EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 10/ January 2015

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Performance of Newly Developed Wheat Advanced Lines Evaluated under Different Planting Dates for Important Traits

GULZAR AHMAD
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
MUHAMAMD ISHAQ
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
Department of Plant Breeding and Genetics
The University of Agriculture, Peshawar, Pakistan
SAJJAD KHAN
Directorate of Livestock Research & Development Agriculture
Department Khyber Pakhtunkhwa-Peshawar, Pakistan
REHAD ALI
Directorate of Livestock Research & Development Agriculture
Department Khyber Pakhtunkhwa-Peshawar, Pakistan
KHILWAT AFRIDI
Department of Plant Breeding and Genetics
The University of Agriculture, Peshawar, Pakistan
IBNI ANIN KHALIL
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan
Department of Plant Breeding and Genetics
The University of Agriculture, Peshawar, Pakistan
IRFAN AHMAD SHAH
Cereal Crops Research Institute (CCRI)
Pirsabak Nowshera Khyber Pakhtunkhwa, Pakistan

Abstract:

Development of new lines in wheat and its evaluation under different planting dates is pre requisites to select promising lines for normal and late planting production system. The study was carried out 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, Dec.15) at Cereal Crops Research Institute, Pirsabak, Nowshera during 2013-2014. The Experiment was laid out in randomized complete block design with split-plot arrangement replicated thrice. Sowing dates were assigned to main plot and Lines were assigned to subplots. Data were recorded on days heading, Flag leaf area (cm^2), Chlorophyll content at post anthesis stage, Spikelets $Spike^{-1}$, Biomass yield ($kg\ ha^{-1}$) and Harvest index (%). It was observed that delay in sowing decreased values of all the parameters except harvest index. Highly significant differences were found among the planting dates and lines. It is concluded from the present study that for high yield in wheat early planting is recommended.

Key words: Wheat (*Triticum aestivum* L) advance lines, planting dates, yield components

Introduction

Wheat (*Triticum aestivum* L.) belongs to family Gramineae and is one of the leading cereals of many countries of the world. Its diverse uses, nutritive importance and storage qualities have made it a staple food for more than one-third of the world population. It is adapted to temperate regions from 30-60N and 27-40° S latitudes. is grown all over the world, with different varieties sown according to the various climates the greatest portion of the wheat flour produced is used for bread making. Wheat grain contains all essential nutrients; kernel contains about 12 percent water, including carbohydrates (60-80% mainly as starch), proteins (8-15%) containing adequate amounts of all essential amino acids (except lysine, tryptophan and methionine), fats (1.5-2%).

In Pakistan wheat occupies 37.1% of the total cropped area while its share in total production is about 70%. It is the principal food grain produced and occupies a leading position in the cropping patterns of Pakistan. Wheat contributes 10.1

percent to the value added in agriculture and 2.2 percent to the GDP. Wheat was grown in Pakistan on an area of 8.7 million ha which produced 24.2 million tons with an average yield of 2787 kg ha^{-1} during 2009-10 (Economic survey of Pakistan, 2012-113). The average yield of wheat in Pakistan is very low when compared with technologically advanced countries of the world like USA, Australia, France, China, Brazil etc.

Low yield of wheat Pakistan in as a whole is attributed to various factors such as planting date is one of the major factor which determine the ability of the crop to stand against different environmental conditions (air, temperature and humidity). Appropriate sowing date is important to have the crop in the field, when environmental conditions are conducive for growth and development. Variation in weather conditions among and within seasons is one of the most important constraints affecting yield potential (murungu and madanzi, 2010). Therefore one of the requirements for obtaining high yield is the choice of the suitable sowing date due to variations in weather conditions among seasons and developing new high yielding cultivars and by adopting proper sowing date. One of the most important factors influencing the wheat yield is sowing time. Many researchers have carried out some studies on sowing times of wheat and found different results (Dokuyacu *et al*., 2004; Tanveer *et al*., 2009).

Wheat is sown in winter and it has its own definite requirements for temperature and light for emergence, growth and flowering (Dabre *et al*., 1993). Early sowing always produces higher yield than late sowing. Early sown wheat had higher grain yield Qamar *et al*., 2004). The detrimental effect of delayed sowing on grain yield was maximum with reduction in 1000-grain weight (Singh and Pal, 2000; Subhan *et al*., 2004). Delayed sowing also significantly reduced test weight (Kumar and Sharma,2003). High temperature and desiccating winds during the month of April might caused forced maturity of late sown wheat, thus resulting in reduction of test weight (Singh

and Dhaliwal, 2000). Higher grain crude protein content but lower grain sizes were obtained with delayed sowing (Patil *et al*, 2000). High temperature in the post anthesis period of late sown wheat shortened the grain filling period resulting in a smaller endosperm, lower grain weight and increased protein content (Ahmed *et al*, 1994). Subhan *et al*. (2003) and Qasim *et al*. (2008) concluded that crop planted on November 15, produced higher grain yield as compared to late and early planting. However, mid-season sowing of winter wheat for any locality is usually most favourable. When optimum condition was provided by the wheat cultivar, grain filling period was higher as compared to late sown condition under high temperature stress at maturity.

Cereal Crops Research Institute (CCRI), Pirsabak KPK Pakistan has the mandate to produce wheat varieties suitable for normal and late planting in rainfed and irrigated areas of the province. Every year, the promising lines are tested in a sowing dates trial to record their yield performance in various sowing dates and later on make recommendations of these prospective wheat varieties for normal and/or late planting in various parts of KPK. The present study was also undertaken in this perspective. Keeping this in view, the present project was therefore designed with the objectives to find out the effect of sowing dates on yield and yield components of different wheat (*Triticum aestivem L.*) advance lines.

Materials and Methods

The experiment was conducted at Cereal Crops Research Institute, Pirsabak Nowshera during 2013-2014. The experimental site located at 34^{o}N Latitude, 72^{o}E Longitude and 288m Altitude. Six newly developed wheat advance lines namely PR-103, PR-105, PR-106, PR-107, PR-108 and PR-109 were planted on six different sowing dates i.e. October 25, November 5, 15, 25 and December 5 and 15 in a randomized

complete block design with split plot arrangement with three replications Each entry was grown in six rows of five meters long with row to row distance of 30 cm. Plot area was 9 m^2. Uniform seed rate of 100 kg ha^{-1} was used. Planting was done with hand hoe. Fertilizer was applied at the ratio of 120:60 kg ha-1 of NP in the form of Single Super Phosphate (SSP) and Urea. 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. All other recommended and standard agronomic practices were kept normal and uniform for all the experimental units in order to reduce experimental error. Data were recorded on Days to 50% heading, Flag leaf area (cm^2), Chlorophyll content at post anthesis stage, Spikelets $Spike^{-1}$, Biomass yield (kg ha^{-1}) and Harvest index (%).

Statistical analysis:

Data were analyzed statistically with the statistical package MStat-c (Knowledge Dynamics Corporation, USA). The ANOVA test was used to determine significant ($p<0.01$ or $p<0.05$) treatment effect. LSD test was also applied for the significance of treatment differences.

Results and Discussion

Days to 50% heading

Analysis of variance results revealed highly significant differences ($P\leq0.01$) for sowing dates and advanced lines while, non significant differences for date of sowing x advanced lines interaction were observed(Table1). Maximum number of days (130) for 50% heading were recorded when sowing was done on Oct.25th. Days to heading decreased gradually to (107) days as sowing was delayed till Dec.15th. Similar finding were also reported by (Khan *et al.2001)* stated that growing crops at different sowing dates pass through each development stage under different environmental condition. There was no

significant difference in days to 50% heading of the mean of varieties except the PR-109, took minimum days to heading as compared with PR-107 and PR-106. However, as the time passed, differences between varieties/lines became prominent. PR- 103, PR-105 and PR-106 reached up 50% heading in the minimum number of 107,107 and 108 days showing an 18.3, 17 and 19.4% decrease while PR-107,PR-108 and PR-109 recorded 108, 106 and 105 days, showing an 19, 15.8 and 16% decrease in days to 50% heading respectively, when sown on Dec.15th as compared with Oct.25th (Table 2).

Flag leaf area (cm^2)

Average mean data showed that the flag leaf area were decreased significantly with delay planting dates (Table1).There were also significant differences among the varieties/lines for flag leaf area. The flag leaf area (39.9cm^2) was recorded when sowing was done on Nov.5th. These flag leaf area were the maximum across all sowing dates while the minimum flag leaf area was (30cm^2), recorded when sowing was done on Dec.15 which was significantly different due to the different sowing date. On average mean data showed that the PR-108 were the maximum flag leaf area (37.3cm^2) was recorded, and PR-107 were the minimum flag leaf area recorded (33.8cm^2) (Table 3). On average mean data showed that the flag leaf area was decrease from 9 to 20% when sowing was done on Oct. 25th as compare to Dec25th. Elevation in temperature accelerates plant development while growth rate declined showing decline in leaf size and spike size which ultimately result in low yield. (Sial *et al*. 2001). The significant interaction between genotype and sowing dates shows the sensitivity of different genotypes to photoperiod and temperature differently for flag leaf area.

Chlorophyll content at post anthesis stage

Sowing dates were significant affect on Chlorophyll content at post anthesis of the various varieties advance lines (Table 1). On average, the maximum Chlorophyll content at post anthesis stage 44.6c were recorded when sowing was done on Oct.25th and the minimum 39 were recorded when sowing was done on Dec.15th. There was no significant difference in Chlorophyll content at post anthesis stage of the mean of various varieties/advance lines. Differences between varieties/advance lines became prominent with time passed. Chlorophyll content at post anthesis stage PR- 103, PR-105, and PR-106 were recorded to 44.5, 42.6 and.47.2 showing an 15.2, 7.2 and 18.2% decrease while PR-107, PR-108 and PR-109 were recorded 44.9, 43.4 and 45.1 showing an 14.9, 7.6 and 5% decrease in Chlorophyll content at post anthesis stage, respectively, when sown on Oct.25th as compared with Dec.15th (Table 4).

Spikelets Spike^{-1}

Average mean result showed that the Spikelets Spike^{-1} decreased significantly from the maximum value of 17.2 for the Oct. 25th sown crop to the minimum value of 15.9 when sowing was done on Dec.15. On average data recorded that PR-103 gave the large number of 18.8 Spikelets Spike-1 which was not significantly different from that of PR-107 and PR-105, while PR-109 produced the smallest 16.6 Spikelets Spike-1. The number of spikelets per spike probably decreased because of reduction in spike length. The decrease was significant when sowing was done on Oct.25. It decreased to 7.5% in mean, when planting was done on Dec.15th. (Table 5). According to Shafiq (2004) early sowing enhanced spikelets per spike over late sowing. There was no significant difference in spike length of the mean of various varieties/advance lines except PR-109 which have less number 16.6 and significantly effected as compare to other wheat advance lines. The number of spikelets per spike probably decreased because of reduction in spike

length, although it is not necessary because in lax spikes, the number of spikelets per spike is small and it is the characteristic of some varieties (Hussain, 1995).

Biomass yield (kg ha^{-1})

On average mean table revealed that the biomass yield were decreased significantly with delay planting date (Table1). There were also significant differences among the whaet lines for biomass yield. The biomass yield (19517kg/ha) was recorded when sowing was done on Oct. 25th. This Biomass yield were the maximum across all sowing dates, while the minimum biomass yield was (9820kg/ha) recorded when sowing was done on Dec.15 which was highly significant different due to the delay in sowing time. These findings are in agreements with those of Wajjid (2004), who also reported that early planting increases biomass yield while late planting decreases biomass yield. On average mean data showed that the PR-106 was the maximum biomass yield (16651kg/h) were recorded, and the minimum biological yield of PR-109 (14095kg) were recorded. This biomass yield was decrease from 43.2 to 52.3% when sowing was done on Oct. 25th as compare to Dec 25th. On average mean data showed that a lot of decrease due to delay in sowing time. The first reason may be more suitable climatic condition for maximum vegetative and reproductive components resulted increased biomass yield. Secondly it may be due to reproductive plants unit-1 area. In later sowing date's biomass and grain yield decreased due to undesired environmental conditions and lack of suitable transforming preserved matters to seeds as a result of increasing temperature at the end of growth season (Emami *et al*., 2011).

Harvest index (%)

On average mean table revealed that the harvest index (%) were significantly affected by delay planting dates, on Dec.15th, harvest index (%) were increase significantly to 33.2%. this

harvest index were the maximum across all sowing dates while the minimum harvest index (26.8%) were recorded when sowing was done on Oct.25th (Table7). There were significant differences among the wheat advance lines for the harvest index (%). PR-109 were recorded 25.8% decrease significantly and PR-105 were recorded the maximum harvest index 30.1%. The interaction of wheat lines and sowing date for harvest Index (%) was non-significantly affected. On average mean data showed that the harvest index was increased 19.2% when sowing was done on Oct. 25th as compare to Dec 25th. The contrasting results reported by Wajjid (2004), who observed that both early and delay planting affect harvest index significantly.

Conclusions

It was observed that delay in sowing decreased values of all the parameters except harvest index. Highly significant differences were found among the planting dates and lines. It is concluded from the present study that for high yield in wheat early planting is recommended.

Table1. Analysis of variance (mean squares) for various traits of wheat advance lines evaluated under different sowing dates.

SOV	DF	Days to heading	Leaf area	C.T. at post anthesis	Spikelets/spike	Biological yield	Harvest index
Replication	2	8.44	33.24	0.45	0.34	26.02	116.9
Date of sowing	5	1514.31**	281.58**	37.04**	20.28**	150.54**	130.93**
Error a	10	7.03	12.26	0.84	1.59	2.14	17.66
Advanced Lines	5	91.97**	25.95*	0.62ns	6.90**	9.61**	48.28*
Date of sowing x Advanced Lines	25	6.97ns	8.98ns	0.71ns	1.80*	1.86ns	13.81ns
Error b	60	4.44	11.11	0.75	1.06	1.98	16.7

Table 2. Mean values for Days to 50% heading of newly developed advance lines planted on different planting dates at CCRI, Pirsabak Nowshera during 2013 -14.

	Sowing dates						
Wheat Lines	**Oct. 25**	**Nov. 5**	**Nov. 15**	**Nov. 25**	**Dec. 5**	**Dec.15**	**Mean**
PR-103	131ab	131ab	122d-h	119h-k	114i-m	107p	121b
PR-105	129bc	130bc	122e-h	117i-l	116k-m	107p	120bc
PR-106	134a	132ab	124d-g	120g-j	113mn	108op	122a
PR-107	134a	133a	125d-f	121g-i	114l-m	108op	123a
PR-108	126cd	131ab	121f-h	117j-m	114i-m	106p	119c
PR-109	125de	124d-g	117j-m	116k-m	111no	105p	116d
Mean	130a	130a	122b	118c	114d	107e	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates):1.96 LSD (wheat advance lines):1.40 LSD (sowing dates x wheat advance lines):3.43

Table 3. Mean values for flag leaf area of newly developed wheat advance lines planted on different dates evaluated at CCRI Pirsabak during 2013 -14.

	Sowing Dates						
Wheat Lines	**Oct. 25**	**Nov. 5**	**Nov. 15**	**Nov. 25**	**Dec. 5**	**Dec.15**	**Mean**
PR103	39.5a-c	39.4a-d	35.2b-h	34.1c-j	30.2h-k	30.4h-k	34.8b
PR105	37.9a-e	39.3a-d	41.0a	36.5a-g	32.3f-k	28.6jk	35.9ab
PR106	33.9d-k	39.0a-d	34.1c-j	34.8b-i	30.0h-k	30.8h-k	33.8b
PR107	35.3b-h	41.2a	37.0a-g	37.5a-f	29.4i-k	30.2h-k	35.1ab
PR108	40.0ab	41.3a	41.2a	39.1a-d	30.8h-k	31.4g-k	37.3a
PR109	34.7b-i	38.8a-d	39.0a-d	35.2b-h	32.8e-k	28.k	34.8b
Mean	36.9b	39.9a	37.9ab	36.2b	30.9c	30.0c	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates):2.60 LSD (wheat advance lines):2.22 LSD (sowing dates x wheat advance lines):5.44

Table 4. Mean values for Chlorophyll content at post anthesis stage of newly developed wheat advance lines planted on different dates evaluated at CCRI Pirsabak during 2013 -14.

	Sowing Dates						
Wheat Lines	**Oct. 25**	**Nov. 5**	**Nov. 15**	**Nov. 25**	**Dec. 5**	**Dec.15**	**Mean**
PR-103	44.5a-e	43.9a-f	46.2ab	41.9a-g	42.7a-g	37.7g	42.8a
PR-105	42.6a-g	43.5a-g	42.6a-g	41.4a-g	41.3a-g	39.5d-g	41.7a

PR-106	47.2a	44.1a-f	41.4a-g	40.3b-g	44.5a-e	38.1fg	42.6a
PR-107	44.9a-d	43.2a-g	40.9b-g	41.0b-g	42.6a-g	38.2fg	41.1a
PR-108	43.4-ag	44.0a-f	41.6a-g	41.2a-g	40.7b-g	40.1b-g	41.8a
PR-109	45.1a-c	38.5e-g	39.4e-g	43.1a-g	40.4b-g	42.8a-g	41.5a
Mean	44.6a	42.8ab	42.0b	41.5b	42.1b	39.0c	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 1.77 LSD (wheat advance lines):2.59 LSD (sowing dates x wheat advance lines):6.36

Table 5. Mean values for Spikelets Spike-1 of newly developed wheat advance lines planted on different dates evaluated at CCRI Pirsabak during 2013 -14.

	Sowing Dates						
Wheat Lines	**Oct. 25**	**Nov. 5**	**Nov. 15**	**Nov. 25**	**Dec. 5**	**Dec.15**	**Mean**
PR-103	16.7e-h	19.7ab	19.0a-c	17.7c-g	16.7e-h	17.4c-h	18.8ab
PR-105	18.7b-d	18.3b-e	18.0b-f	18.0b-e	17.3c-h	16.0gh	17.7ab
PR-106	17.0c-h	18.3b-e	18.0b-f	18.3b-e	16.3f-h	16.0gh	17.3b
PR-107	18.3b-e	20.7a	19.7ab	17.7c-g	17.0c-h	17.0c-h	18.4a
PR-108	16.3f-h	18.0b-f	18.3b-e	19.0a-c	16.3f-h	15.7h	17.3b
PR-109	16.6e-h	17.0c-h	17.7c-g	17.7c-g	16.7e-h	13.7i	16.6b
Mean	17.2bc	18.7a	18.4a	18.1bc	16.7cd	15.9d	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates):0.93 LSD (wheat advance lines):0.68 LSD (sowing dates x wheat advance lines):1.67

Table 6. Mean values for biomass yield of newly developed wheat advance lines planted on different dates evaluated at CCRI Pirsabak during 2013 -14.

	Sowing Dates						
Wheat Lines	**Oct. 25**	**Nov. 5**	**Nov. 15**	**Nov. 25**	**Dec. 5**	**Dec.15**	**Mean**
PR-103	18407b-f	19591a-c	17145c-g	16443d-i	14332ij	9629lm	15428bc
PR-105	18369c-f	17628c-g	16332f-i	14887h-j	14369ij	9628m	14569c
PR-106	19665a-c	19628a-c	19110a-e	16888d-i	15369f-i	12258jk	16651a
PR-107	20776a	19924a-c	17961c-f	16406e-i	15036ij	10369km	15939ab
PR-108	19554a-d	17702c-g	16554e-i	15406g-j	15258h-j	9629m	14910c
PR-109	20332ab	16813e-i	16962c-h	16369d-i	12925jl	7406m	14095c
Mean	19517a	18548ab	17344b	16067c	14548d	9820e	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates):1.08

LSD (wheat advance lines):0.93 LSD (sowing dates x wheat advance lines):2.29

Table 7. Mean values for harvest index (%) of newly developed wheat advance lines planted on different dates evaluated at CCRI Pirsabak during 2013 -14.

	Sowing dates						
Wheat Lines	**Oct. 25**	**Nov. 5**	**Nov. 15**	**Nov. 25**	**Dec. 5**	**Dec.15**	**Mean**
PR103	28.3d-g	27.2d-g	26.9d-g	28.9c-g	30.4a-f	33.9a	29.3a
PR105	30.0b-f	26.6d-g	26.3d-g	31.7a-e	32.6a-d	33.3a-c	30.1a
PR106	24.7fg	29.1c-g	28.6d-g	31.2a-f	26.3d-g	32.8b-f	28.8a
PR107	26.3d-g	28.3d-g	25.9d-g	29.0c-g	31.6a-e	33.8ab	29.2a
PR108	26.5d-g	27.8d-g	30.0b-f	29.1c-g	25.9d-g	32,7a-d	28.6ab
PR109	25.1e-g	22.7g	25.5e-g	22.6g	26.4d-g	32.7a-d	25.8b
Mean	26.8b	26.9b	27.2b	28.8b	28.9b	33.2a	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates):3.12 LSD (wheat advance lines):2.72 LSD (sowing dates x wheat advance lines):6.67

LITERATURE CITED

Ahmad, I.Z. Effect of irrigation and cultivars on the growth and yield of wheat. M.Sc (Hons.) Agri. Thesis, University of Agriculture, Faisalabad-Pakistan, 1991.

Ahmed, M., M.A. Arain and K.A. Siddiqui. 1994. Effect of contemporary rotation simulation on the grain weight, protein and lysine content of bread wheat (*Triticum aestivum* L.). Pak. J. of Bot. 26(2): 311-339.

Ahmad S., H. gul. Shaleema l. l. Parveen (2012). Response of wheat to different planting dates and seeding rates for yield and yield components. 7(2):1990-6145.

Akhtar, M., N. Ahmad, M. Nasrullah, B. Ali, A. R. Zahid and M. I. Shahid. Effect of late planting on emergence, tillering and yield of the various varieties of wheat. 2012. The J. of Ani, & Pl, Sci, 22(4): 1163-1166.

Anwar, J., S. B. khan, I. Rasuli, M.Zulkiffal and M.Hussain (2007), Effect of Sowing Dates on Yield and Yield Components in Wheat Using Stability Analysis INT. J. OF AGRI, & BIO. 9(1):129–131.

Anonymous 2011-2012a. Economic Survey of Pakistan. Government of Pakistan, Finance Division, Economic Advisory Wing, Islamabad.

Anonymous 2011-2012b. Agricultural Statistics of Pakistan. Government of Pakistan, Ministry of National Food Security and Research (Economic wing), Islamabad

Anjum M. Al, M. Al i 1 , Q. Mohy-Ud-Din1(2004) Determination of Grain Yield of Different Wheat Varieties as Influenced by Planting Dates in Agro-Ecological Conditions of Vehari Pak. J. life Soc. sci., 2(1): 5-8.

Dokuyucu, T, Akkaya A, and Yigitoglu, D, 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. Journal of Agronomy. 3(2), 126-130.

Dabre, W.M., Lall, S.B. and Lngole, G.L. Effects of sowing dates on yield, ear number, stomatal frequency and stomatal index in wheat. J. Maharashatra Agri. Univ., 1993, 18: 64-66.

French, R.J., J.E. Schultz and C.L. Rudd. 2005. Effect of time of sown on wheat phenology in South Australia. Austral. J. Exp. Agric. Anim. Husb. 19(96): 89-96.

Hanson, B. 2001. Planting rate influence on yield and agronomic traits of hard red spring wheat in northeasternNorth Dakota. Langdon Res. Ext. Center NDSU Agric. Report I.

Haider, R.S. 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.) Agri. Thesis, University of Agriculture, Faisalabad-Pakistan, 2004.

Hussain, A. 1995. Wheat and barley varieties of Pakistan. National Seed Registration Dept., Ministry of Food, Agric. and Livestock, Islamabad.

Khan, M.A, J. Anwer, A. Sattar and M.A Akhter, 2001 effect of seed rate on wheat yield under different sowing dates and row spacing. J. Agric. Res., 39: 223-253.

Khosravi1 V., G. K-Nejad, G. M-Nejad and khatoon Yousefi (2010): The effect of different sowing dates on yield and yield components of wheat Cultivars Inter. J. of Agro. and P. Prod. 1 (3):77-82.

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.

Lak, M., Amin Farnia and Morad Shaban (2013) Effect of different sowing dates on yield components of wheat cultivars in Lorestan province, Iran Adv. Agri. Biol. 1 (4): 89-93.

Murungu, FS and Madanzi, T, 2010. Seed priming, genotype and sowing date effect on emergency, growth and yield of wheat in a tropical low altitude area of Zimbanwe. African Journal of Agriculture Research, 5(17), 2341-2349.

Patil, K.S., D.V. Durge, B.N. Phadnawis, R.S. Shivankar and T.H. Rathod. 2000. Effect of sowing dates on biomass production of wheat cultivars. Ann. of Pl. Phys. 14 (2): 115-119.

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. of Agri. 20(1): 99-102.

Qasim, M, Qamer, M, Faridullah, M, and Alam, M, 2008. Sowing dates effect on yield and yield components of different wheat cultivars. Journal of Agriculture Research, 46(2), 135-140.

Singh, S. and M. Pal. 2003. Growth, yield and phonological response of wheat cultivars to delayed sowing. Ind. J. of Plant. Phys. 8(3): 277-286.

Sial, M.A., M.A. Arain, M.A. Javed and N.A. Nizamani. 2001. Response of wheat genotypes on yield and yield components with changing plant population densities. *Pak. J. Bot*., 33: (Special Issue): 797-800.

Sial, M. A., M. A. Arain, M. U. Dahoti, G. S. Markhand2, K. A. Laghari, S.M. Mangrio3, A. A. Mirbahar4 and M. H. Naqvi(2010) effect on sowing dates on yield yield components on mutant-cum-hybrid lines of bread wheat Pak. J. Bot., 42(1): 269-277, 2010.

Shahzad, K., Bakht, J., Shah, W.A., Shafi, M. and Jabeen, N. Yield and yield components of various wheat cultivars as affected by different sowing dates. Asian J. PI. Sci., 2002, 1(5): 522-525.

Shafiq, H.M. Modeling growth, radiation use efficiency and yield of wheat at different sowing dates and nitrogen levels under arid conditions of Bhawalpur. M.Sc. (Hons.) Thesis, University of Agriculture, Faisalabad-Pakistan, 2004.

Spink, J.H., Semere, T., Sparkes, D.L., Whaley, J.M., Foulkers, M.J., Clare, R.W. and Scott, R.K. Effect of sowing date on plant density of winter wheat. Ann. App. Biol., 2000, 137: 179-188.

Subhan, F., N. Ahmaed, M., Anwar, N. H., Shah, M., Siddiq, I., Ali, J. Rahman, and T. Sajjad, 2004a. 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.

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.

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

Subhan, F, Khan M, and Jamro G H, 2003. Weed management through planting date, seeding rate and weed control method in wheat. Pakistan Journal of Weed Sciences Research, 9(1-2), 49-57.

Subhan, F., M. Khan and G.H. Jamro. 2004. Effect of different planting date, seeding rate and weed control method on grain yield and yields components in wheat. Sarhad J. of Agri. 20(1):51-55.

Singh, T. and G.S. Dhaliwal. 2000. Performance of wheat varieties under late sowing conditions in southwestern region of Punjab. J. of Res.; Pb. Agri. Univ. 37(3-4):181-183.

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.

Tahir, M., A. Ali, M. A. Nadeem, A.Hussain and F. Khalid(2009) Effect of Different Sowing Dates on Growth and Yield of Wheat Varieties in District Jhang, Pak. Pak. j. life soc. sci. 7(1):66-69.

Tanveer, S K, Hussain L, Asif M, Mujahid MY, Muhammad S, Qmar M, and ASIM M, 2009. Performance of different wheat cultivars/ line as affected by different planting dates and seeding rates under high painfall after of potohar. Pakistan Journal of Agriculture Science, 46(2), 102-106.

Wajid, S.A. 2004. Modeling development, growth and yield of wheat under different sowing dates, plant populations

and irrigation levels. Department of Agron. Univ. of Arid Agric. Rawalpindi.