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Research Article

Selected Wheat Germplasm Trial Evaluation for Semi-Arid Zone of Balochistan

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ABSTRACT

Approximately 21.8% of the current agricultural land cultivates wheat. High-yielding wheat varieties that are tolerant to biotic and abiotic stresses fulfil a large demand for wheat consumption, especially in the developing world. The Balochistan Agricultural Research and Development Centre, in Quetta (BARDC) held a field experiment to test and evolve wheat germplasm from the CIMMYT nursery semi-arid wheat yield trial (28 SAWYT) on 2022-23 for Balochistan. The experiment had 24 entries, as well as one control variety, Shalkot-14. The alpha-lattice design of the experiment included two replications. There were 25 plots, each measuring 3 m2 (4 rows x 0.25 m x 3 m long apart). We recorded a variety of parameters, including days to heading 50%, plant height (cm), days to maturity, spike length (cm), number of grains per spike, 1000 grain weight, total dry matter (Kg), canopy temperature, chlorophyll content, and grain yield. The maximum (130) and minimum days to heading (118) was recorded in entries 16 and 8, respectively. Germplasm nos. 3 and 4 recorded the minimum plant height of 69.5 cm. Germplasm no. 20 recorded the maximum days to maturity (188.5 days), while germplasm no. 6 recorded the minimum days to maturity (174 days). Germplasm no. 14 recorded the maximum spike length of 13.0 cm, while germplasm no. 7 recorded the minimum mean spike length of 7.0 cm. Germplasm no. 21 recorded the maximum number of grains per spike (63.5), while germplasm no. 2 recorded the minimum number of grains per spike (50.5). A wide range (192200-13060kg) of total dry matter was found in entry 8 and entry 21, respectively. Similar varied arrays were recorded in canopy temperature (28.0-34.0 °C) in entries 11 and 14, likewise maximum and minimum 1000 grain weight and yield was recorded in entry 7, 11 and 9, 6, respectively.

Keywords: Germplasm, CIMMYT, Semi-arid, Wheat, Yield trial, Balochistan.

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INTRODUCTION

Wheat belongs to the family Poaceae, the subfamily Pooideae, the tribe Triticeae, and the genus *Triticum* L. Researchers have proposed several classification schemes for wheat, including those based on morphological, cytogenetic, and genomic characteristics (Schnurbusch, 2019).

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Agriculture plays an important role in improving a large proportion of the rural population, in particular, and the overall economy in general. Nearly every region of the world today desires agricultural development. The competition between the growing population and the increasing food supply is quite intense. The unprecedented drought and water shortage conditions have severely affected the wheat crop during the last few years in Pakistan (Mahmood et al., 2019). Agriculture is the backbone of Pakistan's economy and it contributes to the economic and social wellbeing of the nation through its influence on the gross domestic product, employment, and foreign exchange earnings (Mahmood and Munir, 2018). Wheat and rice are the most important food grain crops in the agriculture sector, with rice contributing 5.4% of value added in agriculture and 1.3% to GDP, while the grain crop accounts for 13.8% of value added in agriculture and 3.4% of GDP (Amin et al., 2014). Per capita wheat consumption in the country is 120 kg a year, which is considered to be one of the highest in the world (Hassan et al., 2013). Like many other developing countries in the world, Pakistan's agriculture sector is the most important sector of its economy, and wheat is the country's most important agricultural product (Longove et al., 2014). About 80% of the farmers are more than four million and account for close to 40% of the total cropped area, which contributes about a quarter of the total crop sector value-added production (Naeem et al., 2017).

We only cover a few aspects of the complex evolutionary and domestication history of wheat here. About 21% of the world's food depends on the wheat (*Triticum aestivum*) crop, which grows on 200 million hectares of farmland worldwide (http://www.fao.org). Although wheat is traded internationally and developing countries are major importers (43% of food imports), the reality is that 81% of wheat consumed in the developing world is produced and utilised within the same country, if not the same community (Enghiad et al., 2017).

In these circumstances, many poor households rely on increased wheat production on their own farms to improve household food security. While countries are major importers (43% of food imports), the reality is that 81% of wheat consumed in the developing world is produced and utilised within the same country, if not the same community (Kumar and Kalita, 2017). In these circumstances, many poor households rely on increased wheat production on their own farms to improve household food security.Today the wheat suffers from severe heat stress during grain filling, it has been shown that the enzyme soluble starch synthase in wheat appears to be rate-limiting at temperatures in excess of 20 °C (Qadir et al., 2023). Furthermore, heat stress severely impairs wheat grain filling of wheat is seriously impaired by heat stress due to reductions in current leaf and ear photosynthesis at high temperatures (Ullah et al., 2022).Extensive genetic diversity, including advanced cultivars, breeding lines, traditional cultivars and landraces, genetic stocks, introgression lines, mutants, and CWR, is conserved in gene banks worldwide for wheat improvement (Najaphy et al., 2012). According to the Food and Agriculture Organisation's (FAO) World Information and Early Warning System (WIEWS), nearly 855,000 accessions of *Triticum* are conserved in 218 gene banks located in 88 countries around the globe. An earlier overview was based on a larger number of information sources (Sharma et al., 2021). The most edible crop in Pakistan is wheat. We should increase wheat production to meet the needs of the ever-growing population. Pakistan cultivates wheat on an area exceeding 9 M ha, yielding an annual production of 25 mt (Kirby et al., 2017). The agricultural productivity decreases due to salt accumulation; in Pakistan, about 40,000 hectares of land tumble down every year because of salinity (Mushtaq et al., 2019).

Wheat, *Triticum aestivum* L., is one of the most cultivated cool-season crops originated in the Middle East. It has a slightly longer growing period and minimum heat requirement than the other small grain crops, and billions of people around the world use it as food in various forms, such as steamed breads, cookies, cakes, pasta, noodles, and couscous (Cooper, 2015). The province of Balochistan, which is the largest in size but is a wheat-deficit province, depends on Sindh and Punjab for wheat requirements (Joshi et al., 2017). Environmental stresses are the primary limiting factor in crop production in Balochistan. Cold and drought in winters are major stresses, and salinity is one of the major abiotic environmental stresses that reduce wheat production in Balochistan. Silicon supplementation can overcome the salinity problem (Saddiq et al., 2021). The country produces wheat under irrigated conditions, but low rainfall and late heat stress conditions hinder the desired results.

MATERIALS AND METHODS

A tryout was conducted from CIMMYT nursery (28th SAWYT) at Balochistan Agricultural Research and Development Centre, in Quetta on 2022-23. The trial was composed of 24 entries including on check (Shalkot-14) using alpha lattice design with two replications by keeping the experimental area of 75 m^2 for each replication. There were 25 plots having a size of 0.25m x 3m with 4 rows each.

Parameters

The following parameters were recorded.

Days to heading (50%)

Days to heading was counted as the number of days from sowing to days when (50%) of heads emerged fully from the boot of the flag leaf in each plant.

Plant height (cm)

The plant height (cm) was randomly measured at maturity from the surface of the ground to the tip of the spike.

Days to maturity

Days to maturity was counted when the number of days from sowing to the days of wheat peduncle of the spike in each plot becomes completely yellowish.

Spike length (cm)

The spike length (cm) of each germplasm was measure after harvesting.

No. of grains spike^{-1}

Three spikes from each entery were randomly picked, and the number of grain spike^{-1} was counted.

1000 grain weight (g)

1000 grains from each entry were counted and weighed on a digital balance.

Grain yield

The grain yield of each entry was recorded after harvested and converted in to kg ha$^{-1.}$

Total dry matter (kg ha-1)

The total dry matter was recorded after harvesting the crop from each plot using the quadrate method and converted to Kg ha$^{-1.}$

Canopy temperature (˚C)

Canopy temperature (˚C) was recorded using a canopy temperature meter.

Chlorophyll Content (mg cm-2)

Total chlorophyll content (mg/cm^2) was recorded (three samples from each treatment) by chlorophyll meter (at leaf)

Statistical analysis:

The data was processed statistically through Statistix Ver. 8.1 Software as followed by Gomez and Gomez (1984).

RESULTS

Agronomic Parameters

Days to 50% heading

There was a significant difference found between various germplasms. Table no.1 shows mean result of different germplasms tested for days to heading 50%. Maximum mean days to 50% heading 130 was observed in germplasm no 16 which was 4 days more for heading 50% than shalkot-14, after that three germplasm i.e.,5, 14, and 15 shows similar result of 129 days. While the minimum days to heading 50% was observed in germplasm no 8. Germplasm 8 showed 7 days less than shalkot-14. The results regarding days to heading 50% are in line with the results of resultsrmany et al., (2009).

Plant height (cm)

The maximum plant height 84.5 cm was recorded in germplasm no 21 and the height of check variety Shalkot-14 was 77 cm. the check variety and germplasm 21 with difference of 7.5cm in plant height. While the minimum plant height 69.5 cm was recorded in germplasm no 3 and 4 which were 7.5 cm shorter than Shalkot-14, while no significant difference found among germplasm no 2, 5, 8, 10, 11, 12, 16, 17, 18, 19, 20, and 24. Similar result are reported by (Bakry et al., 2014).

Days to maturity

Maximum days to maturity 188.5 days was found in germplasm no 20 and the minimum days to maturity 174 days was found in germplasm no 6. Shalkot-14 (check variety) takes 177.5 days for maturity and mature 11 days earlier than germplasm 20 while 3.5 days later than germplasm 6. No significant difference was found between all the tested germ plasm. The best performance for days to maturity was noted in germplasm 6 which mature earlier than all other tested germplasms. These results are in line with Araus et al. (2001).

Spike length (cm)

The maximum spike length 13.0 cm was recorded in germplasm no 14 and minimum mean spike length 7.0 cm was recorded in germplasm no 7. The spike length of Shalkot-14 was 12.5 cm which was 0.5 cm shorter than germplasm 14 and 5.5 cm larger than germplasm 7. The spike length of germplasms 11 and 21 were same 12.5 cm as Shalkot-

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14. There was a significant difference found between various tested germplasms.

No. of grain spike^{-1}

Mean result of different germplasms tested for number of gains per spikes is shown in table no.5. Maximum number of grains per spike (63.5) was noted in germplasm no 21 and minimum number of grains per spike (50.5) was noted in germplasm no 2. Germplasm 21 showed 10.5 more grains than Shalkot-14 and germplasm 2 showed 2.5 less grains than Shalkot-14. Significant difference was found between various tested germplasms. These finding are in line with Kashif and Khaliq (2004).

Table 1. Means of different germplasms tested for Physiological parameters (plant height, spike length, No. of grain/spike, grain yield)

Germplasm	Plant height	Spike length (cm)	No. of grain spike-1	Grain yield
1	84.0 AB	11.5 AB	55.0 AB	4740 AB
2	75.0 ABCD	9.5 ABC	50.5 B	4180 AB
3	69.5 D	10.5 ABC	58.5 AB	4420 AB
4	69.5 D	9.0 ABC	61.0 AB	4400 AB
5	75.5 ABCD	11.5 AB	56.0 AB	5300 AB
6	80.5 ABC	11.0 ABC	54.0 AB	3800 B
7	70.5 CD	7.0 BC	52.5 AB	4300 AB
8	77.5 ABCD	8.0 BC	60.0 AB	5725 AB
9	73.5 BCD	10.5 ABC	57.0 AB	6660 A
10	78.0 ABCD	10.5 ABC	63.0 A	5600 AB
11	80.0 ABCD	12.5 A	56.0 AB	3850 B
12	79.5 ABCD	12.0 AB	58.0 AB	4920 AB
13	83.5 AB	9.0 ABC	55.0 AB	4210 AB
14	84.0 AB	13.0 A	61.0 AB	4110 AB
15	83.0 AB	12.0 AB	54.0 AB	4440 AB
16	78.5 ABCD	9.5 ABC	52.0 AB	5650 AB
17	76.0 ABCD	9.0 ABC	58.5 AB	5360 AB
18	79.0 ABCD	9.5 ABC	55.5 AB	4700 AB
19	78.0 ABCD	9.5 ABC	61.0 AB	4650 AB
20	80.0 ABCD	10.0 ABC	61.0 AB	3950 AB
21	84.5 A	12.5 A	63.5 A	4350 AB
22	82.0 AB	9.5 ABC	56.5 AB	4850 AB
23	77.0 ABCDE	9.0 ABC	56.0 AB	4870 AB
24	79.0 ABCD	10.5 ABC	61.0 AB	5600 AB
Shalkot-14	77.0 ABCDE	12.5 A	53.0 AB	5500 AB
Significance	0.2359	0.4055	0.7020	0.6766
LSD	10.89	4.17	11.61	2738.7

Germplasm yield

The maximum grain yield was noted in germplasm number 9 while minimum grain yield was noted in germplasm number 6. The grain yield of Shalkot-14 (check variety) was 5500 which was 1160 less than germplasm 9. There was a significant difference found between maximum and minimum grain producing germplasm while no significant difference was found between the remaining germplasms. (Mondal and Khajuria, 2001) have reported substantial variation among genotypes for grain yield and related traits. There was a significant difference between tested germplasms.

Total dry matter (kg ha-1)

Highest total dry matter 19220 kg was recorded in germplasm no 8 and the lowest total dry matter 13060 g was recorded in germplasm no 21. The total dry matter of Shalkot-14 was 17790 which was 1430 kg less than germplasm 8. There was no significant difference found between all the tested germplasms. Fellahi et al. (2013) reported the same same results regarding total dry matter.

Canopy temperature

Maximum mean canopy temperature 34.0 C was recorded in germplasm no 14 which was 3 ˚C more than Shalkot-

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14. While the minimum canopy temperature (28.0 C) was recorded in germplasm no 11 which was 3 ˚C less than Shalkot-14. There was significant difference found between tested germplasms no 14 and 11. No significant difference was found between germplasm no 1, 3, 4, 5, 6, 7, 9, 13, 15, 16, 17, 19, 20, 21, 22, 23, 24 and 25.

Table 2. Means of different germplasms tested for physiological chemical and others parameters (maturity days, total dry matter, canopy temperature, chlorophyll).

Germplasm	Maturity days	Total dry matter	Canopy temperature	Chlorophyll
1	179.0 *N/S	15020 *N/S	31.5 ABCD	56.0 ABC
2	180.5	14840	32.5 ABC	61.5 A
3	181.0	13470	30.5 ABCD	59.5 ABC
4	187.0	13770	30.0 ABCD	57.0 ABC
5	186.5	17450	30.0 ABCD	56.5 ABC
6	174.0	15710	30.5 ABCD	59.0 ABC
7	178.0	14270	30.5 ABCD	57.0 ABC
8	184.5	19220	29.5 BCD	59.5 ABC
9	187.5	17110	30.0 ABCD	56.0 ABC
10	179.5	17600	28.5 CD	56.0 ABC
11	182.5	13830	28.0 D	58.0 ABC
12	175.0	18930	33.5 AB	58.0 ABC
13	175.0	16070	32.0 ABCD	59.5 ABC
14	175.0	14360	34.0 A	56.0 ABC
15	183.0	16090	32.0 ABCD	61.5 A
16	179.0	18200	32.0 ABCD	59.5 ABC
17	180.0	17785	31.0 ABCD	57.0 ABC
18	177.5	15080	29.5 BCD	56.5 ABC
19	181.0	15490	32.0 ABCD	59.0 ABC
20	188.5	16420	30.5 ABCD	57.0 ABC
21	181.0	13060	31.0 ABCD	59.5 ABC
22	184.0	14350	30.5 ABCD	56.0 ABC
23	186.5	14150	32.0 ABCD	56.0 ABC
24	182.0	18710	30.5 ABCD	58.0 ABC
Shalkot-14	177.5	17790	31.0 ABCD	58.0 ABC
Significance	0.8414		0.1699	0.6841
LSD	15.15		4.42	8.28

Chlorophyll content

Mean result of different germplasms tested for chlorophyll content are shown in table no. 10. Maximum chlorophyll content 61.5 was noted in germplasm no 2, 16 and 20 while minimum chlorophyll content 52.5 was found in germplasm no 25. Significant difference was found between germplasm no 2,16, 20 and 25 while no significant difference was found between several other germplasms.

Table 10. Means of different germplasms tested for Chlorophyll content

CONCLUSION

Significant variations exist among wheat genotypes in terms of their adaptability to stressful environments. The ability of the wheat genotypes to withstand high-temperature stress is associated with various physiological adaptability traits. The germplasm 7 and 11 is a highly grain yield producing, while 8 and 21 is recommended for fodder under the semi-arid rain fed conditions. Adapted genotypes can play an essential role in enhancing wheat productivity under rainfed conditions

AUTHOR CONTRIBUTIONS

All authors contributed equally to this research.

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COMPETING OF INTEREST

The authors declare no competing interests.

REFERENCES

Amin, M., Amanullah, M., Akbar, A., 2014. Time series modeling for forecasting wheat production of Pakistan. JAPS: Journal of Animal & Plant Sciences 24.

Araus, J., Casadesus, J., Bort, J., 2001. Recent tools for the screening of physiological traits determining yield. Application of Physiology in Wheat Breeding Mexico, DF: CIMMYT, 59-77.

Bakry, A., Takahashi, H., Otsuki, M., Tagami, J., 2014. Evaluation of new treatment for incipient enamel demineralization using 45S5 bioglass. Dental Materials 30, 314-320.

Cooper, R., 2015. Re-discovering ancient wheat varieties as functional foods. Journal of Traditional and Complementary Medicine 5, 138-143.

Enghiad, A., Ufer, D., Countryman, A.M., Thilmany, D.D., 2017. An overview of global wheat market fundamentals in an era of climate concerns. International Journal of Agronomy 2017, 3931897.

Fellahi, Z., Hannachi, A., Bouzerzour, H., Boutekrabt, A., 2013. Correlation between traits and path analysis coefficient for grain yield and other quantitative traits in bread wheat under semi arid conditions. Journal of Agriculture and Sustainability 3.

Hassan, N.U., Mahmood, Q., Waseem, A., Irshad, M., Pervez, A., 2013. Assessment of heavy metals in wheat plants irrigated with contaminated wastewater. Polish Journal of Environmental Studies 22.

Joshi, K.D., Rehman, A.U., Ullah, G., Nazir, M.F., Zahara, M., Akhtar, J., Khan, M., Baloch, A., Khokhar, J., Ellahi, E., 2017. Acceptance and competitiveness of new improved wheat varieties by smallholder farmers. Journal of crop Improvement 31, 608-627.

Kashif, M., Khaliq, I., 2004. Heritability, correlation and path coefficient analysis for some metric traits in wheat. International Journal of Agriculture and Biology 6, 138-142.

Kirby, M., Mainuddin, M., Khaliq, T., Cheema, M., 2017. Agricultural production, water use and food availability in Pakistan: Historical trends, and projections to 2050. Agricultural Water Management 179, 34-46.

Kumar, D., Kalita, P., 2017. Reducing postharvest losses during storage of grain crops to strengthen food security in developing countries. Foods 6, 8.

Longove, M., Farid Akbar, F.A., Shamsuddin Baqa, S.B., Hidayatullah, H., Sher Azam, S.A., 2014. Performance evaluation of different wheat varieties under agro-ecological conditions of Quetta (Balochistan). Journal of Biology, Agriculture and Healthcare 4, 39-43.

Mahmood, K., Munir, S., 2018. Agricultural exports and economic growth in Pakistan: an econometric reassessment. Quality & Quantity 52, 1561-1574.

Mahmood, N., Arshad, M., Kächele, H., Ma, H., Ullah, A., Müller, K., 2019. Wheat yield response to input and socioeconomic factors under changing climate: Evidence from rainfed environments of Pakistan. Science of the Total Environment 688, 1275-1285.

Mondal, S., Khajuria, M., 2001. Correlation and path analysis in bread wheat (*Triticum aestivum* L.) under rainfed condition. Environment and Ecology 19, 405-408.

Mushtaq, A., Rizwan, S., Jamil, N., Ishtiaq, T., Irfan, S., Ismail, T., Malghani, M.N., Shahwani, M.N., 2019. Influence of silicon sources and controlled release fertilizer on the growth of wheat cultivars of Balochistan under salt stress. Pakistan Journal of Botany 51, 1561-1567.

Naeem, M., Shah, S.G., Rasheed, M., 2017. Analyses of cost and revenue of wheat crop production in district Musakhail, Balochistan. Journal of Economics and Sustainable Development 8, 86-92.

Najaphy, A., Parchin, R.A., Farshadfar, E., Farshadfar, E., 2012. Comparison of phenotypic and molecular characterizations of some important wheat cultivars and advanced breeding lines. Australian Journal of Crop Science 6, 326-332.

Qadir, A., Saeed, M.S., Yasin, M.U., Ali, Z., Rais, A., Shahid, M.U., 2023. STUDY REGARDING HEAT SHOCK, DRASTICALLY REDUCED THE WHEAT YIELD IN PUNJAB, PAKISTAN. Annals of Agriculture and Environment 1, 01-05.

Saddiq, M.S., Iqbal, S., Hafeez, M.B., Ibrahim, A.M., Raza, A., Fatima, E.M., Baloch, H., Jahanzaib, Woodrow, P., Ciarmiello, L.F., 2021. Effect of salinity stress on physiological changes in winter and spring wheat. Agronomy 11, 1193.

Schnurbusch, T., 2019. Wheat and barley biology: towards new frontiers. Journal of Integrative Plant Biology 61, 198-203.

Sharma, S., Schulthess, A.W., Bassi, F.M., Badaeva, E.D., Neumann, K., Graner, A., Özkan, H., Werner, P., Knüpffer, H., Kilian, B., 2021. Introducing beneficial alleles from plant genetic resources into the wheat germplasm. Biology 10, 982.

Ullah, A., Nadeem, F., Nawaz, A., Siddique, K.H., Farooq, M., 2022. Heat stress effects on the reproductive physiology and yield of wheat. Journal of Agronomy and Crop Science 208, 1-17.

https://doi.org/10.55627/agrivet.003.02.997