Asian Plant Research Journal

8(1): 9-15, 2021; Article no.APRJ.69802
ISSN: 2581-9992

Influence of Sowing Dates and Varieties on the Biological Yield of Wheat Crop (*Triticum aestivum* L.)

Sediq Omar Roshan[1*], Rahmatullah Hashimi[2] and Ghulam Habib Noori[2]

[1]Department of Agribusiness Management, Agriculture Faculty, Shaikh Zayed University, Khost, Afghanistan.
[2]Department of Agronomy, Agriculture Faculty Shaikh Zayed University, Khost Afghanistan.

Authors' contributions

This work was carried out in collaboration among all authors. Author SOR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors RH and GHN managed the analyses of the study. Author GHN managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/APRJ/2021/v8i130165
Editor(s):
(1) Dr. Langa Tembo, University of Zambia, Zambia.
Reviewers:
(1) Barlin Orlando Olivares Campos, University of Cordoba, Spain.
(2) Habtamu Zeleke, Haramaya University, Ethiopia.
Complete Peer review History: http://www.sdiarticle4.com/review-history/69802

Original Research Article

Received 20 April 2021
Accepted 25 June 2021
Published 01 July 2021

ABSTRACT

A field experiment was carried out in Dar-ul-Aman Research Farm, Kabul Afghanistan in 2017, to study the influence of sowing dates and varieties on the biological yield of wheat crop (*Triticum aestivum* L.). The experiment was laid out in RCBD with a split-plot arrangement having three replications. Wheat was sown in different sowing dates i.e., October 24th, November 2nd, 12th, and 22nd in main plots, whereas five wheat varieties (Chounth # 1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07 and Solh 2002) were in sub plots. November 2nd planted wheat had a highest biological yield of (6642.1 kg ha^{-1}) followed by October 24th and November 12th which gave (6576.5) and (5711.0 kg ha^{-1}) respectively. The lowest biological yield of (2975.1 kg ha^{-1}) was given by the wheat varieties sown on November 22nd. Among the all-wheat varieties, Solh 2002, had significantly higher biological yield of (6263.7 kg ha^{-1}) followed by Shisham Bagh-08 with biological yield of (5571.8 kg ha^{-1}). However, Moqawim-09 had lowest biological yield of (4976.8 kg ha^{-1}) compare to other varieties. While, evaluating performance of different wheat varieties on different sowing dates,

**Corresponding author: E-mail: sediqomar2014@gmail.com;*

Solh 2002, resulted in maximum biological yield (7476.2 kg ha^{-1}) on November 2nd followed by Dar-ul-Aman-07 (6933.3 kg ha^{-1}) and Shisham Bagh-08 (6860.0 kg ha^{-1}) on November 2nd and October 24th respectively. On the other hand, Dar-ul-Aman-07 had lowest biological yield among the varieties (2015.5 kg ha^{-1}) on November 22nd, it shows that, Dar-ul-Aman-07 had highest biological yield on early planting but lower yield on late sowing dates. The study shows that delay in wheat planting or selection of other varieties rather than Solh 2002 and Dar-ul-Aman-07 reduces the biological yield of the crop.

Keywords: Wheat; sowing date; soil pH; biological yield; crop yield.

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is a plant that is grown for its grain. It is also known as cereal grass. They are located at the top of the 'head' of the plant. Wheat grain is milled or grounds up to make flour, which is used to make bread and pasta. Wheat is one of the major cereal crops with unique protein content and it is grown around the world in diverse environments. High yield production of wheat is needed to feed the growing population of the world [1]. Afghanistan strategically positioned between Central Asia, the Middle East, and South Asia, is a landlocked country where key threats to food security stem from weak transportation links that limit Afghanistan's access to international markets, coupled with a domestic agricultural sector that is inadequate for meeting food needs. Wheat crop is grown on some 2.55 million hectares and more than 20 million rural people directly depend on it. Out of 2.55 million hectares, 1.17 million hectares are irrigated and the remaining 1.38 million hectares are rain-fed [2]. Wheat is the most important staple crop in Afghanistan [2], it accounts for over half of the population's caloric intake on average, [3]. Afghanistan is an exceptionally arid country, which experiences a wide range of seasonal rainfall and exposure to drought, people are usually growing those wheat verities, which are less sensitive to water scarcity, the majority of farmers in the country are familiar with wheat production in the country. Imports from neighboring countries have played a key role in stabilizing wheat and flour prices in Afghanistan. Although Afghanistan imports wheat from various neighboring countries, Pakistan has historically supplied more than half of these imports. In the last three decades, 95% of research has been directed toward increasing productivity and only 5% on reducing postharvest losses [4]. The demand for Wheat in Afghanistan is growing at an increasing rate due to its rapid expansion in population. It occupies a premier position among the crops due to its food value. It supplies more nutrients particularly essential amino acids than any other single crop [5]. Wheat is grown throughout Afghanistan in the diverse locality and a wide variety of environments. The crop is typically sown in autumn and harvested in early summer.

According to previous study, early sowing enhanced germination per unit area and overall increases the biological yield of crop, [6]. To meet the food requirement of ever-increasing human population, there is need to intensify efforts on judicious use of the available resources to increase the production and productivity. Hence this study was laid out to determine the appropriate combination of sowing date with wheat varieties for to obtain optimum biological yield.

2. MATERIALS AND METHODS

A field experiment was laid out at Dar-ul-Aman Research Farm Kabul during the year 2017. The experiment was conducted in RCBD with four treatments and three replications having different sowing dates (October 24th, 2nd, 12th, and 22nd of November respectively) and varieties (Chounth # 1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07, and Solh 2002). The total area under experiment was 600 m^2 and the planted area was 420 m^2 and the row-to-row distance was 20 cm [5]. Chemical fertilizers were applied i.e. DAP at the rate of 200 kg ha^{-1}, in which pure (P_2O_5) was 92 kg, and Urea at the rate of 250 kg ha^{-1} in which pure nitrogen was 115 kg. Total 8400 g DAP and 10500 g Urea fertilizer were applied in the whole experiment, 700g DAP and 875 g Urea fertilizers were used in each plot, where Urea was applied in three different stages (sowing, knee height, and flowering). DAP was applied at the time of sowing. Three-time weeding and five-time irrigations have been taken place during the whole life of this experiment. Upon analysis of composite soil sample, it was observed that the soil pH was neutral in reaction (7.3) and sample from the field was silt loam in texture, non-saline in nature, non-calcareous. The soil in the region

is high in calcium carbonate, with high pH and low soil organic matter content, ranging from 0.2 to 2.5%. [6]. After harvesting, the data were recorded for further analysis.

Statistical analysis was done by computer using statistic 8.1, package. The recorded data were statistically analyzed using the ANOVA technique and means were compared by LSD-test of significance [7].

3. RESULTS AND DISCUSSION

3.1 Biological Yield

The results obtained for biological yield as affected by different sowing dates and varieties are presented in Table 1. Both sowing dates and the selection of varieties significantly increased the biological yield of wheat. On average, the maximum biological yield of (6642.1 kg ha^{-1}) was obtained with a sowing date of 2nd November. The yield (6576.5 kg ha^{-1}) produced with sowing wheat on October 24th was significantly greater than that produced (5711 kg ha^{-1} and 2975.1 kg ha^{-1}) with sowing on November 12th and November 22nd respectively but was significantly lower than that produced with a sowing date of 2nd November. Similarly, [4] described the response of wheat to different planting dates and seeding rates for yield, yield components, and reported that both sowing dates and seeding rates affect the yield and yield components of wheat. Similarly, the average highest biological yield of 6263.7 kg ha^{-1} was obtained with the selection of variety (Solh 2002) for sowing and this was statistically greater than those obtained with a selection of other four varieties for sowing i.e. Chounth # 1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07, which produced (95301.0 kg ha^{-1}), (4976.8 kg ha^{-1}), (5571.8 kg ha^{-1}) and (5267.6 kg ha^{-1}) respectively. Similarly, the interactive effect of different sowing dates and the selection of varieties on the biological yield of wheat was also significant. The greatest biological yield of (6933.3 kg ha^{-1}) was obtained with both sowing date of 2nd November and selection of (Dar-ul-Aman-07) variety for sowing. The lowest biological yield of (2015.5 kg ha^{-1}) was obtained with a sowing date of 24th November and selection of (Dar-ul-Aman-07) variety for sowing.

3.2 Number of Plants per Square Meter

The result obtained on the number of plants as affected by different sowing dates and selection of different varieties for sowing are presented in Table 2. Both sowing dates and selection of varieties significantly increased the number of plants of wheat. On average, the maximum number of plants of 246.3 m^{-2} produced with a sowing date of 2nd November. The number of plants 216 m-2 produced with sowing wheat on October 24th was significantly greater than that produced (212.3 m^{-2} and 150 m^{-2}) with sowing on November 12th and November 22nd respectively but was significantly lower than that produced with sowing date of 2nd November. Similarly, the average maximum number of plants of 218.8 m-2 was obtained with the selection of variety 5th (Solh 2002) for sowing and this was statistically greater than those obtained with a selection of other four varieties for sowing i.e. Chounth # 1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07, which produced 207.5 m^{-2}, 189.8 m^{-2}, 216.1 m^{-2} and 198.8 m^{-2} respectively. The interactive effect of different sowing dates and selection of varieties on the number of plants of wheat was also significant. The greatest number of plants of 263.3 m^{-2} was obtained with both sowing date of 2nd November and selection of (Dar-ul-Aman-07) variety for sowing. The lowest number of plants of 140 m^{-2} was obtained with a sowing date of 24th November and selection of (Moqawim-09) variety for sowing.

3.3 Number of Kernels per Spike

The result obtained on the number of grains as affected by different sowing dates and selection of different varieties for sowing are presented in Table 3. Both sowing dates and selection of varieties significantly increased the number of grains of wheat. On average, the highest number of grains of 59.4 $spike^{-1}$ produced with a sowing date of 2nd November. The number of grains 54.2 $spike^{-1}$ produced with sowing wheat on October 24th was significantly greater than that produced (51.8 $spike^{-1}$ and 42.6 $spike^{-1}$) with sowing on November 12th and November 22nd respectively but was significantly lower than that produced with sowing date of 2nd November. Similarly, the average maximum number of grains of 55.3 $spike^{-1}$ was obtained with the selection of variety 5th (Solh 2002) for sowing and this was statistically greater than those obtained with a selection of other four varieties for sowing i.e Chounth # 1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07, which produced 52.8 $spike^{-1}$, 48.9 $spike^{-1}$, 53.3 $spike^{-1}$, 49.7 $spike^{-1}$ respectively.

The interactive effect of different sowing dates and selection of varieties on the number of grains of wheat was also significant. The greatest

number of grains of 67.3 spike^{-1} was obtained with both sowing date of 2nd November and selection of (Solh 2002) variety for sowing. The lowest number of grains of 32.7 spike^{-1} was obtained with a sowing date of 24th November and selection of (Moqawim-09) variety for sowing.

3.4 Number of Spikelet's per Spike

The result obtained on the number of spikelet's per spike, as affected by different sowing dates and selection of different varieties for sowing, which are present in Table 4. Both sowing dates and selection of varieties significantly increased the number of the spikelet of wheat. On average, the maximum number of the spikelet of 20.5 spike^{-1} produced with a sowing date of 2nd November. The number of the spikelet of 19.3 spike^{-1} produced with sowing wheat on October 24th was significantly greater than that produced (18.1 spike^{-1} and 17.3 spike^{-1}) with sowing on November 12th and November 22nd respectively but, was significantly lower than that produced with sowing date of 2nd November. Similarly, the average maximum number of the spikelet of 19.3 spike^{-1} was obtained with the selection of variety 5th (Solh 2002) for sowing and this was statistically greater than those obtained with a selection of other four varieties for sowing i.e. Chounth #1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07, which produced spikelet of 18.9 spike^{-1}, 18.2 spike^{-1}, 19 spike^{-1}, 18.7 spike^{-1} respectively.

The interactive effect of different sowing dates and selection of varieties on the number of the spikelet of wheat was also significant. The greatest number of the spikelet of 22 spike^{-1} was obtained with both sowing dates of 2nd November and selection of (Solh 2002) variety for sowing. The lowest number of the spikelet of 16.3 spike^{-1} was obtained with a sowing date of 24th November and selection of (Dar-ul-Aman-07) variety.

3.5 Number of Spike per Square Meter

The result obtained on the number of spikes m^{-2} as affected by different sowing dates and selection of different varieties for sowing, which are presented in Table 5. Both sowing dates and selection of varieties significantly increased the number of spikes m^{-2} of wheat. On average, the maximum number of spikes of 283.1 m^{-2} produced with a sowing date of 2nd November. The number of spikes 274.1 m^{-2} produced with sowing wheat on October 24th was significantly greater than that produced (224.9 m^{-2} and 212.9 m^{-2}) with sowing on November 12th and November 22nd respectively but, was significantly lower than that produced with sowing date of 2nd November. Similarly, the average maximum number of the spikelet of 273.1 m^{-2} was obtained with the selection of variety 5th (Solh 2002) for sowing and this was statistically greater than those obtained with a selection of other four varieties for sowing i.e Chounth # 1-2010, Moqawim-09, Shisham Bagh-08, Dar-ul-Aman-07, which produced 255.1 m^{-2}, 226 m^{-2}, 258.4 m^{-2}, 231.1 m^{-2} respectively.

The interactive effect of different sowing dates and selection of varieties on the number of spikes m^{-2} of wheat was also significant. The greatest number of spikes of 285 m^{-2} was obtained with both sowing dates of 2nd November and selection of (Shisham Bagh-08) variety for sowing. The lowest number of spikes of 151. m^{-2} was obtained with a sowing date of 12th November and selection of (Moqawim-09) variety.

Our results establish that climatological factors such as temperature and rainfall are key in the development of this crop. Historically, Kabul has had an arid climate. However, the monthly average precipitation has varied over the years, with a notable stronger seasonality in some areas and with a clear decrease in precipitation in the summer. Our results coincide with the study carried out by [8,9,10], who emphasize that sowing dates are the factor that most influences both in terms of yield and certain management characteristics in tropical, arid and semi-arid territories.

Likewise, the deficient soil moisture condition, in addition to causing delays in the growth of wheat and other winter cereals and even in tropical territories, delays sowing work, as pointed out by [11,12,13]. Although the availability of water is an essential condition for seed germination, since it determines the imbibition and subsequent activation of metabolic processes, such as rehydration, repair mechanisms (membranes, proteins and DNA), cell elongation and appearance of the radicle, the quite negative water potentials that occur in soils in periods of drought prevent water absorption [9], affecting the sequence of events involved in the germination process of seeds and the growth of seedlings in cereals [14].

Our study establishes that the hydric stress associated with the sowing dates is, in terms of the amount of plant matter affected, the most important that this type of crop can suffer. In this sense, various authors [15] have indicated that the stress caused by drought limits the productivity of these plants and that the intensity of their response depends on the severity and duration of the stress, and the state of development of the crop. That is why the search for sowing dates and varieties tolerant to drought stress constitutes one of the ways considered by researchers and producers for the exploitation of areas, where droughts are frequent or there is no water supply necessary [15]. Given the intense drought and the scarcity of water resources that have been occurring in the study site that have forced to limit the areas dedicated to cultivation, our study emphasized the need and relevance of studies on the effects of sowing date and variety of crops.

Table 1. Effect of sowing dates and varieties on biological yield of wheat crop

Varieties	Dates(D)				Mean
	Biological yield (kg ha^{-1})				
	D 1	D 2	D 3	D 4	
V 1	6533.3 bc	6172.6 bcd	5638.1 de	2860.0 g	5301.0b c
V 2	6622.6 bc	5997.6 cd	4779.8 f	2507.1 gh	4976.8 c
V 3	6860.0 ab	6631.0 bc	6232.1 bcd	2564.3 gh	5571.8 b
V 4	6533.3 bc	6933.3 ab	5588.1 de	2015.5 h	5267.6 bc
V 5	6333.3 bcd	7476.2 a	6316.7 bcd	4928.6 ef	6263.7 a
Mean	6576.5 a	6642.1 a	5711.0 b	2975.1 c	

LSD for sowing date (D) (0.050) = 352.74
LSD for verity (V) (0.050) = 394.37
*LSD for V*D (0.050) = 788.74*

Table 2. Effect of sowing dates and varieties on number of plants per square meter of wheat crop

Varieties(V)	Dates(D)				Mean
	Number of plant.m^{-2}				
	D 1	D 2	D 3	D 4	
V 1	231.7 cd	240.0 bc	175.0 h	183.3 gh	207.5 b
V 2	198.3 fg	220.0 de	200.0 fg	141.0 i	189.8 d
V 3	226.7 cd	253.3 ab	240.0 bc	144.3 i	216.1 ab
V 4	185.0 gh	263.3 a	206.7 ef	140.0 i	198.8 c
V 5	238.3 bc	255.0 ab	240.0 bc	142.0 i	218.8 a
Mean	216.0 b	246.3 a	212.3 b	150.1 c	

LSD for sowing date (D) (0.050) = 7.7026
LSD for verity (V) (0.050) = 8.6118
*LSD for V*D (0.050) = 17.224*

Table 3. Effect of sowing dates and varieties on number of grains per spike of wheat crop

Varieties(V)	Dates(D)				Mean
	Number of grains spike^{-1}				
	D 1	D 2	D 3	D 4	
V 1	52.7 efg	61.7 b	57.0 bcde	40.0 i	52.8 a
V 2	55.0 def	56.7 cde	51.3 fg	32.7 j	48.9 b
V 3	48.3 gh	60.0 bc	50.0 gh	55.0 def	53.3 a
V 4	56.7 cde	51.3 fg	50.7 fg	40.0 i	49.7 b
V 5	58.3 bcd	67.3 a	50.0 gh	45.3 h	55.3 a
Mean	54.2 b	59.4 a	51.8 c	42.6 d	

LSD for sowing date (D) (0.050) = 2.1648
LSD for verity (V) (0.050) = 2.4203
*LSD for V*D (0.050) = 4.8406*

Table 4. Effect of sowing dates and varieties on number of spikelet per spike of wheat crop

Varieties(V)	Dates(D)				Mean
	Number of spikelet's per spike				
	D 1	D 2	D 3	D 4	
V 1	18.3 fghi	20.3 bcd	19.3 cdefg	17.7 hij	18.9 a
V 2	19.7 cdef	18.3 fghi	17.0 ij	17.7 hij	18.2 b
V 3	19.7 cdef	21.3 ab	17.0 ij	18.0 ghi	19.0 a
V 4	18.7 efgh	20.7 abc	19.0 defgh	16.3 j	18.7 ab
V 5	20.0 bcde	22.0 a	18.0 ghi	17.0 ij	19.3 a
Mean	19.3 b	20.5 a	18.1 c	17.3 d	

LSD for sowing date (D) (0.050) = 0.6424
LSD for verity (V) (0.050) = 0.7182
*LSD for V*D(0.050) = 1.4365*

Table 5. Effect of sowing dates and varieties on number of spike per square meter of wheat crop

Varieties (V)	Dates(D)				Mean
	Number of spike m^{-2}				
	D 1	D 2	D 3	D 4	
V 1	270.0 abcd	272.0 abcd	263.3 abcdef	215.0 efgh	255.1 ab
V 2	266.7 abcde	302.3 ab	151.0 i	184.0 ghi	226.0 c
V 3	282.3 abc	285.0 ab	254.3 abcdef	212.0 fgh	258.4 a
V 4	275.0 abcd	250.0 bcdef	176.0 hi	223.3 defgh	231.1 bc
V 5	276.7 abcd	306.0 a	279.7 abc	230.0 cdefg	273.1 a
Mean	274.1 a	283.1 a	224.9 b	212.9 b	

LSD for sowing date (D) (0.050) = 23.990
LSD for verity (V) (0.050) = 26.822
*LSD for V*D (0.050) = 53.644*

Finally, the climatic risks to wheat cultivation in our study area are expected to increase in the coming decades, particularly in low-income countries, where the adaptation capacity is weaker, the Impacts on agriculture threaten food security and the fundamental role of agriculture in rural livelihoods and the development of sustainability [16], which is why our study concludes that any delay in wheat planting or selection of other varieties rather than Solh 2002 and Dar-ul-Aman-07 might reduce biological yield.

4. CONCLUSION

Dar-ul-Aman-07 had highest biological yield on early planting but lower yield on late sowing dates. The study shows that delay in wheat planting or selection of other varieties rather than Solh 2002 and Dar-ul-Aman-07 reduces the biological yield of the crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Khakwani AA, Dennett MD, Munir M & Abid M. Growth and yield response of wheat varieties to water stress at booting and anthesis stages of development. Pakistan Journal of Botany. 2012;44(3):879-886.
2. Dreisigacker S, Sharma RK, Huttner E, Karimov A, Obaidi MQ, Singh PK & Braun HJ. Tracking the adoption of bread wheat varieties in Afghanistan using DNA fingerprinting. BMC Genomics. 2019;20(1): 1-13.
3. Chabot P & Dorosh PA. Wheat markets, food aid and food security in Afghanistan. Food Policy. 2007;32(3):334-353.
4. Costa SJ. Reducing food losses in Sub-Saharan Africa. *An* 'Action Research' evaluation trial from Uganda and Burkina Faso; 2014.
5. Malik UM, Ahmad AHA, Bukhsh & Hussain. Effect of seed rates sown on different dates on wheat under agro-ecological conditions of Dera Ghazi

Khan. Animal & Plant Sci. 2009;19(3):126-129.
6. Hashimi R, Matsuura E & Komatsuzaki M. Effects of cultivating rice and wheat with and without organic fertilizer application on greenhouse gas emissions and soil quality in khost, Afghanistan. Sustainability, 2020;12(16):6508.
7. Assaad HI, Hou Y, Zhou L, Carroll RJ & Wu G. Rapid publication-ready MS-Word tables for two-way ANOVA. Springer Plus. 2015;4(1):1-9.
8. Said A, Hasina G, Saeed B, Haleema B, Badsha NL, Parveen L. Response of wheat to different planting dates and seeding rates for yield and yield components. Journal of Agricultural and Biological Science. 2012;7(2):138-140.
9. Olivares B, Cortez A, Lobo D, Parra R, Rey J & Rodriguez M. Evaluation of agricultural vulnerability to drought weather in different locations of Venezuela. Revista de la Facultad de Agronomía, Universidad del Zulia. 2017;34(1):103-129.
10. Orlando Olivares B, Hernández R, Coelho R, Molina JC & Pereira Y. Analysis of climate types: Main strategies for sustainable decisions in agricultural areas of Carabobo, Venezuela. Scientia Agropecuaria. 2018;9(3):359-369.
11. Mohsen L, Amin F, Morad S. The changes in seed yield of wheat (*Triticum festival L*.) cultivars in different sowing dates. Intl. J. Agric. and Crop Sci. 2009;5(8):861-867.
12. Muhammad Q, Maqsood Q, Faridullah & Maraj A. Sowing dates effects on yield and yield components of different wheat varieties. J. Agric Res. 2008;46(2):135-140.
13. Rita C, Nuno P, Ana SA, Conceica G, José C, Joa C, Armindo C, Benvindo M. Effect of sowing date and seeding rate on bread wheat yield and test weight under Mediterranean conditions. J. Food Agric. 2013;25(12): 951-961.
14. Zafar K, Imtiaz H, Badruddin K & Muhammad S. Effect of planting date on yield of wheat genotypes. In Sindh. J. Agric. Res. 2010;23(3-4):103-107
15. Raum PM, Penwalt C. Note on level of nutrients to add under expanded wheat flour fortification / enrichment program. Cereal Chemistry. 1980;57(1):70-72.
16. Shafiq HM. Modeling growth, radiation use efficiency and yield of wheat at different sowing dates and nitrogen levels under arid conditions of Bhawalpur. M. Sc. (Hons.) Thesis, University of Agriculture, Faisalabad-Pakistan; 2004.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/69802