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Comparative performance of wheat cultivars under semi-arid climatic conditions of Khyber Pakhtunkhwa, Pakistan

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Abstract

Wheat is the staple food of the people of Pakistan. Concern for sustainable production of wheat crop under the arid climatic conditions of Khyber Pakhtunkhwa, Pakistan led to renewed interests in investigations for high yielding tolerant cultivars. In order to address the issue, an experiment was conducted at the research farm of The University of Swabi, Khyber Pakhtunkhwa, Pakistan during winter 2013-14 using Randomized Complete Block Design (RCBD) with three replications to test different wheat cultivars (Atta Habib, Pirsabak-2008, Hashim-8 and Fakhri Sarhad) for economic yield and its contributing components. Statistical analysis of the data revealed a significant ($P \leq 0.05$) effect of different varieties on spike weight (g), grains spike^{-1} and 1000 grains weight (g). However, the effect of different varieties was non-significant ($P>0.05$) for productive tillers plant^{-1}, spike length (cm), spikes ft^{-2} and grain yield (kg ha^{-1}). The data revealed highest spike weight (g) and 1000 grains weight (g) for Atta Habib. The results further indicated maximum productive tillers plant^{-1}, spike length (cm), spikelets spike^{-1}, spikes ft^{-2} and grain yield (kg ha^{-1}) for Pirsabak-2008. Similarly maximum value for grains spike^{-1} was recorded for Fakhri Sarhad. It was concluded from the study that Pirsabak-2008 performed better than other varieties tested for the said purpose.

Key words: wheat, varieties, 1000 grains wheat, grain yield

1. Introduction

Pakistan is principally an agricultural country, where 70% people are directly and indirectly involved in this sector. It is the most immense sector of the economy and earns about 35-40% of the national income (Farooq *et al.*, 2007). Pakistan, like many other developing countries of the world is facing with the quandary of low agricultural productivity. Average yield of wheat in Pakistan has never crossed 30-35% of its yield potential produced under experimental conditions(Iqbal *et al.* 2005). Many countries including Pakistan are faced with the challenge of engendering more food and fiber, while there is miniature room for expansion in the cultivated area and yield per unit area of miscellaneous crops.

In spite of the fact that our country is mystically enchanted with a galaxy of climate, soil condition and irrigation water.In food scenario of developing countries, 21% of the total calories intake and 20% protein are from wheat (Braun *et al.,* 2010). Its grain is rich in mineral, essential amino acids (except lysine) and vitamins (Khan and Zeb, 2007). It is mainly intake in the form of baked products, chapatti, bran, malt, poultry and livestock feeds etc. Its demand may increase by 60% of the present up to 2050 (Rosegrant and Agcaoili, 2010) due to rapid expansion in world human population, which may touch 8.3 billion up to 2025 (Mannion, 1998).

Pakistan falls in top ten wheat-producing countries of the world and ranks at 9 in terms of area, at 5 in terms of yield per hectare and at 8 in terms of production (Manzoor *et al.,* 2009). It is utilized to feed about one-third of the world population. It also occupies an utmost spot in nourishment grains of Pakistan as it covers 66% of the total area under food grains and contributes 74% to the total food grain engenderment (Ghulam *et al.,* 2007). The yield per hectare in the year 2012-13 stood at 2787 (kg ha^{-1}) posted a positive magnification of 2.7 percent as compared to

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negative 4.2 percent magnification of last year (PES 2013). In Khyber Pakhtunkhwa territory, wheat was planted on area of about 0.7245 million hectares with an average yield of about 1434 kg ha^{-1}, which is lower than the average yield of the country (CSKP, 2011).

Despite higher yield potential, average grain yield of wheat in Pakistan is much less than most of the countries of the world. The factors which cause the reduction in the yield of wheat in Pakistan are delayed sowing, imbalanced utilization of fertilizer, shortage and mismanagement of irrigation water, old and traditional methods of sowing, low genetic potential of varieties and above all weather fluctuations, which cause at times the solemn reduction in yield.

Variety selection is one of the most important decisions for a wheat grower. The right or wrong decision can negate all other factors in profitable wheat farming. Environmental factors such as abiotic (Soil fertility, moisture, temperature, sowing time, day length) and biotic (diseases and pests) stresses are not constant across years and sites which eventually affect the yield stability of wheat varieties (Arain *et al.*, 2011). High temperature and desiccating winds during the month of April might cause coerced maturity of tardy sown wheat, thus resulting in reduction of test weight (Singh and Dhaliwal, 2000). High temperature in the post anthesis period of tardy sown wheat minimized the grain filling period resulting in a more diminutive endosperm, lower grain weight and incremented protein content (Ahmed *et al.*, 1994).

The varieties in the field are exposed to the range of biotic and abiotic factors and the prosperity of variety is evaluated from its survival under such circumstances. For having the higher engenderment with good floor quality, it is the most paramount to screen the more preponderant varieties predicated on agronomic performance and some regards of yield.

Keeping in view the importance of potential varieties in higher wheat yield, the current study was conducted to screen out suitable varieties based on their comparative performance (grain yield) for District Swabi to get maximum output by applying less input.

2. Materials and methods

The present study was carried out at the research farm of The University of Swabi, Khyber Pakhtunkhwa, Pakistan during winter 2013-14. Four cultivars (Atta Habib (V1), Pirsabak-2008 (V2), Hashim-8 (V3) and Fakhri Sarhad (V4)) were considered for various yield components using randomized complete block (RCBD) with three replications. Land was ploughed with cultivator and then rotavator was used for breaking the clods before sowing. Macronutrients (N, P and K) were applied at the rate of 120, 90 and 60 kg ha^{-1} respectively. The experimental area was comprised of 960 m^2 (60 m×16 m). Single plot size was 80 m^2 (20 m×4 m). Seeds were sown at 30 cm row to row distance. Each plot was consisted of 21 rows. Half nitrogen and full phosphorus, potassium fertilizers were applied at sowing time. The remaining half nitrogen was applied after 40 days of sowing. Standered agronomic practices were carried out throughout the experiment.

Productive tillers $plant^{-1}$ data were noted by counting the number of spiked tillers in five randomly selected plants in each replication and then their mean was calculated. Lengths of five spikes, randomly selected in each replication were measured with a ruler and then averaged for obtaining spike length data. Spikes ft^{-2} were obtained by counting the spiked tillers in a square feet area at three different locations in each replication and then their mean was worked out. To obtain spike weight data, spikes of five randomly selected plants in each replication were weighted and averaged. Grains $spike^{-1}$ data were recorded by counting the number of grains per spike in five randomly selected spikes in each sub plot and their mean was calculated. Data regarding spikelets $spike^{-1}$ were recorded by counting the number of spikelets per spike in five spikes randomly selected spikes in each sub plot and then averaged. Data concerning grains weight $spike^{-1}$ were recorded by weighting grains of five randomly selected spikes and then their mean values were worked out. 1000 grains weight data were recorded by weighting randomly selected 1000 grains in each replication. Grain yield data was recorded by taking grain yield per sq ft at three different locations in each replication and then averaged. The data were then converted to kg ha^{-1} by multipling with a standard factor of 1076.10 and dividing by 100.

3. Results

Productive tillers $plant^{-1}$: Data regarding productive tillers $plant^{-1}$ of wheat cultivars are presented in Table 1. Statistical analysis of the data revealed a non-significant (P>0.05) effect of varieties on productive tillers $plant^{-1}$ of wheat crop. However, maximum productive tillers $plant^{-1}$ of (3.66) was noted for Pirsabak-2008, followed by Atta Habib with 3.55 productive tillers $plant^{-1}$ when compared with lowest productive tillers $plant^{-1}$ (3.33) from Fakhri Sarhad. Our results are in line with the findings of Husnain *et al.* (2011). They revealed a significant effect of different varieties on productive tillers $plant^{-1}$ of wheat in arid climatic conditions.

Spike length: Data relating spike length of wheat crop as affected by different cultivars are presented in Table 1. A non-significant (P>0.05) effect of varieties on spike length of wheat crop was evident from statistical analysis of the data. Longest spike length (12.54 (cm) was noted for Pirsabak-2008, followed by Atta Habib with spike length of

12.07cmas compared to shortest spike length (10.65 cm) from Hashim-8. These results are in conformity with those of Mushtaq *et al.* 2011. A significant effect of different wheat cultivars on spike length of wheat crop was evident from their findings.

Spikes ft^{-2}: Data pertaining spikes ft^{-2} are shown in Table 1. Statistical analysis of the data revealed a non-significant ($P>0.05$) effect of different on spikes ft^{-2} of wheat crop. However, maximum spike ft^{-2} (25.44) were detailed for Pirsabak-2008 followed by Fakhri Sarhad with 24.77 spike ft^{-2} as compared to lowest spike ft^{-2} of 23.88 from Atta Habib. These results are in conformity with those reported by Saleem *et al.* (2007). They revealed a significant effect of different varieties on spikes ft^{-2} of wheat.

Grains Spike^{-1}: Grains spike^{-1} data of wheat as affected by different cultivars are presented in Table 2. Statistical analysis of the data showed a significant ($P\leq0.05$) effect of cultivars on grains spike^{-1} of wheat crop. Maximum grains spike^{-1} of 78.22 were noted for Fakhri Sarhad, followed by Pirsabak-2008 with 72.55 grains spike^{-1} , while minimum grains spike^{-1} of 62.44 were noted for Hashim-8. Similar results were also reported by Shahzad *et al.* (2013). They revealed a significant effect of different cultivars on grain spike^{-1} of wheat.

1000 grains weight (g): Data relating 1000 grains weight of wheat as influenced by different cultivars are indicated in Table 2. Statistical analysis of the data showed a significant ($P\leq0.05$) impact of varieties on 1000 grains weight of wheat crop. Highest 1000 grains weight of 43.29 (g) was confirmed for Atta Habib followed by Fakhri Sarhad with 35.35 (g) 1000 grains weight, when compared with lowest 1000 grains weight of 34.95 (g) from Hashim-8. Similar results were also reported by Iqbal *et al. (*2005), where maximum 1000 grains weight (g) was produced by cultivar Atta Habib with nitrogen application of 120 kg ha^{-1}.

Table 1. Productive tillers plant^{-1}, spike length (cm), spikes ft^{-2} and spike weight (g) of wheat as affected by different varieties

Varieties	**Productive tillers plant^{-1}**	**Spike length (cm)**	**Spikes ft^{-2}**	**Spike weight (g)**
Atta Habib	3.55	12.07	23.88	4.00 a
Pirsabak-2008	3.66	12.54	25.44	3.85 a
Hashim-8	3.44	10.65	24.44	3.44 b
Fakhri Sarhad	3.33	12.05	24.77	2.85 c
LSD ($P \leq 0.05$)	Ns	Ns	Ns	0.33

Mean values of the same category are non-significant and followed by different letters are significant at $P\leq0.05$ level.

Table 2. Spikelets spike^{-1}, grains spike^{-1}, 1000 grains weight (g) and grain yield (kg ha^{-1}) of wheat as affected by different varieties

Varieties	**Spikelets spike^{-1}**	**Grains spike^{-1}**	**1000 grains weight (g)**	**Grain yield (kg ha^{-1})**
Atta Habib	19.22	70.77 a	43.29 a	4907
Pirsabak-2008	19.44	72.55 ab	33.60 b	5525
Hashim-8	17.44	62.44 c	34.95 b	4606
Fakhri Sarhad	19.10	78.22 a	35.35 b	4746
LSD ($P \leq 0.05$)	Ns	6.90	3.06	Ns

Mean values of the same category are non-significant and followed by different letters are significant at $P\leq0.05$ level.

Grain yield (kg ha^{-1}): Table 2 indicates the impact of four cultivars on grain yield (kg ha^{-1}) of wheat. Statistical analysis of the data showed a non-significant ($P>0.05$) effect of varieties on grain yield (kg ha^{-1}) of wheat crop. However, maximum grain yield (kg ha^{-1}) of 5525 kg was verified for Pirsabak-2008, followed by Atta Habib with 4907 (kg ha^{-1}) grain yield as compared to minimum grain yield of 4606 (kg ha^{-1}) from Hashim-8. Our results are in line with the findings of Shahzad *et al.* (2013). They concluded that maximum grain yield (kg ha^{-1}) was produced in cultivar Pirsabak-2008 with nitrogen applied at the rate of 120 kg ha^{-1}.

4. Conclusions and discussion

Among the tested cultivars, Pirsabak-2008 showed higher values for productive tillers plant^{-1}, spike length (cm), spikes ft^{-2}, spikelets spike^{-1} and grain yield (kg ha^{-1}). Maximum spike plant^{-1} and 1000 grains weights (g) were recorded for Aatta Habib. Grains spike^{-1}was higher in Fakhri Sarhad.On the basis of above conclusions, Pirsabak-2008 was recommended for general cultivation in district Swabi, Khyber Pakhtunkhwa with a seed rate of 100 kg ha^{-1} and fertilizer rate of 120, 90 and 60 (NPK) kg ha^{-1} respectively for higher yield in the current challenging environmental scenario. The study also showed that farmers of the area need motivation for adopting the standard cultural practices and obtaining pre-tested verities for arid region of Swabi

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