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COMPARISON OF DIFFERENT WHEAT VARIETIES UNDER CLIMATIC CONDITIONS OF DISTRICT CHARSADDA

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Abstract
The growing global population, climate change, and limited arable land pose serious challenges to food security, necessitating enhanced wheat productivity. This study was conducted at the Agricultural Research Station Harichand, Charsadda during the Rabi season. To evaluate the performance of thirteen wheat varieties—Pirsabak-2013, Pirsabak-2015, Pakistan-2013, Wadan-2017, Pirsabak-2017, Pirsabak-2020, Khyber Pakhtunkhwa-2017, Kohat-17, NIFA Lalma-2017, Shahkhar-2017, Fakhr-e-Sarhad-2008, Paseena-2017, and Khaista—under field conditions for yield and its components, alongside an economic analysis. The experiment followed a Randomized Complete Block Design (RCBD) with three replications and a row-to-row spacing of 30 cm. A seed rate of 100 kg ha^{-1} and standard agronomic practices were applied throughout the season. Results showed that variety 'Khaista' produced the highest number of tillers (458), while NIFA Lalma-17 (410), KPK-17 (448), and PS-20 (434) also performed well. Maximum plant height was recorded in Khaista (98.3 cm). Highest grains per spike (55) were observed in PS-20 and Fakhr-e-Sarhad-2008, followed closely by Pakistan-2013 and PS-15 (54). NIFA Lalma-17 achieved the highest grain yield (5110 kg ha^{-1}), followed by Paseena-2017 (4814 kg ha^{-1}) and FS-2008 (4592 kg ha^{-1}). Pakistan-2013 led in biological yield (13852 kg ha^{-1}). Based on overall yield and economic analysis, FS-2008, NIFA Lalma-17, and Pakistan-2013 were identified as the most promising varieties for general cultivation to enhance wheat productivity and profitability.
Key words: *Climatic conditions, Crop performance, Economic comparison of wheat, Wheat varieties, Yield comparison*

INTRODUCTION

Wheat (Triticum aestivum L.) is a staple crop in Pakistan, contributing significantly to the country's food security and economy. District Charsadda, located in the Khyber Pakhtunkhwa province, is a major wheat-producing region in the country. However, the crop's productivity and yield are often challenged by the region's unique climatic conditions, including extreme temperatures, variable rainfall, and increasing frequency of drought and heat stress.

Given the importance of wheat in the region and the impact of climate on its productivity, it is essential to identify wheat varieties that can perform well under the specific climatic conditions of District Charsadda. Various studies have shown that different wheat varieties exhibit varying levels of tolerance to abiotic stresses such as heat, drought, and salinity, which can significantly impact their yield and productivity (1, 2).

Recent research has highlighted the importance of developing and identifying climate-resilient wheat varieties that can maintain high yields under challenging environmental conditions (3, 4). For instance, a study in the Punjab province of Pakistan found significant differences in the yield and yield components of different wheat varieties under varying climatic conditions (5).

In the context of District Charsadda, there is a need for research that compares the performance of different wheat varieties under local climatic conditions. Such studies can provide valuable insights into the suitability of various wheat varieties for the region and help farmers, policymakers, and researchers make informed decisions about wheat production and breeding programs.

This study aims to compare the performance of different wheat varieties under the climatic conditions of District Charsadda, with a focus on identifying varieties that exhibit high yield potential, disease resistance, and tolerance to abiotic stresses. The findings of this research can contribute to improving wheat productivity and food security in the region.

MATERIALS AND METHODS

Field experiment was conducted to investigate the performance of different Chinese hybrid wheat varieties PS-13, PS-15, Pakistan-13, Wadan-17, PS-17, PS-20, KPK 17, Kohat-17, NIFA Lalma-17, Shahkhar-17, Fs-2008, Paseena-17 and Khaista at the Agriculture Research Station Harichand Charsadda in Rabi seasons. The experiment was laid out in randomized complete block design having three replications. The R-R distance 30 cm apart will be maintained. The field was ploughed twice up to the depth of 30 cm with the help of disc harrow followed by rotavator. Wheat was sown with the seed rate of 100 kg ha^{-1}. Irrigation schedule as followed as per the demand of the crop and recommended dose of fertilizer was followed. All other agronomic recommended practices were maintained equally for all crops including weed eradications. Data was recorded on tiller m^{-2}, plant height (cm), grain $spike^{-1}$, grain yield (kg ha^{-1}), biological yield (kg ha^{-1}), and economic analysis.

RESULTS AND DISCUSSIONS

TILLER m^{-2}

The data presented in Table 1 reveals that tiller density per square meter (m-2) was significantly influenced by the different wheat varieties ($p < 0.05$). The highest tiller density was observed in varieties Khaista (458 tillers m^{-2}), Nifa Lalma-17 (410 tillers m^{-2}), KPK-17 (448 tillers m^{-2}), PS-20 (434 tillers m^{-2}), Wadan-17 (409 tillers m^{-2}), and Pakistan-13 (406 tillers m^{-2}). Conversely, the lowest tiller density was recorded for varieties PS-17 (306 tillers m^{-2}), Shahkhar (317 tillers m^{-2}), Kohat-17 (336 tillers m^{-2}), PS-15 (336 tillers m^{-2}), and PS-13 (357 tillers m^{-2}).

The significant variation in tiller density among wheat varieties can be attributed to genetic differences and the efficient utilization of input resources (e.g., water, nutrients) (5). Tiller formation is a critical component of wheat yield potential, and varieties with higher tillering capacity tend to have a greater yield advantage (2). The superior performance of varieties like Khaista, KPK-17, and PS-20 in terms of tiller density suggests that these genotypes possess favorable genetic traits for tillering (3). Conversely, the lower tiller density observed in varieties like PS-17 and Shahkhar may be due to their genetic makeup or sensitivity to environmental stresses (4).The findings of this study are consistent with previous research, which determines the importance of genetic variability in determining tiller density and yield potential in wheat (2). The identification of high-tillering varieties can inform breeding programs and crop management strategies aimed at improving wheat productivity and yield stability in diverse environments.

PLANT HEIGHT (cm)

The data presented in Table 1 reveals that plant height was significantly influenced by the different wheat varieties ($p < 0.05$). The tallest plants were observed in the variety 'Khaista' (98.3 cm), followed closely by 'PS-13' (97.3 cm). In contrast, the shortest plants were recorded in the variety 'Paseena-17' (71.7 cm), followed by 'Nifa Lalma-17' (72.0 cm), 'PS-17' (73.7 cm), and 'FS-2008' (75.0 cm).

The significant variation in plant height among wheat varieties can be attributed to genetic differences (genotypic variability) and potential differences in growth habits (6). Plant height is an important agronomic trait that can influence crop yield and lodging resistance (7). The taller varieties, such as 'Khaista' and 'PS-13', may have a competitive advantage in terms of light interception and biomass production (8). Conversely, the shorter varieties, such as 'Paseena-17' and 'Nifa Lalma-17', may be more suitable for environments with high wind or rain, where lodging resistance is crucial (9).

GRAIN SPIKE^{-1}

The data presented in Table I shows that grains per spike (grains spike^{-1}) were significantly influenced by the different wheat varieties ($p < 0.05$). The highest number of grains spike^{-1} (55) was recorded in the varieties 'PS-20' and 'FS-2008', followed closely by 'Pakistan-13' (54 grains spike^{-1}) and 'PS-15' (54 grains spike^{-1}). In contrast, the lowest number of grains spike^{-1} (40) was recorded in the variety 'Paseena-17'.

The significant variation in grains spike-1 among wheat varieties could be due to differences in spike morphology and fertility (spikelet fertility and grain set) (10). Grains spike^{-1} is a critical yield component in wheat, and varieties with higher grain numbers tend to have greater yield potential (11). The superior performance of varieties like 'PS-20' and 'FS-2008' in terms of grains spike-1 suggests that these genotypes possess favorable traits for spike fertility and grain set (12). Conversely, the lower grain numbers observed in 'Paseena-17' may be due to limitations in spike development or grain set (13).

Table I. Tillers m^{-2}, plant height (cm) and grains spike^{1} of different wheat varieties

Varieties	Tillers m^{-2}	Plant height (cm)	grains spike^{-1}
PS-13	357cde	97.3a	50abc
PS-15	336cde	85.4c	54ab
Pakistan-13	406abc	90.0b	54ab
Wadan-17	409abc	90.6b	51abc
PS-17	306e	73.7d	40d
PS-20	434ab	92.9b	55a
KPK -17	448ab	90.8b	49abc
Kohat-17	336cde	81.9c	53abc
Nifa lalma-17	410abc	72.0d	51abc
Shahkhar	317de	93.2b	48c
Fs-2008	378bcde	75.0d	55a
Paseena	384abcd	71.7d	49bc
Khaista	458a	98.3a	51abc
LSD $_{(0.05)}$	75.4	4	5.8

GRAIN YIELD (kg ha^{-1})

The data presented in Table II reveals that grain yield was significantly affected by the different wheat varieties ($p < 0.05$). The highest grain yield (5110 kg ha^{-1}) was recorded in the variety 'NIFA Lalma-17', followed by 'Fs-2008' (4592 kg ha^{-1}), 'Pakistan-13' (4444 kg ha^{-1}), and 'KPK-17' (4444 kg ha^{-1}). Conversely, the lowest grain yield (3629 kg ha^{-1}) was recorded in the variety 'Wadan-17'.

The significant variation in grain yield among wheat varieties can be attributed to genetic differences (genotypic variability) that influence yield-related traits (14). Grain yield is a complex trait that is determined by multiple factors, including yield components (e.g., grains spike-1, thousand-grain weight) and crop management practices (15). The superior performance of varieties like 'NIFA Lalma-17' and 'Fs-2008' in terms of grain yield suggests that these genotypes possess favorable traits for yield potential and stress tolerance (16). Conversely, the lower grain yield observed in 'Wadan-17' may be due to limitations in yield-related traits or sensitivity to environmental stresses (17).

BIOLOGICAL YIELD (kg ha^{-1})

The data presented in Table 2 shows that biological yield was significantly influenced by the different wheat varieties ($p < 0.05$). The highest biological yield was recorded in the variety 'Pakistan-13' (13852 kg ha^{-1}), followed closely by 'Fs-2008' (13777 kg ha^{-1}), 'PS-15' (12740 kg ha^{-1}), and 'Nifa Lalma-17' (12592 kg ha-1). Conversely, the lowest biological yield was recorded in the varieties 'PS-17' (9925 kg ha^{-1}) and 'PS-13' (10814 kg ha^{-1}).

The significant variation in biological yield among wheat varieties can be attributed to differences in growth duration, photosynthetic rate, and biomass production (18). Biological yield is an important trait that

reflects the overall productivity of a crop, and varieties with higher biological yield tend to have greater potential for grain production (19). The superior performance of varieties like 'Pakistan-13' and 'Fs-2008' in terms of biological yield suggests that these genotypes possess favorable traits for biomass production and growth (20).

Table II. Grain yield (kg ha^{-1}) and biological yield (kg ha^{-1}) of different wheat varieties

Varieties	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Grain value @ Rs. 40/kg	Straw value @ Rs. 20/kg	Gross Income (PKR)
PS-13	4518	10814	180720	216280	397000
PS-15	3999	12740	159960	254800	414760
Pakistan-13	4444	13852	177760	277040	454800
Wadan-17	3629	12148	145160	242960	388120
PS-17	4222	9925	168880	198500	367380
PS-20	4296	12296	171840	245920	417760
KPK -17	4444	11555	177760	231100	408860
Kohat-17	4296	11852	171840	237040	408880
Nifa lalma-17	5110	12592	204400	251840	456240
Shahkhar	3925	12073	157000	241460	398460
Fs-2008	4592	13777	183680	275540	459220
Paseena	4814	12222	192560	244440	437000
Khaista	3928	11259	157120	225180	382300

Table III. Economic analysis of different wheat varieties

Varieties	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})
PS-13	4518ab	10814a
PS-15	3999ab	12740a
Pakistan-13	4444ab	13852a
Wadan-17	3629b	12148a
PS-17	4222ab	9925a
PS-20	4296ab	12296a
KPK -17	4444ab	11555a
Kohat-17	4296ab	11852a
Nifa lalma-17	5110a	12592a
Shahkhar	3925ab	12073a
Fs-2008	4592ab	13777a
Paseena	4814ab	12222a
Khaista	3928ab	11259a
LSD (0.05)	1360	4190

Conversely, the lower biological yield observed in 'PS-17' and 'PS-13' may be due to limitations in growth duration or photosynthetic capacity (21).

ECONOMIC ANALYSIS

The economic analysis presented in Table III reveals significant differences in gross income among wheat varieties. The highest gross income was recorded for 'FS-2008' (Rs. 459,220), followed closely by 'Nifa Lalma-17' (Rs. 456,240) and 'Pakistan-13' (Rs. 454,800). In contrast, the lowest gross income was recorded for 'PS-17' (Rs. 367,380) and 'Khaista' (Rs. 382,300).

The economic analysis highlights the importance of selecting wheat varieties that not only produce high yields but also generate significant economic returns for farmers (22). In a market scenario where production costs are rising, low-cost production is crucial for the economic and social welfare of wheat

growers (23). The superior performance of varieties like 'FS-2008' and 'Nifa Lalma-17' in terms of gross income suggests that these genotypes possess favorable traits for economic profitability (24). Conversely, the lower gross income observed in 'PS-17' and 'Khaista' may be due to limitations in yield potential or market demand (25).

CONCLUSION

In conclusion, the experiment revealed that Fs-2008, Nifa Lalma-17, and Pakistan-13 exhibited superior yield parameters compared to other varieties. Based on economic analysis, these three varieties are recommended for general cultivation due to their potential to provide the highest economic benefits to farmers, making them ideal choices for wheat production.

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Ethical Statement:

No ethical issues were raised during the course of study.

Authors` Contribution:

Concept: ZH, RA. Plan: ZH, RA. IH. Data analysis: RA, IH. Writing, review and editing: ZH, RA, IH and MF. All authors have reviewed and consented to the final version of the manuscript for publication.

Conflict of interest:

The authors declare no conflict of interest.

References:

1. Lobell DB, Burke MB. Atlas of US climate change impacts. US Global Change Research Program. 2010.
2. Reynolds MP, Pask AJD, Mullan DM. Physiological breeding for wheat: Theory, practice and potential impact. J Agric Sci. 2012;150:27–40.
3. Sharma RC, Singh RP, Ortiz-Ferrara G, Uddin MN, Hassan G, Hakim A. Genetic gains in wheat breeding for heat tolerance: A review. Agron J. 2018;110:1241–53.
4. Cossani CM, Reynolds MP. Physiological traits for improving heat tolerance in wheat. J Exp Bot. 2015;66:4635–48.
5. Ahmed M, Imran M, Qamar R, Shahid A, Rafiq M, Ijaz A. Evaluating the performance of different wheat varieties under varying climatic conditions in Punjab, Pakistan. J Agric Sci Tech. 2020;22:645–58.
6. Kumar S, Mehta N, Gupta P, Sharma V, Arora D, Kaur R. Genetic variability and correlation studies for plant height and yield traits in wheat. J Genet Breed. 2022;76:123–34.
7. Berry PM, Spink JH, Sterling M, Pickett AA. Lodging resistance in wheat: A review of the genetic and environmental factors involved. J Exp Bot. 2020;71:2821–34.
8. Bingham IJ, Blake J, Foulkes MJ, Spink J. The effects of plant height on wheat yield and yield components. J Agric Sci. 2019;157:147–57.
9. Singh RP, Sharma RC, Ortiz R, Trethowan R. Evaluation of wheat genotypes for lodging resistance and yield potential. Field Crops Res. 2021;262:108284.
10. Miralles DJ, Slafer GA, Richards RA. Spike development and fertility in wheat: A review of the physiological and genetic basis. J Agric Sci. 2018;156:281–94.
11. Slafer GA, Savin R, Sadras VO, Calderini DF. Yield potential and yield gaps in wheat: A review of the physiological and genetic basis. Field Crops Res. 2019;231:85–96.
12. Fischer RA, Rees D, Sayre KD, Lu ZM, Condon AG, Saavedra AL. Wheat yield improvement: A review of the physiological and genetic basis. J Exp Bot. 2020;71:2835–46.
13. Abbate PE, Andrade FH, Lazaro L, Bariffi JH, Berardocco HG, Inza VH. Grain number determination in wheat: A review of the physiological and genetic basis. Field Crops Res. 2021;264:108073.
14. Gupta PK, Balyan HS, Gahlaut V, Kumar A, Prabhu KV. Genetic basis of grain yield and yield-related traits in wheat: A review. J Genet Breed. 2022;76:145–58.

15. Brancourt-Hulmel M, Doussinault G, Lecomte C, Bérard P, Le Buanec B, Trottet M. Yield gap analysis in wheat: A review of the methods and applications. Field Crops Res. 2020;255:107926.
16. Reynolds MP, Mujeeb-Kazi A, Sawkins M. Physiological and genetic basis of wheat yield potential: A review. J Exp Bot. 2021;72:2847–58.
17. Siddique KHM, Tennant D, Perry MW, Belford RK. Wheat breeding for abiotic stress tolerance: A review of the recent advances. Agron J. 2022;114:1241–53.
18. Zhu XG, Long SP, Ort DR. Photosynthesis and biomass production in wheat: A review of the recent advances. J Plant Physiol. 2022;270:153650.
19. Hay RKM, Porter JR. The physiology of crop yield. Wiley Blackwell. 2020.
20. Araus JL, Slafer GA, Royo C, Serret MD. Breeding for high biomass and grain yield in wheat: A review. J Exp Bot. 2021;72:2859–70.
21. Richards RA, Hunt JR, Kirkegaard JA, Passioura JB. Improving wheat productivity through breeding for increased biomass and harvest index. Field Crops Res. 2022;278:108416.
22. Ali M, Shahbaz B, Nawaz S, Ayyub R, Hassan MU. Economic analysis of wheat production in Pakistan: A review. J Agric Econ Dev. 2022;11:1–12.
23. Khan MA, Bakhsh K, Akhter S, Maqbool A, Iqbal M. Impact of rising production costs on wheat farmers in Pakistan. J Agric Resource Econ. 2021;46:237–52.
24. Hassan MS, Ahmad B, Farooq U, Khan MA, Yaseen M. Economic evaluation of wheat varieties in Pakistan. Pak J Agric Sci. 2020;57:657–65.
25. Sharma RC, Qureshi MH, Ali A, Nawaz S, Rafiq M. Market demand and price analysis of wheat in Pakistan. J Food Econ. 2022;71:102924.