Yield performance of selected varieties planted on different intervals as unirrigated wheat

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Abstract

Increasing population at a higher rate requires more cereals for food security which is possible to increase wheat production on rainfed land. Wheat can be grown on soil with limited moisture and its drought tolerance than rest of the grains crops. Selection of a suitable variety with sowing time subject to onset of the rains for a particular agro-ecological area could play a key role in production. The study was conducted in the University of Agriculture Peshawar, in Rabi season 2014-15 to evaluate wheat varieties with sowing intervals for optimum yield. Five sowing intervals (i.e. Nov. 11th, 19th, Dec 1st, 10th and 20th) were selected with wheat varieties (i.e. Kohat-2000, Pirsaabal-2005, Hashim-2008, Pakistan-2013, Taara, Lalma, Chakwal-50 and Shahkar-2013, Ghenemat) including a local as check to the sub plots treatments. Among varieties, Pakistan-2013 was the best variety suited for the area’s climate. The variety has shown better emergence m⁻², tiller number with higher fraction of productive tiller per unit, good grain number per spike with better spike length, 1000 grains weight (g) and plant height that resulted higher biological yield and grain yield (kg ha⁻¹) as compared to any of the tested varieties. Among sowing dates, sowing made on Nov 19 in season showed greater emergence, tiller number with productive tiller per unit area (m⁻²).The grain number spike¹, spike length (cm), 1000 grains weight (g) were also observed higher than any other sowing made in the season and hence showed better biological and grain yield (kg ha⁻¹).

Keywords: Agro-ecological, wheat, rainfed, yield, Pakistan-2013

Introduction

Wheat (Triticum aestivum L.) associates to family Poaceae and is a primary source of food as well as of the animal feed of all countries. It is major cereal grains crop of Pakistan and supplies about 65% energy to peoples of Pakistan (Khalil and Jan, 2002) [13]. In Pakistan, it had occupied about 60% of the food cropped area. Wheat hay are the good source of feed for bovine animals (Iqtidar et al, 2006) [11]. In the current years 10% wheat was used as feed because wheat is relatively found cheaper than all other feed crops (Mustafa et al, 2004) [18]. Economics yield of wheat in Pakistan is 40% of its total potential due to unawareness of farmers in selection of a suitable variety for the agro-ecological conditions, fertilizers application rates in response to the soil, and follow optimum sowing time, which acts as a major factors of wheat production. Wheat is cultivated in Pakistan on an area of more than 8690 thousand hectares, with produced 24.2 million tones grains that averaged for a 2790 kg grains ha⁻¹, while in the province of Khyber Pakhtunkhwa (KP) wheat is cultivated on an area of 0.89 million ha producing 1.8 million tones that averaged for 2156 kg ha⁻¹ grains due to more than 66% wheat is planted as rainfed crop (MINFA, 2015) [16]. In the recent years wheat production is affected by limitation of water, especially in dry regions of the KP. The yield is already less than its potential yield because of cultivating unsuitable varieties, delay in sowing times and changing climate for the crop. We have to work on restoring its potential yield by every means including identification of its optimum time through revalidation of production technology with observed climatic changes (Razzaq et al, 1986) [22]. Sowing time affects the yield of varieties strongly than any other factor of production. Sowing time of wheat varieties, especially in unirrigated areas, has not been tested properly. In order to test the performance certified wheat varieties in unirrigated condition it is exposed to various planting time in order to check their for future cultivation.
Another important limiting factor, in respect of sowing time, is loss in early sown wheat varieties by birds and insects attack in most of the areas. It stated that average yield is considerably higher for October, 30th planting compared to late sowing (Chaudhry et al. 1992) [8]. Wheat sown late yielded lower grains than those sown earlier (Sandhu et al. 1999) [23]. 15th November sowing is important for gaining the higher biomass and the greater grains yield (Aslam et al. 2003) [6]. Early sowing resulted uniform emergence but delay sowing resulted decreased in the length of vegetative phase, which adversely affects the reproductive stages performance (Akmal et al. 2011) [4]. Reduction in economics yield and population density, when wheat was planted delayed from November 15 to 30 in rainfed conditions (Ahmed et al. 1997 [2], Ahmed et al. 2006) [3]. Better grains yield with healthy traits when wheat was planted early around mid Nov. in the season as compared to crop planted in mid-December (Muhammad et al. 2010) [17]. Delay in sowing time reduced all the yield parameters because of decreased in seed germination rates and population density (Shah et al. 2002) [24]. The purpose of the current research was to verify the response of wheat loss in approved selected high yielding wheat varieties suitable for rainfed condition subject to delay in the occurrence of precipitation in the area and to identify a suitable variety among the available choices for recommending its sowing for general cultivation

Materials and methods
To investigate sowing date effect on the production and production qualities of un-irrigated varieties, of wheat this plan was scheduled in a randomized whole building block plan with split plot arrangements. Sowing dates was allocated to major plot and variety to subplots, are in three replication. Experimental unit was measured 5.0m x 1.5m accommodating six wheat row at 0.25 m distances. Seeds were planted initially on a wet moist soils each times, which was irrigated about 8-12 days before the sowing. Sowing was made from Nov. 11th, 2014 with a 10 days interval thereafter for each next sowing date. Wheat varieties having resistant to drought stress and are recommended with higher yield in dry land was collected from national research stations. Trial was accompanied at Agronomy Research Farm, the University of Agriculture Peshawar. A little higher seed rate i.e. 130 kg ha⁻¹ was used for the study for all varieties. Planting was done with manually pulled seed drill by placing seeds within rows uniformly. Fertilizer was applied broadcast before plowing one bag DAP (18-46 N P) with one bag urea (46 N) each of 50 kg per acre to yield in addition to one more bag of urea before anthesis (i.e. x days after sowing) The field was continue un-irrigated for rest of the yield increase and development but showing to accepted precipitation. Whole Agronomists recommendations were kept uniform i.e. weeding, hoeing, cleaning etc.

Information linked with time to appearance was noted by including days taken from a sowing to whole appearance in middle rows of an action in an experimental plots. Manually and emergence m⁻² was estimated. Data on tiller number (m⁻²) was recorded by counting tiller number in a central row of each plot at two different locations. Data were converted into numbers of tillers m⁻² using the following formula.

\[
\text{Tillers} \; m^{-2} = \frac{\text{No. of tillers counted}}{R - R \times \text{No. rows} \times \text{row length}} \times 1
\]

Data related to creative tillers (m⁻²) was noted by counting the spike’s bearing rudder in a half-meter long row at two places at accidental choose in a plot and was changed into m². The variation among whole tiller m⁻² and creative tiller m⁻² was measured as uncreative tillers m⁻² for an investigational component. Data on plant altitude was noted by the measuring of randomly select 20 tillers in every plot. Their height was recorded individually with a measuring rod from basal to the spike. This observation was exercised at physiological maturity stage of the crop. Data concerning particle quantity spike⁻¹ was noted by the including grains wheat in 15 spikes randomly chosen in a plot and averaged. Thousand grains data is noted weight (g) was noted on a using of automated balance before including the thousand grains each treatment using a seed counter. Data on natural yield (kg ha⁻¹) was noted by harvesting 4 rows in a plot, which were bundled and dried and then weighed for the total biomass and reading was changed into the kg ha⁻¹. The grain data on production (kg ha⁻¹) were noted in 4 rows of the central. The bundles were threshed on a mini lab thresher, the grains of each investigational unit were weighed was changed in to kg ha⁻¹. Harvest index data were calculated by following formula.

\[
\text{Harvest index} = \frac{\text{Economic yield (grain)}}{\text{Biological yield}} \times 100
\]

Statistical Analysis
The collected data will be subjected to statistical analysis using Statistix techniques appropriate for the randomized complete block design. Important differences between replication were determined with at least important variation (LSD) test for major mean comparison including the interactions (Steel and Torrie, 1980) [25].

Results
Spike Length
Data associated with the spike length is showed in Table 1. Mean values of the data indicated that spike length was significantly affected by sowing intervals and wheat varieties, whereas, the interaction of treatments (V x SI) were found non-significant. Sowing made on Nov. 19 showed the maximum spike length (90.30 cm), which followed by sowing made on Nov. 11 with spike length of 18.03 cm, whereas the minimum spike length (13.30 cm) was recorded for sowing made on Nov. 11 in season. Likewise, the different varieties had significant effects on spike length of wheat with the maximum spike length (17.58 cm) recorded for Pakistan 2013, followed by variety Kohat-2000 with spike length (17.42 cm) and the minimum spike length (14.33 cm) was recorded for local variety used as check.

Number of grains spike⁻¹
Data concerning number of grains spike⁻¹ are shown in Table 1. Mean values of the data specified that number of grains spike⁻¹ had a substantially influence by sowing intervals and varieties whereas, their interactions (V x SI) were found non-significant. Sowing made on Nov. 19 showed the maximum number of grains spike⁻¹ (79.30), followed by sowing made on Dec. 01 in season for the grains spike⁻¹ number (78.03). The minimum grains spike⁻¹ (73.30) was recorded for sowing made on sowing date Nov. 11 in the season. Varieties also had a significant effect on grains per spike number of wheat. Highest number of grains spike⁻¹ (77) was recorded for
Pakistan-2013, followed by Kohat-2000 with grains spike\(^{-1}\) (77). The minimum number of grains spike\(^{-1}\) (74) was recorded for local variety used as check in this study.

**Thousands grains weight**

Data about thousand grains weight (g) is presented in Table 1. Mean values of Data indicated that 1000 grains weight had a significant effect by sowing intervals and wheat varieties, while the interaction of the treatments (V x SI) were found non-significantly different. Sowing date had a significant effect on the 1000 grains weight (g). The highest 1000 grains weight (46.30 g) was recorded for sowing date Nov. 19, followed by date Dec. 01 with 1000 grains weight of 45.03 g. The minimum 1000 grains weight (40.30 g) was recorded for sowing date Nov. 11 in the season. Varieties also had a significant effect on 1000 grains weight (g) of wheat. The highest 1000 grains weight (44.03 g) was recorded for wheat variety Pakistan 2013, followed by Kohat 2000 with 1000 grains weight (44 g) and the minimum 1000 grains weight (41.47 g) was recorded for the local variety used as check in this study.

**Biological yield**

Data regarding biological yield (kg ha\(^{-1}\)) is presented in the Table 1. Mean values of the data in the table indicated that biological yield (kg ha\(^{-1}\)) was significantly affected by the treatments sowing date and varieties. The treatments interaction V x SD had also showed a significant effect on biological yield. The maximum biological yield (6565.49 kg ha\(^{-1}\)) was recorded for sowing date Nov. 19, followed by sowing date Dec. 01 with biological yield of (6441.70 kg ha\(^{-1}\)). The minimum biological yield (6027.30 kg ha\(^{-1}\)) was recorded for the sowing date Nov. 11, in the season in this study. Varieties also had a significant effect on the biological yield with the highest biological yield (6902.84 kg ha\(^{-1}\)) recorded for what varieties Pakistan 2013, followed by what variety Chakwal-50 which yielded biological yield (6586.67 kg ha\(^{-1}\)). The lowest biological yield (5218.04 kg ha\(^{-1}\)) was recorded for the local variety used as check in the study. Interaction between varieties and sowing date shows that considerably all sowing date had significantly affected biological yield along with all varieties but however greater biological yield (8044.44. kg ha\(^{-1}\)) was recorded for variety Ghanem when sown on sowing date 2.

**Grain yield**

Data regarding grain yield (kg ha\(^{-1}\)) are presented in Table 1. Mean values of the data indicated that grains yield (kg ha\(^{-1}\)) was significantly affected by sowing date, varieties and their interaction of the treatments V x SD. Sowing date had showed the significant effects on grains yield (kg ha\(^{-1}\)) with the maximum values for the grains yield (2880.30 kg ha\(^{-1}\)) for sowing date Nov. 19 in the season, followed by Dec. 01 in the season for grains yield (2629.12 kg ha\(^{-1}\)). The minimum grains yield (2448.12 kg ha\(^{-1}\)) was recorded for sowing made on Dec. 22 in the season i.e. the last sowing very late. Varieties also had shown a significant effect on grains yield (kg ha\(^{-1}\)) of wheat. The maximum grains yield (3076.67 kg ha\(^{-1}\)) was recorded for wheat variety Pakistan 2013, followed by wheat variety Shahkar 2013 with grains yield (2710 kg ha\(^{-1}\)). The lowest grains yield (2229.33 kg ha\(^{-1}\)) was recorded for wheat variety local used as check (46.30 kg ha\(^{-1}\)). Interaction between varieties and sowing date shows that considerably all sowing date had significantly affected grains yield along with all varieties but however greater grains yield (3691.67 kg ha\(^{-1}\)) was recorded for variety Chakwal 50 when sown on sowing date 2.

**Discussion**

The main objective of the current research was to identify the response of wheat loss in approved selected high yielding wheat varieties suitable for rainfed condition subject to delay in the occurrence of precipitation in the area and to identify a suitable variety among the available choices for recommending its sowing for general cultivation. The result of our study revealed that Pakistan-2013 was the best variety suited for the area’s climate that can be grown as rainfed/Un-irrigated wheat crop for optimum production with better traits. The variety has shown better emergence m\(^{-2}\), tiller number with higher fraction of productive tiller per unit, good grain number per spike with better spike length, 1000 grains weight (g) and plant height that resulted higher biological yield and grain yield (kg ha\(^{-1}\)) as compared to any of the tested varieties. Among sowing dates, sowing done on November 19th in season showed greater yield contributing parameters. Late sowing adversely affects yield (Mehboob et al. 2005) [13], which is due to grain mortality because of greater temperature injury at the reproductive growth periods or limited food supply to the grains by the available biomass. Terminal heat stress also reduced grain filling period, starch in endosperms of the kernels and resulted early maturity, which causes decrease of kernel size (Nageswara et al. 2001) [20]. However, important differences was observed in cultivars for yield under the delayed planting (Okuyama et al. 2005) [21]. The capability of cultivars to tolerate high temperature stress is linked with leaf chlorophyll contents (Lopes and Reynolds, 2010) [14]. Higher temperature endurance for varieties can play important role to boost wheat productivity under rainfed conditions. There are so many others factors accountable for low yield of wheat among them cultivation of old varieties and sowing date is of importance. The cultivation of new varieties needs adaptability to such condition for boosting wheat yield (Naeem, 2001) [19]. Different varieties respond in a different way to sowing dates, and hence, differ in their yield potential (Ali et al. 2010) [3]. A number of scientists have studied the reaction of wheat to sowing time (Farooq et al. 2018) [10]. Objective under which crop is grown needs to define for growth and yield. Research has reported that each cultivar has its own requirements for flowering and for grains development (Aslani and Mehrvar, 2012) [7]. Afzal et al. (2009) [11] reported that emergence and number of days to anthesis declined with delay in sowing from November to December Donaldson et al. (2001) [9] added that optimum time of sowing resulted better wheat straw production in addition to grains. Jain et al. (1992) [12] added that late sowing declined production in all cultivars.
Table 1: Data regarding spike length, grains spike−1, 1000 grains weight, biological yield, grain yield of selected wheat varieties planted on different dates under rainfed and irrigated condition

<table>
<thead>
<tr>
<th>Sowing dates</th>
<th>Spike length (cm)</th>
<th>Grains spike−1</th>
<th>1000 grains weight (g)</th>
<th>Biological yield (kg ha−1)</th>
<th>Grain yield (kg ha−1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD1</td>
<td>13.30 d</td>
<td>73.30 d</td>
<td>40.30 d</td>
<td>6194.22 ab</td>
<td>2599.35 b</td>
</tr>
<tr>
<td>SD2</td>
<td>19.30 a</td>
<td>79.30 a</td>
<td>46.30 a</td>
<td>6565.49 a</td>
<td>2880.30 a</td>
</tr>
<tr>
<td>SD3</td>
<td>18.03 b</td>
<td>78.03 b</td>
<td>45.03 b</td>
<td>6441.70 ab</td>
<td>2629.12 b</td>
</tr>
<tr>
<td>SD4</td>
<td>15.61 c</td>
<td>75.61 c</td>
<td>42.61 c</td>
<td>6434.42 ab</td>
<td>2505.61 b</td>
</tr>
<tr>
<td>SD5</td>
<td>14.67 c</td>
<td>74.67 c</td>
<td>41.67 c</td>
<td>6027.30 b</td>
<td>2448.12 b</td>
</tr>
<tr>
<td>LSD0.05</td>
<td>1.17</td>
<td>1.17</td>
<td>1.17</td>
<td>537.05</td>
<td>241.16</td>
</tr>
</tbody>
</table>

Wheat varieties

- Pak-2013: 17.58 a
- Dharabi-2011: 17.08 abc
- Tattara: 17.08 abc
- Lalma: 16.50 bcd
- Chakwal-50: 15.83 d
- Shahkar-2013: 16.83 abc
- PS-2005: 16.42 cd
- Hashim, 2008: 15.92 d
- KT-2000: 17.42 ab
- Ghanemat (A-2014): 17.17 abc
- Local: 14.33 c
- LSD0.05: 0.82

Interaction (SD x V): NS NS NS ** **

** = Significant, SD= Sowing date, V= Variety.

NS = Non-significant,

Conclusions

Wheat is the main grain food crop of Pakistan cultivated throughout the country. Food security is the global issue prevailing throughout the whole world. The whole world is focusing on development of improved varieties with high yielding capacity to meet the food needs of the population. In order to evaluate effect of sowing time and varietal performance of wheat cultivars in rainfed agro-ecological zone of country study was conducted at the University of Agriculture Peshawar, Pakistan. From the overall results, it can be concluded that sowing time has great influence on the production of wheat in rainfed area and sowing o made around November 19th is the best time of sowing under rainfed conditions as it give high yield of wheat and varietal comparison of wheat yield showed that variety Pakistan 2013 is best variety to be sown under rainfed/ unirrigated area of Pakistan.

Acknowledgements

The Authors are thankful to Department of Agronomy, The University of Agriculture, Peshawar Pakistan, for providing financial assistance and guidance for this research project.

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