Pure Appl. Biol.,14(2):599-606,June, 2025
http://dx.doi.org/10.19045/bspab.2025.140057

Research Article

Impact of different sowing dates on yield and agronomic traits of wheat under arid and semi-arid conditions of Bannu Division

Abdul Quddoos[1*], Khalid Mahmood[1], Muhammad Ali[1], Muhammad Farooq[1], Alamgir Khan[2], Noman Khan[2] and Bashir Ullah[3]
1. Agricultural Research Station Serai Naurang (Bannu) Khyber Pakhtunkhwa, Pakistan
2. Shaheed Benazir Bhutto University, Sheringal, Upper Dir Khyber Pakhtunkhwa, Pakistan
3. Climate Change, Forestry, Environment & Wildlife Department Khyber Pakhtunkhwa, Pakistan
**Corresponding author's email:* abashaheed47@gmail.com

Citation
Abdul Quddoos, Khalid Mahmood, Muhammad Ali, Muhammad Farooq, Alamgir Khan, Noman Khan and Bashir Ullah. Impact of different sowing dates on yield and agronomic traits of wheat under arid and semi-arid conditions of Bannu Division. Pure and Applied Biology. Vol. 14, Issue 2, pp599-606.
http://dx.doi.org/10.19045/bspab.2025.140057

Received: 01/01/2025 Revised: 06/03/2025 Accepted: 12/03/2025 Online First: 16/03/2025

Abstract

The impact of different sowing dates on wheat crop was tested in two seasons, Rabi 2021-22 and 2022-23 at Agricultural Research Station Serai Naurang (Bannu) Khyber Pakhtunkhwa Pakistan to sort out optimum sowing date to get the required yield potential and the highest wheat production. Five sowing dates, 18th - 24th October, 3rd – 9th November, 18th – 24th November, 2nd – 8th November and 17th – 23rd December were tested. Genotypes of wheat SN– 005, SN – 010, SN – 013, SN - 016, SN – 017, SN- 020, SN – 022, Khaista - 17 and Gulzar-2019 were used during this investigation. The study was concentrated on growth traits and yield parameters. The highest significant 1000 grains weight (49.50 grams), biological yield (23265kg ha^{-1}) and grain yield (6874kg ha^{-1}) was acquired by 1st sowing date 18th – 24th October (SD1). SD1 also got highly significant days to heading (113), days to maturity (170) and plant height (109.70 cm) as compared to all other treatments but at par result with 2nd sowing date 3rd - 9th November (SD2) and 3rd sowing date 18th - 24th November (SD3). SD2 and SD1 got highly significant tillers m^{-2} among all treatments but at par with one another. This research will help farmers to follow optimum date of sowing and frame updated production technology. Moreover, it will help agricultural scientists to evolve and develop genotypes of wheat to survive in the existing effects of climate change and pave ways to meet food security problem in the prevailing scenario of global warming.

Keywords: Impact; Sowing dates; Wheat growth

Introduction

Pakistan is an agricultural country and its economy is mainly based on agriculture. Most people of Pakistan adapt agriculture as a profession. It is the main contributor of the economic development of Pakistan and it earns 30-40 % national savings. Pakistan faces a problem of low productivity like many developing countries of the world. Like many developing countries of the world Pakistan cannot expand cultivated area. Besides this, yield per acre of different crops is also very low and this challenge may be met only through growing of more food grain. Agriculture is the sole source of food supply. Therefore, it is cry of the day to raise the production of food items; it will not only solve the food security problem but also increase foreign exchange reserve of the country and will get self – sufficiency in food items.

Wheat (*Triticum aestivum* L.) is a basic food item, providing food grain to most people of the world and it is the third most grown crop in the world having unique nutritional value [1]. The nutritive value of it is much more than any other cereal crop because it is the sole source of rich calories, protein, dietary fibers, vitamins and many other minerals of the diet for the people of the world [2]. Wheat is the food item that is traded on a large scale in the world by providing more than 20 % of calories and protein content through human diet [3, 4]. The increase in population growth and change in dietary habit has been increasing the demand for cereal for decades [5, 6]. In the present challenges such as dangers of climate change, low chance of increase in cropland and huge increase in scarcity of fresh water, cropping systems will have to increase production to meet the demand [7-9]. Climate change affects crop growth and production by increasing temperature, changing pattern of rainfall system and intense of drought and higher intensity of other very great conditions [10]. Productivity of cropping systems is increased through genetic improvement and following of agronomic management that is to use optimum sowing dates and sowing rates under the prevailing climatic conditions [11, 12]. It is very necessary to understand that how sowing dates and its density affect crop growth and yield to adapt optimum sowing condition under climate change. Growing season of wheat is shortened by increase in temperature and in this way the optimum condition for sowing dates is also changed [13]. Tillers development and competition is affected by changing in sowing dates and sowing rate [14]. Tillering has a major role in crop growth and productivity of wheat crop. Moreover, tillers catch light for the photosynthesis. Sowing time and selection of proper varieties are some of the factors that contribute in the yield and production of crops. It means that by using optimum sowing date, high-yielding and disease resistant genotypes and seed treatment, we can increase yield of wheat. High yield is result of interaction among genetic traits, ecological conditions and management factors. Sowing date is one of the factors that not only affects yield of cereal crops but also plays a role in adjusting of timing and duration of vegetative and reproductive stages [15]. The yield along with bread quality of wheat is affected by optimum date of sowing because it causes better adjustment to the physiology, phenology and ecological conditions [16]. Moreover, water, temperature and availability of solar radiations for the crop is also affected by optimum sowing date [17]. Use of optimum sowing date, high-yielding and disease resistant genotypes and suitable environmental conditions increase grain yield by 10 to 80 % [18]. Although favorable degree of hotness for wheat crop is 15-25 ^{0}C yet it can also survive and grow at low degree of hotness too i.e. at 3 to 4 ^{0}C and at higher temperature up to 30- 32 ^{0}C [19]. A significant decrease in carbohydrate formation is noted because of intense heat during anthesis and grain maturity stages as compared to favorable sowing stage [20]. Prevailing of high temperature before and after anthesis affects the crop growth severely and this causes reduction of photosynthetic efficiency of crop [21].

Yield of wheat can be increased by following an appropriate date of sowing, using high-yielding varieties and adaptation of low cost and updated crop production technology. Hence, in view of these conditions, the mentioned research was formulated to chalk out the impact of various sowing dates on growth and yield of wheat under agro- climatic condition of Bannu division Khyber Pakhtunkhwa Pakistan.

Materials and Methods

To find out optimum date of sowing the research was carried out at the research station of agriculture located at Serai Naurang Bannu Khyber Pakhtunkhwa Pakistan during the Rabi seasons 2021-22 and 2022-23. The trial was laid out in split-plot block design with three replications. The following dates of sowing were used.

1st Date of Sowing (DS1):- 18th - 24th October

2nd Date of Sowing (DS2) :- 3rd – 9th November

3rd Date of Sowing (DS3):- 18th – 24 November

4th Date of Sowing (DS4):- 2nd – 8th December.

5th Date of Sowing (DS5):- 17th – 23rd December

Genotypes SN– 005, SN – 010, SN- 016, SN – 017 and Khaista-17 were used for the Rabi season 2021-22 while SN – 013, SN – 017, SN- 020, SN – 022 and Gulzar- 19 were used for the Rabi season 2022-23. Trials were conducted in split- plot block design. Each block consists of five small plots with three replications having a small plot size of 1.2 x 5.0 m with row to row space 30 cm. Nitrogenous and phosphoric fertilizers doses @ 120-90 kg/ha were used. The whole phosphoric fertilizer was added at the time of seedbed preparation while nitrogenous fertilizers were used in two to three equal amounts in a proper interval. Weedicides Axil and Alymax were applied in the months of December and January to control weeds. Necessary observations, inspection and monitoring were regularly done of the major traits. As this work was carried out for two seasons, therefore, the average values of two years were taken for different traits. Data was collected for traits such as days to emergence, days to heading, plant height (cm), days to maturity, grains spike^{-1}, spike length (cm), spike m^{-2} , 1000 grains weight (gram), tillers m^{-2} , grain yield (kg ha^{-1}), biological yield (kg ha^{-1}) and harvest index percentage and analyzed statistically through Excel ANOVA .

Results and Discussion.

Days to 50 % emergence

The (Table 1) showed that SD1 acquired statistically significant result amongst all treatments by getting minimum days to emergence (6) followed by SD2 (8 days) while maximum days were taken by SD5 (13 days).

Days to 50 % heading

The (Table 1) showed that SD1 got maximum (113) days to heading followed by SD2 (111 days) while SD5 acquired minimum days (87) followed by SD4 (99 days). It is clear from the data that SD1 gets the higher significant result as compared to SD4 and SD5 but at par result with SD2 and SD3. Similar research was done by [22, 25] and got the same result.

Days to maturity

The (Table 1) indicated that maximum days (170) were taken by SD1 to get maturity followed by SD2 (161 days) and SD3 (152 days) while SD5 got minimum days to maturity (124) followed by SD4 (138 days). The statistical analysis showed that SD1 got the highest significant result of SD3, SD4 and SD5 but at par result with SD2. A similar study was conducted by [22, 25] and got at par result.

Plant height (cm)

The (Table 2) revealed that highest average height was obtained by SD1 (109.70 cm) followed by SD2 (109.60 cm) and SD3 (105.75 cm) while minimum average plant height was recorded for SD5 (69.44 cm) followed by SD4 (87.05 cm). Statistical analysis indicated that SD1, SD2 and SD3 had significantly the higher plant height than SD4 and SD5 but at par with each other. Similar research was done by [22-24] and got the same result**.** These findings are also at par with the results of [25, 26].

Length of spike (cm)

The (Table 2) showed that SD3 reached the highest average length of spike (12.22 cm) followed by SD1 (12.08 cm) and SD2 (12.05 cm) while SD5 achieved the shortest spike with 10.35 cm length. Statistically SD3, SD1 and SD2 are significant to SD4 and SD5 but at par with each other. .This result is in agreement with [22, 24, 25].

Discussion

This research work provides understanding of how watering frequency effects feed intake which ultimately leads to better milk production. Thus, we compare different watering regimes to investigate its effect on milk production and its composition, feed intake and water intake in Achai-Jersey cross cattle at Surezai, Peshawar.

The current study reveals a significant effect of different watering regimes on milk production which is evident from the data that the animals in group-C having free access to drinking water and have higher average milk production of 5.08 liters as compare to group-B animals which were offered three time drinking water in a day having production of 4.89 liters. The findings of present study were supported by Meyer [3] who reported that milk production increased with increment of water intake. Findings of the present study is also supported by Khan [5] who reported that the reducing or decreasing watering had negative effect on milk production whereas free access to drinking water had a positive effect on milk yield. Results of the present trial are parallel with the research conducted by Senn [11] who is of the view that water deprivation decreased milk yield by about 30%. The results of the present study is supported by Thokal [12] who reported that the average milk production was decreased by 16% due to restriction of watering frequency from free access to twice-a-day in cattle, but there was no significant effect of watering frequency on fat, protein, solids not fat and total solids contents of milk.

Findings of the present study in terms of milk production is in line with the findings of Little [10] who reported that milk production reduced by 28% on third day of water deprivation in the dairy cow, but milk composition was not altered much. The present study is in contrast with the findings of Aganga [8] who reported that water deprivation for 72 hours reduces milk production by 50% in lactating sheep and goats, but water deprivation for 72 hours causes an increase in the viscosity of milk as well as protein, fat and lactose content.

Water availability also affects water intake of the animals significantly. It is evident from the collected data that the animals in group-C having free access to drinking water have higher average water consumption (33.26 liters) as compared to group-B animals having average (31.28 liters). The lowest average water consumption was observed (28.90) in group-A animals. The findings of present study in terms of water intake were supported by Thokal [12] who reported that the mean value of water intake by cows was significantly ($P<0.05$) greater in watering thrice a day as compared to cows watering twice a day. The findings of Abdelatif [13] and Ahmed are also parallel to the present study who reported reduction in total water intake when sheep were watered at an interval of 24, 48 and 72 hours compared with animals that had free access to water.

Watering frequency significantly affects feed intake in cattle as water availability is critical for their digestion, metabolism and overall health. Feed consumption is highly related to water intake. The optimal water to feed intake ratio is crucial for proper nutrient absorption and health. An adequate level of water intake is necessary for proper digestive and other vital functions of the body **[14]**. The present study is supported by the studies conducted by Jaber **[15]** which shows that when Awassi sheep experienced a 3 to 4 days intermittent watering regimen voluntary feed intake was reduced to approximately 60% as compared to control group. In contrast, Kay **[16]** states that drinking water is not needed for swallowing and moistening feed, since water can be circulated from the blood to maintain high salivation; it is, however, needed to replace the inevitable water loss by excretion and evaporation. Findings of the recent study are supported by study conducted by Misra **[17]** and Singh who reported that animals watered once in a day, had lower feed intake. Similarly, **[7]** Burgos reported that feed intake declined during the first 3 days of water restriction depending on the restriction level. Findings of present study were supported by Silanikove **[18]** who reported that reduction in water intake causes reduction in dry matter intake.

Spike m^{-2}

The (Table 2) showed that SD2 gave the highest average number (366) of spikes per square meter followed by SD1 (359 spikes) while minimum average number (233) of spikes were noted in SD5 followed by SD4 (267 spikes). The reason for this is that due to late sowing, the vegetative growth is affected which causes the low spikes m^{-2}. The Statistical analysis showed that SD2 and SD1 had significant number of spikes as compared to SD3, SD4 and SD5 but at par with one another. These findings are at par with **[22, 23]**. These results are also in agreement with research work of **[24, 25]**.

Grains per spike

The (Table 3) revealed that SD2 had maximum numbers of grains per spike (68) followed by SD1 (67 grains) while minimum number of grains (46) per spike were recorded for SD5 followed by SD4 (55 grains). It was observed statistically that SD2, SD1 and SD3 had the significant numbers of grains per spike amongst SD5 and SD4 but at par with each other. Results of this research work are in accordance with the work of **[22, 24]**.

1000 Grains weight (grams)

The (Table 3) showed that SD1 had maximum 1000 grain weight (49.50 gram) followed by SD2 (48.50 grams) while SD5 maintained minimum weight (35.00 grams) followed by SD4 (38.50 grams). Data showed that SD1 and SD2 had significant 1000 grain weight as compared to SD5 and SD4 but at par result with one another statistically. Similar investigation was carried out by **[22, 23]** and got same findings. Similarly, results of **[24, 25]** coincide with this research work.

Tillers m^{-2}

The (Table 3) revealed that SD2 had maximum tillers m^{-2} (379) followed by SD1 (374 tillers) while the SD5 produced minimum tillers (248) followed by SD4 (286 tillers). Statistically, SD2 and SD1 had significant result as compared to SD5, SD4 and SD3 but at par result with one another. Similar task was completed by **[22, 23]** and got the same result. Similar findings were searched out by **[24, 25]**.

Biological yield (Kg/ha)

The (Table 4) revealed that SD1 got the highest biological yield per hectare (23265 kg) followed by SD2 (20399 kg) while SD5 achieved the lowest biological yield (8177 kg). Statistically, SD1 got the highest significant biological yield amongst all treatments. It is clear from the result that biological yield decreases with the late date of sowing. These results are supported by research work of [22, 23].

Yield/hectare (Kg)

The (Table 4) showed that the highest average grain yield ha^{-1} (6874 kg) was got by SD1 followed by SD2 (6308 kg) while the lowest average grain yield (2839 kg) was produced by SD5 followed by SD4 (4853 kg). Statistically, it was observed that SD1 got the most significant result of all the treatments. Similar study was carried out by [22-25] and reported similar results.

Harvest index %

The (Table 4) revealed that maximum harvest index (36.56 %) was recorded in treatment SD4 followed by SD5 (34.66 %) while minimum harvest index was calculated for SD1 (30.50 %). Result showed that SD4 had the highest significant percentage of harvest index over all other treatments. This result is in contrast to [24] because in the area concerned temperature is very low during the stage of vegetative growth, thus vegetative growth of the crop is severely affected which causes low biological yield and as biological yield is put as a dominator in calculation of harvest index, therefore, harvest index is increased with the low temperature and late sowing.

Table 1. Impact of different sowing dates on growth of wheat

Treatment	Days to Emergence			Days to Heading			Days to Maturity		
	2021-22	2022-23	Average	2021-22	2022-23	Average	2021-22	2022-23	Average
SD1	5	7	6^{e}	107	119	113^{a}	166	174	170^{a}
SD2	7	10	8^{d}	114	108	111^{ba}	160	161	161^{ba}
SD3	8	11	10^{c}	113	102	108^{cab}	152	151	152^{cb}
SD4	10	12	11^{b}	102	96	99^{d}	136	139	138^{d}
SD5	13	14	14^{a}	88	86	87^{e}	115	132	124^{e}
LSD .05	0.57	0.70	0.65	6.86	7.85	7.01	9.77	10.72	10.27

Table 2. Impact of different sowing dates on the characteristics of wheat

Treatment	Plant Height (cm)			Spike Length (cm)			Spike m^{-2}		
	2021-22	2022-23	Average	2021-22	2022-23	Average	2021-22	2022-23	Average
SD1	111.00	108.40	109.70^{a}	12.35	11.82	12.08^{ba}	345	373	359^{ba}
SD2	110.40	108.80	109.60^{ba}	12.20	11.90	$12.05c^{ab}$	352	380	366^{a}
SD3	110.50	101.00	105.75^{cab}	12.23	12.20	12.22a	329	349	339^{c}
SD4	95.43	78.67	87.05^{d}	11.31	10.97	11.14d	306	228	267^{d}
SD5	81.20	57.68	69.44^{e}	10.00	10.70	10.35e	266	200	233^{e}
LSD .05	6.71	5.59	6.17	0.79	0.80	0.78	21.42	19.31	20.45

Table 3. Impact of dates of sowing on agronomic traits of wheat

Treatment	Grains $Spike^{-1}$			1000 grains weight (grams)			Tillers/m^{2}		
	2021-22	2022-23	Average	2021-22	2022-23	Average	2021-22	2022-23	Average
SD1	67	66	67^{ba}	49	50	49.50^{a}	361	386	374^{ba}
SD2	67	69	68^{a}	48	49	48.50^{ba}	368	390	379^{a}
SD3	66	65	66^{cab}	47	47	47.00^{cb}	344	363	354^{c}
SD4	58	52	55^{d}	35	42	38.50^{d}	321	251	286^{d}
SD5	53	39	46^{e}	32	38	35.00^{e}	284	212	248^{e}
LSD .05	4.21	3.59	3.93	1.51	1.77	1.64	22.64	20.23	21.54

Table 4. Impact of dates of sowing on the yield of wheat

Treatment	Biological Yield (Kgha^{-1})			Grain Yield (Kgha^{-1})			Harvest Index (%)		
	2021-22	2022-23	Average	2021-22	2022-23	Average	2021-22	2022-23	Average
SD1	27135	19394	23265[a]	6721	7027	6874[a]	24.77	36.23	30.50[e]
SD2	23677	17121	20399[b]	6159	6457	6308[b]	26.00	37.71	31.86[d]
SD3	16390	13636	15013[c]	5522	4595	5059[c]	33.69	33.70	33.70[c]
SD4	14587	11970	13279[d]	5311	4395	4853[d]	36.40	36.72	36.56[a]
SD5	8778	7576	8177[e]	3077	2600	2839[e]	35.00	34.32	34.66[b]
LSD .05	407.01	356.98	385.39	321.56	302.24	312.37	2.08	2.49	2.30

Conclusion

It was concluded on the basis of two years research that the highest significant grain yield, biological yield, 1000 grain weight, grain per spike, tillers m^{-2}, spike m^{-2}, days to heading, days to maturity, plant height were noted in the first two sowings i.e. 18th – 24th October and 3rd – 9th November. So, if farmers of the area plant their wheat crop from the last week of October to the 2nd week of November then they may get the highest yield of wheat and achieve the maximum potential of their crop. Moreover, by following these sowing dates, wheat crop takes maximum days to maturity hence crop will remain for more time in the field using maximum amount of nutrient gradients, therefore, the grain of these sowing dates will have high nutritional value as well as good quality of bread and baking characteristics. This research will help farmers to follow suitable date of sowing and frame updated production technology for the farming community. Moreover, it shall help agricultural scientists to evolve and develop genotypes of wheat to cope with the existing effects of climate change and pave ways to meet food security problem in the present scenario of global warming.

Authors' contributions

Conceived and framed the trials: A Quddoos & K Mahmood, Conducted trials: A Quddoos, Performed the data analysis: K Mahmood & M Farooq, Searched materials / analysis/ tools A Quddoos & M Farooq, Wrote the paper: A Quddoos & K Mahmood, Overall analysis and proof reading: A Khan and N Khan, Evaluated the materials for article on environmental point of view: B Ullah.

References

1. Farooq O, Ali M, Naeem M, Abdul S, Ijaz M, Sher A, Yasir TA & Iqbal MM (2015). Impact of sowing time and planting method on the quality traits of wheat. *J Glob Innov Agric Soc Sci* 3(1): 8-11.
2. Hussain I, Ahmad HB, Rauf S, Aslam M & Mehmood AM (2015). Effect of sowing time on quality attributes of wheat grain. *Inter J Biosci* 6(12): 1-8.
3. Shiferwa B, Smale B, Braun HJ, Duveiller E, Reynolds M & Muricho G (2013). Crops that feed the world 10. Past successes and future challenges to the role played by wheat in global food security. *Food Sec* 5: 291-317.
4. Curtis T and Halford NG, (2014). Food security: The challenge of increasing wheat yield and the importance of not compromising food safety. *Ann of Appl Biol* 164: 354-372.
5. Alexandratos N and Bruinsma J.2012. World agriculture towards 2030\2050: The 2012 revision.ESA Working Paper No.12-03. Rome: *Food and Agriculture Organization of the United Nation.*
6. Van Dijk M, Morley T, Rau ML & Saghai Y (2021). A meta-analysis of projected global food demand and population at risk of hunger for the period 2010-2050. *Nature Food* 2: 494-501.
7. Eitelberg DA, Van VJ & Verburg PH (2015). A review of global potentially available cropland estimates and their consequences for model-based assessments. *Global Change Biol* 21: 1236-1248.

8. FAO (2017). The future of food and agriculture trends and challenges. Annual Report 296. Rome: *Food and Agriculture Organization of the United Nation.*
9. Gerten D, Heck V & Jagermeyr J (2020). Feeding ten billion people is possible within four terrestrial planetary boundaries. *Nat Sust* 3: 62-70.
10. Mbow C, Rosenzweig C & Barioni LG *et al*. (2019). Food security In: Shukla PR, Skea J, Calvo Buendia E *et al*., eds. Climate change and land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security and greenhouse gas fluxes in terrestrial ecosystem. Geneva: *Inter Panel on Cli Change* 437-550.
11. Spiertz H (2012). Avenues to meet food security. The role of agronomy on solving complexity in food production and resource use. *Eur J of Agro* 43: 1-8.
12. Bai H & Tao F (2017). Sustainable intensification options to improve yield potential and eco-efficiency for rice-wheat rotation system in China. *Field Crop Res* 211: 89-105.
13. Tao F, Zhang Z, Xio D, Zhang S, Rotter RP, Shi W, Liu Y, Wang M, Liu F & Zhang H (2014). Response of wheat growth and yield to climate change in different climate zones of China, 1981-2009. *Agric and Forest Metrol* 18, 91-104.
14. Spink JH, Semere T, Sparkes DL, Whaley JM, Foulkes MJ, Clare RW & Scott RK (2000). Effect of sowing date on the optimum plant density of winter wheat. *Annals of Appl Biol* 137: 179-188.
15. Sarag, EI and Ismail RIM. (2015). Evaluation of some bread wheat cultivars productivity as affected by sowing dates and water stress in semi-arid region. *Asian J Crop Sci* 5(2):167-178.
16. Riberio, TLP, Cunha GR, Pires JLF. & Pasinato A (2009). Phenological Responses of Brazilian wheat cultivars to vernalization and photoperiod. *Psequisa Agropecuaria Brasileria* 44(11): 1383-1390.
17. Silva RR, Benin G, Almeida JL, Fonseca ICB & Zucareli C (2014).Grain yield and baking quality of wheat under different sowing dates. *Acta Scientarum Agron* 36(2): 201-210.
18. Coventry DR, Gupta RK, Poswal RS, Chhokar RS, Sharma RK, Yadav VK, Gil SC, Metha A, Kleemann SGL, Bonamano A & Cummins JA (2011). Wheat quality and productivity as affected by varieties and sowing time in Haryana India. *Field Crop Res* 123(3): 214-225.
19. Sial MA, Dahot MU, Arain MA, Mangrio M S, Naqvi MH & Nizamani NA (2005). Effect of time of planting and heat stresses on wheat advanced genotypes. *Pak J Bitechnol* 2(1): 13-23.
20. Hurkman WJ, McCu KF & Altenbach SB (2003). Effect of temperature on expression of gene encoding enzymes for starch biosynthesis in developing wheat endosperm. *Plant Sci* 164(5): 873-881.
21. Wang X, Cai J, Jiang D, Liu F, Dai T & Cao V (2011). Pre-anthesis high temperature acclimation alleviates damage to the flag leaf caused by post-anthesis heat stress in wheat. *J Plant Physiol* 168(6): 585-593.
22. Sing H & Vimal SC. (2022). Impact of dates of sowing on growth and yield of wheat (*Triticum aestivum L.*). *The Pharma Inn J* 11(6): 2383-2391.
23. Habibi A, Omran AH, Jahish F & Alemyar SA (2023). Effect of Different Sowing Dates on Growth and Yield of Spring Wheat (*Triticum aestivum* L.) Varieties in Baghlan Province, Afghanistan. *Eur Exp Biol* 13: 12.
24. Yousaf M, Kumar S, Dhaka AK, Sing B & Bhukar A (2019). Effect of Sowing Dates and Varieties on Yield and Quality Performance of Wheat (*Triticum aestivum* L.). *Agric Sci Digest* 39(4): 306-310.
25. Walaa SE, Abdelmageed MSK & Hanan EG (2023). Effect of sowing dates on productivity and seed quality on some wheat varieties. International Conference of Field Crops Research Institute Egypt. *J Agric Res* 101(2): 497-504.
26. Sing DP, Chandra V & Tiwari T (2022). Effect of sowing dates on yield and yield components of wheat in Maharajganj district Eastern U.P. *The Pharma Inn J* 11(1): 228-231.