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Comparison of different wheat (*Triticum aestivum L.*) varieties under agro-climatic condition of Swabi for yield and yield components

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Abstract
Wheat is an important cereal crop and used as staple food for the people of Pakistan. Concern for sustainable production of wheat crop under the agro-climatic conditions of District Swabi, Khyber Pakhtunkhwa, Pakistan focused to renewed interest in researches for high yielding tolerant varieties. In order to address the problem, an experiment entitled "Comparison of different wheat (*Triticum aestivum L.)* varieties under agro-climatic condition of Swabi for yield and yield components" was conducted at the Agriculture Research Station Swabi, Khyber Pakhtunkhwa, Pakistan during winter 2017-18 and the trail was laid out in Randomized Complete Block Design (RCBD) with three replications to check various wheat varieties (Atta Habib, Pirsabak-2013, Pakhtunkhwa-2015 and Fakhri Sarhad) for economic yield and its contributing apparatuses. Statistical analysis of the data exposed a significant ($P \leq 0.05$) effect of different varieties on spike weight (g), grains spike^{-1}, grain yield and 1000 grains weight (g). However, the conclusion of different varieties was non-significant ($P > 0.05$) on productive tillers plant^{-1}, spike length (cm), and spikes ft^{-2}. The data exposed maximum and 1000 grains weight (g) for Atta Habib. The results further specified extreme productive tillers plant^{-1}, spikelet's spike^{-1}, grains per spike, spikes ft^{-2}, Spike weight (gm) and grain yield (kg ha^{-1}) for Pirsabak-2013. In the same way, maximum value for Spike length (cm) were noted for Fakhri Sarhad. It was concluded from the study that Pirsabak-2013 performed better than other cultivars under study for yield and yield components.

Keywords: Wheat, 1000 grains weight (g), Grain yield (kg ha^{-1}), Grains spike^{-1}, Spikelet's spike^{-1}

1. Introduction
Wheat (*Triticum aestivum* L.) belongs to kingdom Plantae, order poales, family poaceae, tribe triticeae, and genus triticum. It is monocot cool season annual crop, needs vernalization (cold treatment during seedling stage needed to trigger reproductive growth) has spike inflorescence and 2-15 tillers depending on species, variety, plant density and nutrition. It is a grain cereal that is actually from the Middle East and the Leone region of Ethiopia Holland, but now cultivated around the world. In 2010, the world's wheat production was 651 million tons and made it third highest production after corn and rice (844 million tons), (672 million tons). In 2009 wheat ranked second among cereal; this year worldwide production of wheat was 682 million tons, after corn (817 million tons), and nearly of rice (679 million tons). In 2005, the top ten wheat producer was China (96 million metric tons), India (72 million metric tons), United States (57 million metric tons), Russia (46 million metric tons), France (37 million metric tons), Canada (26 million metric tons), Australia (24 million metric tons), Germany (24 million metric tons), Pakistan (22 million metric tons) and Turkey (21 million metric tons). The world total was 626 million metric tons [1].

Pakistan is principally an agricultural country and its economy is mainly agrarian. It is the largest sector in the economy and earned about 35-40% of national income [2]. Pakistan is facing endangerment of low agricultural production, like many developing countries in the world. Many countries, including Pakistan, are faced with the challenge of eating more food and fiber, while there is a small room for the expansion of agriculture and the per unit of diverse crops. Despite the fact that our country is a mysteriously a magician with environmental, soil condition and water supply irrigated water. The country is mainly dependent on agriculture for the supply of food and fiber. Therefore, it is imperative to increment food and fiber engenderment to cope up not only with ever growing requisites of the country, but for the sake of foreign exchange earnings and to procure self-sufficiency.

In Pakistan, wheat (*Triticum aestivum L.*) is considered as the king of cereals and staple foods [3]. Apart from this, wheat crop is the main source of carbohydrate and protein for humans and animals as well. In average diet wheat is the cheapest source of calories and protein 72% [4]. In food scenario of developing countries, 21% of the total calorie and 20% protein are from wheat [5]. Its grains are rich in minerals, mandatory amino acid (except lysine) and vitamins [6]. It is basically linked to the form of baked products, malt, chapati, inulin, malt, poultry and livestock feed etc. Its demand can increase by 60% of the current up to 2050 [7] due to rapid expansion of the global population which may reach to 8.3 billion by 2025 [8].

It is the leading cereal among other cereal crops, which rank first, both in land area and in engenderment in the world [9]. Globally Pakistan ranked 9th in top ten wheat-producing countries in terms of area, in terms of yield per hectare Pakistan ranked 5th and ranked 8th in terms of production [10]. It is used to feed one third of the world population. It holds an extremely important place in the foods of Pakistan because it covers 66 percent of the total area under food

grains, and 74% of the food grain engines in the overall part of the diet. It is grown on sizably voluminous area. Contribution of wheat to the value integrated in agriculture is 10.1% and 2.2% to GDP. Area under growing of wheat incremented to 8693 thousand hectares in 2012-13, from 8650 thousand hectares increased by 0.5 percent in the previous year. During 2012-13 it was 24.2 million tons, with a target of 25.5 million tons, which decline by 5.1 percent and 3.2% in the corresponding period of 23.5 million tons last year. In 2012-13, yield kg per hectare stood at 2787 (kg ha^{-1}) there was a growth of 2.7 percent per hectare as compared to 4.2 percent negative magnification of the previous year [11]. It calculates 80% between the grain on the index and the taste [12].

In Khyber Pakhtunkhwa region, wheat was planted at approximately 0.7245 million hectares, with an average yield of around 1434 kg ha^{-1}, Which is less than the country's average yield [13]. Despite the higher yield capacity, average wheat grain yield in Pakistan is much less as compared to the world's maximum number of countries. Factors causing reduction in wheat production in Pakistan include delayed sowing, non-consumption fertilizer, scarcity of irrigation and misconduct, old and traditional methods of sowing, due to various genetic abilities and above all season fluctuations which may cause extreme reduction in production. Variety selection is the most important decision for growers to promote a wheat. Right or wrong decision can negatively affect all other factors in the farm of wheat. While selecting seeds, consider this type of variety: yield Capacity, maturity, cold intensity, stiff strength, plant height, lodging, shattering, seed size, test weight, insect and disease resistance, weed Tolerance, milling and quality of baking products. Environmental factor such as biotic (pests and diseases) and abiotic (Soil fertility, temperature, moisture, sowing time and day length) stresses are not constant every year and sites that eventually affect the yield stability and production of wheat varieties [14]. The time of sowing is also a major cause in production and damage. The production of grains in the early sown wheat crop were higher [15]. The harmful effect of delaying in sowing on grain yield was maximum with decrease in 1000 –grain weight [15, 16]. Delaying in sowing also reduced test weight [17]. During the month of April, the high temperature and lower air can cause rapid fatigue of tardy sown wheat, which results in reduction of test weight. Crude protein content incremented with delayed sowing [18, 19, 20]. Effects of tardy sowing on milling yield were statistically paramount and bread quality was not lamentably affected [21]. Higher grain raw protein content but smaller grain sizes were obtained with delayed sowing [22]. Due to high temperature in the post anthesis stage of tardy sown wheat decreased the grain filling period resulted in a more diminutive endosperm lower grain weight and increasing protein content [23].

In the field varieties are exposed to the range of abiotic and biotic factors and the prosperity of variety is appraised from its survival under such circumstances. To make high frequency with good floor quality, it is the most important on the screen, in which more preview has some connection with different types of agricultural performance and some regards of production.

Given the importance of potential varieties in higher wheat yield, the current study was carried out to evaluate best wheat varieties, according to the implementation of lower inputs based on their comparative performance (grain yield) for Swabi district. To get maximum output.

2. Material & Methods

A field experiment of some wheat varieties entitled "Comparison of different wheat (*Triticum aestivum L.)* varieties under agro-climatic condition of Swabi for yield and yield components" was evaluated at the research farm of Agriculture Research Station Swabi, Khyber Pakhtunkhwa, Pakistan during winter 2017-18 to observe the relative performance of four wheat varieties (Pirsabak-2013, Fakhri Sarhad, Pakhtunkhwa-2015 and Atta-Habib) for the production potential. The experiment was laid out in randomized complete block (RCBD) with three replications and The experimental area was contained of 750 ft^2 (50 ft×15 ft) and Single plot size was 75 ft^2 (15 ft×5 ft) and Seeds were sown at 25 cm row to row distance while Each plot was contained of 17 rows and fertilizer recommended dose is 120:90:60 kg/ha. Sowing is done manually with the help of labour. Before sowing Land was tilled with cultivator and followed by rotavator to break the clods. The crop was examining for to check out the performance of different wheat varieties for yield and which one is best for local condition of district Swabi. Uniform cultural practices were kept same for all treatments such as weeding, hoeing, thinning, pest and disease control were carried out for all treatment. At sowing time Half nitrogen and full phosphorus, potassium fertilizers were applied and After 40 days of sowing The remaining half nitrogen was applied. under ordinary condition crop was irrigated at all serious growth phases manually. Data were documented for the plant parameters (i-e. Productive tillers $plant^{-1,}$ Spike length (cm), Spikes $ft^{-2,}$ Spike weight (g), Grains $spike^{-1}$, Spikelets $spike^{-1,}$ 1000 grains weight (g), Grain Yield (kg ha^{-1}) using standard techniques. statistical analysis was executing by using analysis of variance (ANOVA) method which are suitable for the randomized complete block design using Statistics 8.1 software and significant differences between the treatments were insistent with least significant difference (LSD) test ($P \leq 0.05$; Statistics 8.1 Software.

The following parameters were evaluated during the experiment.

1. 2.1 Productive tillers $plant^{-1}$
2. 2.2 Spike length (cm)
3. Spikes ft^{-2}
4. Spike weight (g)
5. Grains $spike^{-1}$
6. Spikelets $spike^{-1}$
7. 1000 grains weight (g)
8. Grain Yield (kg ha^{-1})

Procedure for data recording

2.1 Productive tillers $plant^{-1}$

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.

2.2 Spike Length (cm)

Lengths of five spikes randomly selected in each replication were measured with a ruler and then averaged.

2.3 Spikes ft^{-2}
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.

2.4 Spike weight (g)
To obtain spike weight data, spikes of five randomly selected plants in each replication were weighted and averaged.

2.5 Grains spike^{-1}
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.

2.6 Spikelets spike^{-1}
Data regarding spikelet 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.

2.7 1000 grains weight (g)
1000 grains weight data were recorded by weighting randomly selected 1000 grains in each replication.

2.8 Grain yield (kg ha^{-1})
Grain yield data was recorded by taking grain yield per sq ft at three different locations in each replication and then averaged. The data was then converted to kg ha^{-1} by multiply with (1076.10) and dividing by 1000.

3. Results & Discussion
3.1. Productive tillers plant^{-1}
Productive tillers plant^{-1} data of wheat varieties are presented in Table 4.1. Statistical analysis of the data examined a non-significant (P>0.05) effect of varieties on productive tillers plant^{-1} of wheat. However, maximum productive tillers plant^{-1} of (3.68) were recorded for Pirsabak-2013 followed by Atta Habib with (3.37) productive tillers plant^{-1} when compared with lowest productive tillers plant^{-1} of (3.29) from Fakhri Sarhad. Our results are in line with the findings of [24]. They showed a significant effect of different varieties on productive tillers plant^{-1} of wheat.

3.2. Spike length
Table 1 showed data regarding, spike length of wheat crop as affected by different varieties. Statistical analysis showed a non-significant (P>0.05) effect of varieties on spike length of wheat. Longest spike length of (12.48cm) was noted for Fakhri Sarhad followed by Atta Habib with spike length of (12.25cm) as compared to smallest spike length (10.45 cm) from Pakhhtunkhwa-2015. Our results are in conformity with the result of [25]. Their findings showed a significant effect of different wheat varieties on spike length of wheat crop.

3.3. Spikes ft^{-2}
Data regarding spikes ft^{-2} are presented in Table 1. Statistical examination of the data evident a non-significant (P>0.05) impact of different varieties on spikes ft^{-2} of wheat. However, highest spike ft^{-2} (24.89) were counted for Pirsabak-2013 competed by Fakhri Sarhad with (24.46) spike ft^{-2} as compared to minimum spike ft^{-2} from Atta Habib (23.12). These results are in line with those recorded by [26]. They reported a significant effect of different wheat varieties on spikes ft^{-2}.

3.4. Spike weight (g)
Data concerning spike weight (g) are presented in Table 1 of wheat as affected by different varieties. Analysis of the data revealed a significant (P≤0.05) effect of wheat varieties on spike weight (g). Maximum spike weight of (4.00g) were noted for Pirsabak-2013 followed by Atta-Habib with (3.87g) spike weight whereas, minimum spike weight (2.89 g) was recorded for Fakhri Sarhad. Our results are in opposite with the findings of [26]. They revealed maximum spike weight (g) for Fakhri Sarhad when comparing with other cultivars.

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

Wheat varieties	Productive tillers plant^{-1}	Spike length (cm)	Spikes ft^{-2}	Spike weight (g)
Atta Habib (V1)	3.37	12.25	23.12	3.87 a
Pirsabak-2013 (V2)	3.68	12.00	24.89	4.00 a
Pakhtunkhwa-2015 (V3)	3.44	10.45	23.54	3.42 b
Fakhri Sarhad (V4)	3.29	12.48	24.46	2.89 c
LSD (P ≤ 0.05)	Non-Sign	Non-Sign	Non-Sign	0.34

Mean values of the same category followed by different letters are significant at P≤0.05 level.

3.5. Spikelets spike^{-1}
Spikelet's spike^{-1} data are stated in Table 2 as effected by different wheat varieties. Statistical analysis of the data revealed a non-significant (P>0.05) effect of different varieties on spikelet spike^{-1} of wheat. However, maximum spikelet's spike^{-1} of (26.05) were counted for Pirsabak-2013 followed by Fakhri Sarhad with (25.32) spikelet's spike^{-1} as compared to lowest spikelets spike^{-1} of (23.83) from Pakhtunkhwa-2015. Our results are in line with the findings of [27]. They stated a significant effect of various wheat varieties on spikelets spike^{-1}.

3.6. Grains Spike^{-1}
Grains per spike data of wheat crop as influenced by different varieties are presented in Table 2. Analysis of the data statistically showed a significant (P≤0.05) effect of different varieties on grains per spike of wheat crop. More grains spike^{-1} of (70.38) were observed for Pirsabak-2013 followed by Atta Habib with (66.11) grains spike^{-1} while less grains spike^{-1} of (56.80) were investigated for Pakhtunkhwa-2015. Same results were also reported by [28]. They studied a significant effect of different varieties on grain spike^{-1} of wheat.

3.7. 1000 grains weight (g)
Data pertaining thousand grains weight of wheat as effected by different varieties are indicated in Table 2. Statistical analysis of the data revealed a significant (P≤0.05) effect of wheat varieties on 1000 grains weight. Heaviest 1000 grains weight of (46.10g) were counted for Atta Habib followed by

Pirsabak-2013 with (43.84g) 1000 grains weight when compared with lowest 1000 grains weight of (36.20g) from Fakri Sarhad. Similar results were also observed by [28]. They concluded that heaviest 1000 grains weight (g) was produced by Atta Habib when compared with other wheat varieties.

3.8. Grain yield (kg ha^{-1})

Table 2 indicated the impact of varieties on grain yield (kg ha^{-1}) of wheat. Statistical analysis of the data indicates a significant (P≤0.05) effect of various varieties on grain yield (kg ha^{-1}) of wheat crop. However, maximum grain yield (kg ha^{-1}) of (5611.5 kg ha^{-1}) were verified for Pirsabak-2013 competed by Atta Habib with (5167.0kg ha^{-1}) grain yield as compared to lowest grain yield of (4348.5 kg ha^{-1}) from Fakhri Sarhad. Our results are in conformity with the findings of [29]. They concluded that highest grain yield (kg ha^{-1}) was produced by variety Pirsabak-2013 as compared with others.

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.

Wheat varieties	Spikelets spike^{-1}	Grains spike^{-1}	1000 grains weight (g)	Grain yield (kg ha^{-1})
Atta Habib (V1)	25.00	66.11 b	46.10 a	5167.0 b
Pirsabak-2013 (V2)	26.05	70.38 a	43.84 cb	5611.5 a
Pakhtunkhwa-2015 (V3)	23.83	56.80 c	39.41 bc	4785.0 c
Fakhri Sarhad (V4)	25.32	58.96 c	36.20 c	4348.5 d
LSD (P ≤ 0.05)	Non-sig	3.0520	4.7274	207.67

Mean values of the same category followed by different letters are significant at P≤0.05 level.

4. Conclusion & Recommendations

The following conclusions can be drawn from the present study:

1. Among the evaluated varieties, Pirsabak-2013 indicated higher values for productive tillers plant^{-1}, spike length (cm), spikes ft^{-2}, spikelets spike^{-1} and grain yield (kg ha^{-1}) Spike weight (g).
2. Maximum thousand grains weights (g) were noted for Aatta Habib.
3. Spike length (cm) and grains spike^{-1} were maximum in Fakhri Sarhad.

On the basis of above conclusions, Pirsabak-2013 is recommended for general cultivation in Distt: Swabi, Khyber Pakhtunkhwa with a seed rate of 120 kg ha^{-1} and fertilizer rate of 120, 90 and 60 (NPK) kg ha^{-1} respectively.

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