PHILIPP AGRIC SCIENTIST
Vol. 101 No. 4, 326– 332
December 2018

ISSN 0031-7454

Optimization of Sowing Time and Seed Rates Can Enhance Wheat Yield in Semi-arid Environment

Abdul Basir[1,*], Adnan Tahir[1], Kilwat Afridi[2], Shah Fahad[1], Zahoor Ahmad[3], Muhammad Adnan[1], Mukhtar Alam[1], Shaheen Shah[4], Ahmad Khan[4], Fazli Wahid[1], Muhammad Ibrahim[1], Inayat-ur-Rahman[1], Mushtaq Ahmad Khan[1] and Rehad Ali[1]

[1]Department of Agriculture, University of Swabi, Khyber Pakhtunkhwa-Pakistan
[2]Cereal Crops Research Institute (CCRI), Pirsabak Nowshera Khyber Pakhtunkhwa-Pakistan
[3]Department of Agriculture, The University of Haripur, Khyber Pakhtunkhwa-Pakistan
[4]Department of Agronomy, The University of Agriculture Peshawar, Khyber Pakhtunkhwa-Pakistan

[*]Author for correspondence; e-mail: a.basir@uoswabi.edu.pk, abasir68@yahoo.com; Tel.: 0092-315-9777993; Address: Department of Agriculture, the University of Swabi, Anbar Swabi-23561, Pakistan

Optimization of planting time and seed rate are of prime importance to determine crop yield with change in climate. Hence, a field experiment was conducted using two-factorial randomized complete block design (RCBD) with split-plot arrangement where sowing time was assigned to main plots and seed rates were assigned to subplots to evaluate the response of wheat to varying seed rates (90, 100, 110, 120, 130 and 140 kg ha^{-1}) and planting time (sowing started from October 25 with a 10-d gap till December 15). Different planting time significantly affected heading stage, spike length, plant height, number of spikes per unit area, 1000-grain weight, biological and grain yield, and harvest index. Similarly various seed rates also had significantly affected spike production, grains per spike, grain weight, biomass, grain yield, and harvest index. Significant interactive effect of planting days and seed rates was noticed for spike production, 1000-grain weight and yield. Thus, to maximize yield, wheat should be grown from 25th October to 5th November at the rate of 120 kg seed ha^{-1} in the central plains of Khyber Pakhtunkhwa (KP) and other regions of similar agro-climatic conditions.

Key Words: plant population, seed rate, sowing dates, wheat cultivar, yield associated traits

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a staple food of Pakistan and is grown on an area of 9.2 million ha, producing 25.08 metric tons with an average yield of 2726 kg ha^{-1} (Economic survey of Pakistan, 2014–2015). However, the national yield per unit area is low compared with that of technologically advanced countries. Among the yield-limiting factors, late planting due to delayed harvest of the previous crop or lack of irrigation facility and use of improper seed rate may also reduce wheat yield.

Appropriate planting time is important for optimum production (Soomro and Oad 2002; Nazir et al. 2004; Sadeghipour 2008). Delayed sowing has shown a reduction in yield (Basir et al. 2015). Increasing seed rate is one of the ways to compensate for planting density caused by limited tiller in late-sown crops (Aslam et al. 2003; Ahmad et al. 2007). Nevertheless, use of higher seed rate can reduce number of grains spike^{-1} and 1000-grain weight (Khan et al. 2002; Mehrvar and Asadi 2006), though the overall grain yield per unit area is increased in delayed-sown crops (Shah et al. 2006).

Proper planting time plays an important role in wheat production and can influence seed development, quality and yield of wheat. Similar to optimum planting dates, the use of balanced and appropriate seed rates is important in wheat production, and therefore, has an effect on plant population, number of tillers m^{-2}, 1000-grain weight and straw yield (Amanullah et al. 2008). Although the number of spikes per unit area depends on variety or genotype and environment, it is strongly affected by seed rate (Fischer et al. 1976). Optimum planting time with optimum planting density improves crop efficiency, resulting in greater yield (Nazir et al. 2004).

With recent changes in agro-climatic conditions and the unpredictable rainfall pattern of the country, specifically of Khyber Pakhtunkhwa, there is a need for wheat genotypes to be tested at different times of the growing season and at different planting densities for yield optimization. Evaluation of wheat genotypes for optimum seed rate and planting period for irrigated and rainfed areas of Khyber Pakhtunkhwa is also important for setting a proper cropping pattern in wheat-growing regions. Therefore, the present study was conducted to find out appropriate seed rate and planting time for yield optimization and other agronomic traits of wheat variety Pirsabak-2013.

MATERIALS AND METHODS

Experiment Site

The influence of seed rate and planting time on wheat production was studied during 2013–14 and 2014–15 at the Cereal Crop Research Institute (CCRI) Pirsabak Nowshera, Pakistan under irrigated conditions. Soil in the farm is silt clay loam, moderately calcareous and deficient in total N (0.6 g kg^{-1} soil) and phosphorus (0.0002%). The farm is located in the semi-arid agro-climatic zone where annual rainfall is 300–500 mm.

Treatments

Wheat variety Pirsabak-2013 was tested on six different planting dates, i.e., October 25, November 5, 15, 25, and December 5, 15 of 2013. Six seed rates (90, 100, 110, 120, 130 and 140 kg ha^{-1}) were used on each date of sowing. The experiment was conducted in a two-factorial RCBD split-plot arrangement having three replications where six planting dates were assigned to main plots and different seed rates to subplots, making 36 treatments per replication.

Methodology

Wheat genotype Pirsabak-2013 was planted and sowing was done with the use of a hand hoe at respective planting times. Each subplot consisted of six rows of 5 m in length with 30 cm distance within rows. The total area of each subplot was 9 m^2. A distance of 1 m was kept between two main plots while 50 cm distance was maintained within subplots. Fertilizer N and P were applied in the form of urea and single super phosphate (SSP) at the rate of 120 and 60 kg N ha^{-1}, respectively. Fertilizer SSP was applied at the time of sowing as basal dose while urea was applied in split doses: half at the time of sowing and half with first irrigation. All agronomic practices such as weeding, irrigation at critical growth stages and plant protection measures were uniformly carried out in all experimental units at each sowing date. Data on agronomic traits, e.g., days to heading (d), plant height (cm) and spikes or productive tillers m^{-2} were recorded using a procedure described by Basir et al. (2016) and Arafat et al. (2016). Other agronomic data such as spike length (cm), grains per spike, thousand-grain weight (g), biological yield (kg ha^{-1}), grain yield (kg ha^{-1}) and harvest index (%) were recorded according to the standard protocols.

Statistical Analysis

The collected data were analyzed according to the procedure relevant to RCBD split plot and mean square values were reported (Table 1). Analysis of variance (ANOVA) and least significant difference test (LSD) were used to know treatment effects and to separate means, respectively (Jan et al. 2009).

RESULTS AND DISCUSSION

Effect of Planting Dates on Yield and Other Agronomic Traits of Wheat

Different sowing times had significantly affected heading duration of wheat variety Pirsabak 2013 (Table 1). Mean results showed statistically similar days to heading when wheat crop was planted from October 25 to November 25 of the growing season. However, the days to heading were statistically decreased when wheat sowing was delayed, i.e., sown after 25 November till December 15 (Table 1). The results showed that maturity duration had been reduced as sowing was delayed till December 15. Our results are consistent with those of Basir et al. (2015) who were of the opinion that days to maturity decrease as sowing is delayed due to exposure of the late-sown crop to relatively shorter growing period. Crops grown at different timings of the season pass through different environmental conditions at each developmental stage (Khan et al. 2001), and hence, need definite requirements of temperature and light for emergence, growth and days to heading (Hossain et al. 2011).

Statistical results showed that different sowing dates had significantly affected plant height of wheat variety Pirsabak 2013 (Table 1). The crop sown in October was significantly taller than the crop sown after November 05 and plant height decreased as sowing was delayed till December 15 (Table 2). The possible reason for the decrease in plant height is reduction in growing period for the late-sown crop (Basir et al. 2015). October-grown crops may have utilized better environmental conditions such as

Table 1. Mean square values for various agronomic traits of wheat variety Pirsabak-2013 evaluated under different seed rates at CCRI, Pirsabak.

Separation of Variables (SOV)	DF	DH	PH	SL	Spike m^{-2}	G S^{-1}	1000-GW	BY	GY	HI
Replication	2	76.36	0.56	0.0045	548.42	70.19	6.68	2.1700000	990389	18.78
Sowing date (SD)	5	1127.98**	884.86**	18.85**	1641.49**	75.40*	43.59**	146800000**	27240000**	116.91**
Error-a	10	105.74	26.53	0.513	509.62	51.57	3.33	3187002	477834	13.21
Seed Rate (SR)	5	99^{ns}	13.24^{ns}	0.28^{ns}	2401.11**	18.72*	3.51*	3303563*	118523*	11.37*
SD x SR	25	91.27^{ns}	5.36^{ns}	0.23^{na}	131.74*	12.53^{ns}	3.26*	2030657^{ns}	410993*	17.29^{ns}
Error-b	60	89.13	13.25	0.24	247.17	28.92	5.58	2901231	263045	17.25
CV%	-	8.65	5.47	5.96	12.68	14.17	3.56	11.26	13.24	11.06

ns: non-significant, * and **: significant at 5% and 1% probability levels, respectively DH – days to heading, PH – plant height, SL – spike length, G S^{-1} – grains per spike, GW – thousand-grain weight, BY – biological yield, GY – grain yield, HI – harvest Index

exposure to maximum radiations and temperature, and thus resulting in the tallest plants.

Similarly, sowing dates had significantly affected spike length and greater spike lengths (13.18 cm) were observed in the crop sown from October 25 to November 05 (Table 1). Spike length gradually decreased as planting was delayed. The spike length decreased probably due to delayed planting and caused plant sensitivity to long diurnal photoperiod and high temperature (Slafer and Whitechurch 2001; Sial et al. 2009). Photoperiod and temperature increased in the later growth stages, resulting in hastened maturity to complete life cycle due to shorter period for plant height and spike length in the growing season. Spikes m^{-2} ranged from 249 (December-planted crop) to 324 (October-planted crop) which shows that statistically higher spikes m^{-2} were recorded for the early crop compared with the late planted crop (Table 2). Similarly, statistically greater numbers of grains per spike were recorded for the crop sown between the last week of October and the first week of November. Number of grains per square meter decreased as sowing was delayed. Our results regarding spikes m^{-2} and grains $spike^{-1}$ concur with those of Basir et al. (2015). Minimum numbers of spikes m^{-2} and grains per spike in the delayed crop plants may be due to occurrence of less photosynthesis due to shorter growing period (Shahzad et al. 2002; Malik et al. 2009). Greater sensitivity due to long daily photoperiod and exposure to abrupt high temperature at reproductive growth stages decreased fertilization (Sial et al. 2005; Tanveer et al. 2009), respectively. Similarly statistically higher 1000 GW, bio-yield, grain yield and harvest index were recorded for the early sown crop (from Oct. 25 to Nov. 05) compared with the late sown crop (Table 2). Grain weight, biomass, grain yield and harvest index gradually decreased as wheat planting was delayed till mid-December. The improvement in yield and yield components as well as harvest index for the early sown crop (from October 25 to November 05) might be ascribed to optimal environment during the grain filling stage and more plant height and stem thickness compared with the late sown crop. Ahmad et al. (1996) and Basir et al. (2015) also reported similar results. Other possible reasons for decreased grain yield, yield components and biomass in the delayed sown plots could be low temperature at sowing time, resulting in poor germination and crop stand. Delayed planting could expose plants to undesirable environmental conditions which may impair assimilate transformation to the kernels as a result of increasing temperature at reproductive stage and therefore, decreases individual plant growth and tiller production (Nazir et al. 2004;

Table 2. Main effect of sowing dates on heading stage (HS), plant height (PH), spike length (SL), spikes m^{-2}, grains per spike (G S^{-1}), thousand-grain weight (1000-GW), biological yield (BY), grain yield (GY) and harvest index (HI) of wheat at CCRI Pirsabak.

Sowing Dates	HS (d)	PH (cm)	SL (cm)	Spike m^{-2}	G S^{-1}	1000-GW (g)	BY (kg ha^{-1})	GY (kg ha^{-1})	HI (%)
Oct. 25	128 a	101.4 a	13.18 a	324 a	51 a	53.16 a	18284 a	6513 a	35.62 a
Nov. 05	129 a	97.6 b	13.18 a	308 b	51 a	51.81 b	18271 ab	6464 ab	35.38 a
Nov. 15	123 a	97.0 b	12.49 ab	298 b	50 ab	50.55 b	17963 b	6020 c	33.51 b
Nov. 25	120 a	97.4 b	12.12 b	281 c	49 b	49.56 c	16420 b	5160 d	31.43 c
Dec. 05	112 b	90.2 c	10.94 c	264 d	46 c	47.52 d	14444 c	4519 e	31.29 c
Dec. 15	107 b	82.0 d	10.60 c	249 e	45 c	43.82 e	10741 d	3020 f	28.12 d
LSD $_{(0.05)}$	7.63	3.82	0.53	6.23	5.33	1.35	1325.9	513.40	2.69

Means followed by different letters are significantly different at 5% level of probability.

Emami et al. 2011). Kamrozzaman et al. (2016) has also reported similar results for harvest index.

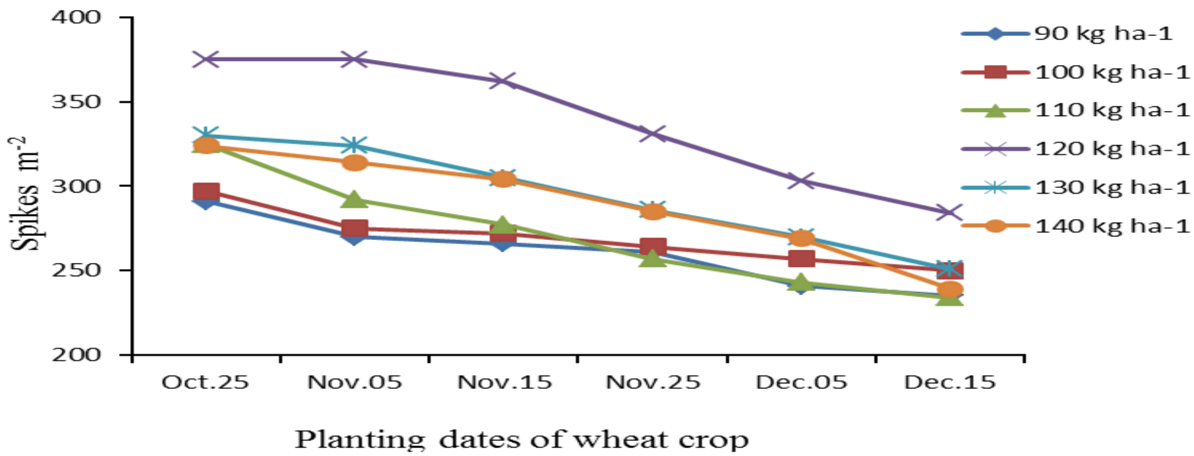
Seed Rate Effects on Yield and Other Agronomic Traits of Wheat

Different seed rates had not significantly affected heading duration, plant height and spike length of wheat crop (Table 3). However, statistically different spikes m^{-2} was observed at different seed rates. Greater spikes m^{-2} was recorded when wheat was planted with seed quantity of 120 kg seed ha^{-1} compared with other seed rates. The reason for the greater number of spikes by using 120 kg seed ha^{-1} may be due to judicious utilization of proper space, nutrients and radiation by individual plant, thus improving fertilization compared with seed rates that used more than 120 kg ha^{-1}. Statistically greater 1000-grain weight was observed in the plots sown at a seed rate of 90 kg ha^{-1} (Table 3). Grain weight decreased as the seed rate increased and lowest grain weight was observed in plots where a seed rate of 140 kg ha^{-1} was used. The decrease in grain weight in the higher seed rate plots was due to distribution of less nutrients, space and radiation among the higher number of plants per unit area. On the other hand, statistically greater bio-yield and grain yield were recorded where 120 kg seed ha^{-1} was used while statistically lowest bio-yield and grain yield were recorded where 140 kg seed ha^{-1} was planted. The reason for higher bio-yield and grain yield is that optimum seed rate, i.e., 120 kg per hectare, has resulted in optimum plant population which utilized the available nutrients, space and radiation for proper translocation of photosynthetic materials to the sink and thus individual plant dry weight increased. Our arguments are further confirmed by Sial et al. (2001), who found that different planting geometry of wheat crop affect the biomass, 1000-grain weight and other yield components. Biological yield is interrelated with plant height and number of tillers per unit area (Ahmad et al. 1996; Akhtar et al. 2012; Lak et al. 2013). Therefore, the optimum seed rate (120 kg ha^{-1})

Table 3. Effect of seed rate on heading stage (HS), plant height (PH), spike length (SL), spikes m^{-2}, grains per spike (G S^{-1}), thousand grain weight (1000-GW), biological yield (BY), grain yield (GY) and harvest index (HI) of wheat at CCRI Pirsabak.

Sowing (kg ha^{-1})	HS (d)	PH (cm)	SL (cm)	Spike m^{-2}	G S^{-1}	1000-GW (g)	BY (kg ha^{-1})	GY (kg ha^{-1})	HI (%)
90	120	93.8	12.04	261 d	51.8 a	51.08 a	15284 d	5094 e	33.33 a
100	120	93.8	11.84	269 c	50.7 a	50.26 ab	16271 c	5160 d	31.71 b
110	120	94.0	12.19	271 c	50.0 a	49.80 b	16963 b	5338 b	31.47 b
120	120	95.0	12.45	338 a	50.0 a	49.19 b	17420 a	5495 a	31.54 b
130	120	93.2	11.99	294 b	46.0 b	48.32 bc	17412 a	5360 b	30.78 b
140	120	95.0	12.02	289 b	45.0 b	47.75 c	17331 ab	5250 c	30.29 b
LSD $_{(0.05)}$	NS	NS	NS	11.05	3.50	1.57	1135.70	441.97	2.76

Means followed by different letters denote significant difference at 5% level of probability.



. **Fig. 1. Interactive effect of planting time and seed rate on numbers of spikes per unit area of wheat**

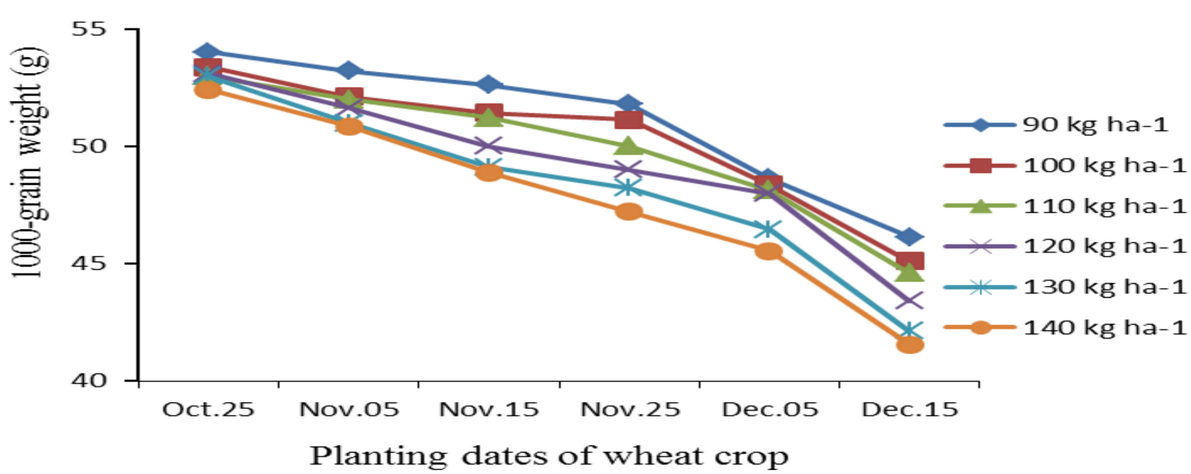
resulted in greater biological and grain yield compared with the rest of the planting seed rates. However, greater harvest index was recorded for low seed rate (90 kg ha^{-1}) used in the experiment compared with the rest of the seed rates where similar harvest index was observed.

Planting Time and Seed Rate Interaction Effect

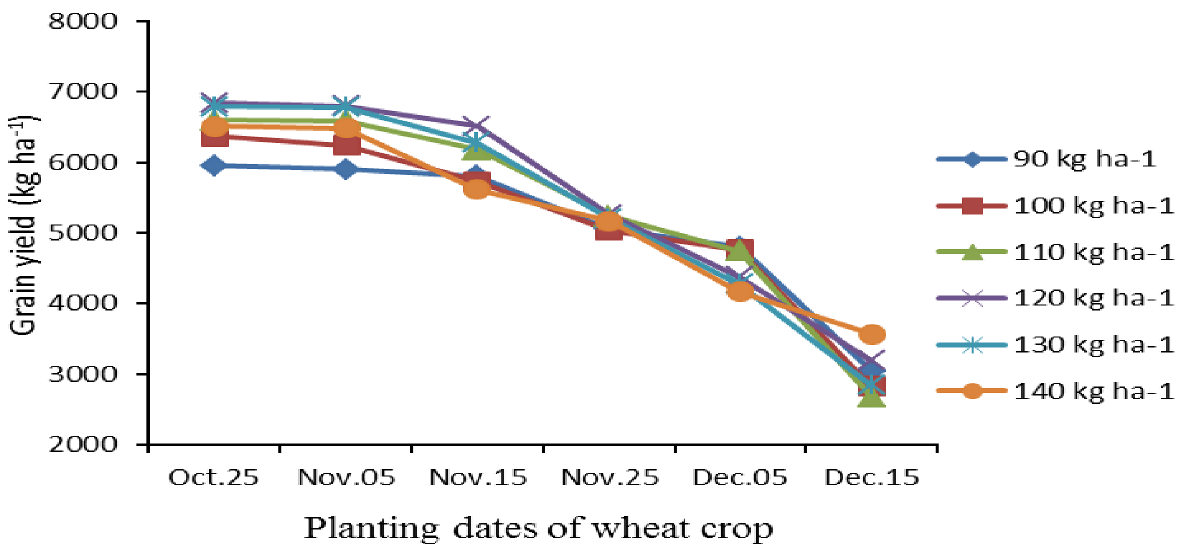
Different sowing dates and their interaction with seed rate had not significantly affected all the parameters except spike m^{-2}, 1000 grain weight and grain yield (Table 1). Numbers of spikes were significantly influenced by planting dates and seed rate interaction (Fig. 1). Greater variation in spikes produced per unit area was observed at different planting times and seed rates. Number of spikes per unit area increased when crop was sown early (October 25) using a seed rate of 120 kg ha^{-1}. Spike per unit area production decreased as wheat planting was delayed and seed rate increased (Fig. 1). Similar trends were observed for 1000-grain weight in case of planting dates, however, higher grain weight was observed with use of the lowest seed rate (90 kg ha^{-1}) compared with plots where the highest seed rate (140 kg ha^{-1}) was used (Fig. 2). Grain yield responded positively to early planting and application of 120 kg seed ha^{-1} (Fig. 3). Minimum grain yield was observed in delayed sown plots (Dec. 15 sown plots) and in plots sown with 140 kg seed per hectare. The possible reasons for variation in spikes, grain weight and yield at different planting dates and seed rate have already been explained earlier.

CONCLUSION

Optimization of planting time and seed rate had a great effect on wheat production under semi-arid conditions. Planting of wheat in early winter from October 25 to November 5 had shown significant improvement in plant growth, fertilization, spike production, grain weight, grains per spike, bio-mass and grain yield, while delay in



. **Fig. 2. Wheat 1000-grain weight (g) as affected by interaction of planting time and seed rate.**



. **Fig. 3. Integrated effect of planting time and seed rate on grain yield of wheat.**

the planting of crop decreased both yield and biomass. Seed sown at the rate of 120 kg ha^{-1} performed statistically better than the rest of the treatments in terms of tillering capacity, grain weight and grain yield. Based on these findings, wheat should be preferably be planted at the rate of 120 kg seed ha^{-1} between the last week of October and the first week of November in the semi-arid environment of Khyber Pakhtunkhwa and in other regions of similar agroclimatic conditions.

ACKNOWLEDGMENTS

The author is highly grateful to the management and support staff of the Cereal Crop Research Institute for providing land for research and extending technical and logistic support. The author is also grateful to the reviewers for their valuable suggestions and comments on the manuscript.

REFERENCES CITED

AHMAD J, CHAUDHRY MH, DIN S, ALI MA. 1996. Stability for grain yield in wheat. Pak J Bot 28(1): 61–65.

AHMAD N, RAHIM M, KHAN U. 2007. Evaluation of different varieties, seed rates and row spacing of groundnut, planted under agro-ecological conditions of Malakand Division. Agron J 6(2): 385–387.

AKHTAR M, AHMAD N, NASRULLAH M, ALI B, ZAHID AR, SHAHID MI. 2012. Effect of late planting on emergence, tillering and yield of the various varieties of wheat. J Anim Plant Sci 22(4): 1163–1166.

AMANULLAH Z, AHMAD K, JAN D. 2008. Performance of wheat cultivars sown at different seed rate under drought stress condition. Arch Agron Soil Sci 56: 99–105.

ARAFAT Y, SHAFI M, KHAN MA, ADNAN M, BASIR A, RAHMAN IU, ARSHAD M, KHAN, SALEEM N, ROMMAN M, RAHMAN Z, SHAH JA. 2016. Yield response of wheat cultivars to zinc application rates and methods. Pure Appl Biol 55(4): 1260–1270.

ASLAM M, HUSSAIN M, AKHTAR M, CHEEMA MS, ALI L. 2003. Response of wheat varieties to sowing dates. Agron J 2(4): 190–194.

BASIR A, ALI R, ALAM M, SHAH AS, AFRIDI K, ADNAN M, IBRAHIM M, REHMAN I, TAHIR A. 2015. Potential of wheat (Triticum aestivum L.) advanced lines for yield and yield attributes under different planting dates in Peshawar Valley. Am Eurasian J Agric Environ Sci 15(12): 2484–2488.

BASIR A, JAN MT, ARIF M, KHAN MJ. 2016. Response of tillage, nitrogen and stubble management on phenology and crop establishment of wheat. Int J Agric Biol 18: 1–8.

EMAMI T, NASERI R, FALAHI H, KAZEMI E. 2011. Response of yield, yield component and oil content of safflower (cv. Sina) to planting date and plant spacing on row in rainfed conditions of western Iran. Am Eurasian J Agric Environ Sci 10(6): 947–953.

FISCHER RA, AGUILAR I, MAURER R, RIVAS S. 1976. Density and row spacing effects on irrigated short wheat at low latitude. J Agric Sci 87: 137–147.

HOSSAIN A, SARKER MAZ, HAKIM MA, LOZOVSKAYA MV, ZVOLINSKY VP. 2011. Effect of temperature on yield and some agronomic characters of spring wheat (Triticum aestivum L.) genotypes. International Journal of Agricultural Research, Innovation and Technology (IJARIT) 1 (1&2): 44–54.

JAN A, HAMID I, JAN M. 2000. Yield and yield components of wheat as influenced by seed rate and sowing dates. Pak J Biol Sci 3(2): 323–325.

KAMROZZAMAN MM, KHAN MAH, AHMED S, SULTANA N. 2016. Growth and yield of wheat at different dates of sowing under charland ecosystem of Bangladesh. J Bangladesh Agril Univ 14(2): 147–154.

KHAN AZ, KHAN H, KHAN R, GHONEIM A, EBID A. 2002. Effect of sowing dates and seed rates on yield and yield components of wheat. Trends Appl Sci Res 2 (6): 529–534.

KHAN MA, ANWAR J, SATTAR A, AKHTAR MA. 2001. Effect of seed rate on wheat yield under different sowing dates and row spacing. J Agric Res 39: 223–30.

LAK M, FARNIA A, SHABAN M. 2013. Effect of different sowing dates on yield components of wheat cultivars in Lorestan province, Iran. Adv Agric Biol 1(4): 89–93.

MALIK AU, HAJI MA, BUKHSH A, HUSSAIN I, ATHAR MA, ALI M. 2009. Comparative performance of some new wheat cultivars in agro-ecological zone of Dera Ghazi Khan. J Anim Plant Sci 19(2): 78–81.

MEHRVAR MR, ASADI H. 2006. Agronomical and economical assessment of planting methods and seeding rates in irrigated wheat. J Agron 5(4): 626–633.

NAZIR A, ULLAH F. 2004. Effect of different seeding rates, sown dates and weed control on grain yield of wheat. Pak J Weed Sci Res 11(3-4): 19–23.

SADEGHIPOUR O. 2008. Response of mungbean varieties to different sowing dates. Pak J Biol Sci 11 (16): 2048–2050.

SHAH WA, BAKHT J, ULLAH T, KHAN AW, ZUBAIR M, KHAKWANI AA. 2006. Effect of sowing dates on the yield and yield components of different wheat varieties. J Agron 5(1): 106–110.

SHAHZAD K, BAKHT J, SHAH WA, SHAFI M, JABEEN N. 2002. Yield and yield components of various wheat cultivars as affected by different sowing dates. Asian J Plant Sci 1(5): 522–525.

SIAL MA, ARAIN MA, JAVED MA, NIZAMANI NA. 2001. Response of wheat genotypes on yield and yield components with changing plant population densities. Pak J Bot 33: 797–800.

SIAL MA, ARAIN MA, KHANZADA SD, NAQVI MH, DAHOT MU, NIZAMANI NA. 2005. Yield and quality parameters of wheat genotypes as affected by sowing dates and high temperature stress (2005). Pak J Bot 37(3): 575–584.

SIAL MA, DAHOT MU, ARAIN MA, MARKHAND GS, MANGRIO SM, NAQVI MH, LAGHRI KA, MALAH AA. 2009. Effect of water stress on yield and yield components of semi-dwarf bread wheat (Triticum aestivum L.). Pak J Bot 41(4): 1715–1728.

SLAFER GA, WHITECHURCH EM. 2001. Manipulating wheat development to improve adaptation. In: Reynolds MP, Ortiz-Monasterio JI, McNab A, editors. Application of Physiology in Wheat Breeding. Mexico, D.F.: CIMMYT. 160–170.

SOOMRO A, OAD FC. 2002. Yield potentials of wheat genotypes under different planting times. J Appl Sci 2 (7): 713–714.

TANVEER SK, HUSSAIN L, ASIF M, MUJAHID MY, MUHAMMAD S, QMAR M, ASIM M. 2009. Performance of different wheat cultivars/line as affected by different planting dates and seeding rates under high rainfall after of Potohar. Pak J Agric Sci 46 (2): 102–106.