crop frequently then it tends to lodge, whereas last week of October sown crop completes anthesis about 15 days earlier

than timely sowing and this leads to proper grain development. Under such conditions if heat stress due to hot wind prevails during mid March and April, the crop has already reached to ripening stage. Thus, there will be lesser chance of grain shriveling due to heat stress. This is the reason that early sown crop performed significantly better than timely sown crop. Last week of October sowing, varietal selection and 50 kg/ha more nitrogen with recommended seed rate (100 kg/ha) could be explored for enhancing the wheat productivity in North West plain zone of India.

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