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Performance of wheat (*Triticum aestivum*) varieties under different sowing dates and nitrogen levels in the sub-montane region of Punjab

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ABSTRACT

The effect of sowing time and nitrogen application on some newly developed varieties of wheat (*Triticum aestivum* L. emend. Fiori. & Paol). was studied at Gurdaspur, on sandy-loam soil conditions of sub-montane region of Punjab during winters of 1997–98 to 1999–2000. Sowing time significantly influenced the growth, yield attributes, grain and straw yields in all the years. Delay in sowing from 15 November to 15 December decreased the wheat grain yield by 32.6 and 27.4% in 1997–98 and 1998–99, respectively, with mean reduction of 45 kg grain/ha/day. Nitrogen application up to 150 kg/ha improved various yield attributes and increased the grain yield in both years, with mean increase of 7.4% over 120 and 13.9 % over 90 kg N/ha. Varieties also differed significantly. The maximum grain yield was registered in 'PBW 343', whereas 'HD 2329' gave the minimum grain yield. 'PBW 343' and 'HD 2687' gave comparable yields when sown on 15 November; whereas in case of 15 December sowing, 'PBW 343' gave significantly higher grain yield than all other varieties. 'PBW 343' also gave significantly higher yield than 'WH 542' and 'HD 2329' at 150 kg N/ha and all varieties at lower levels of nitrogen.

Key words : Nitrogen levels, Sowing time, Varieties, Wheat

The productivity of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) is governed by improved varieties coupled with matching production and protection technology. Suitability of varieties to a particular agro-climate is the most important factor in realizing their yield potential which is further influenced by their response to application of nutrients particularly nitrogen. Environmental conditions prevailing over a particular agro-climatic zone cannot be altered, however, sowing time of a crop can be adjusted to take maximum advantage of the environmental factors to best suit various growth stages of crop. In the recent past, several

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long-duration, high-yielding varieties of wheat have been developed for cultivation in different wheat-growing areas of north-western plains zone. Since the information about the response of these new varieties to major agronomic practices under sub-montane region of Punjab, which experiences severe winter and high humidity during wheat season, is not available, the present investigation was undertaken.

MATERIALS AND METHODS

A field experiment was conducted during the winter (*rabi*) seasons of 1997–2000 at the Regional Research Station, Gurdaspur (32°02' N, 75°22' E and 260 m above mean sea-level) on sandy-loam soils of neutral pH (7.8) and testing low in organic carbon (0.22%) and medium in available phosphorus (22.2 kg P/ha).

In the first trial conducted during the winters of 1997–99, 2 sowing dates (15 November and 15 December) were the main plots and 5 varieties ('PBW 343', 'WH 542', 'HD 2329', 'UP 2338' and 'HD 2687') were the subplot treatments. In the second trial conducted during the winter seasons of 1998–99 and 1999–2000, 4 nitrogen levels (90, 120, 150 and 180 kg/ha) and 6 varieties ('PBW 343', 'PBW 443', 'WH 542' 'HD 2329' 'UP 2338' and 'HD 2687') comprised the main and subpot treatments respectively. The crop was sown at a spacing of 20 cm between rows. The gross plot size was 14.4 m^2 (8.0 m × 1.8 m) and net plot size was 9.8 m^2 (7.0 m × 1.4 m).

The crop in the first trial was sown on experimental dates and in the second experiment on 19 November in both the years. Nitrogen was applied @ 150 kg N/ha in the first investigation and as per treatments in the second with a basal dose of 60 kg P_2O_5/ha as diammonium phosphate in both the trials. One-third of total nitrogen in the form of urea was drilled along with phosphorus at time of sowing and remaining nitrogen was uniformly broadcast at first node stage of the crop. Application of isoproturon @ 0.94 kg/ha at 30 days after sowing (DAS) and 2,4-D @ 0.5 kg/ha at 40 DAS was made to control grassy and broad-leaf weeds. Three irrigations were applied to crop during both years in both the trials. The crop was harvested in the last week of April to first week of May in different years.

RESULTS AND DISCUSSION

Sowing dates

Sowing time significantly influenced the grain yield of wheat (Table 1). Grain yield decreased by 32.6% in 1997–98, by 27.4% in 1998–99 and by 30.1% in the mean analysis with delay in sowing from 15 Novembr to 15 December. Thus late sowing caused mean yield reduction of 45 kg/ha/day compared to early sowing of wheat. Similarly, straw yield of late-sown crop was lower compared to its early sowing; the difference was, however, significant in 1997–98 only. The higher grain yield in early sowing may be attributed to better plant growth leading to significantly more plant height, ear/m^2, grains/ear, bold grains and better partitioning of photosynthates compared to its delayed sowing. The improvement in yield attributes may be owing to more time available for better use of growth resources and expression of its

potential. Saini *et al.* (1986), Singh and Verma (1990) and Behera (1994) reported similar results.

Delayed emergence of seedlings caused by low temperature at sowing time and early maturity due to high temperature during reproductive phase with lesser time available for the expression of various phenophases particularly the process of grain filling in case of late-sown crop (Radhawa *et al.*, 1992) might be the reason for reduced number of ears/m^2, grains/ear and grain size compared to early sowing. The reason for increased plant height and more ears/m^2 in early sowing may be the enhanced vegetative development of crop with more number of effective tillers/plant. Wardlaw *et al.*(1989) reported that grain number was the most sensitive to temperature after anthesis. Ortiz-Monasterio *et al.* (1994) reported similar results.

Nitrogen

Increasing dose of nitrogen significantly increased the grain yield in both years (Table 2). However, such an increase was restricted up to 150 kg N/ha in 1998–99 and in the mean analysis. Thus application of 150 kg N/ha increased the mean grain yield (48.1 q/ha) by 13.7% over 90 kg and by 7.4% over 120 kg N/ha. However, the effect of N application on straw yield was not conspicuous. Plant height also increased up to 150 kg N/ha. The increase in grain yield with incremental dose of N was mainly owing to significant increase in ears/m^2 and non-significant increase in grains/ear. Although the 1,000-grain weight decreased with increasing dose of N, the difference was marked only at its highest level, i.e. 180 kg N/ha, compared to its lower levels (90–150 kg/ha). Singh and Verma (1990) and Patel and Upadhyay (1993) also reported simialr results.

Nitrogen is an integral constituent of photosynthetically active pigment, the chlorophyll by virtue of which plants are able to utilize light energy and enzyme nucleotides which play an important role in cell development. Vigorous growth of crop plants with increase in fertility is associated with higher sink capacity. Nitrogen fertilization increases photosynthetic activity and translocation of photosynthates which might have promoted the growth and resulted in better partitioning of photosynthates in yield attributes and eventually produced larger sized and more grains of higher weight that ultimately increased the yield. Singh and Brar (1994) reported that positive effect of N application on yield attributes resulted in higher grain yield of wheat.

Varieties

In the trial comprising sowing dates and varieties, grain and straw yields of varieties significantly differed in both years (except straw yield in 1997–98) and in the mean analysis (Table 1). The maximum mean grain yield was obtained in 'PBW 343', which was at par with 'HD 2687' but significantly higher than rest of the varieties. Grain yield of 'HD 2687' was also signficantly higher than 'WH 542' and 'HD 2329'. The straw yield was the maximum in 'WH 542'. Significantly lowest grain and straw yields were registered in 'HD 2329'. Marked differences in plant height, ears/m^2 (in 1997–98), grains/

ear and grain size led to differences in yield among varieties. Although 'WH 542' produced the maximum number of ears/m^2, and grains/ear it produced the shrivelled

Table 1. Effect of sowing dates and varieties on the mean plant height, mean yield attributes and yield of wheat

Treatment	Plant height (cm)	Number of ears/ m^2	Number of grains/ ear	1,000-grain weight (g)	Grain yield (q/ha)			Straw yield (q/ha)		
					I	II	Mean	I	II	Mean
Sowing date										
15 November	77.6	216.8	48.6	37.9	45.7	44.2	44.9	80.3	64.6	72.4
15 December	69.7	192.5	43.1	28.4	30.8	32.1	31.4	59.4	52.4	55.9
CD (P=0.05)	2.9	NS	3.9	1.0	3.8	6.2	5.0	18.7	NS	NS
Variety										
'PBW 343'	74.7	209.3	44.8	39.4	43.9	41.1	42.5	70.4	56.7	63.5
'HD 2329'	69.1	195.4	41.6	32.2	30.7	35.4	33.0	64.1	50.1	57.1
'UP 2338'	78.7	198.2	46.2	35.5	38.9	37.3	38.1	72.5	62.2	67.4
'WH 542'	70.5	216.2	49.2	27.9	38.7	35.3	37.0	70.1	64.9	67.5
'HD 2687'	75.1	204.3	47.7	30.7	39.3	41.6	40.4	72.0	58.5	65.3
CD (P=0.05)	1.7	NS	3.7	1.6	4.2	3.4	3.0	NS	4.4	5.4

I, 1997–98; II, 1998–99

Table 2. Effect of nitrogen levels and varieties on the mean plant height, mean yield attributes and yield of wheat

Treatment	Plant height (cm)	Number of ears/m^2	Number of grains/ ear	1,000-grain weight (g)	Grain yield (q/ha)			Straw yield (q/ha)		
					I	II	Mean	I	II	Mean
Nitrogen (kg/ha)										
90	78.9	271.0	45.8	39.1	41.2	43.4	42.3	62.6	72.0	67.3
120	79.8	293.2	45.6	38.9	44.9	45.3	44.8	67.8	74.5	71.2
150	81.1	305.2	48.3	38.5	49.6	46.6	48.1	68.6	77.1	72.8
180	79.8	308.0	48.5	37.4	47.7	48.6	48.1	65.2	79.4	72.3
CD (P=0.05)	NS	10.8	NS	0.7	3.5	2.1	2.6	NS	NS	NS
Variety										
'PBW 343'	79.8	305.1	45.7	44.5	47.9	51.5	49.7	66.2	73.2	69.7
'PBW 443'	79.7	308.8	39.9	37.2	47.2	47.7	47.4	64.2	73.5	68.8
'HD 2329'	75.3	275.6	45.3	41.7	39.8	42.5	41.2	58.0	73.5	65.8
'HD 2687'	80.4	291.8	52.4	36.0	46.2	45.0	45.6	66.1	74.2	70.1
'WH 542'	77.6	294.8	53.3	31.8	45.5	44.6	45.0	66.3	78.5	72.5
'UP 2338'	86.7	290.2	45.7	39.5	48.5	44.5	46.5	75.5	81.5	78.5
CD (P=0.05)	1.7	9.5	3.4	0.8	2.9	3.2	2.2	7.5	6.0	5.2

I, 1998–99, II, 1999–2000

grains of lowest test weight compared to other varieties. Eventhough the number of grains/ear was similar in 'PBW 343', and 'HD 2687' the former produced grains of significantly bold size as indicated by its higher 1,000-grain weight than all the varieties. Variety 'HD 2329' produced plants of shortest stature with least number of ears/m^2 and grains/ear than the other varieties.

In the study of nitrogen levels and varieties also, different varieties showed marked differences in grain and straw yields, plant stature and yield-contributing characters in both years (Table 2). Variety 'PBW 343', which gave grain yield at par with 'UP 2338' in 1998–99 was significantly superior to all other varieties in 1999–2000.

The mean grain yield of 'PBW 343' (49.7 q/ha) was significantly higher than rest of the varieties. The maximum straw yield in both years was registered in 'UP 2338'. Significantly lowest grain and straw yields were recorded in 'HD 2329' in both years. The grains of 'PBW 343' were of significantly larger size and those of 'WH 542' of the smallest size than rest of the varieties in both years. However, 'WH 542' produced the maximum number of grains/ear which were at par with 'HD 2687' and significantly more than all other varieties. 'PBW 343' and 'PBW 443' produced statistically similar number of ears/m^2 which differed significantly from the remaining varieties.

Sowing dates x varieties

Mean grain yield of all the varieties significantly decreased with delay in sowing from 15 November to 15 December (Table 3). The maximum mean grain yield in early sowing date was recorded in 'HD 2687', followed by 'PBW 343'. However, in 15 December sowing, 'PBW 343' gave the maximum mean grain yield. Although

Table 3. Effect of sowing dates on the mean grain yield (q/ha) of different wheat varieties

Sowing date	Variety				
	'PBW 343'	'HD 2329'	'UP 2338'	'WH 542'	'HD 2687'
15 November	48.3	37.2	45.8	44.2	49.1
15 Decembr	36.6	28.8	30.3	29.8	31.7
CD (P=0.05)	4.24				

Table 4. Effect of nitrogen levels on the mean grain yield (q/ha) of different wheat varieties

Nitrogen (kg/ha)	Variety					
	'PBW 343'	'PBW 443'	'HD 2329'	'HD 2687'	'WH 542'	'UP 2338'
90	46.1	45.2	37.5	43.8	39.7	41.7
120	47.8	44.4	42.1	43.0	43.5	45.9
150	53.2	49.6	43.4	49.5	45.5	49.5
180	51.9	50.5	41.8	44.3	51.4	48.8
CD (P=0.05)			4.34			

the mean grain yield of 'WH 542' (44.2 q/ha) was significantly higher than 'HD 2329' when sown on 15 November; both gave statistically similar yields in case of delayed sowing on 15 December. The maximum reduction of 17.4 q/ha or 58 kg grain/ha/day with delay in sowing from 15 November to 15 December was registered in 'HD 2687', whereas similar delay in sowing reduced the grain yield of 'PBW 343' by 11.7 q/ha or 39 kg/ha/day. 'HD 2329' registered the lowest mean grain yield under both sowing dates.

Nitrogen levels x varieties

At each level of nitrogen, mean grain yield of wheat was the maximum in 'PBW 343' (Table 4). The mean grain yield of 'PBW 343' was significantly higher than that of 'WH 542' and 'HD 2329' at each level of nitrogen. Grain yield of varieties increased up to 150 kg N/ha. except in 'WH 542' in which such an increase was discerned up to 180 kg N/ha. The lowest grain yield was registered in 'HD 2329' at all levels of N. Increase in mean grain yield with application of 150 over 120 kg N/ha was significant for varieties 'PBW 343', 'PBW 443' and 'UP 2338'.

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