American-Eurasian J. Agric. & Environ. Sci., 15 (12): 2484-2488, 2015
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2015.15.12.12827

Potential of Wheat (*Tritium aestivum* L.) Advanced Lines for Yield and Yield Attributes under Different Planting Dates in Peshawar Valley

[1]Abdul Basir, [1]Rihad Ali, [1]Mukhtar Alam, [1]Abdul Sattar Shah, [2]Khilwat Afridi, [1]Muhammad Adnan, [1]Mohammad Ibrahim, [1]Inayat-ur-Rahman and [1]Adnan Tahir

[1]Department of Agriculture, University of Swabi, Khyber Pakhtunkhwa, Pakistan
[2]Cereal Crops Research Institute (CCRI), Pirsabak Nowshera, Khyber Pakhtunkhwa, Pakistan

Abstract: Development, identification and evaluation of high yielding genotypes under farm conditions and different planting dates are pre-requisite for enhancing over-all productivity on a cost effective and sustainable basis. In this respect, an experiment was conducted at Cereal Crops Research Institute (CCRI), Pirsabak, Nowshera, Pakistan during 2013-2014 to evaluate six wheat advanced lines (PR-103, PR-105, PR-106, PR-107, PR-108 and PR-109) under six different planting dates (Oct. 25, Nov. 5, Nov. 15, Nov. 25, Dec. 5 and Dec.15). The sowing dates as well as the genotypes both, significantly affected yield and yield components. Days to maturity, plant height, spike length, spikes m^{-2}, grains $spike^{-1}$, 1000-grain weight and grain yield of the genotypes decreased by 19.0, 15.0, 5.0, 7.5, 16.0, 26.7 and 35.2 percent, respectively when sowing was gradually delayed from Oct. 25th to Dec. 15th. The highest average grain yield (4803 kg ha^{-1}) among the tested genotypes was recorded for the line PR-107. In case of planting dates, statistically higher grain yields of 5196 kg ha^{-1} and 5008 kg ha^{-1} were recorded for Oct 25th and Nov. 05th sown crop, respectively, as compared to the Dec. 15th sown crop (3366 kg ha^{-1}). Thus, it is concluded from the current study that for obtaining maximum grain yield in the Peshawar valley and similar agro-climatic zones, the optimum period for planting wheat crop is Oct 25th to Nov. 05th. Moreover, on the basis of greater grain yield and better yield components, PR-107 is recommended for further adaptability tests at national and regional levels.

Key words: Wheat advanced lines · Grain yield · Yield attributes · Planting dates

INTRODUCTION

Low yield of wheat varieties having genetic potential for higher yield can be attributed to various environmental factors such as lack of water, use of unbalanced fertilizers, low seed rate and inadequate planting time. Among the crop husbandry practices, planting within a suitable period, play a crucial role in insuring availability of favourable environmental conditions essential for growth and development. A variation in environmental conditions, among and within seasons, is one of the most essential restrictions affecting return prospective [1]. Therefore, one of the requirements for obtaining high yield is the identification of suitable sowing period for potentially high yielding cultivars to realize their genetic potential. Significant variation in yield of wheat has been noted by many researchers while testing wheat for optimum planting times [2, 3]. Late planting has been reported to shorten plant height and growth cycle in wheat in the central agro-ecological zone of Khyber Pakhtunkhwa Pakistan [4, 5]. Previous studies have also shown that significantly higher yield of wheat can be obtained when the crop is sown in November rather than December in the Southern regions of KP province [6]. Similarly, it has been reported by Akhtar *et al.* [7] that December 1st sown crop resulted in significantly higher grain yield as compared to January 16th sown crop.

Wheat crop has its own specific temperature and light requirements for emergence, growth and flowering [8]. Qamar *et al.* [9] have concluded that early sown wheat had higher grain yield than late sown crop. Conversely, maximum reduction in grain weight and grain yield has been reported due to delayed sowing [10, 5]. Reduction in spike length, one of the key yield components, has been

Corresponded Author: Abdul Basir, Department of Agronomy, University of Swabi, Khyber Pakhtunkhwa, Pakistan.
Cell: +92333-9718907.

noted to occur, probably due to delayed sowing, because of the sensitivity of the wheat plants to changes in photoperiod and temperature [11].

Kumar and Sharma [12] and French *et al.* [13] had also reported that delayed sowing significantly reduces grain weight which is another important yield component. Singh and Dhaliwal [14] have highlighted that heat and scorching winds during the early summer might cause enforced maturity of late sown crop, thus, resulting in reduced test weight. On the other hand, crop planted around mid-November or earlier may be able to escape such harsh conditions at the time of maturity and hence produce higher grain yield as compared to too late, or too early, planting [15, 16].

Recommending a technology package to the farmers in various regions will be incomplete without including recommendations on optimum planting dates/periods. Testing for and finding out the optimum planting period is also inevitable for identifying cultivars suitable for irrigated or rain-fed areas and for recommending promising genotypes for further evaluation in the context of prevailing cropping pattern of a certain area. The present study was, therefore, designed with the objectives to find out the performance of wheat (*Triticum aestivem L.*) advanced lines for yield and yield attributes under different sowing dates in central plains of KP.

MATERIALS AND METHODS

The experiment was conducted at Cereal Crops Research Institute (CCRI), Pirsabak (34°N Latitude, 72°E Longitude and 288m Altitude), Nowshera, during 2013-2014. Six wheat advanced lines (PR-103, PR-105, PR-106, PR-107, PR-108 and PR-109) were planted on six different sowing dates (October 25th, November 5th, 15th, 25th and December 5th and 15th) covering the earliest and latest dates on which the local farmers were observed to practice sowing. The experiment was conducted in a Randomized Complete Block Design (RCBD) with split-plot arrangement having three replications. Sowing dates were assigned to main plots and wheat lines were assigned to sub-plots. Each advanced line was grown in six rows of five meters length, with row-to-row distance of 30 cm. The plot area measured 9 m^2 in total. Standard dose of fertilizer was applied at the ratio of 120:60 kg ha^{-1} of N : P in the form of Urea and Single Super Phosphate (SSP), respectively. SSP was applied as basal dose at the time of sowing while urea was applied in split doses; half at the time of sowing and half with first irrigation. Sowing was done with hand drill. A uniform seed rate of 100 kg ha^{-1} was used. Weeds were eliminated chemically and manually after first irrigation. Recommended and standard agronomic and cultural practices were uniformly carried out for all experimental units in order to minimize experimental error. Data (Table 1) on days to physiological maturity (DPM), plant height (PH), spike length (SL), spike m^{-2}, number of grains spike^{-1} (GS^{-1}), 1000-grain weight (1000 GW) and grain yield (GY) was recorded according to standard procedures. The data were analysed statistically to determine significance of treatment using computer statistical program MSTAT-C [17]. Least significance difference (LSD) test was also applied to separate significant means [18].

Table 1: Abbreviations and units of different observations studied during the experiment

S.No	Observation	Abbreviation	Unit
1	Days to physiological maturity	DPM	days
2	Plant height	PH	cm
3	Spike length	SL	cm
4	Spike per square meter	Spike m^{-2}	No. m^{-2}
5	Grains per spike	GS^{-1}	No. S^{-1}
6	Thousand grain weight	1000-GW	g
7	Grain yield	GY	kg ha^{-1}

RESULTS AND DISCUSSION

Effects of Sowing Dates on Wheat Yield and Yield Attributes: Variation in planting dates had significant effect on all yield components studied (Table 2). Mean values (Table 3) indicated that October 25th sown crop took significantly greater number of days to maturity (174 days) as compared to the relatively later sown (5th Nov) crop. Days to maturity decreased gradually as the sowing was delayed till Dec. 5th resulting in relatively shorter growing season for the late sown crop. Similar results were reported by Subhan *et al*. [5] for the central agro-ecological zone of KP Pakistan.

The results also revealed that plant height significantly varied with delaying planting (Table 3) in a gradual manner from a maximum 116.2 cm recorded for Oct 25th sown crop to a minimum of 99.3 cm for Dec. 15th sown crop. Plant height showed a decrease of 11 to 19% as wheat plantation was delayed from Oct. 25th to Dec 15th. Decrease in plant height could be due to shorter growing period available to the late sown crop. Early sown crop may have utilized the better environmental conditions especially the temperature and solar radiation thus, resulting into tallest plants. These results are in line with those obtained by Shahzad *et al*. [19]. Spike length was

Table 2: Analysis of variance (mean squares) for various agronomic traits of wheat advanced lines as affected by different sowing dates at CCRI, Pirsabak during 2013-14

SOV	DF	DPM	PH	SL	Spike m^{-2}	GS^{-1}	1000-GW	GY
Replication	2	0.45	23.18	1.32	551.46	53.58	3.337	8589.6
Sowing date (SD)	5	3133.59^{**}	572.93^{**}	10.10^{**}	1557.55^{**}	167.58^{*}	378.37^{**}	7789.8^{**}
Error-a	10	2.03	16.61	0.50	505.69	42.39	13.64	3397.7
Wheat lines (WL)	5	2.75^{ns}	145.53^{**}	3.03^{**}	2322.12^{**}	107.16^{**}	114.75^{**}	2478.7^{**}
SD x WL	25	3.00^{ns}	20.30^{ns}	0.38^{ns}	127.84^{ns}	21.29^{ns}	12.08^{ns}	4856.1^{ns}
Error-b	60	2.14	17.85	0.31	241.19	26.73	8.76	2675.8
CV%	-	0.89	3.78	6.77	12.68	10.46	7.83	14.62

ns: Non-Significant, * and **: Significant at 5% and 1% probability levels, respectively.

Table 3: Effect of sowing dates on yield and yield attributes of wheat at CCRI Pirsabak during 2013-14

Sowing Dates	DPM	PH (cm)	SL (cm)	Spike m^{-2}	GS^{-1}	1000-GW (g)	GY (kg ha^{-1})
Oct.25	174 a	116.2 a	10.80 a	292 a	65 a	53.50 a	5196 a
Nov.05	172 b	110.1 b	10.30 bc	287 ab	64 a	50.40 b	5008 ab
Nov.15	166 c	110.2 b	10.20 bc	268 bc	64 a	48.30 c	4679 c
Nov.25	159 d	107.4 c	12.00 a	262 c	62 b	49.90 c	4549 c
Dec.05	149 e	107.5 c	10.80 a	249 d	59 c	44.50 d	4187 d
Dec.15	141 f	99.3 d	9.70 c	238 e	54 d	40.50 e	3366 e
$LSD_{(0.05)}$	1.05	3.02	0.52	5.45	4.83	2.74	4.33

Means in the same category followed by different letters are significantly different from each other at 5% level of probability

significantly reduced from 10.80 cm to 9.70 cm when plantation was delayed from Oct. 25th to Dec. 15th. As the photoperiod and temperature increased, the wheat plants hastened to maturity to complete growth cycle due to which plant height and spike length had relatively shorter durations available for development. Strong interaction of the genotypes for various yield parameters to temperature and photoperiod have also been previously reported by Slafer and Rawson [20] though the possibility of genetic variability *per se* cannot be ruled out as reported by Haider [21] for variability in the number of grains spike^{-1} among wheat lines.

Significantly more spikes m^{-2} were recorded in early sown (Oct. 25) crop as compared to late sown crop (Dec. 15) (Table 3). Number of spikes m^{-2} ranged from a maximum of 292 (recorded for Oct. 15 sown crop) to a minimum of 238 (recorded for Dec. 15 sown crop), showing a decrease of 18.49% as sowing was delayed. Number of grains spike^{-1} significantly decreased from 65 to 54 when sowing of wheat lines was delayed from Oct. 25th to Dec. 15th. These findings are supported by Hanson [22], who reported significant variation in number of grains spike^{-1} for different sowing dates. Less number of grains spike^{-1} in the late sown crop can be attributed to sensitivity of the wheat plants to photoperiod and temperature [11]. Thousand grains weight were also decreased significantly as planting was delayed and this gradual loss in kernel weight continued till Dec. 15th. Early sown crop showed better grain development due to longer growing period available. These findings are strongly supported by Spink *et al*. [23] and Shahzad *et al*. [19], who had noted decrease in 1000-grains weight with the delay in sowing. Similarly, Dokuyucu *et al*. [2] had also reported significant decrease in grain weight between the earlier and later sown crop. In the present study too, the total grain yield per hectare was noted to decrease with the delay in planting, ranging from 5196 kg ha^{-1} (recorded for Oct. 25th sown crop) to 3366 kg ha^{-1} (recorded for Dec. 15th sown crop). The fact that delay in sowing can significantly affect grain yield, had also been reported by Tanveer *et al.* [3]. The decrease in over-all grain yield due to delayed planting might be attributed to decrease in yield components such as, number of productive tellers, grains spike^{-1} and 1000-grain weight because of the gradually lesser number of days available for growth [24]. Longer photoperiods and higher temperatures during the reproductive stage [11], undesirable environmental conditions and lack of suitable transformation of preserved matters to the seeds [25] in case of delayed sown crop have been reported as possible reasons for low grain yield.

Genotypic Differences among the Evaluated Wheat Lines: The yield and yield attributes (except days to physiological maturity) were significantly different among the various wheat genotypes tested (Table 1).

Table 4: Mean values of yield and yield attributes of wheat advanced lines at CCRI Pirsabak during 2013-14

Wheat Lines	DPM	PH (cm)	SL (cm)	Spike m^{-2}	GS^{-1}	1000-GW (g)	GY (kg ha^{-1})
PR-103	160 ab	112.4 a	10.1 b	286 b	57.6 a	46.3 c	4537 c
PR-105	160 ab	105.2 d	10.4 b	282 b	57.4 a	43.5 d	4499 c
PR-106	160 ab	110.5 b	9.9 b	288 b	56.3 ab	48.5 b	4605 b
PR-107	161 a	109.1 bc	11.3 a	298 a	56.4 ab	50.4 a	4803 a
PR-108	160 ab	107.0 cd	10.9 b	272 c	54.3 bc	46.0 cd	4241 d
PR-109	160 ab	105.0 d	10.2 b	264 d	53.3 c	47.5 bc	3847 e
LSD(0.05)	NS	2.81	0.52	4.42	3.44	1.97	3.44

Means in the same category followed by different letters are significantly different from each other at 5% level of probability.
NS = non-significant

The maximum plant height (112.4 cm) was recorded for the wheat line PR-103 followed by PR-106 and PR-107 (Table 4). Differences in plant height among the lines grown under the same agronomic conditions might be attributed to their genetic diversity [26]. Statistically greater spike length (11.3 cm) and spikes m^{-2} (298) were recorded for the genotype PR-107 as compared to the rest of wheat lines however, number of grains per spike (56.4) were statistically at par for the first four lines (Table 4). Grain yield and 1000-grain weight recorded for PR-107 was significantly different from the rest of the wheat lines evaluated in the experiment (Table 4). The difference is indicative of a superior genetic make-up in case of PR-107 in terms of grain weight and production of productive tellers per unit area. At physiological level this could be due to an efficient nutrient uptake which produces more and healthier plants and results in healthier and plump seeds. Differences in 1000-grain weight among varieties tested under similar conditions can only be attributed to their genetic diversity [19]. The interaction among different sowing dates and wheat lines for yield and yield attributes was not significant indicating the suitability of earlier sowing for all the genotypes evaluated (Table 1).

CONCLUSIONS

It can be concluded from the current study that the optimum period for growing wheat crop in general and varieties derived from the advanced lines in particular, is Oct 25th to Nov. 05th for obtaining maximum grain yield under agro-climatic conditions of Peshawar valley of Khyber Pakhtunkhwa and other similar regions. Moreover, on the basis of greater grain yield and better yield components, PR-107 is recommended for further adaptability tests at national and regional levels.

ACKNOWLEDGEMENTS

The author is thankful to the Director and wheat research team of Cereal Crop Research Institute Pirsabak (CCRI) Nowshera, for provision of research field, materials and technical facilities.

REFERENCES

1. Murungu, F.S. and T. Madanzi, 2010. Seed priming, genotype and sowing date effect on emergency, growth and yield of wheat in a tropical low altitude area of Zimbanwe. African J. Agri., Res., 5(17): 2341-2349.
2. Dokuyucu, T., A. Akkaya and D. Yigitoglu, 2004. The effect of different sowing dates on growing periods, yield and yield components of some bread wheat (*Triticum aestivum* L.) Cultivars grown in the East- Mediterranean Region of Turkey. Agron. J., 3(2): 126-130.
3. Tanveer, S.K., L. Hussain, M. Asif, M.Y. Mujahid, S. Muhammad, M. Qmar and M. Asim, 2009. Performance of different wheat cultivars/line as affected by different planting dates and seeding rates under high rainfall after of potohar. Pakistan J. Agri. Sci., 46(2): 102-10.
4. Ahmed, R., R. Munir, A. Zada and Z. Shah, 1997. Response of wheat varieties to different planting dates at Chitral Valley. Sarhad J. Agri., 13: 323-327.
5. Subhan, F., N. Ahmaed, M. Anwar, N.H. Shah, M. Siddiq, I. Ali, J. Rahman and T. Sajjad, 2004. Response of newly developed wheat cultivars/advance lines to planting dates in the central Agro-ecological zones of NWFP. Asian J. Plant Sci., 3(1): 87-90.
6. Baloch, M.S., I.T.H. Shah, M.A. Nadim, M.I. Khan and A.A. Khakwani, 2010. Effect of seeding density and planting time on growth and yield attributes of wheat. J. Animal and Plant Sci., 20(4): 239-40.
7. Akhtar, M., N. Ahmad, M. Nasrullah, B. Ali, A.R. Zahid and M.I. Shahid, 2012. Effect of late planting on emergence, tillering and yield of the various varieties of wheat. The J. Animal, & Plant, Sci., 22(4): 1163-1166.

8. Dabre, W.M., S.B. Lall and G.L. Lngole, 1993. Effects of sowing dates on yield, ear number, stomatal frequency and stomatal index in wheat. J. Maharashatra Agri. Univ., 18: 64-66.
9. Qamar, M., Shafiullah and S. Makeen, 2004. Genetic variability among wheat cultivars and effect of planting date on grain and straw yield under double cropping zone of Northern areas of Pakistan. Sarhad J. Agric., 20(1): 99-102.
10. Singh, S. and M. Pal, 2003. Growth, yield and phonological response of wheat cultivars to delayed sowing. Ind. J. PP. Phys., 8(3): 277-286.
11. Slafer, G.A. and E.M. Whitechurch, 2001. Manipulating wheat development to improve adaptation. In Application of Physiology in Wheat Breeding. Reynolds, M. P. Ortiz-Monasterio, J.I. and A. Mcnab. (Eds.). Mexico, D.F.: CIMMYT.
12. Kumar, R. and S.N. Sharma, 2003. Effect of levels of nitrogen on wheat as influenced by date of sowing. Annals of Agri. Res., 24(1): 104-110.
13. French, R.J., J.E. Schultz and C.L. Rudd, 2005. Effect of time of sowing on wheat phenology in South Australia. Aust. J. Exp. Agric. Anim. Husb. 19(96): 89-96.
14. Singh, T. and G.S. Dhaliwal, 2000. Performance of wheat varieties under late sowing conditions in south western region of Punjab. J. Res. Punjab Agri. Univ., 37(3-4): 181-183.
15. Subhan, F., M. Khan and G.H. Jamro, 2003. Weed management through planting date, seeding rate and weed control method in wheat. Pakistan J. Weed Sci. Res., 9(1-2): 49-57.
16. Qasim, M., M. Qamer, M. Faridullah and M. Alam, 2008. Sowing dates effect on yield and yield components of different wheat cultivars. J. Agric. Res., 46(2): 135-140.
17. MSTAT Development Team. 1993. MSTAT User's Guide: A Microcomputer Program for the Design Management and Analysis of Agronomic Research Experiments. Michigan State University, East Lansing, USA.
18. Jan, M.T., P. Shah, P.A. Hollington, M.J. Khan and Q. Sohail, 2009. Agriculture Research: Design and Analysis, A Monograph. NWFP Agric. Univ. Pesh. Pakistan.
19. Shahzad, K., J. Bakht, W.A. Shah, M. Shafi and N. Jabeen, 2002. Yield and yield components of various wheat cultivars as affected by different sowing dates. Asian J. PI. Sci., 1(5): 522-525.
20. Slafer, G.A. and H.M. Rawson, 1994. Sensitivity of wheat phasic development to major environmental factors: A re-examination of some assumptions made by physiologists and modellers. Aust. J. Plant Physiol., 21: 393-426.
21. Haider, R.S., 2004. Growth and yield response of three wheat varieties to N alone and in combination with P and P+K under late sown conditions. M.Sc. (Hons.) Agric. Thesis, (unpublished) Univ. Agri., Faisalabad-Pakistan,
22. Hanson, B., 2001. Planting date influence on yield and agronomic traits of hard red spring wheat in north eastern North Dakota. Langdon Res. Ext. Center NDSU Agric. Report I.
23. Spink, J.H., T. Semere, D.L. Sparkes, J.M. Whaley, M.J. Foulkers, R.W. Clare and R.K. Scott, 2000. Effect of sowing date on plant density of winter wheat. Ann. App. Biol., 137: 179-188.
24. Sandhu, I.S., A.R. Sharma and H.S. Sur, 1999. Yield performance and heat unit requirement of wheat (*Triticum aestivum* L.) varieties as affected by sowing dates under rainfed conditions. Indian J. Agric. Sci., 69: 175-179.
25. Emami, T., R. Naseri, H. Falahi and E. Kazemi, 2011. Response of yield, yield component and oil content of safflower to planting date and spacing on row in rainfed conditions of Western Iran. American-Eurasian. J. Agric. and Environ. Sci., 10(6): 974-953.
26. Ahmad, I.Z. 1991. Effect of irrigation and cultivars on the growth and yield of wheat. M.Sc (Hons.) Agri. Thesis (unpublished), Dept. Agron. Univ. Agric., Faisalabad-Pakistan.