Asian Plant Research Journal

7(4): 11-17, 2021; Article no.APRJ.67474
ISSN: 2581-9992

Comparison of Broadcast and Row Planting Methods on Growth, Grain yield and Yield Components of Wheat (*Triticum aestivum* L.), Khost Province, Afghanistan

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Authors' contributions

This work was carried out in collaboration between both authors. Author AYA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MJA managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/APRJ/2021/v7i430160
Editor(s):
(1) Dr. Langa Tembo, University of Zambia, Zambia.
Reviewers:
(1) Quanzhong Wu, Tarim University, China.
(2) Ahmed Mohamed Ibrahim Ali Meleha, National Water Research Center, Egypt.
(3) Xiangjun Kong, Henan Institute of Science and Technology, China.
Complete Peer review History: http://www.sdiarticle4.com/review-history/67474

Original Research Article

Received 20 February 2021
Accepted 24 April 2021
Published 05 May 2021

ABSTRACT

Appropriate planting method is an important work from the agronomic practices for the high and qualitative yield of wheat crop according to the agro - ecological condition of one area. This study was conducted to investigate the agronomic performance of three wheat varieties (Junt 01, Kabul 013 and Lalmi 04) in two planting methods (broadcast and row methods) in the growing season of 2019 - 2020 in Nadir shah kot District, Khost Province. The experimental design was Randomized Complete Block with three replications. Planting method differed significantly ($p < 0.05$) for days to heading (DH) 50%, plant height (PH) and significantly ($p<0.01$) for grain yield (GY). Row planting methods had superior means of the mentioned traits compare to broadcast method. In case of varieties, also were significant differences ($p<0.01$). Junt 01 variety produced the highest GY followed by Kabul 013 and Lalmi 01 produced the lowest GY. From the study found that the above

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mentioned varieties to be cultivated in row planting method under Khost climate conditions, and can be used in local studied area.

Keywords: Planting methods; wheat varieties; yield and yield components.

1. INTRODUCTION

Wheat is one of the most important cereal crops that has the widest spreading of any cereal. The crop is mainly cultivated for its grain, which is consumed as human nutrition [1] and it is primarily used as a staple food providing more protein than any other cereal crop [2]. Afghanistan is the country which only about 12% of the land is suitable for agriculture and about 6% is being cultivated now [3, 4]. Wheat is the staple food crop in Afghanistan and is produced under both irrigated and rain-fed conditions [4]. Presently it's grown in Afghanistan at more than 2.00 million hectares with average yield 3.6 million tons [5]. Wheat is the first important cereal crop of Afghanistan and it occupies the 78.5% area of total cereal production, 70% of total cereal consumption and 60% of total calories intake [6]. Afghanistan is the largest importers of flour in South Asia which ahead of Uzbekistan, Iraq and Indonesia, respectively [7].

The increasing population day by day, particularly in developing countries, and the decrease in production inputs such as irrigation resources, depletion of soil fertility, drought, and urbanization push the world to increase crop production per unit area [8]. The increasing for yield is high with the use of improved agro-techniques. Planting method is the technique that has significant effects on water, nitrogen and phosphorus use efficiency and also influenced on soil compaction, absorption of photo synthetically active radiations and crop growth development [9,10]. In Afghanistan, wheat seeds are broadcasted on the surface of the prepared field and soil is prepared mainly by animal power and use of tractors. These the poor seedbed preparation and manual seed broadcasting have been identified as major causes of lower wheat productivity. But in the recent decades mechanization of agriculture has increased and the adoption of wheat line sowing by farmers is expected in the near future [11].

There are several studies which investigated the effect of broadcast and row planting methods [2,12,13,14,15,16]. Their results indicated that row planting method produced more yield followed by broadcasting method while other observed more grain yield in broadcast method compare to different row spacing method [17]. Kiliç (2010) recorded high grain yield in flat planting against to bed planting on row methods [1].

According to the above studied, this study was addressed with the following objectives: (1) to investigate the effects of two planting methods (broadcast and row methods) on wheat grain yield; (2) to determine the influence of planting method on wheat agronomic parameters. Knowing of this research will assist better agronomic practices for wheat crop in Nadir Shah Kot District, Khost province.

2. MATERIALS AND METHODS

2.1 Experimental Site and Design

The investigation was conducted at the Nadir Shah Kot District, Khost Province, Afghanistan, during 2019 – 2020 growing season. The investigation was carried out in a randomized complete block design with split plot arrangement, replicated thrice. The treatments combined with two planting methods (Broadcast and Row method) and three facultative wheat varieties (Junt 01, Kabul 013, and Lalmi 01). Detailed information for the treatments are presented in Table 1. The field was plowed with a chisel plow and basins were prepared. Soil was sandy loam with pH: 7.9 degree, OM%: 0.90, N%:3, P (mg kg^{-1}): 7.5, K (mg kg^{-1}): 171. Each plot size was $6m^2$ and was separated from each other by 1 m space within the blocks.

2.2 Sowing and Measurements

All three wheat varieties were sown on 20th November during the 2019 - 2020 growing seasone in the prepared fields. Sowing density was 120 kg•ha-1 for broadcast method and 100 kg•ha-1 for row method according to the recommended dose of Khost, DAIL. Space between rows were 25 cm in row method. Well decomposed cow dung, 80 kg•ha-1Phosphorus and 1/3 amount of Nitrogen from 120 kg•ha-1were mixture during the sowing time in soil. The remains amount of Nitrogen was applied at jointing and flowering stages of wheat growth.

Table 1. Combination of treatments from three wheat varieties and two planting methods

Treatments	Description
BM V1	Junt 01Variety and Broadcast planting method
RM V1	Junt 01 Variety and Row planting method
BM V2	Kabul 013 Variety and Broadcast planting method
RM V2	Kabul 013 Variety and Row planting method
BM V3	Lalmi 01 Variety and Broadcast planting method
RM V3	Lalmi 01 Variety and Row planting method

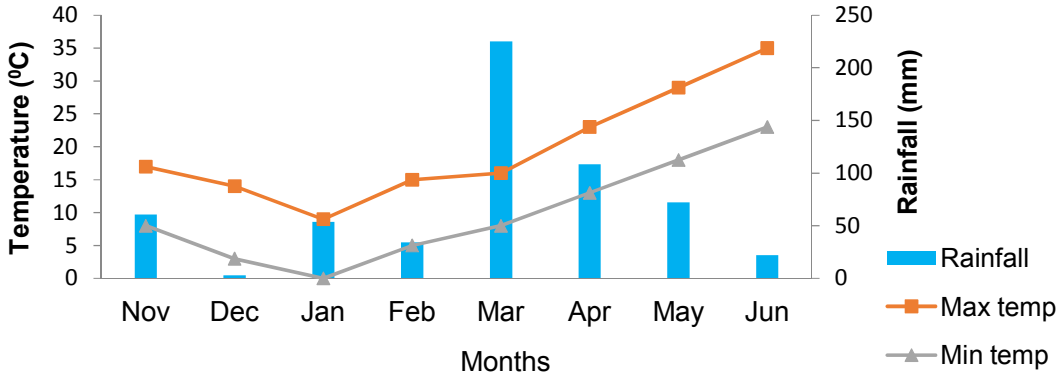

Fig. 1. Climatic chart for growing season (Nov, 2019 – Jun, 2020)

Irrigation was applied through a basin irrigation system based on climate conditions and plant requirements and about five irrigations were applied and weeds were removed three times physically by hand. The data was collected for days to heading (DH) 50% and 100%, plant height (PH), productive tillers (PT), Kernel spike^{-1}(KS), 1000 kernel weight (TKW) and grain yield (GY). Randomly five plants were selected in each plots then the data for plant height, spike length, kernel spike^{-1} and thousand kernel weight were recorded but the data for fertile tillers and grain yield were measured from one meter square, randomly and average values were used for analysis.

2.3 Statistical Analysis

The data were subjected to analysis of variance (ANOVA) to test the effects of planting method and interaction between the factors (planting method x varieties), using the STAR software (version 2.0.1) and R software (version: 4.0.2 for window 32/64 bit) for correlation test. Means for the treatment were separated using the least significant difference (LSD) method at (p<0.05) probability level.

3. RESULT AND DISCUSSION

3.1 Effects of Planting Method

Analysis of the data in Table 2 indicates that the effects of planting method for DH 50% and PH were significant (p<0.05) while higher significant for GY (p<0.01) but there were non- significant differ for DH 100%, DM 100%, PT, KS and TKW. It is examined from the results that the cultivation of row planting method compare to broadcast method had less days to DH 50% (133.00 and 134.44, respectively) Table 3. The PH (81.04 cm) and GY (4.75 tons ha^{-1}) were also more in row method compare to broadcast method (76.16 cm and 3.92 tons, respectively). This higher GY, PH and early heading may be from the cause of appropriate aeration, moistness, sunlight, availability of nutrients, weeds control and good conditions of root interception. Our results were in harmony with the previous findings that row planting method produced higher yield compare to broadcast methods [2,15 and 16].

3.2 Effects of Variety

Data regarded to DH50%, DH100%, PH and GY traits in Table 2 indicate that the effects of variety was higher significant (p<0.01) but not was for

DM 100%, PT, KS and TKW. Mean values in Table 3 show that variety lalmi 01 had less days for DH50% (130.67) followed by Kabul 013 and Junt 01 varieties (135.00 and 135.50), respectively. PH was recorded most (82.55 cm) at Kabul013 against the Junt 01(78.28 cm) and Lalmi 01 (74.97 cm). GY on Junt 01 variety was observed (4.93 tons) highest followed by Kabul 013 (4.32 tons) and the Lalmi 01 variety produced the least amount of GY (3.69 tons). This differences of DH 50%, DH100%, PH and GY may be due to the heredity face of variety which is in agreement with Abd El-Lattief. 2014; Dingkuhn et al. 1999 and Shahzad et al. 2007 [18,19 and 20].

3.3 Interaction Effects of Planting Method and Variety

There were non- significant effects of interacting among the planting method x variety for any traits at any probability level (Table 2). However, there are non-significant difference of interactive among the planting method and variety but it appeared from the interaction in Table 3 that GY and its attributes (PT and TKW) are highly in row method compare to broadcast method. This result is similar with Khan et al. [14]. He reported that wheat cultivation in row method contrary to broadcast method produced higher GY, TKW and total number of tillers.

Table 2. ANOVA for the agronomic traits and grain yield of wheat

Source of Variance		DH 50%	DH 100 %	DM 100%	PH	PT	KS	TKW	GY
	DF	MS	MS	MS	MS	MS	MS	MS	MS
Replication	2	0.72	3.50	0.16	19.65	5834.88	3.47	2.80	0.12
Planting Method (PM)	1	9.38*	6.72	0.22	107.55*	25688.88	5.01	6.72	3.15**
Variety (V)	2	42.38**	37.16**	0.50	86.17**	6160.05	16.89	1.80	2.31**
PM x V	2	1.72	0.38	0.05	0.83	5187.38	27.29	6.14	0.02
Error	10	0.45	0.56	0.43	6.08	2366.15	27.19	3.58	0.07

*** Significant at p<0.01, * significant at p<0.05, DH: Days to heading, DM: Days to maturity, PH: Plant height, PT: Productive tillers, KS: Kernel spike^{-1}, TKW: Thousand kernel weight and GY: Grain yield*

Table 3. Means of DH 50%, DH 100%, DM 100%, PH, PT, KS, TKW and GY are affected by planting methods, varieties and their interaction

Treatment	DH 50% (no)	DH 100% (no)	DM 100 % (no)	PH (cm)	PT (m-^{2})	KS (no)	TKW (gr)	GY (ton)
Planting Method								
Broadcast Method (BM)	134.44a	140.44	189.77	76.16b	397.44	44.00	32.01	3.92b
Row Method (RM)	133.00b	139.22	189.55	81.04a	473.00	42.94	33.23	4.75a
LSD 0.05%	**1.26**	**NS**	**NS**	**3.41**	**NS**	**NS**	**NS**	**0.27**
Varieties (V):-								
Junt 01(V1)	135.50a	141.67a	189.33	78.28b	468.14	43.76	33.25	4.93a
Kabul 013 (V2)	135.00a	140.83a	189.83	82.55a	433.33	44.98	32.38	4.38b
Lalmi 01 (V3)	130.67b	137.00b	139.33	74.97b	404.16	41.66	32.23	3.69c
LSD 0.05%	**0.91**	**1.04**	**NS**	**3.49**	**NS**	**NS**	**NS**	**0.39**
Interaction:-								
BM x V1	136.00	142.00	190.00	75.43	406.33	45.60	33.06	4.55
BM x V2	135.33	141.66	190.00	80.43	428.33	46.66	32.50	3.88
BM x V3	132.00	137.66	189.33	72.60	357.66	39.73	30.46	3.31
RM x V1	135.00	141.33	189.66	81.13	530.00	41.93	33.43	5.31
RM x V2	134.00	140.00	189.66	84.66	438.33	43.30	32.26	4.87
RM x V3	129.33	136.33	189.33	77.33	450.66	43.60	34.00	4.07
LSD 0.05%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

NS: Non –Significant, DH: Days to heading, DM: Days to maturity, PH: Plant height, PT: Productive tillers, KS: Kernel spike^{-1}, TKW: Thousand kernel weight and GY: Grain yield

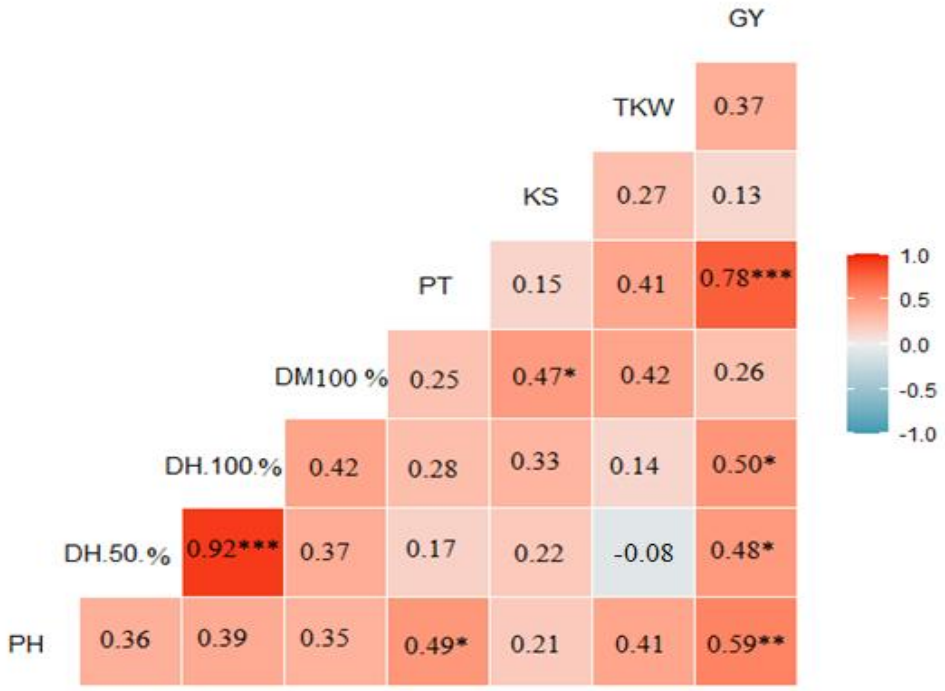

Fig. 2. Correlation coefficients among growth, yield and yield components of wheat

**** Significance at p<0.001% **Significance at p<0.01; * Significance at p<0.05; PH: Plant height, DH 50%: Days to heading 50%, DH 100: Days to heading 100%, DM100%: Days to maturity 100%, PT: Productive tillers, KS: Kernel spike^{-1}, TKW: Thousand kernel weight, GY: Grain yield*

3.4 Correlation Coefficients among Growth, Yield and Yield Attributes of Wheat

The correlation between growth, GY, and yield components of wheat crop in this research is given in Fig. 2. It is seen from the figure that there are positive correlation among the growth and GY yield, GY and yield components and within yield components. There are positive correlation among the PH and GY(r= 0.59**), PH and PT(r=0.49*), DH 50% and GY(r=0.48*), DH 50% and DH 100% (r= 0.92***), DH 100% and GY (r=0.50*), DM 100% and KS(r= 0.47*) and PT and GY(r= 0.78***).

4. CONCLUSION

According to the objectives of our research to determine the effects of broadcast and row planting method on growth yield and yield components of selected three wheat varieties in Khost province, the results can concluded that broadcast planting method for the wheat crop caused a decrease in wheat GY by 0.83 tons ha^{-1} compare to row planting method and variety Junt 01 and Kabul 013 produced higher GY (1.24 and 0.69 tons ha^{-1}, respectively) followed by Lalmi 01. Hence, row planting method and varieties, Junt 01 and Kabul 013 are recommended for higher GY of wheat in Khost province.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/67474