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Comparing the Yield of Various Wheat Varieties in the Climatic Conditions of Maidan Wardak Province

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ABSTRACT

Wheat *(Triticum aestivum L.)* is a staple crop in Afghanistan that is vital to nutrition, food security, and farmer income. It is widely cultivated in different ecological regions in the country and is highly dependent on seasonal precipitation. Varieties with good agronomic performance help farmers earn more and improve their food security. Therefore, a field experiment was conducted during the winter season of 2022- 23 at the Agriculture Faculty Research Farm of Wardak University to compare the growth and yield of different wheat varieties in Wardak climatic conditions. The experiment comprised four different wheat crop varieties, V_1: Solh 0.18, V_2: Elham 0.15, V_3: Wahdat 0.15, and V_4: Diama 0, 17. Out of four varieties, Solh and Elham were winter wheat varieties, while the Daima and Wahdat were facultative wheat varieties. Three replicates of the experiment were set up in a randomized complete block design. Cultivation, irrigation, fertilization, weeding, and other fields were the same for all varieties. As a result, The V_3 and V_2 significantly increased plant height, number of tillers per m^2, number of spikes per m^2, number of spikelets per spike, number of grain per spike, number of grain per spikelet,1000 seed weight, and grain yield per ha, respectively, compared to the V_4. Considering the performances of varieties, it seems that V_3 and V_2 have the potential to produce high-yield products in Maidan Wardak, Afghanistan.

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Introduction

Wheat (*Triticum aestivum L.*) is an important staple crop in nutritional and food security. Therefore, it is highly consumed and shares up to 40 percent of total food grain production. Wheat is one of the five complete nutritional sources such as meat, egg, wheat, milk, and peanut (Kumar et al., 2017).

Afghanistan is a semi-arid country where drought frequently occurs due to fluctuations in a rain-fed region. However, irrigation or direct precipitation are the two factors that determine wheat production (FAO/WFP, 2003). Wheat is a key crop in Afghanistan, making up around 83% of the country's total cereal consumption. The northern provinces of Afghanistan grow a significant portion of the country's wheat, mostly dependent on seasonal precipitation. Afghanistan produces 5.0 tons of wheat per hectare annually, using 2.30 million hectares of land and 2.17 tons of productivity per hectare (Tamim et al., 2019).

Adoption to the environment is thought to be a crucial factor in wheat genotype selection. A cultivar must yield well and satisfactorily in various stressful and non-stressful conditions. Mean productivity (average yield performance in stress and non-stress conditions), mean yield, and relative yield performance in drought-stressed and more favorable environments are the most fundamental factors in choosing high-yield performance (Osmani et al., 2020). Muzafer (2014) experimented with the Balochistan condition and found that among Rakhshan-10, Zardana, Sariab-95, Rasco-2005, and Tijaban-10 cultivars, Zardana produced significantly higher grain yield. Sufyan et al. (2013) conducted a study on three varieties, including Inqalab-91, Uqaab-2000, and AS-2002, in Sheikhpura Research Farm, Punjab; among the mentioned varieties, the variety AS-2002 has the highest yield (3647 kg/ha) has shown. (Obaidi et al., 2017) conducted research on the varieties including Vahdat 15, Chonta 1, Ariana 07, Mazar 99, Wafer 15, Ariana 07 and Saleh 02 from 2008 to 2013 in provinces such as Kabul, Nangarhar, Baghlan, Takhar, Balkh., Kunduz, Helmand have done that among the mentioned varieties, Vafar 15 variety has the highest yield (5960 kg/ha) followed by Vahdat 15 variety with the highest yield (5557 kg/ha). Tamim (2019) found that Chunta 0.1 showed a higher yield among four tested wheat cultivars. Chaterje et al. (1980) researched three wheat varieties (Janak, UP262, and Sonalika) and obtained the highest yield in the Janak variety and the lowest yield in the Sonalika variety. Osmani (2020) reported that among four varieties (Surkha Andrab, Zarddana Baghlan, Safida Andrab, and Safida Kondoz), Safida Kondoz showed higher tillers and grain yield. Considering the information above, choosing resistant cultivars highly adaptable to particular environmental conditions is essential for increasing grain output.

ICARDA conducted a needs assessment in 2002 on the situation of plant improvement and the supply of eggs in Afghanistan. During the assessment, it was found that 32% of the farmers bought seeds from local markets, 23% from other farmers, and 5% from extension agents, while the rest stored their seeds. In addition, the lack of quality seeds of improved varieties was mentioned as one of the most important limitations of farmers. Therefore, there is an urgent need for the rapid transfer of new agricultural technologies so that farmers can rebuild their production capacity to achieve food security, produce surplus for markets, and improve rural livelihoods (Srinivas et al., 2010).

Many factors cause a decrease in yields, such as the cultivation of old varieties, low spawning rate, low amount of fertilizers, etc. Introducing new varieties with higher yield and good agreement is an important factor in increasing wheat yield. Different varieties show

different reactions to the used nutrients, so there are significant differences in their yield strength (Ali et al., 2010; Naeem, 2001). Accordingly, this research was evaluated to compare the results of different modified varieties of wheat, which include (Ilham 0.15, Solh 0.18, Vahdat 0.15, and Daimeh 0.17) until a suitable variety is found in the climatic conditions of Wardak field province can be found.

Materials and Methods

Experimental site

The study was conducted in the agriculture faculty of Wardak University's research farm, which is located in Maidan Wardak, Afghanistan (as shown in Figure 1). The geographic coordinates of the experimental site are 2210 meters above sea level, 34° 8' 28" North latitude, and 68° 48' 19" East longitude. The climate is characterized by a humid continental, dry, warm summer climate. The average annual temperature ranges from 39.74°F, and the region receives an annual average of 18.92 mm of precipitation and rainfall yearly.

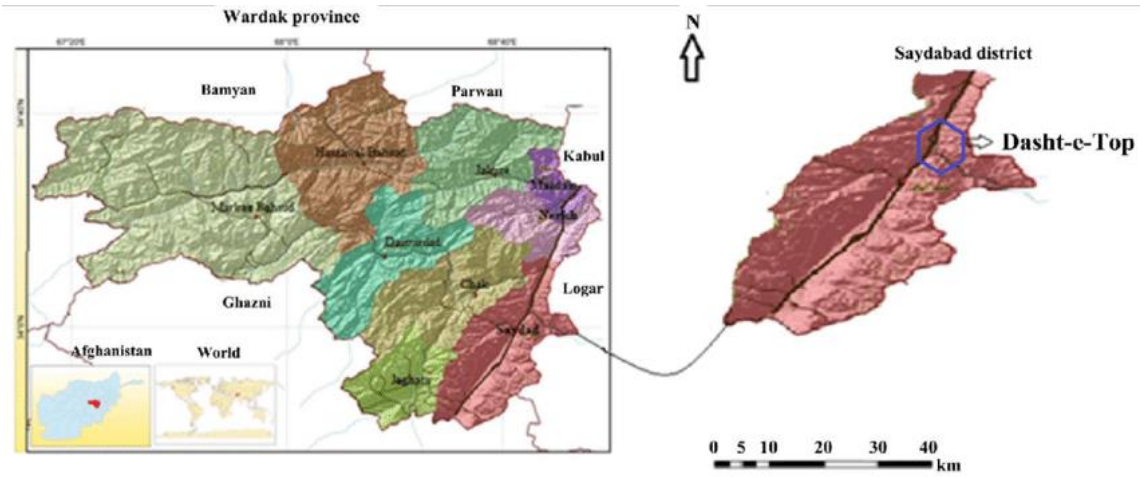

Figure 1. Map of the research site: (i) location of research site in Maidan Wardak, Afghanistan; (ii) map of Maidan Wardak province districts

Soil Characteristics and Experimental Design

For this research, we used certified seeds of the four wheat types, and we carried out a field trial using a randomized complete block design with three replications and four treatments. The soil in the wheat field (0-30 cm depth) had a pH of over eight, a sandy loam texture, and low organic matter (0.52%). Additionally, the soil had a total nitrogen content of 98 ppm and available phosphorus and potassium content of 36.5 ppm and 233 ppm, respectively.

The experiment comprised four different wheat crop varieties (Elham 0.15, Solh 0.18, Wahdat 0.15, and Diama 0,17). Solh and Elham were winter wheat varieties, and Daima and Wahdat were facultative varieties of wheat crops. An experiment was laid out in a randomized complete block design with four treatments and three replications. On October 16, 2022, the crop was seeded with 120 kg/ha seed rates and row spacing of 25 cm. Irrigation

was planned according to crop water requirements and rainfall gaps. Ten randomly chosen and labeled plants from each plot were used to record observations on several agronomical parameters. Following the conclusion of growth parameter observations and the crop reaching physiological maturity, the plants were manually harvested, bundled into small bundles, and moved to the threshing yard. Manual threshing was used, and the grains were meticulously gathered for counting and documentation.

Statistical Analyse

We collected data by randomly selecting ten plants from the middle three rows of each plot for data collection. The collected data were statistically analyzed using Tukey's HSD test at a significance level of $P < 0.05$ (JMP pro16 statistical software).

Results and Discussion

Growth Parameters

Enhancing crop growth traits is essential for increasing crop yields. The current study found that effective plant height, spikelets per spike, grains per spike, 1000-grain weight, and yield were significantly influenced by varieties (Tables 1 and 2). The considerably higher effective plant height was recorded from V3: (Wahdat 0.15) at 81.00 cm. The highest tillers number was obtained from V1: (Solh 0.18) at 318.66. However, a study in India by Yadav et al. (2014) reported maximum effective tillers from sowing in a North-South direction at 15 cm spacing. Similar results were reported by Naeem (2001) and Ali et al. (2004), who also observed that cultivars differed significantly in plant height at maturity. Compared to other types, the V2 had a longer spike (8.8 cm). In V1, V3, and V4, the spike length was increased to 8.5, 8.2, and 7.9 cm, respectively. Osmani et al. (2020) published similar findings from a two-year field experiment that among four varieties, maximum plant height achieved from V1 (Surkh Andarab) at 86.8 cm and 88.4 cm, number of tillers/m^2 at 416 and 425 and number of spikes/m2 at 397 and 419 achieved form V4 (Safida Andrab), and also V4 was enhanced in spike length at 10.83 cm and 10.67 cm, respectively. And also, it was noted by Naeem (2001) and Aslani and Mehrvar (2012) that cultivars differed noticeably in spike length.

Table 1: *Findings from different wheat varieties on the wheat's plant height, number of tillers/plant, number of tillers/cm2, number of spike/m^2, number of spikelets/spike length of spikes*

Treatments	Plant Height	Number of tillers/ plant	Number of tillers/m2	Number of spikes/ m2	Number of spikelet/ spike	Length of spike (cm)
V1 (Solh 0.18)	68.76b	4.33a	318.66a	250.00a	13.76a	8.52a
V2 (Elham 0.15)	76.20ab	3.30a	260.00a	248.66a	13.90a	8.87a
V3 (Wahdat 0.15)	81.03a	2.90a	229.66a	220.33a	14.26a	8.25a
V4 (Diama 0.17)	75.93ab	3.56a	233.33a	215.00a	13.76a	7.98a

Different letters in the same column represent results with statistical differences, according to Tukey's test at $P < 0.05$ significance level.

Yield parameters

The current study found that the number of spike/m2 increased in V1 at 250. Also, V2, V3, and V4 were 248, 220, and 215, respectively. Several spikelets per spike were enhanced in V3 at 14.2 compared to V2, V4, and V1 at 13.9, 13.7, and 12.8 spikelets per spike, respectively. Grain number per spike increased significantly in V2 and V3 at 45.5 and 43.2, compared to V4 at 28.9. The grain number per spikelet increased among varieties at V2 (3.2), V3 (3.1), V4 (2.7), and V1 (2.7). The 1000 seeds' weight increased significantly in V3 and V4 at 50 g and 47 g compared to V2 (40 g). Grain weight per hectare significantly increased in V3 at 3116 kg /ha than in V4 (1466 kg /ha). An average grain yield was 2206 kg/ha in V1, 2286 kg/ha in V2, 3116 kg/ha in V3, and 1466 kg /ha in V4, respectively. Osmani et al. (2020) published similar findings from a two-year field trial in which they found that among four varieties, V4 (Safida andarab) achieved a maximum number of seeds per spike at 50.67and 53.3, number of seeds per spikelets at 3 and 3, 1000 seeds weight at 40.33 and 41.33 g, and the highest grain yield at 4.17 t/ha and 4.43 ha. Donaldson et al. (2001) and Naeem (2001) also noted that cultivars varied greatly regarding final grain production.

Table 2: *Findings from different wheat varieties on the wheat's seed number/ spike, number of seeds/spikelet, 1000 seeds weight, and grain yield/ha*

Treatments	Number of seeds/spike	Number of Seeds/spikelet	Weight of 1000 seeds (g)	Grain yield (Kg/ha)
V1 (Solh 0.18)	33.60ab	2.76a	44.66ab	2206ab
V2 (Elham 0.15)	45.56a	3.26a	40.00b	2286ab
V3 (Wahdat 0.15)	43.20a	3.10a	50.00a	3116.a
V4 (Diama 0.17)	28.96b	2.76a	47.00a	1466b

Different letters in the same column represent results with statistical differences, according to Tukey's test at P <0.05 significance level.

Conclusion

The current study compared the yield of different wheat varieties in the Climatic Conditions of Maidan Wardak Province. The results showed that the array of (Wahdat 0.15) promoted growth parameters and increased yield characteristics of the test crop compared to other varieties, especially (Daima 0.17). Further research is recommended to stop the birds from assaulting wheat varieties under the agro-climatic conditions of Maidan Wardak Province.

Author Contributions

Abdul Basir Turabi: Methodology, investigation, data collection, writing of the original draft

Noor Mohammad Ahmadi: Methodology, data analysis, editing, and review

Mohammad Jan Arian: Review, editing, and validation

Emal Naseri: Review, editing, and validation

Hikmatullah Hikmat: Review, editing, and validation

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