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AN ANALYSIS OF THE PLANTING DATES EFFECT ON YIELD AND YIELD ATTRIBUTES OF SPRING WHEAT

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ABSTRACT

An experiment was conducted at Cereal Crops Research Institute, Pirsabak, Nowshera (NWFP) Pakistan during 2004-05 on seven wheat cultivars/advance lines (Saleem-2000, Haider-2000, PR-83, PR-84, PR-85, PR-86 and PR-87) to identify the most suitable time of planting and judge their performance under late sowing in the central agro-ecological zone of NWFP, Pakistan. Five planting dates were used from October 25th to December 5th with 10 days interval in a randomized complete block design with split-plot arrangement replicated thrice. Sowing dates effect was studied in main-plots and varieties/advance lines in sub-plots. Data were recorded on days to maturity, plant height, spike length, spikelets/spike, grains/spike, 1000-grain weight and grain yield. Delay in sowing decreased values of all the parameters. Decrease in days to maturity of various cultivars ranged from 9% (PR-83) to 12% (Saleem-2000), plant height from 10.5% (PR-84) to 26% (PR-85), grains/spike from 14.6% (PR-87) to 33.4 % (Haider-2000), 1000-grain weight from 3.5% (PR-83) to 28.7% (Haider-2000) and grain yield from 45.2% (PR-83) to 59% (PR-86) when sowing was delayed from October 25th to December 5th. Larger decreases in grain yield despite comparatively smaller decreases in grains/spike and 1000-grain weight showed the importance of seed germinability and the number of productive tillers per unit area in late sowing. The significant sowing date x genotype interaction for all the parameters especially the grain yield highlighted the importance of further research for evolving new varieties through crosses, other indigenous sources and/or introduction/selection that give higher yield if sown late in the cropping pattern of central NWFP having maize or sugarcane.

INTRODUCTION

Wheat is the most important staple food of masses in Pakistan. Wheat requirements of the country are increasing due to rapid increase in population. North West Frontier Province (NWFP) is area-wise the smallest province of the country for which wheat is equally important as for the rest of the country. However, it is always deficient in wheat and has to import it from the neighbouring province, the Punjab. Wheat production of Pakistan was 19.5 million tones during 2003-04. Punjab was the dominant wheat-producing province contributing 81% of the national wheat production, Sindh 11%, NWFP 5% and Baluchistan 3% only (Agric. Statistics of Pakistan, 2004).

Wheat yield is the lowest in NWFP among all the four provinces of the country (Agricultural Statistics of Pakistan, 2004). One major reason is that 60% of the area on which wheat is grown in NWFP is rainfed. The growers have to wait for rainfall so that the soil get proper moisture (*wattar*) required for seed germination. Another major reason is the late maturity of maize, sugarcane, rice and cotton crops, on the same piece of land. In both cases, the farmers have to suffer yield losses due to delay in sowing. For normal sowing of wheat, the time duration from 25th October to 20th November is recommended (Shah, 1994). Due to delay in sowing till December 5th, a yield loss of 42% has been recorded (Subhan *et al*. 2004a).

As sowing of wheat is delayed in the central NWFP,

soil temperature decreases which has detrimental effect on seed germination (Gardner, *et. al*. 1985), tillering capacity and number of productive tillers (Shah and Akmal, 2002). Number of productive tillers per plant or per unit area is one of the most important economic yield-determining component of wheat. Furthermore, wheat is a long-day plant, which produces spikes (the wheat inflorescence) when days become longer (Hatam, 1994). That is why even the plants of the late-sown wheat crop flower on the availability of the proper photoperiodic condition. The late sown crop matures also in shorter time as compared with the normal sown crop as the hot summer approaches. Thus the late-sown crop takes less number of Growing Degree Days (GDD) due to which yield components decrease and hence the economic yield of the crop suffers negatively (Lone, *et al*. 1999). Breeding for photo-insensitive varieties may be one of the objectives of wheat breeders to overcome this problem. In present circumstances, varieties suitable for late sowing is the need of the growers in order to avoid yields losses due to delayed sowing.

Cereal Crops Research Institute (CCRI), Pirsabak NWFP Pakistan has the mandate to produce wheat varieties suitable for normal and late planting in rainfed and irrigated areas of the

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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 NWFP. The present study was also undertaken in this perspective. The objective of the study was to assess the yield performance of two commercial wheat varieties (Saleem-2000 and Haider-2000) and five advance lines (PR-83, PR-84, PR-85, PR-86 and PR-87) of CCRI, under normal and late sowing so as to make recommendations of the present and prospective wheat varieties for normal/late planting. The study was also aimed to quantify and document yield losses occurred due to late planting.

MATERIALS AND METHODS

The experiment was conducted at Cereal Crops Research Institute, Pirsabak Nowshera (34^{o}N Latitude, 72^{o}E Longitude and 288m Altitude) under irrigated conditions during 2004-05. Two commercial wheat varieties i.e. Saleem-2000 and Haider-2000 along with five advance lines namely PR-83, PR-84, PR-85, PR-86 and PR-87 on five different sowing dates i.e. October 25, November 5, 15, 25 and December 5 in a randomized complete block design with split-plot arrangement and three replications. Planting was done with hand hoe. Each plot consisted of six rows 30 cm apart and five meters long. Uniform seed rate of 100 kg ha^{-1} was used. 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. The central four rows were used for data collection. Days to maturity was recorded when 90% of the plants have reached physiological maturity. Plant height was recorded from the base to the tip of the awns just before harvesting. Lodging score was determined as percent lodged portion of plants in each subplot. Ten spikes were randomly selected in each subplot to determine their average spike length. These spikes were threshed to determine the average number of grains per spike. Three lots of thousand grains were randomly selected from the threshed grains in each subplot and weighed on an electronic balance to determine 1000-grain weight and average was calculated. Grain yield was recorded by manually harvesting the central four rows and then threshing them on the experimental thresher. Yield per plot was converted to yield per hectare. Data were analyzed statistically with the statistical package MSTAT-C (Knowledge Dynamics Corporation, USA) and the significant differences between treatments were determined using Tukey’s test (Clewer and Scarisbrick, 2001).

RESULTS AND DISCUSSION

Days to Maturity

Sowing dates significantly affected days to maturity of the various varieties/advance lines (Table I). On average, the maximum number of days (178) to maturity were recorded when sowing was done on Oct.25th. Days to maturity decreased gradually to 158 days as sowing was delayed till Dec.5th. Subhan *et al*. (2004a) and Khalifa *et al*. (1998) also reported decrease in days to maturity due to delay in sowing in the central agro-ecological zone of NWFP Pakistan and in Assyut (Egypt), respectively. There was no significant difference in days to maturity of the varieties except the PR-86, which showed significantly lesser days as compared with PR-84 and Haider-2000 when sown on Oct.25th. However, as the time passed, differences between varieties/lines became prominent. PR-86, PR-87 and Saleem-2000 matured in the minimum number of 156 days showing an 11.4, 11.9 and 11.9% decrease while PR-85 and Haider-2000 recorded 157 and 159 days, showing an 11.8 and 11.2% decrease in days to maturity, respectively, when sown on Dec.5th as compared with Oct.25th (Table I). A number of authors, including Major (1980) and Worland *et al*. (1994), have reported a third group of genetic factors, the other two being photo-sensitive and vernalization-sensitive genes, that determine differences in “basic development rate” or “intrinsic earliness,” also termed earliness *per se* of different crop varieties. Intrinsic earliness genes have been reported to be responsive to temperature (Slafer, 1996). In this experiment, the early maturing varieties/advance lines responded to high temperature at the time of maturity probably because of the presence of intrinsic earliness genes. Such varieties, if high yielding, are the most suitable for the existing cropping pattern of NWFP.

Table I ***Days to maturity of newly developed varieties and advance lines planted on different dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	178ab	179a	178ab	176bcd	177abc	177abc	179a	178a
Nov. 5	177abc	178ab	177abc	174def	175cde	175cde	177abc	176b
Nov. 15	175cde	177abc	175cde	172fg	173ef	174def	174def	174c
Nov. 25	173ef	172fg	169hi	167 i	167 i	167 i	170gh	169d
Dec. 5	162 j	162 j	s157 kl	156 l	156 l	156 l	159 k	158e
Mean	173ab	174a	171cd	169e	170de	170de	172bc	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 1.47 LSD (varieties/advance lines): 1.22 LSD (sowing dates x varieties/advance lines): 2.11

Plant Height

Plant height decreased significantly with delay in planting (Table II). There were also significant differences among the varieties/lines for plant height. The maximum plant height (96 cm) was recorded when sowing was done on Oct. 25th. PR-83 recorded the maximum plant height (102 cm) across all sowing dates while PR-84 the minimum plant height (78 cm), which was not significantly different from that of Saleem-2000 (79 cm). Plant height recorded 10.5% (PR-84) to 26% (PR-85) decrease as sowing was delayed till Dec.25th as a result of the significant genotype x sowing dates interaction (Table II). As wheat is a determinate plant by the growth habit (Hatam, 1994), it stops vegetative growth in terms of plant height and produces spikes after meeting the photoperiodic requirements, which results in shorter height in late sowing. Ahmed et al. (1997) reported decrease in plant height due to late sowing in wheat. The significant interaction between genotype and sowing date is due to the earliness or lateness in flowering initiation controlled by the genetic background and/or environment.

Table II ***Plant height (cm) of newly developed varieties and advance lines to different sowing dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	108a	95d-g	100b-d	84jk	97c-f	87h-k	104ab	96a
Nov. 5	108a	90f-j	95d-g	84jk	84jk	82k-m	98b-e	92b
Nov. 15	103a-c	92e-i	92e-i	75n	76mn	76mn	92e-i	86c
Nov. 25	95d-g	89g-k	88h-k	75n	75n	75n	85i-k	83cd
Dec. 5	94d-h	85i-k	74n	72n	75n	77l-n	84j-l	80d
Mean	102a	90b	90b	78d	81c	79cd	92b	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 4.31 LSD (varieties/advance lines): 3.15 LSD (sowing dates x varieties/advance lines): 7.05

Spike Length

Average spike length decreased significantly from the maximum value of 10.7 cm for the Oct. 25th sown crop to the minimum value of 8.8 cm when sowing was done on Dec.5 (Table III). Ahmed et al. (1997) found that late sowing resulted in reduced spike length in all cultivars. In our experiment, Haider-2000 gave the longest spikes (10.9 cm) while PR-86 produced the smallest spikes (8.3 cm). Spike length ranged from 12.7 cm (Haider-2000) to 9.2 cm (PR-86) when sown on Oct.25th. It decreased to 9.9 cm (PR-84) to 8 cm (PR-86) when sown on Dec.5th. Decrease in spike length ranged from 10.8% (PR-84) to 24.4% (Haider-2000) when sowing was done on Dec.5th as compared with Oct.25th. The spike length probably decreased due to delay in sowing because of the sensitivity of the wheat plants to photoperiod and temperature (Slafer and Whitechurch, 2001). As the photoperiod and temperature increased, the wheat plants hastened maturity to complete growth period due to which the plant parameters, like plant height and spike length got shorter period to increase in size. Slafer and Rawson (1994) have suggested that there is a strong interaction between the responses to temperature and photoperiod in terms of various plant parameters and that the size of interaction may differ among genotypes. The significant interaction between genotype and sowing dates for spike length signifies the sensitivity of different genotypes to photoperiod and temperature differently and, thus, confirms the suggestions of Slafer and Rawson (1994).

Table III ***Spike length (cm) of newly developed varieties and advance lines to different sowing dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	10.1d-h	11.1b-d	10.5c-g	9.2h-m	10.4c-g	10.8c-e	12.7a	10.7a
Nov. 5	10.7c-f	9.4g-l	11.3bc	8.5k-n	10.0d-h	10.2d-h	11.9ab	10.3a
Nov. 15	9.6g-j	9.6g-j	9.5g-l	7.8n	9.3h-m	9.5g-l	10.5c-g	9.4b
Nov. 25	9.2h-m	9.9e-h	9.3h-m	8.1n	8.8i-n	9.5g-l	9.8e-i	9.2b
Dec. 5	8.8i-n	9.9e-h	8.2mn	8.0n	8.4l-n	8.7j-n	9.6f-j	8.8b
Mean	9.7bc	10.0b	9.8bc	8.3d	9.4c	9.7bc	10.9a	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 0.65 LSD (varieties/advance lines): 0.49 LSD (sowing dates x varieties/advance lines): 1.1

Spikelets Spike^{-1}

Spikelets per spike ranged from 16.4 (PR-86) to 22.2 (Haider-2000 when sowing was done on Oct.25 (Table IV). It decreased to 16.1 (PR-86) and 19.1 (Haider-2000) when planting was done on Dec.5th. The decrease was significant only in PR-83 (7.2%), PR-87 (9%) and Haider-2000 (14%). On average, Haider-2000 produced the highest number of spikelets per spike (20.1), which was not significantly different from that of Saleem-2000 (20) and PR-87 (19.7). PR-86 recorded the minimum number of 16.0 spikelets per spike while PR-83 recorded 17.6. 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).

Table IV ***Spikelets per spike of newly developed varieties and advance lines to different sowing dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	18.0k-m	19.3e-j	19.1e-k	16.4op	20.1b-f	20.3b-e	22.2a	19.3a
Nov. 5	18.6h-l	18.3i-m	20.9b-d	16.4op	21.3ab	20.9b-d	21.1a-c	19.6a
Nov. 15	17.3l-o	17.9k-n	18.3j-m	15.5p	19.9c-h	19.6d-i	19.5e-j	18.3b
Nov. 25	17.2m-o	18.5i-m	17.8k-n	15.6p	18.7g-k	20.0c-g	18.8f-k	18.1b
Dec. 5	16.7n-p	18.3i-m	18.3i-m	16.1op	18.3j-m	19.1e-k	19.1e-k	18.0b
Mean	17.6c	18.5b	18.9b	16.0d	19.7a	20.0a	20.1a	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 0.69 LSD (varieties/advance lines): 0.79 LSD (sowing dates x varieties/advance lines): 1.32

Grains Spike^{-1}

Number of grains per spike decreased significantly from 58.6 when planting was done on Oct. 25th, to 44 when planting was done on Dec.5th (Table V). For Oct.25 sown crop, PR-86 produced the minimum number of 44.3 grains per spike while Saleem-2000 produced the maximum number of 69.1 grains per spike, which was not significantly different from PR-84 (68.5), PR-83 (62.5) and Haider-2000 (58.7). Almost gradual decrease, which was non-significant only in PR-86 and PR-87 was observed when sowing was delayed till Dec.5th. Number of grains per spike ranged from 36.4 (PR-86) to 54.9 (PR-84). The decrease in number of grains per spike ranged from 14.6% (PR-87) to 33.4% (Haider-2000). Averaged across sowing dates, Saleem-2000 produced the highest number of grains per spike (57.8), not significantly different from that of PR-83 (53.8) and PR-84 (57.0). PR-86 recorded the minimum number of 39.4 grains per spike while Haider-

2000 recorded 47.8. The grains per spike seemed to have decreased due to delay in sowing because of the sensitivity of the wheat plants to photoperiod and temperature (Slafer and Whitechurch, 2001). As the photoperiod and temperature increased, proper fertilization of the ovule may not have occurred to produce grains.

The significant interaction between genotype and sowing dates shows the sensitivity of different genotypes to photoperiod and temperature differently in terms of grain formation. The data also showed that grains per spike are not strictly related with spike length or spikelets per spike in different genotypes. For example, Haider-2000 produced the longest spikes with the largest number of spikelets per spike but it produced almost the smallest number of grains per spike. This shows that genotype may affect the number of grains per spike but it is mostly environment dependent phenomenon.

Table V ***Grains per spike of newly developed varieties and advance lines to different sowing dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	62.5a-c	68.5ab	57.9b-e	44.3f-k	49.3d-j	69.1a	58.7a-d	58.6a
Nov. 5	61.7a-c	52.9c-g	62.9a-c	40.5h-k	49.8d-i	66.4ab	54.8c-f	55.6a
Nov. 15	50.0d-i	53.9c-f	45.3f-k	36.1k	50.1d-i	51.1d-h	45.5f-k	47.4b
Nov. 25	49.9d-i	54.9c-f	44.4f-k	39.6i-k	45.3f-k	54.6c-f	41.1h-k	47.1b
Dec. 5	45.0f-k	54.9c-f	43.2g-k	36.4k	42.1h-k	47.7e-j	39.1jk	44.0b
Mean	53.8ab	57.0a	50.7bc	39.4d	47.3c	57.8a	47.8c	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 3.94 LSD (varieties/advance lines): 4.75 LSD (sowing dates x varieties/advance lines): 10.63

1000-Grain Weight

Thousand grains weight ranged from 34.8 g (Haider-2000) to 51.4 g (PR-87) (Table-VI) when planting was done on Oct.25th. As planting was delayed, gradual decrease took place in 1000-grains weight of all varieties/lines except PR-83 and PR-85 in which 1000-grains weight increased to 53 g and 46.8 g, respectively, when planting was done on Nov.15th and then decreased till Dec.5th. From Dec.5th sown crop, 1000-grains weight decreased in all varieties/lines except PR-83, PR-86 and Saleem-2000. Thousand grains weight ranged from 24.8 g (Haider-2000) to 46.5 g (PR-83) when sowing was done on Dec.5th. The percent decreased in thousand grains weight ranged from 3.5% (PR-83) to 28.7% (Haider-2000). Averaged over sowing dates, PR-83 produced the maximum 1000-grains weight (49.4 g) followed by PR-87 (42.7 g) while Haider-2000 recorded the minimum of 29.5 g 1000-grains weight. The 1000-grains weight probably decreased due to delay in sowing because the wheat plants may not have got sufficient time to increase the grain size sufficiently because of longer photoperiod and higher temperature (Slafer and Whitechurch, 2001). The significant interaction between genotype and sowing dates shows the sensitivity of different genotypes to photoperiod and temperature differently in grain size. The data also showed that 1000 grains weight is not related with grains per spike in different genotypes. For example, Haider-2000 produced the smallest number of grains per spikes but it produced the smallest grain size also. It shows that genotype strongly affects the grain size.

Table VI ***Thousand grains weight (g) of newly developed varieties and advance lines planted on different dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	48.2a-c	46.9a-d	44.5b-g	35.9h-m	51.4ab	39.8d-j	34.8i-n	43.1a
Nov. 5	51.5ab	43.3cg	45.4b-f	38.7f-k	48.1a-c	39.6d-j	31.2l-o	42.5ab
Nov. 15	53.0a	42.7c-h	46.8a-e	33.7j-n	35.2i-n	38.7f-k	28.7m-o	39.8bc
Nov. 25	47.8a-c	39.5e-j	46.3a-e	34.1i-n	41.2c-i	31.9k-o	27.9no	38.4c
Dec. 5	46.5a-e	35.4h-m	29.6m-o	34.2i-n	37.6g-l	33.9i-n	24.8 o	34.6d
Mean	49.4a	41.6b	42.5b	35.3c	42.7b	36.8c	29.5d	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 3.11 LSD (varieties/advance lines): 3.30 LSD (sowing dates x varieties/advance lines): 7.38

Grain Yield

Planting dates affected grain yield significantly (Table VII). The maximum grain yield (4456 kg ha^{-1}) was recorded when planting was done on Oct.25th, which decreased gradually and significantly to 2132 kg ha^{-1} when planting was done on Dec.5th. Averaged over sowing dates, PR-84 gave the highest grain yield (3835 kg ha^{-1}), which was followed by PR-85 with 3545 kg ha^{-1} grain yield. Grain yield of PR-85 was not significantly different from those of PR-83, PR-87 and Saleem-2000. Haider-2000 gave the lowest grain yield of 1715 kg ha^{-1}, which may be attributed to the smaller number of grains per spike and smaller grain size. Furthermore, the excessive rains and downpours in the growing season caused lodging in Haider-2000, which is a comparatively taller variety with weak straw and is recommended for rainfed areas of NWFP (Subhan *et al*., 2004b) (Lodging data not shown). Saleem-2000 gave grain yield of (3446 kg ha^{-1}) across all the planting dates as this variety has been released for normal and late sowing in irrigated areas of NWFP (Subhan *et al*. 2004c). From Oct.25 sown crop, the grain yield ranged from 2408 kg ha^{-1} (Haider-2000) to 5463 kg ha^{-1} (PR-87). Grain yield decreased gradually and significantly in all the varieties/lines with delay in sowing. From Dec.5 sown crop, grain yield ranged from 1162 kg ha^{-1} (Haider-2000) to 2788 kg ha^{-1} (PR-83). The percent decrease from Dec.5th sown crop ranged from 45.2% in PR-83 to 59% in PR-86 and 58.9% in PR-87 as compared with Oct.25th sown crop. On average, yield losses due to late planting recorded were 17.2% when planting was done on Nov.5th, 38% when planting was done on Nov.15, 44.8% when planting was done on Nov.25th and 52.2% when planting was further delayed till Dec.5th in comparison to the highest yield obtained from planting done on Oct.25th. Decrease in the yield attributes i.e. grains/spike and 1000-grain weight due to delay in sowing date contributed to decrease in the grain yield for which the main reasons are the decrease in growing degree days (Sandhu *et al*. 1999), longer photoperiod and higher temperature during the reproductive stage (Slafer and Whitechurch, 2001) and the genotype. The yield attributes studied in this experiment showed smaller decrease i.e. 24.9% in grains/spike and 19.7% in 1000-grain weight as compared with the 52.2% decrease in the grain yield when sowing was delayed till Dec.5th as compared with Oct.25th. It shows that the rest of the decrease in grain yield might be due to decrease in the number of productive tillers per unit area.

Table VII ***Grain yield (kg ha^{-1}) of newly developed varieties and advance lines to different sowing dates at CCRI, Pirsabak during 2004-05***

	Advance Lines / Varieties							
Sowing Date	PR-83	PR-84	PR-85	PR-86	PR-87	Saleem-2000	Haider-2000	Mean
Oct. 25	5089a-c	5225ab	4794b-d	3236g	5463a	4981a-c	2408k-n	4456a
Nov. 5	4074ef	4278d-f	4494c-e	2709g-l	4273d-f	3995ef	2006m-p	3690b
Nov. 15	3026g-j	3848f	3173g-i	1978n-p	2618h-l	3185g-i	1519pq	2764c
Nov. 25	2499j-n	3219gh	2952g-k	1694o-q	2788g-l	2584i-m	1479pq	2459cd
Dec. 5	2788g-l	2607i-m	2312 l-n	1326q	2244 l-o	2488j-n	1162 q	2132d
Mean	3495b	3835a	3545b	2188c	3477b	3446b	1715d	

Means in the same category following by different letters are significantly different from each other at 5% level of probability. LSD (sowing dates): 364.8 LSD (varieties/advance lines): 269.4 LSD (sowing dates x varieties/advance lines): 602.4

CONCLUSION AND RECOMMENDATION

Sowing in time around Oct.25, in central NWFP is the best policy for getting higher yields and even the cultivars recommended for late sowing cannot recover the yield losses due to delay in sowing. Significant differences exist among wheat varieties in maturity duration. So breeders should produce/select those genotypes, which could compensate up to large extent, although it may not recover fully, yield losses due to delay in sowing. Our advance lines PR-83, PR-84, PR-85 and PR-87 produced higher average yields and especially PR-83 recorded minimum yield losses in case of late planting. These lines will be released as new varieties after further testing in regional and national trials.

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