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Impact of sowing dates on the growth and yield of wheat variety benazir-2013, Sindh Province, Pakistan

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Abstract

The study was carried out to investigate the impact of sowing dates on the growth and yield of wheat variety Benazir-2013. For the Purpose, Experiment was conducted at Agriculture Research Institute (ARI), Tando Jam. Four Treatments (sowing dates T_1 = 1st November, T_2 = 15th November, T_3 = 1stDecember and T_4 = 15th December) were applied to the experiment with Randomized Complete Block Design (RCBD) technique. The collected data were analyzed accordingly with the help of Statistical Software Statistix 8.1 (SX). The T_1 resulted in 87.10 cm plant height, and 4015.8kg ha^{-1} grain yield. The results of T_2 with plant height of 86.36 cm and ha^{-1} grain yield 3971.8kg were observed. The crop sown on 1stDecember (T_3) revealed 80.08cm plant height and ha^{-1} grain yield of 3574.3kg. The crop sown at 15th December resulted in 79.21cm plant height, and 3257.6kg ha^{-1} grain yield. The results of four treatments revealed that T_1 has performed significantly better than T_2, T_3 and T_4. On the basis of the results of this study, it is concluded that sowing time has significant effect on plant growth, height and on overall yield. So it is suggested that sowing of wheat crop in the month of November will yield more than sowing of wheat crop in the month of December. So, it is recommended that farmers should complete their cultivation of Wheat crop in first half of November to get more yield and financial benefits.

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Introduction

Wheat *(Triticum aestivum* L.) is one of the major food grain crop of the world including Pakistan being consumed as staple food of the one third world's population. In Pakistan, wheat is grown on an area of 9204 thousand hectares with an annual production of 9260 thousand hectare having an average yield of 2752kg ha^{-1} (Tunio *et al.* 2016). Despite higher yield potential, average yield in Pakistan is much less than most countries of the world. Wheat is a chief source of food for a great deal of population in the world. In Pakistan it ranks first among the cereal crops and occupies about 66% of the annual food cropped area (Anonymous, 2012). It is the staple food for the people of Pakistan and meets the major dietary requirements, supplies about 60% of the calories and protein of the average diet (Khalil and Jan, 2012).

There are many factors responsible for low yield of wheat such as cultivation of old varieties, sowing date, low seed rate, and low fertilizer rates. Where, Jain *et al.* (2012) have investigated the effect of 5 sowing dates on 6 wheat cultivars and concluded that late sowing significantly reduced grain yield in all the varieties compared to the crop sown on December 20. Lathwal *et al.* (2012). Chaudhry *et al.* (2014) evaluated that average yield was significantly higher in October 30 planting, as compared to other planting dates of November 15, November 30, December 15, December 30 and January 15. Kumar *et al.* (2011) reported that wheat growth was better when sown on 20th November than on 1st November or December, although there was little grain yield difference between the two dates in November. Donaldson *et al.* (2013) in a field trial reported that early sowing resulted in increased wheat straw production and generally higher grain yield compared with mid to late sowing date.

Akdamar *et al.* (2012). Patel *et al.* (2010) Aslam *et al.* (2013) tested newly introduced varieties, Inqalab 91 and Punjnad-1, for their optimum date of sowing with respect to yield and observed that the highest yield (5484kg ha^{-1}) was obtained in cultivar sown on November 15 (Tunio *et al.* 2016).

Sowing time play a vital role in the growth and yield of wheat and appropriate sowing time results in high economically higher yields without involving extra costs as it helps varieties to express their full growth potential (Ouda *et al.* 2016). The sowing time of wheat crop plays a pivotal role in a country like Pakistan, where climatic conditions vary throughout the country and delay in sowing decreases wheat grain yield by 58.2 percent (Haider, S.A. 2007). Hameed *et al.* (2013) observed that early seeding resulted in higher yields as compared with late seeding. After studying sowing date effect on production potential of three wheat cultivars Kumar *et al.* (2000) reported better grain yield in 20th November sowing than 1st November or 10th December sowings. A yield reduction of 27 and 52 percent was noted by Ali *et al.* (2014) when wheat crop was sown on December 15 and 31, respectively. Tahir *et al.* (2011) concluded that regardless of varieties/cultivars, better yields were obtained when wheat was sown after 15th and before 30th November under Bahawalpur conditions. Inamullah *et. al* (2012) while studying the influence of seeding time on wheat grain yield observed that wheat planted on November 10, displayed more grain yield (5777kg ha^{-1}), followed by November 1 (5411kg) and November 20 (5234kg). He noted that each successive delay in sowing beyond November 10 significantly reduced the grain yield. Shah and Akmal (2002) conducted experiments on four wheat varieties sown on October 24 to December 11 with 15 days interval and reported that grain yield decreased by 28 percent when sowing delayed by 45 days in the season. They further concluded that early sowing favoured the varieties Fakhr-e-Sarhad and Noshera-96 while in contrast Inqalab-91 might be better for late planting. Shahzad *et al.* (2002) recorded maximum grain yield when crop was sown on November 01 and variety Tatara-96 performed better than others. Hameed *et al.* (2003) reported that wheat varieties performed better when sown in last week of October or 1st week of November. Subhan *et al.* (2003) and Qasim *et al.* (2008) concluded that wheat crop planted on November 15, produced higher grain yield as compared to late and early planting.

Sindh province is a major contributor of wheat after Punjab in Pakistan where most of the area under wheat comes after cotton crop. Therefore, wheat sowing under cotton-wheat cropping system is delayed which causes significant yield reduction. Wheat cultivation by drilling on raised beds has been investigated for its suitability in cotton-wheat cropping system (Laghari *et al.* 2015; Hobbs and Gupta, 2003) and obtained better grain yields over flat beds and broadcast seeding, which must be economically viable (Koondhar *et al.* 2016). In fact, there is little literature available on the comparison of different sowing dates of this cash crop in Sindh province of Pakistan. Therefore, the present study was carried out to investigate the impact of sowing dates on the growth and yield of specific wheat variety called Benazir-2013.

Materials and methods

Study Area

The experiment was conducted at the experimental field of Agronomy Section, Agriculture Research Institute (ARI), Tando jam, to see the impact of sowing dates on the growth and yield of wheat variety Benazir-2013.

Experimental Design

The experiment was laid out in a three replicated randomized complete block design (RCBD) with plot size of 3m x 5m (15m^2). Treatments included four sowing dates T_1 = 1st November, T_2 = 15th November, T_3 = 1stDecember and T_4 = 15th December.

The observations were recorded on plant height (cm), tillers m^{-2}, spikes length (cm), spikes plant^{-1}, seed index (1000 seed weight, g) and grain yield (kg ha^{-1}).

Data Analysis

The data was subjected to statistical analysis using computer software statistix 8.1 (SX, 2006). The differences among the treatments were compared by the least significant difference (LSD) test, where necessary.

Results and discussion

Plant height (cm)

The results regarding the plant height of wheat as influenced by various sowing dates and seeding methods are presented in Table-1. The analysis of variance suggested significant (P<0.05) influence of sowing dates on the plant height of wheat. It is evident from the results that the wheat plants grew tallest (87.10cm) when the crop was sown on 1st November, followed by crop sown on 15th November and 1st December that resulted in average plant height of 86.36 cm and 80.08 cm, respectively. However, the minimum plant height (79.21cm) was observed in the late sown crop (15th December). The results indicated that the first fortnight of November could be considered as an appropriate sowing time, because there was a simultaneous decrease in the plant height with delaying the sowing. Moreover, regardless the sowing time, the drilling method resulted in taller plants than those sown by broadcasting, mainly due to proper aeration, better utilization of nutrients and moisture by the plants.

Table 1. Plant height (cm) of wheat crop as influenced by different sowing dates.

Sowing dates	R-I	R-II	R-III	Mean
T_1 = 1st November	84.70	87.25	89.35	87.10 A
T_2 = 15th November	84.21	86.68	88.21	86.36 B
T_3 = 1stDecember	80.00	82.25	81.00	80.08 C
T_4 = 15th December	79.04	77.35	81.24	79.21 D

S.E.± 0.9661, LSD 0.05±2.3641

Tillers m^{-2}

The data in regards to number of tillers m^2 of wheat as affected by different sowing dates are given in Table-2. The analysis of variance demonstrated that the tillers m^2 of wheat was significantly affected by sowing dates. It is apparent from the results (Table-2) that the tillers was maximum (342.33m^2) when the crop was sown on 1st November, followed by 339.67 and 322.33 average tillers m^2 observed from the crop sown on 15th November and 1st December, respectively. However, the lowest number of tillers (307.00m^2) was recorded in the late sown crop (15th December). The LSD test indicated that the differences in the tillers m^2 of wheat were significant (P<0.05) between T_1 = 1st November, T_2 = 15th November, T_3 = 1stDecember and T_4 = 15th December sowing dates.

Spike length (cm)

The results pertaining to spike length of wheat as influenced by various sowing dates are shown in Table-3 and their analysis of variance. The results of analysis of variance indicated significant (P<0.05) influence of sowing dates on the spike length. The results for the effect of sowing dates indicated that spike length of wheat was maximum (12.12cm) when wheat was sown on 1st November, while spike length ranked second (12.12cm) and third (10.40cm) in wheat crop sown on 15th November and 1st December, respectively. However, the minimum spike length (9.14cm) was recorded in wheat crop sown on 15th December. The LSD test suggested linear significance of differences in spike length, due to sowing dates.

Table 2. Tillers m^{-2} of wheat crop as influenced by different sowing dates.

Sowing dates	R-I	R-II	R-III	Mean
T_1 = 1st November	350	342	335	342.33 A
T_2 = 15th November	345	339	335	339.67 B
T_3 = 1stDecember	315	322	330	322.33 C
T_4 = 15th December	299	307	315	307.00 D

S.E.± 6.7563, LSD 0.05 16.532

Table 3. Spikes length (cm) of wheat crop as influenced by different sowing dates.

Sowing dates	R-I	R-II	R-III	Mean
T_1 = 1st November	12.10	11.13	13.12	12.12 A
T_2 = 15th November	11.13	12.04	13.20	12.12 B
T_3 = 1stDecember	8.50	10.55	12.16	10.40 C
T_4 = 15th December	7.00	9.42	11.00	9.14 D

S.E.± 0.9378, LSD 0.052.2948

Spikes plant^{-1}

The data in regards to the number of spike plant^{-1} of wheat as influenced by different sowing intervals are given in Table-4. The analysis of variance illustrated that the number of spike plant^{-1} of wheat was significantly affected by sowing intervals. It is apparent from the results (Table-4) that the number of spike plant^{-1} was maximum (8.93) when the crop was sown on 1st November, followed by 8.47 and 7.83 average number of spike plant^{-1} observed from the crop sown on 15th November and 1st December, respectively. However, the minimum number of spike (6.36) plant^{-1} was recorded in the late sown crop on 15th December. The crop sown in the first and second fortnight of November produces spikes with more spikes. The LSD test indicated that the differences in the spike plant^{-1} of wheat were linearly significant (P<0.05) under sowing dates.

Table 4. Spikes plant^{-1} of wheat crop as influenced by different sowing dates.

Sowing dates	R-I	R-II	R-III	Mean
T_1 = 1st November	10.59	8.55	7.66	8.93 A
T_2 = 15th November	8.82	8.23	8.36	8.47 B
T_3 = 1stDecember	6.65	7.43	9.42	7.83 C
T_4 = 15th December	6.86	5.47	6.77	6.36 D

S.E.± 1.8223, LSD 0.054.4589

Seed index (1000 seed weight, g)

The data in relation to seed index of wheat as affected by different sowing dates are shown in Table-5. The analysis of variance indicated that the differences in seed index due to different sowing dates were statistically significant (P<0.05). The effect of sowing dates indicated that the highest seed index (50.68g) was recorded in crop sown on 1st November, followed by 15th November and 1st December sowings, where the average seed index was 50.09g and 46.03g, respectively. However, the lowest seed index (43.63g) was obtained from 15th December sown wheat. The results further showed that wheat crop sown in the month of November, particularly in the first fortnight

of November was found to be more effective to have higher seed index; Linearly significant differences ($P<0.05$) in seed index between all sowing date have been indicated by the LSD test.

Table 5. Seed index (1000 seed weight, g) of wheat crop as influenced by different sowing dates.

Sowing dates	R-I	R-II	R-III	Mean
T_1 = 1st November	51.12	51.25	49.69	50.68 A
T_2 = 15th November	48.28	49.66	52.33	50.09 B
T_3 = 1stDecember	46.56	43.21	48.32	46.03 C
T_4 = 15th December	43.66	45.58	41.66	43.63 D

S.E.± 2.4513, LSD 0.05 5.9982

Grain yield (kg ha^{-1})

The data in relation to grain yield ha^{-1} of wheat as affected by different sowing dates are presented in Table-6. The analysis of variance suggested significant ($P<0.05$) effect of sowing dates on grain yield ha^{-1}. The results (Table-6) showed that the highest grain yield of 4015.8kg ha^{-1} was achieved from the wheat sown on 1st November, followed by 15th November and 1st December sowings, where the average grain yield was 3971.8kg and 3574.3kg ha^{-1}, respectively. However, the lowest grain yield of 3257.6kg ha^{-1} was recorded in 15th December sown wheat. The results further showed that regardless the sowing date, the grain yield was higher in crop sown on 1st November. The LSD test showed that differences in grain yield ha^{-1} among the sowing dates were linearly significant ($P<0.05$) when respective treatment means were compared.

Table 6. Grain yield (kg ha^{-1}) of wheat crop as influenced by different sowing dates.

Sowing dates	R-I	R-II	R-III	Mean
T_1 = 1st November	4111.12	3936.22	4000.00	4015.8 A
T_2 = 15th November	4050.69	3998.55	3866.29	3971.8 B
T_3 = 1stDecember	3777.82	3588.33	3356.69	3574.3 C
T_4 = 15th December	3255.95	3389.96	3126.96	3257.6 D

S.E.± 84.742, LSD 0.05 207.36

Discussion

The present study showed that all the traits examined in this study were significantly ($P<0.05$) influenced by sowing time. The T_1 resulted in 87.10cm plant height, and 4015.8kg ha^{-1} grain yield. The results of T_2 with plant height of 86.36cm and ha^{-1} grain yield 3971.8kg were observed. The crop sown on 1st December (T_3) revealed 80.08cm plant height and ha^{-1} grain yield of 3574.3kg. The crop sown at 15th December resulted in 79.21cm plant height, and 3257.6kg ha^{-1} grain yield. The results of four treatments revealed that T_1 has performed significantly better than T_2, T_3 and T_4..

On the other hand, the 1st November sowing results maximum values in crop seed index value and grain yield; while 15th November 1st December and 15th December sowing wheat showed gradual reduction in values for almost all the traits examined except seed index by (Kumar *et al.* 2011).

The delay in sowing caused a marginal decrease in grain yield kg ha^{-1} (Aslam *et al.* 2013) but seed index improved with delayed sowing, which was mainly associated with decreased foliage weight with increasing temperature in April.

Conclusions

It was concluded that the wheat variety Benazir sown on 1st November showed superior performance with higher grain yield of 4015.8kg ha^{-1}. While sowing delayed beyond 15th December showed adverse effects on the growth and yield traits.

Therefore, it is suggested that the information should be disseminated through agricultural extension department, Government of Sindh, to the wheat farmers to grow this variety, in order to enhance their productivity, and ultimately to augment their revenue.

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