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Effect of Sowing Dates and Varieties on Yield and Quality Performance of Wheat (*Triticum aestivum* L.)

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ABSTRACT

A field experiment conducted during *Rabi* season of 2017-18 at wheat research farm of CCS Haryana Agricultural University, Hisar, India to study the effect of sowing dates and varieties on yield and quality performance of wheat *(Triticum aestivum* L.). The experiment was laid out in split plot design with three replications containing four sowing dates *viz*. 5th November, 25th November, 15th December and 5th January as main plot treatments and seven wheat varieties *i.e*. HS 562, HD 2967, HD 3086, HI 1544, MACS 6222, WR 544 and WH 1105 as sub plot treatments. On the basis of one year study it was concluded that among sowing dates, 5th November sowing is the most economical and suitable than rest of the sowing dates. 5th November sown crop recorded significantly longer spike (11.7 cm), higher number of effective tillers (98.3 per mrl), grains per spike (48.6), test weight (39.9 g), grain appearance score (8.3), hectoliter weight (82.9 kg/hl), grain yield (5432 kg ha^{-1}) and harvest index (39.0%) compared to rest of the sowing dates, while highest protein content (12.9 %) was observed with 5th January sown crop. Maximum net return (Rs.54, 262 ha^{-1}) and B: C (1.73) were recorded with 5th November sowing. Among the varieties, HI 1544 recorded significantly higher number of effective tillers (94.6 per mrl), grains per spike (48.4), test weight (38.6 g), grain yield (4920 kg ha^{-1}) harvest index (39.2), grain appearance score (8.1) and hectoliter weight (82.0 kg/hl), while variety WH 1105 resulted in longer spike (11.5 cm) and WR 544 in higher protein content (12.6 %) as compared to rest of the varieties. While comparing the interaction of varieties with date of sowing, HI 1544 produced significantly higher grain higher yield (6007 kg ha^{-1}) of wheat sown at 5th November which was statistically at par with WH 1105 (5833 kg ha^{-1}) and HD 3086 (5616 kg ha^{-1}) at same date of sowing. Delayed sowing of HI 1544 from 5th November to 25th November reduced the grain yield by 9.1 per cent; to 15th of December by 21.0 per cent and to 5th January by 42.3 per cent.

Key words: Economics, Quality, Sowing dates, Wheat varieties, Yield attributes, Yield.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the major food grain crops of the world including India and India is the second largest wheat producing country after China which contributes more than 30% to the world wheat production. India produced about 97.4 million tons of wheat form an area of 30.7 million hectare with an average productivity of 3172 kg ha^{-1} (ICAR-IIWBR, 2017). Haryana, which is one of the major wheat growing states, produced 11.5 million tons of wheat from 2.6 million hectares area with an average productivity of 4514 kg ha^{-1}(Anonymous, 2017). Timely sowing of wheat provides optimum environment for crop growth to accumulate more biomass and finally higher grain yield. Under late sown condition wheat crop exposed to low temperature at the germination, which delayed the crop emergence. and to higher temperature at the reproductive phase leads to force maturity and resulted in reduction of the yield and yield attributes (Gupta *et al*., 2017). While too early sowing produced weak plants with poor root system which ultimately affected growth, yields attributes and yield of the crop adversely (Nahar *et al*., 2010).

Verma (2015) reported higher spike length, grains per spike and grain test weight with 11th November sowing as compared to 6th December sown crop. Singh *et al.* (2018) reported that under timely sown condition, wheat crop experienced prolonged favorable growth environment which resulted in higher accumulation of carbon photosynthates and ultimately enhanced the yield attributes positively. Torbica *et al*., (2008) expressed that sometimes early and timely sown crops, experienced low temperature before flowering stage as compared to late sown crop, which resulted in reduction of cell division and less accumulation of structural protein. However high temperature during grain filling period resulted higher accumulation of starch and less storage protein which is inversely related to carbohydrate accumulation. Kaur *et al.* (2010) reported that protein content of the wheat grain was higher under late sowing than timely sowing, while the hectoliter weight was higher in case of 15th November date of sowing. Also it was reported that in Hisar, delayed sowing resulted in significantly higher protein content (11.7 per cent) followed by early sowing (10.5 per cent) and the lowest protein content (10.4 per cent) was observed under normal date of sowing (Anonymous, 1993). Jat *et al*. (2013) and Eslami *et al*. (2014) reported higher amount of total protein with late sowing, due to higher temperature during grain filling period which induced higher nitrogen accumulation than photosynthates. In similar

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trends, Waheddullah *et al*. (2018) reported that under delayed sown crop, maximum grain protein content and minimum hectoliter weight and grain appearance score were obtained.

Improper selection of varieties also affects crop yield because performance of varieties vary correspondingly with their genetic potential and adaptable environment, so there is scope for increasing yield of wheat with cultivation of climate resilient varieties (Hussain *et al*., 2012). Different genotypes have evolved various mechanisms to cope up with heat stress which are rolling, shedding and thickening of leaves, reduction in leaf size, short duration of growth period and transpirational cooling (Wahid *et al.,* 2007). Wheat yield can be increased 10 to 80% through proper selection of sowing time and suitable cultivars (Coventry *et al*., 2011). Keeping the above facts in consideration, the current experiment was conducted in *Rabi* season of 2017-18 to study the effect of sowing dates and varieties on yield and quality performance of wheat (*Triticum aestivum* L.).

MATERIALS AND METHODS

The field experiment was conducted during *Rabi* season of 2017-18 at wheat research farm of CCS Haryana Agricultural University, Hisar, which is located at 29.09°N latitude and 75.46 °E longitude in western Haryana with an elevation of 215 m above mean sea level. The experiment was laid out in split plot design with three replications containing four sowing dates *viz*. 5th November, 25th November, 15th December and 5th January as main plot treatments and seven wheat varieties *viz*. HS 562, HD 2967, HD 3086, HI 1544, MACS 6222, WR 544 and WH 1105 as sub plot treatments. Details of varieties are given in Table 1.

The experimental field soil was sandy loam in texture having 128 kg ha^{-1}, 16.5 kg ha^{-1} and 243 kg ha^{-1} nitrogen, phosphorus and potassium, respectively. Field was prepared on 5th November by two ploughing with harrow followed by cultivator and planking after pre-sowing irrigation and first sowing was done on the same day. For the rest sowings, the field was ploughed and prepared similarly on 25th November, 15th December and 5th January after application of pre-sowing irrigation. Seed of each variety at the rate of 100 kg per hectare was used in each sowing date. The seeds were sown by *pora* method in 20 cm spaced rows in plots having the net size of 1.4m x 7.0m in each sowing dates. All agronomic practices recommend by CCSHAU, Hisar were followed evenly irrespective to treatments in each sowing. Yield attributes *viz*. number of effective tillers per meter row length, spike length (cm), grains per spike and grain test weight (g), quality parameters *viz.* grain appearance score, hectoliter weight (kg/hl) and grain protein content (%) were recorded. Grain yield was recorded by threshing of wheat bundles separately for each treatment after taking the biological weight. Economics of various treatments was calculated on the basis of approved inputs and practices cost fixed by Directorate of Farm, CCS HAU, Hisar by using below formulas.

Net return = Gross return – cost of cultivation

$$B : C = \frac{\text{Gross return (Rs./ha)}}{\text{cost of cultivation n (Rs./ha)}}$$

RESULTS AND DISCUSSION

Yield performance

Yield of wheat crop is directly related to yield attributes of the crop. Higher the values of the yield attributes more will be the crop yield. Sowing dates influenced significantly yield attributes and yield of the crop (Table 2). Among the sowing dates, 5th November sown crop resulted in significantly higher yield attributes and yield. Number of effective tillers, number of grains per spike and harvest index in 5th November sowing were significantly higher than 15th December and 5th January sowings although yield attributes statistically at par with 25th November sown crop while spike length, test weight and grain yield were significantly higher with 5th November sown crop as compared to rest of the sowing dates. Reduction in number of effective tiller (per meter row length), spike length (cm), number of grains (per spike), grain test weight (g), grain yield (kg ha^{-1}) and harvest index (%) were up to 24.5, 12.8, 11.1, 18.8, 39.0 and 2.8 per cent, respectively when sowing was delayed by each 20 days interval up to 5th January compared to 5th November sowing. Higher yield attributes and yield with 5th November sowing might be due to favourable climatic condition, which prolonged vegetative as well as reproductive phases of the crop and resulted in more interception of solar radiation and translocation of assimilated photosynthates from source (leaves and stalk) to sink, which caused the plant to produce higher yield

Table 1: Details of varieties.

Variety	Date of release	Recommended zone	Pedigree	Origin
HS 562	29.06.2016	NHZ	OASIS/SKAUZ//4*BCN/3/2*PASTOR	IARI RS, Shimla
HD 2967	10.10.2011	Irrigated, timely sown conditions of NWPZ	ALD/COC//URES/HD2160M/HD2278	IARI, N. Delhi
HD 3086	24.01.2014	Irrigated, timely sown conditions of NWPZ	DBW14/HD2733//HUW468	IARI, N. Delhi
HI 1544	08.05.2008	Irrigated, timely sown conditions of CZ	HINDI62/BOBWHITE/CPAN 2099	IARI RS, Indore
MACS 6222	01.04.2010	Irrigated, timely sown conditions of PZ	HD 2189*2//MACS2496	ARI, Pune
WR 544	05.11.2005	Delhi state	KALYANSONA/HD1999//HD2204/DW 38	IARI, N. Delhi
WH 1105	10.04.2013	Irrigated, timely sown conditions of NWPZ	MILAN/S87230//BABAX	CCS HAU, Hisar

attributes and viable pollen which affected directly grain set up and ultimately resulted in higher grain yield. The results are in line with Kamrozzaman *et al*. (2016), Baloch *et al*. (2012) and Spink *et al*. (2000).

Wheat varieties also varied significantly in relation to the yield attributes and yield while performance of varieties in relation to harvest index was found non-significant (Table 3). Variety HI 1544 being at par with HD 3086 resulted in significantly higher number of effective tillers, test weight and grain yield as compared to HD 2967, WH 1105, HS 562, MACS 6222 and WR 544 varieties. Variety WH 1105 recorded significantly higher spike length than HD 3086 and WR 544 but it was statistically at par with rest of the varieties. Variety HI 1544 resulted in significantly higher number of grains per spike than HS 562, MACS 6222 and WR 544 but it was statistically at par with rest of the varieties. The variation among the varieties in relation to yield attributes and yield could be due to their genetic makeup and somehow could be due to environmental conditions. The results are supported by those of Amrawat*et al*. (2013), Kaur (2017) and Mahajan *et al*. (2018).

Interaction effect of sowing dates and wheat varieties was significant in terms of grain yield (Table 4). Variety HI 1544 being at par with WH 1105, HD 3086 and HD 2967 in 5th November sowing and with HD 3086, HD 2967, WH 1105, HS 562 and MACS 6222 in 25th November sowing resulted in significantly higher grain yield as compared to rest of the varieties in both sowings. HD 3086 resulted in significantly higher grain yield than WH 1105, HS 562 and WR 544 but at par with HI 1544, HD 2967 and MACS 6222 with 15th December sowing while the recorded grain yield with HD 3086 in 5th January sowing was statistically at par with all the varieties. All varieties resulted in significantly higher grain yield with 5th November sowing as compared to 15th December and 5th January sowings but it was at par with 25th November sowing except in case of HI 1544 and WH 1105.

Quality performance

Quality parameters of wheat grain were significantly influenced by sowing dates (Table 5). 5th November sown crop being at par with 25th November sowing date resulted in significantly higher grain appearance score (8.3) and hectoliter weight (82.9 kg/hl) as compared to rest of the sowing dates. Lower grain appearance score and hectolitre weight with late sowings might be due to lesser leaf area (source) to intercept light radiation and insufficient photosynthates synthesis, reduced translocation of assimilates to sink and prevailing of hot wind and high temperature during grain filling period, which resulted in small and shriveled grains. The results are in line with those of Waheddullah *et al.* (2018) and Kuar *et al*. (2010). While very late sowing (5th January) resulted in significantly higher protein content as compared to rest of the sowing dates.Which might be due to increase in temperature during growth phase of the crop and resulted in development of less leaf area which caused less interception of solar radiation and ultimately reduced photosynthate manufacturing and increased absorption of nitrogen by the crop because of the inverse relation between carbohydrates and nitrogen accumulation rate by the crop. Higher protein content was also reported by Eslami *et al*. (2014) under late sown condition. Effect of varieties in relation to hectolitre weight was found non-significant.

Among varieties, HI 1544 being at par with HD 3086, HD 2967 and WH 1105 resulted in significantly higher grain appearance score than HS 562, MACS 6222 and WR 544 varieties (Table 2). Variety WR 544 resulted in significantly higher protein content as compared to rest of the varieties. The variations could be due to genetic makeup of the

Table 2: Effect of sowing dates on yield attributes and yield of wheat.

Treatments	Effective tillers/ mrl (No)	Spike length (cm)	Grains/spike (No)	Test weight (g)	Grain yield (kg ha^{-1})	Harvest index (%)
5th November	108.4	11.7	48.6	39.9	5432	39.0
25th November	106.1	11.2	46.8	36.7	5071	38.7
15th December	100.3	10.9	45.0	34.8	4403	38.0
5th January	81.8	10.2^{c}	43.2	32.4	3315	37.9
SEm ±	1.4	0.1	0.6	0.3	95.1	0.2
CD at 5%	5.0	0.4	2.0	1.2	335.6	0.6

Table 3: Effect of varieties on yield attributes and yield of wheat.

Treatments	Effective tillers/ mrl (No)	Spike length (cm)	Grains/spike (No)	Test weight (g)	Grain yield (kg ha^{-1})	Harvest index (%)
HS 562	94.8	11.5	45.3	34.2	4434	37.8
HD 2967	101.3	11.3	48.4	36.6	4697	38.6
HD 3086	105.0	10.7	47.7	38.4	4842	39.0
HI 1544	105.6	11.2	47.8	38.6	4920	39.2
MACS 6222	94.4	11.3	45.3	35.2	4513	38.8
WR 544	91.3	9.8	38.5	33.0	3838	37.0
WH 1105	101.5	11.5	48.3	35.8	4645	38.4
SEm ±	1.2	0.1	0.5	0.3	71.9	0.8
CD at 5%	3.5	0.3	1.4	1.0	205.2	NS

Table 4: Interaction effect of sowing dates and wheat varieties on grain yield (kg ha^{-1}).

Varieties	Sowing dates				
	5th November	25th November	15th December	5thJanuary	Mean
HS 562	5320	5065	4204	3146	4434
HD 2967	5510	5395	4578	3306	4697
HD 3086	5616	5401	4830	3520	4842
HI 1544	6007	5463	4745	3466	4920
MACS 6222	5412	5027	4483	3129	4513
WR 544	4330	4068	3660	3296	3838
WH 1105	5833	5078	4323	3344	4645
Mean	5432	5071	4403	3315	
Factors			SEm ±	CD at 5%	
Sowing dates			95.1	335.6	
Varieties			71.9	205.2	
Varieties at same level of sowing dates			251.7	443.2	
Sowing dates at same level of varieties			163.7	504.2	

Table 5: Effect of sowing dates and varieties on quality and economics of wheat.

	Quality parameters			Economic		
Treatments	Grain appearance score	Hectolitre weight (kg/hl)	Protein content (%)	Gross return (Rs/ha)	Net return (Rs/ha)	B :C
Sowing dates						
5th November	8.3	82.9	9.6	129,114	54,262	1.73
25th November	8.0	81.6	10.5	121,103	46,750	1.63
15th December	7.6	79.2	11.4	106,025	31,673	1.43
5th January	7.0	77.8	12.9	79,967	6,115	1.08
SEm ±	0.1	0.9	0.1	2,262	2,262	0.03
CD at 5%	0.3	3.0	0.4	7,978	7,978	0.11
Varieties						
HS 562	7.4	79.6	10.4	107,135	32,782	1.44
HD 2967	7.8	80.8	11.2	112,137	37,785	1.51
HD 3086	8.1	81.2	10.7	114,834	40,482	1.54
HI 1544	8.1	82.0	10.3	116,868	42,515	1.57
MACS 6222	7.5	79.8	11.1	107,557	33,204	1.45
WR 544	7.1	78.8	12.6	93,602	19,249	1.26
WH 1105	7.8	80.5	11.5	111,233	36,881	1.49
SEm ±	0.1	1.4	0.1	1,248	1,248	0.02
CD at 5%	0.3	NS	0.3	3,558	3,558	0.05

varieties and also can be due to environmental conditions. The result is in line with Punia *et al*. (2017) and Gupta *et al*. (2017) who reported variation in protein content and hectoliter weight of wheat grain, respectively.

Economics

Gross return, net return and benefit cost ratio (B: C) were significantly influenced by sowing dates (Table 5). Among sowing dates, 5th November sown crop resulted in significantly higher gross return as compared to 25th November, 15th December and 5th January sowings while in case of net return and B: C ratio, 5th November sown crop being at par with 25th November sowing resulted in significantly higher net return and B: C as compared to rest of the sowing dates. 5th November sown crop recorded 38.1, 88.7 and 37.3 per cent higher gross return, net return and B: C compared to 5th January sown crop. Mukherjee (2012) reported higher gross return, net return and B: C with early sowing as compared to late sown crops.

Varieties significantly influenced gross return, net return and B: C (Table 2). Variety HI 1544 being at par with HD 3086 resulted in significantly higher gross return, net return and B: C as compared to rest of the varieties which might be attributed to high yielding ability of the variety. The results are supported with those of Verma *et al*. (2015) and Bachhao *et al*. (2018).

CONCLUSION

Based on one year research study it was concluded that 5th November is the best sowing time for wheat crop to obtain higher yield, quality (except protein content) and economic returns. Among varieties, HI 1544 performed best in terms of yield and economic returns. All varieties resulted in significantly higher grain yield with 5th November sowing as compared to 15th December and 5th January sowings but it was at par with 25th November sowing except in case of HI 1544 and WH 1105.

REFERENCES

Amrawat, T., Solanki, N. S., Sharma, S. K., Jajoria, D. K. and Dotaniya, M. L. (2013). Phenology growth and yield of wheat in relation to agrometeorological indices under different sowing dates. African Journal of Agricultural Research. 8: 6366-6374.

Anonymous, (1993). Quality results of co-ordinated experiments. (In) Progress Report, (1992-93), AICWIP, Directorate of Wheat Research, Karnal, pp. 22-24.

Anonymous, (2017).Progress report of all India Coordinated Wheat and Barely Improvement Project 2016-17, Director's report. Ed. G.P. Singh, ICAR-Indian Institute of Wheat and Barely Research, Karnal, India.

Bachhao, K.S., Kolekar, P.T., Nawale, S.S. and Kadlag, A.D.(2018). Response of different wheat varieties to different sowing dates. Journal of Pharmacognosy and Phytochemistry. 7: 2178-2180.

Baloch, M. S., Nadim, M.A., Zubair, M.U.H.A.M.M.A.D., Awan, I.U., Khan, E.A. and Ali, S.A.J.I.D. (2012).Evaluation of wheat under normal and late sowing conditions. Pakistan Journal of Botany. 44: 1727-1732.

Coventry, D. R., Gupta, R. K., Yadav, A., Poswal, R. S., Chhokar, R. S., Sharma, R. K., Kleemann, S. G. L. (2011). Wheat quality and productivity as affected by varieties and sowing time in Haryana, India. Field Crops Research. 123: 214-225.

Eslami, H., Hadi, S.M. and Arabi, M.K. (2014).Effect of planting date on protein content of wheat varieties. International Journal of Farming Allied Sciences. 3: 362-364.

Gupta, S., Singh, R. K., Sinha, N. K., Singh, A. and Shahi, U.P. (2017). Effect of different sowing dates on growth and yield attributes of wheat in Udham Singh Nagar District of Uttarakhand, India. Plant Archives. 17: 232-236.

Hussain, M., Mehmood, Z., Khan, M. B., Farooq, S., Dong-Jin, L. and Farooq, M. (2012). Narrow row spacing ensures higher productivity of low tillering wheat cultivars. International Journal of Agriculture and Biology. 14.

ICAR-IIWBR (2017). Director's Report of AICRP on Wheat and Barley. (2016-2017). Ed: G.P. Singh. ICAR-Indian Institute of Wheat and Barley Research, Kernal, Haryana, India. pp. 87.

Jat, L.K., Singh, S.K., Latare, A.M., Singh, R.S. and Patel, C.B. (2013).Effect of dates of sowing and fertilizer on growth and yield of wheat (Triticumaestivum L.) in an Inceptisol of Varanasi. Indian Journal of Agronomy. 58: 168-171.

Kamrozzaman, M.M., Khan, M.A.H., Ahmed, S. and Sultana, N. (2016). Growth and yield of wheat at different dates of sowing under chrl and ecosystem of Bangladesh. Journal of the Bangladesh Agricultural University. 14: 147-154.

Kaur, A., Pannu, R.K. and Buttar, G.S. (2010).Quality of wheat (Triticumaestivum L.) as influenced by sowing dates and nitrogen scheduling. Indian Journal of Agriculture Science. 80:781-85.

Kaur, C. (2017). Performance of wheat varieties under late and very late sowing conditions. International Journal of Current Microbiology Applied Sciences. 6: 3488-3492.

Mahajan, A. Y., Mohite, A. B., Jadhav, Y. R. and Patil, J. B. (2018). Effect of varieties (Triticumaestivum L.) under extended sowing times on yield, protein content, nutrient uptake and soil properties of wheat. IJCS. 6: 55-58.

Mukherjee, D. (2012). Effect of different sowing dates on growth and yield of wheat (Triticumaestivum L.) cultivars under mid hill situation of West Bengal. Indian Journal of Agronomy. 57: 152-156.

Nahar, K., Ahmad, K. and Fujita, M. (2010). Phenological variation and its relation with yield in several wheat (Triticumaestivum L.) cultivars under normal and late sowing mediated heat stress condition. Notulae Scientia Biologicae. 2: 51-56.

Punia, S., Sandhu, K. S. and Siroha, A. K. (2017). Difference in protein content of wheat (Triticumaestivum L.): Effect on functional, pasting, color and antioxidant properties. Journal of the Saudi Society of Agricultural Sciences.

Singh, B., Kumar, M. and Dhaka, A.K. (2018). Relationship of temperature based meteorological indices with phenology and yield performance of wheat as influenced by swing times. International Journal of Current Microbiology and Applied Sciences. 7: 230-24.

Spink, J.H., Kirby, E.J.M., Frost, D.L., Sylvester-Bradley, R., Scott, R.K., Foulkes, M.J. and Evans, E.J. (2000). Agronomic implications of variation in wheat development due to variety, sowing date, site and season. Plant Varieties and Seeds. 13: 91-108.

Torbica, A. and Mastiloviæ, J. (2008). Influence of different factors on wheat proteins quality. Food and Feed research. 35: 47-52.

Verma, N.S. (2015). Agronomic performance of new wheat varieties on different dates of sowing in Northern Madhya Pradesh. Thesis of Master's degree. Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya.

Waheddullah., Dhaka, A.k., Kumar, S., Bhatia, J.K., Singh, B. and Ramprakash. (2018). Growth and yield performance of dual purpose wheat as influenced by sowing time and cutting schedule. International Journal of Chemical Studies. 6: 2611-2614.

Wahid, A., Gelani, S., Ashraf, M. and Foolad, M. R. (2007). Heat tolerance in plants: an overview. Environmental and experimental Journal of botany. 61: 199-223.

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