Impact of Sowing Dates on the Growth and Yield Performance of Modern Wheat Varieties Under the Argo-Climatic Conditions of D.I. Khan

Rashid Khan[1,*], Haris Khan[2]

[1]Department of Agronomy, Faculty of Agriculture, Gomal University, D.I. Khan, Khyber Pakhtunkhwa, Pakistan

[2]Gomal Center of Biochemistry and Biotechnology, Gomal University, D.I. Khan, Khyber Pakhtunkhwa, Pakistan

[*]Corresponding author

Abstract

A field experiment was conducted to assess the impact of different sowing dates on the growth and yield of various wheat varieties under irrigated conditions at the Agronomic Research Area, Gomal University, Dera Ismail Khan, during 2013. The study was arranged in a Randomized Complete Block Design (RCBD) with a split-plot layout and three replications. Sowing was done manually using a hand-driven drill. The net plot measured 1.8m × 5m, comprising six rows, each 5m long and spaced 30cm apart. Factor A represented sowing dates, while Factor B included different wheat varieties. The findings indicated significant effects of both sowing dates and wheat varieties on growth and yield parameters. The most favorable results were obtained from the October 25 sowing, which recorded the highest values for days to heading (101.25), spike length (9.45 cm), tiller density (316.94 m^2), biological yield (11.58 t ha^{-1}), grain yield (6.29 t ha^{-1}), and grain filling duration (79.75 days). In contrast, wheat sown on December 5 produced lower yield parameters. Among the tested varieties, Pirsabak-13 achieved the highest grain yield (6.29 t ha^{-1}) when sown on October 25, followed by Hashim-8 (6.42 t ha^{-1}) when sown on November 15. Gomal-8 yielded the lowest grain output (3.43 t ha^{-1}) when planted on December 5. Based on these results, it is recommended that wheat cultivation in Dera Ismail Khan should be conducted between October 25 and November 15, with Pirsabak-13 being the most suitable variety for early sowing, while Hashim-8 and Gomal-8 should be grown at their optimal sowing times.

Keywords

Wheat, Sowing Dates, Yield Performance, Agro-Climatic Conditions

1. Introduction

Wheat (*Triticum aestivum L.*) is one of the most important staple food crops globally, playing a vital role in ensuring food security. As a self-pollinated, annual member of the Gramineae family, it serves as a dietary cornerstone for nearly two billion people worldwide. However, wheat yield is highly sensitive to climatic variations, which can significantly impact its productivity. In Pakistan, wheat occupies a dominant position in the agricultural sector, covering approximately 68% of the total cultivated area [1]. The demand for wheat continues to grow nationally, with the 2012–13 season reporting a cultivation area of 8.693 million hectares and a total production of 24.2 million tons, yielding an average of 2,787 kg ha^{-1}. The crop contributes about 14.4% to the value addition in agriculture and accounts for 3.0% of the national GDP [2]. Among the various factors limiting wheat productivity, sowing time and varietal selection are of critical importance. Timely sowing enhances crop establishment, optimizes resource use, and improves yield. Optimal sowing schedules vary by region, depending on local agro-climatic conditions, such as temperature fluctuations and rainfall distribution. Early planting enables better crop performance due to longer exposure to favorable temperatures and sunlight [3], while delayed sowing especially beyond November 20—can lead to significant yield reductions, estimated at about 39 kg ha^{-1} per day [4]. Late planting adversely affects tiller production and overall plant vigor due to exposure to lower temperatures. In such conditions, short-duration varieties that can mature quickly and avoid terminal heat stress are preferred. Numerous studies have reported that delayed sowing reduces key yield-contributing parameters such as tiller number, grains per spike, and final grain yield [5]. Furthermore, grain development and quality are compromised under late sowing conditions, as reduced vegetative growth limits the plant's productive potential [6]. In extreme cases, sowing in December can lead to yield reductions ranging between 27% and 57% [7]. Wheat varieties exhibit differential responses to sowing dates, with some genotypes showing better adaptation to early sowing conditions. In this context, the present study was conducted to evaluate the performance of newly introduced wheat varieties under varying sowing dates and to identify the most suitable variety and planting window for maximizing grain yield under the agro-climatic conditions of Dera Ismail Khan.

2. Materials and Methods

The field experiment was carried out in 2013 at the Agronomic Research Area of Gomal University, Dera Ismail Khan, under irrigated conditions. A randomized complete block design (RCBD) with a split-plot arrangement was employed, comprising three replications. Sowing was performed manually using a hand-operated seed drill. Each plot measured 1.8 meters in width and 5 meters in length, consisting of six rows spaced 30 cm apart. Sunflower seeds were sown at a rate of 100 kg ha^{-1}. Fertilizer application followed the recommended NPK ratio of 120:90:60 kg ha^{-1}, with Urea, DAP, and SOP serving as the nutrient sources. The full doses of phosphorus and potassium, along with half of the nitrogen, were incorporated at sowing. The remaining nitrogen was applied with the first irrigation. Weed management was done manually, and all other agronomic practices were conducted according to standard regional recommendations.

Measured Parameters:

Days to 50% Heading: Recorded from the sowing date until 50% of the plants in each block had reached heading.

Plant Height (cm): Measured at maturity using a meter rod from the base of the plant to the tip of the spike, using five randomly selected plants per treatment.

Spike Length (cm): Determined by averaging the spike lengths of five randomly selected spikes per plot.

Number of Tillers (m²): Counted using a one-meter quadrate, and means we**re calculated.**

Number of Grains per Spike: Recorded from five randomly selected spikes, and the average was calculated.

1000-Grain Weight (g): A sample of 1000 grains from each plot were weighed using a sensitive electronic balance.

Biological Yield (t ha^{-1}): The total biomass harvested from each plot was sun-dried for two weeks, weighed, and converted to t ha^{-1} using the formula:

Biological yield (t ha^{-1}) = (Plot Yield) / (Plot Size) × 10

Grain Yield (t ha^{-1}): The threshed and weighed grain yield was recorded and converted into t ha^{-1} **using the formula:**

Grain Yield (t ha^{-1}) = (Plot Yield) / (Plot Size) × 10

Grain Filling Duration: Counted as the number of days from flowering to harvesting**.**

Harvest Index (%): The ratio of economic yield to biological yield, calculated as**:**

Harvest Index (%) = (Economic Yield) / (Biological Yield) × 100

Meteorological Data: Meteorological data for crop growth and development were collected from the Arid Zone Research Institute, Dera Ismail Khan.

Statistical Analysis: The collected data were statistically analyzed using the analysis of variance (ANOVA) technique. The least significant difference (LSD) test was applied for mean comparisons using Statistix-8.1 software.

3. Results and Discussion

3.1 Days to 50% Heading

The data in Table 1 indicated that sowing date, wheat variety, and their interaction had a significant effect on the number of days required to reach 50% heading. The longest duration to 50% heading was recorded when sowing was done on October 25, averaging 101.25 days. Sowing on December 5 resulted in slightly fewer days (99.67), but the difference was not statistically significant. Among the tested varieties, Hashim-8 consistently reached heading earlier than the others, averaging just 87.33 days. In contrast, Gomal-8, Shahkar-13, and Pirsabak-13 required 104.44, 103.89, and 103.33 days, respectively, to reach 50% heading. The notably shorter time to heading in Hashim-8 is indicative of its early maturity, likely driven by its genetic makeup and sensitivity to warmer early-season temperatures. [8] noted that the expression of earliness genes in wheat can be highly responsive to temperature conditions. The maximum days to heading (112.67) were observed in Shahkar-13 sown on October 25, followed closely by Gomal-8 with 110.67 days under the same sowing date. Conversely, the shortest duration (71.67 days) was recorded for Hashim-8 when sown on October 25, emphasizing its rapid phenological development under favorable conditions.

Table 1. Effect of sowing dates and verities on plant height (cm)

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	110.67ab	103.67c	99.1d	104.44a
Hashim-8	71.67f	91.0e	99.34d	87.33b
Shahkar-13	112.77a	99.0d	100.0d	103.89a
Pirsabak-13	110.0b	99.67d	100.33d	103.33
Mean	101.25a	98.33	99.68ab	

3.2 Plant Height (cm)

In Table 2 sowing date, variety, and their interaction all significantly influenced plant height. The tallest plants, averaging 102.39 cm, were recorded under the October 25 sowing, followed by 100.41 cm in the November 15 sowing.

Delayed sowing on December 5 led to a reduction in plant height, with an average of 97.13 cm. Among the varieties, Shahkar-13 attained the greatest height (103.50 cm), which was statistically similar to Hashim-8 (102.05 cm). The shortest plants were observed in Gomal-8 (97.06 cm) and Pirsabak-13 (97.30 cm). These variations can be attributed to genetic differences among varieties, as previously reported by Shahzad et al. (2002). The interaction between sowing date and variety revealed that Shahkar-13 sown on October 25 produced the tallest plants (107.28 cm). In contrast, Pirsabak-13 sown on December 5 exhibited the shortest plant height (93.07 cm). The reduction in height with late sowing is likely due to a compressed vegetative period, limiting biomass accumulation. This is supported by Ismail et al. (2013), who also observed reduced plant height under delayed planting conditions.

Table 2. Effect of sowing dates and varieties on plant height (cm)

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	103.07ab	93.61de	94.49cde	97.06b
Hashim-8	100.93bc	103.64ab	101.57ab	102.05a
Shahkar-13	107.28a	103.84ab	99.37bcd	103.50a
Pirsabak-13	98.28	100.54bc	93.07e	97.30b
Mean	102.39^{NS}	100.41	97.13	

3.3 Spike Length (cm)

Spike length was significantly influenced by sowing dates and varieties in Table 3, though their interaction was statistically non-significant. The longest spikes were produced when the crop was sown on October 25, with an average of 10.7 cm. However, this value decreased sharply to 8.35 cm when sowing was delayed to December 5. The reduction in spike length under late sowing is attributed to temperature stress and a shortened growth period, consistent with findings by Ahmad et al. (1997). Significant varietal differences were also observed. Pirsabak-13 recorded the longest average spike length (9.44 cm), followed by Shahkar-13 (9.17 cm). The shortest spikes (8.41 cm) were produced by Gomal-8. Regardless of variety, spike lengths declined under late sowing conditions, as late-season temperature sensitivity and reduced photoperiod during critical growth stages may limit spike development [9]. Although the interaction between planting date and variety was statistically non-significant, notable trends were evident. For instance, Pirsabak-13 sown on October 25 achieved the longest spike (10.43 cm), followed by Shahkar-13 (9.56 cm) at the same sowing date. On the other hand, Gomal-8 produced the shortest spike (7.83 cm) when planted on December 5.

Table 3. Effect of sowing dates and varieties on spike length (cm)

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	8.91^{NS}	8.50	7.83	8.41c
Hashim-8	8.92	8.73	8.43	8.69bc
Shahkar-13	9.56	9.18	8.76	9.17bc
Pirsabak-13	10.43	9.53	8.36	9.44a
Mean	9.45a	8.98ab	8.35b	

3.4 Grains Spike^{-1}

The number of grains in the Table 4 per spike was significantly influenced by the wheat varieties, while the effects of sowing dates and their interaction were non-significant. The highest number of grains per spike (40.58) was recorded for the crop sown on October 25, while the lowest (36.08) was observed in the December 5 sowing. Among the varieties, Shahkar-13 produced the maximum grains per spike (42.00), followed closely by Hashim-8 (40.00). The minimum number of grains per spike was observed in Gomal-8 (34.33), which was statistically similar to Pirsabak-13 (37.33). These varietal differences in grains per spike are likely due to genetic variability among the cultivars, corroborating the findings of [10] who also reported significant differences among wheat genotypes in this trait. Though the interaction between sowing dates and varieties was statistically non-significant, notable values were observed. Hashim-8 produced the highest grains per spike (45.00) when sown on November 15, followed by Shahkar-13 (43.30) under October 25 sowing. The lowest values (33.33) were recorded for Gomal-8 under both November 15 and December 5 sowing dates.

Table 4. Effect of sowing dates and varieties on number of grains spike1

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	36.33 ^{NS}	33.33	33.23	34.33c
Hashim-8	40.00	45.00	35.00	40.00ab
Shahkar-13	43.33	43.10	39.66	42.00a
Pirsabak-13	42.66	33.00	36.33	37.33bc
Mean	40.58 ^{NS}	38.58	36.08	

3.5 Number of Tillers (m^{-2})

Sowing date significantly affected the number of tillers per square meter in Table 5, with the highest tiller count (316.94 m^{-2}) recorded under October 25 sowing, which was statistically similar to the 15th November sowing (302.47 m^{-2}). The lowest number of tillers (254.83 m^{-2}) was observed in the December 5 sowing. Early planting enhanced tiller formation due to a longer vegetative period and favorable growth conditions, while delayed planting reduced tillering. These results align with those of [11], who reported fewer tillers in late-sown wheat. Although varietal differences in tiller number were statistically non-significant, Gomal-8 produced the highest number of tillers (302.2 m^{-2}), followed by Hashim-8 (300.41 m^{-2}), while the lowest was recorded in Pirsabak-13 (269.63 m^{-2}). The interaction between sowing dates and varieties also remained non-significant. Nonetheless, the maximum tillers (325.11 m^{-2}) were obtained from Gomal-8 sown on November 15, while the minimum (226.83 m^{-2}) was observed in Gomal-8 under December 5 sowing.

Table 5. Effect of sowing dates and varieties of tillers (m^{-2})

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	253.22 ^{NS}	325.11	230.33	302.89 ^{NS}
Hashim-8	311.22	319.33	270.66	300.41
Shahkar-13	290.66	266.11	252.11	292.74
Pirsabak-13	312.67	299.33	266.22	269.63
Mean	316.94a	302.47a	254.83b	

3.6 1000-Grain Weight (g)

The sowing dates and the interaction between varieties and sowing dates significantly influenced 1000-grain weight in Table 6, whereas the varietal effect was non-significant. The maximum 1000-grain weight (47.67 g) was observed in the October 25 sowing, while the lowest (43.22 g) was recorded under November 15 sowing. Among the varieties, Shahkar-13 produced the highest 1000-grain weight (46.47 g), followed closely by Pirsabak-13 (46.32 g), while Hashim-8 recorded the lowest (42.41 g). The highest individual value (52.84 g) was noted in Shahkar-13 sown on October 25, whereas the lowest (38.75 g) was observed in Hashim-8 sown on November 15.

Table 6. Effect of sowing dates and varieties on 1000-grains weight(g)

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	44.80 ^{NS}	43.240	45.043	44.361 ^{NS}
Hashim-8	44.740	38.750	43.870	42.417
Shahkar-13	52.847	44.430	42.142	46.471
Pirsabak-13	47.661 ^{NS}	46.490	44.333	46.320
Mean		43.228	43.918	

3.7 Biological Yield (t ha^{-1})

Biological yield was significantly affected by sowing dates and their interaction with varieties in Table 7, whereas the effect of varieties alone was non-significant. The highest biological yield (11.58 t ha^{-1}) was achieved under October 25 sowing, followed by November 15 (10.56 t ha^{-1}), while the lowest yield (7.82 t ha^{-1}) was recorded in December 5 sowing. The superior performance of early sowing is attributed to longer vegetative and reproductive phases, which facilitated increased biomass accumulation. Although varietal differences were non-significant, Pirsabak-13 produced the highest biological yield (10.78 t ha^{-1}) across sowing dates, followed by Hashim-8 (9.97 t ha^{-1}). The interaction between varieties and sowing dates revealed significant differences. The highest biological yield (12.63 t ha^{-1}) was obtained from Pirsabak-13 under October 25 sowing, which was statistically similar to Gomal-8 (12.40 t ha^{-1}) sown on the same date. Conversely, the lowest biological yield (6.11 t ha^{-1}) was recorded in Gomal-8 when sown on December 5. These findings are consistent with Khosarvi et al. (2010), who also reported higher biological yields in early sown wheat due to favorable temperature and photoperiod conditions that promote optimal growth and biomass production.

Table 7. Effect of sowing dates and varieties on biological yield (t ha^{-1})

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	12.41ab	10.73bc	6.12e	9.750 ^{NS}
Hashim-8	10.72bc	11.23ab	8.06d	9.970
Shahkar-13	10.67bc	9.12cd	8.58d	9.466
Pirsabak-13	12.62a	11.19ab	8.54d	10.783
Mean	11.68a	10.76a	7.82b	

3.8 Grain Yield (t ha⁻¹)

The analysis of variance in Table 8 revealed that sowing dates had a significant impact on grain yield. Wheat sown on October 25th achieved the highest grain yield (6.29 t ha^{-1}), which was statistically at par with the crop sown on November 15th (5.93 t ha^{-1}). In contrast, the lowest grain yield (4.14 t ha^{-1}) was recorded for the December 5th planting. Among the varieties, Pirsabak-13 produced the highest average grain yield (5.82 t ha^{-1}), which was statistically comparable to Hashim-8 (5.64 t ha^{-1}). The lowest grain yields were recorded for Gomal-8 (5.19 t ha^{-1}) and Shahkar-13 (5.16 t ha^{-1}). The interaction between sowing dates and wheat varieties was non-significant. However, the maximum grain yield (6.88 t ha^{-1}) was obtained from Pirsabak-13 sown on October 25th, followed by Hashim-8 (6.42 t ha^{-1}) planted on November 15th. The lowest grain yield (3.43 t ha^{-1}) was produced by Gomal-8 under late sowing on December 5th. The reduction in grain yield with delayed sowing is attributed to the decline in yield components due to shortened growth periods and exposure to low temperatures. These findings align with those of [12,13] who also reported yield reductions with delayed wheat planting.

Table 8. Effect of sowing dates and varieties on Grain yield (t ha^{-1})

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	6.33	5.28	3.43	5.19b
Hashim-8	5.93	6.43	4.57	5.64ab
Shahkar-13	6.03	5.23	4.26	5.16b
Pirsabak-13	6.88	6.31	4.31	5.82a
Mean	6.29a	5.93a	4.14b	

3.9 Grain Filling Duration (Days)

The Table 9 shows grain filling duration was markedly influenced by sowing dates, varieties, and their interaction. The longest grain filling duration (79.75 days) was recorded in the October 25th sowing, followed by November 15th (61.41 days), whereas the shortest duration (30.33 days) was observed in the December 5th sowing. Among the varieties, Hashim-8 exhibited the longest grain filling period (72.33 days), while Pirsabak-13, Gomal-8, and Shahkar-13 showed relatively shorter durations of 56.44, 56.00, and 55.88 days, respectively. The interaction effect was also significant. Maximum grain filling duration (109.33 days) was recorded for Hashim-8 planted on October 25th, followed by the same variety sown on November 15th (68.00 days). In contrast, the shortest grain filling period (38.67 days) was recorded in Pirsabak-13 sown on December 5th. These results suggest that earlier sowing ensures a longer grain filling period due to favorable temperature and photoperiod, while high temperatures during the grain development phase in late sowing restrict duration. Similar observations were reported by [14].

Table 9. Effect of sowing dates and varieties on Grain filling duration

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	70.43b	57.67d	40.00	56.00b
Hashim-8	109.33a	68.00c	39.67f	72.33a
Shahkar-13	68.32c	60.33d	39.10f	55.88b
Pirsabak-13	71.00b	59.67d	38.57f	56.44b
Mean	79.65a	61.41b	39.43c	

3.10 Harvest Index (%)

Sowing date had a significant effect on harvest index in the Table 10. The highest harvest index (55.82%) was recorded when wheat was sown on October 25th, followed by November 15th (54.15%). The December 5th sowing exhibited the lowest harvest index. While varietal differences in harvest index were not statistically significant, Gomal-8 recorded the highest harvest index (57.50%) under December 5th sowing, whereas Pirsabak-13 showed the lowest (49.88%) under the same sowing date. These results suggest that while sowing time considerably affects the harvest index, varietal response may vary depending on environmental conditions, particularly temperature during the grain filling period.

Table 10. Effect of sowing dates and varieties on Harvest index %

Verities	Date of Sowing			Mean
	Oct-25	Nov-15	Dec-05	
Gomal-8	51.715 ^{NS}	54.20	57.50	54.47
Hashim-8	55.77	56.30	55.23	64.56
Shahkar-13	56.74	56.66	49.89	54.56
Pirsabak-13	54.82	55.91	49.98	53.54
Mean	55.82 ^{NS}	54.76	53.25	

4. Conclusion and Recommendations

The present study demonstrated that delayed sowing significantly affected key yield-contributing traits in wheat, resulting in reduced grain yield. In contrast, early planting notably enhanced yield and its associated components. Based on the current findings, October sowing proved to be the most suitable timeframe for wheat cultivation under the agro-ecological conditions of Dera Ismail Khan. Among the tested varieties, Pirsabak-13 consistently outperformed the other cultivars and achieved the highest grain yield when sown on October 25th. Therefore, it is recommended that Pirsabak-13 be sown between October 25 and November 15 to achieve optimum yield potential. In contrast, local varieties such as Hashim-8 and Gomal-8 exhibited comparatively lower yield performance across various sowing dates. As such, these varieties should be sown within their specific recommended planting windows to attain satisfactory results. Future research may focus on evaluating additional genotypes across multiple seasons to further validate these findings and ensure varietal stability under changing climatic conditions.

References

[1] Said, A., H. Gul, B. Saeed, B. Haleedma, N.L. Badsha and L. Parveen. 2012. Response of wheat to different planting dates and seeding rates for yield and yield component. ARPN. J. Agri. Bio. Sci., 7(2): 138-140.

[2] Anonymous. 2007. Economic survey of Pakistan. Ministry of food and livestock (Federal bureau of statistics), Islamabad.

[3] Ali, R. 1999. Radiation interception, growth and nitrogen application. M.Sc. Thesis (Agronomy), Uni. Agri. Faisalabad. Pakistan.

[4] Singh, V. P. N. and S. M. Uttam. 1994. Performance of wheat (Triticum aestivum L.) cultivars under limited irrigation and fertility management. Ind. J. Agron.,38:386-388.

[5] Ansari, A. H., A. M. Khushak, M. A. Sethar, N. A. Ariam, and M. Y. M. Emon. 1989. Effect of sowing dates on growth and yield of wheat cultivars. Pak. J. Sci. Ind. Res., 32: 39-42.

[6] Nazir, A and Fathiullaha. 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.

[7] Iqbal, M. S., A. Yar, A. Ali, M. R. Ansari, J. Iqbal and H. M. Akram. 2001. Effect of sowing date and seed rate on grain yield of wheat(cv. 93-BT-022). J. Agri. Res.,39(3-4): 217-220.

[8] Slafer, G. A. 1996. Differences in phasic development rate amongst wheat cultivars independent of responses to photo period and verbalization. A view point of the intrinstic earliness hypothesis. J. Agric. Sci., 126: 403 419.

[9] Slafer, G. An and E.M. Whitechurch. 2001. Manipulating wheat development to improve adaptation. In Application of physiology in wheat breeding, Reynolds, M. P. Oritiz, Monasterio, J. I and A. Mcnab. (Eds), Maxico, D.F.: CIMMYT.

[10] Anwar, J., A. Ahmad, T. Khalid, M. Mubeen and S. R. Sultana.2011. Optimization of sowing time for promising wheat genotypes in semiarid environment of Faisalabad. Crop & environment. 2(1): 24-27.

[11] Akber, H., A. Ali, M. Shafi and B. Ahmed. 2000. Comparative study of agronomic traits of old and new wheat varieties. Sarhad. J. Agric., 16: 1-5.

[12] Aslam, M., M. Hussain, M. Akhtar, M.S. Cheema and L. Ali. 2003. Response of wheat varieties to sowing dates. Pak. J. Agron., 2(4): 190-194.

[13] Baloch, M. S., T. H. Shah, M. A. Nadim, M. I. Khan and A. A. Khakwani. 2010. Effect of seeding density and planting time on growth and yield attributes of wheat. J. Ani. Plant Sci., 20(4): 239-240.

[14] Royo, C., M. Abaza, R. Balamco and L. F. Garc la del. 2000. Triticale grain growth and morphology as affected by drought stress, late sowing and stimulated drought stress. Aust. J. Plant Physio., 27(1): 1051-1059.