EVALUATION OF CHINESE WHEAT LINES IN COMPARISON WITH LOCAL CHECK UNDER SEMI-ARID CONDITION OF PESHAWAR VALLEY

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Abstract- Cultivar with optimum yield potential is of great importance nowadays due to rapid increase in the world population. Due to continuous shrinkage in cultivable land as a result of urbanization and over population, vertical increase in crop yield is the only possible solution to the currently rising food security issue. This field experiment was conducted to identify better performing hybrid wheat lines at the Agronomy Research Farm, The University of Agriculture Peshawar during Rabi season 2020-21. Nine Chinese hybrid wheat lines (20BH001, 20BH002, 20BH003, 20BH004, 20BH005, 20BH006, 20BH007, 20BH008, 20BH009) in comparison with local check (Khaista-2017) were evaluated in randomized complete block design with three replications. Results exhibited that wheat lines 20BH001 and 20BH002 performed well for most of the yield related traits such as tillers m^{-2} (252, 234), grains $spike^{-1}$ (58, 60), 1000-grain weight (56.3, 53.5 g), biological yield (5370 kg ha^{-1}) and grain yield (2770, 2478 kg ha^{-1}), respectively and are thus found suitable for growing in the valley of Peshawar.

***Index Terms*-** Wheat hybrids; Chinese; Phenology and Yield and yield components

I. INTRODUCTION

Agriculture plays leading role in Pakistan's economy. In the Gross Domestic Product of Pakistan, the agriculture sector share is almost 22%. The 22.1 million hectares are cultivated in the total area of 79.6 million hectares (Pracha *et al.*, 2011). Wheat is the leading crop, which plays significant role in the economy of a country. Wheat production for Pakistan in 2020 was 24,946 thousand tons. Pakistan's wheat production increased from 6,476,000 tonnes in 1971 to 24,946,000 tonnes in 2020 at an average annual rate of 3.11% (GOP 2019-20). It is essential to make a scientific assessment of the future productivity of this crop based on past trends. For hybrid wheat to be successful in the great plains, good-quality hybrid seed production must be reliable, and hybrid yield must exceed best commercial inbred cultivars (commercial heterosis). The effects of using chemical hybridization were evaluated by testing the parents against hybrids that were created as full-sib crosses and showed no detrimental effects of the chemical hybridization method on the hybrid performance. Maternal effects were tested by comparing the reciprocals for each combination of parents, where it was shown that reciprocal effects were of minor importance. General and specific combining abilities and narrow-sense heritability were obtained and are being used to select parents for future hybrid combinations (Easterly *et al.*, 2020).

Hybrid varieties increased yield and improved grain quality in both cross and self-pollinated crops. However, hybrid varieties in self-pollinated crops (particularly cereals) have not been very successful, except for hybrid rice in China. In case of hybrid wheat, despite the earlier failures, renewed efforts in recent years have been made and hybrid varieties with desirable attributes have been produced and marketed in some European countries. New technologies have been described, which include the Hordeum chilense-based CMS–fertility restorer system, chromosomal XYZ-4E-ms system and the following transgenic technologies: conditional male sterility involving use of tapetum-specific expression of a gene that converts a pro-toxin into a phytotoxin causing male sterility; barnase-barstar Seed Link system of Bayer Crop Science; split-barnase system that obviates the need of a barstar-based male restorer line; and (4) seed production technology of DuPont-Pioneer that makes use of transgenes in production of male-sterile lines, but gives hybrid seed with no transgenes (Gupta *et al.,* 2019).

Hybrid technology in crop plants, especially cross-pollinated crops is successfully used for enhanced production. However, it remains unutilized in the self-pollinated crops, especially wheat. The future scope of hybrid technology in wheat depends on the male sterility systems, floral biology, level of heterosis and its exploitation of commercial level that may be useful in breaking yield barriers and enhancing the productivity in the major wheat belt of the country (Singh *et al.,* 2010).

Global food security demands the development and delivery of new technologies to increase and secure cereal production on finite arable land without increasing water and fertilizer use. There are several options for boosting wheat yields, but most offer only small yield increases. Wheat is an inbred plant, and hybrids hold the potential to deliver a major lift in yield and will open a wide range of new breeding opportunities. A series of technological advances are needed as a base for hybrid wheat programmers. These start with major changes in floral development and architecture to separate the sexes and force out crossing. Male sterility provides the best method to block self-fertilization, and modifying the flower structure will enhance pollen access. The recent explosion in genomic resources and technologies provides new opportunities to overcome these limitations (Whitford *et al.,* 2013).

In view of the pivotal importance of wheat as a national strategic crop and a staple food crop, the current research was conducted with objectives:

To evaluate the Chinese hybrid lines for morpho-yield traits under agro-ecological condition of Peshawar. Identify potential wheat lines for further testing at multi-locations of Khyber Pakhtunkhwa and release as new cultivars for the growers.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

This experiment was conducted at the Agronomy Research Farm of University of Agriculture Peshawar, Khyber Pakhtunkhwa during Rabi season 2020-21. Nine Chinese hybrid wheat lines (20BH001, 20BH002, 20BH003, 20BH004, 20BH005, 20BH006, 20BH007, 20BH008, 20BH009) along with one check cultivar (Khaista-17) were evaluated in randomized complete block design with three replications. Wheat was sown on 3rd December at the rate of 100 kg ha^{-1}. Plot size was kept 5.4 m^2. There were six rows with three-meter length with row-to-row distance of 30 cm. The field was ploughed twice up to the depth of 30cm with the help of disc harrow followed by rotavator. Irrigation schedule was followed as per need of the crop and recommended dose of fertilizer was followed as NPK at the rate of 120:90:60 kg ha^{-1}respectively. Using urea, DAP and muriate of potash respectively.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

RESULTS AND DISCUSSION

Data regarding emergence m^{-2}, tillers m^{-2} and plant height (cm) are presented in Table 1. Analysis of the data revealed significant differences among the hybrid wheat lines for emergence m^{-2}. Emergence m^{-2} ranged from 115-117. Maximum emergence m^{-2} was recorded by line 20BH006 (117) followed by line 20BH00 (115). Minimum emergence m^{-2} was recorded by line 20BH008 (90) followed by lines 20BH002 (91) and 20BH005 (93). Our findings are similar to Sayar *et al*., (2010) who reported significant differences among wheat genotypes for emergence rate. Analysis of the data revealed significant differences among the hybrid wheat lines for tillers m^{-2}. Tillers m^{-2} ranged from 259-288. Maximum tillers m^{-2} were recorded by line 20BH008 (288) followed by line 20BH005 (259) while minimum tillers m^{-2} were recorded by line 20BH004 (179) and local check Khaista-17 (194). The result is in accordance with Ullah *et al.,* (2007) who has also reported significant differences among genotypes for tillers m^{-2}. Our research findings are supported by Piepho *et al*. (2013) who were of the opinion that the tillers m^{-2} is generally associated with genetic makeup of the parental material of different wheat genotypes in well-watered and water scare environments. Analysis of the data showed significant differences among the hybrid wheat lines for plant height. Plant height ranged from70.3-86.3 cm. Maximum plant height was recorded by line 20BH009 (86.3 cm) followed by line 20BH007 (77.6 cm). Minimum plant height was recorded by line 20BH001 (70.3 cm) and line 20BH008 (71.3 cm). Our research findings are coherent with Ullah *et al.*, (2007) who has also reported significant differences among genotypes for plant height. Decreasing in plant height of wheat genotypes by water stress was reported by (Mirbahar *et al*., 2009).

Table 1. Emergence m^{-2}, tillers m^{-2} and plant height (cm) of different Chinese wheat lines.

Wheat Lines	Emergence (m^{-2})	Tillers (m^{-2})	Plant height (cm)
20BH001	107.0 c	252.0 c	70.0 f
20BH002	98.0 f	234.0 d	72.0 d
20BH003	91.0 h	220.0 e	74.3 c
20BH004	115.3 a	179.0 h	74.3 c
20BH005	93.0 g	259.0 b	72.7 d
20BH006	117.0 a	212.0 f	77.3 b
20BH007	111.0 b	247.0 c	77.6 b
20BH008	90.0 h	288.0 a	71.0 e
20BH009	102.0 e	209.0 f	86.3 a
Khaista-17	104.0 d	194.0 g	72.3 d
LSD$_{(0.05)}$	1.87	5.80	0.85

Data about spike length (cm), spikelet's spike^{-1} and grains spike^{-1} are presented in Table 2. Analysis of data revealed significant differences among the hybrid wheat lines for spike length. Spike length ranged from 13.5-15 cm. Maximum spike length was recorded by line Khaista-17 (15 cm) followed by line 20BH002 (13.5 cm). Minimum spike length was recorded by line 20BH008 (10.8) and line 20BH001 (11 cm). Devesh *et al.*, (2018) have also reported the similar results for spike length among wheat genotypes. Significant effect of environment on wheat cultivars and a higher influence of environmental factor on the spike length were also observed by (Rehman *et al*., 2015). Analysis of data revealed significant differences among the hybrid wheat lines for spikelet's spike^{-1}. Spikelet's spike^{-1} ranged from 17-20. Maximum spikelet's spike^{-1} were recorded by lines 20BH001 and 20BH007 (20) followed by lines 20BH002, 20BH004, 20BH005, 20BH006 and Khaista (19). Minimum spikelet's spike^{-1} were recorded by line 20BH003 (17) followed by line 20BH009 (18). Olumekun *et al*. (2022) have also reported significant differences among wheat genotypes for spikelet's spike^{-1}. The main factor due to which genotypes produced less or more spikelet's spike^{-1} in various environments is the genetic capabilities of a genotype (Baloch *et al*., 2012). Analysis of data revealed significant differences among the wheat lines for grains spike^{-1}. Grains spike^{-1} ranged from 60-62. Maximum grains spike^{-1} were recorded by line 20BH005 (62) followed by line 20BH002 (60). Minimum grains spike^{-1} were recorded by line 20BH009 (18) followed by line 20BH007 (21). Our findings are supported by Bayisa *et al.* (2020) who have observed highly significant differences among wheat genotypes for grains spike^{-1}.Spikes with higher number of grains spike^{-1} become the result of improved grain yield. Research findings for number of grains spike^{-1} are in confirmation with (Yaqoob, 2016).

Table 2. Spike length (cm), spikelet spike^{-1} and grains spike^{-1} of different Chinese wheat lines.

Wheat Lines	Spike length (cm)	Spikelet spike^{-1}	Grain spike^{-1}
20BH001	11.0 g	11.0 g	58bc
20BH002	13.5 b	13.5 b	60 ab
20BH003	12.6 c	12.6 c	42 e
20BH004	11.6 f	11.6 f	38 f
20BH005	12.7 c	12.7 c	62 a
20BH006	12.1 de	12.1 de	41 e
20BH007	12.3 d	12.3 d	21 g
20BH008	10.8 g	10.8 g	57 c
20BH009	12.0 e	12.0 e	18 h
Khaista-17	15.0 a	15.0 a	50 d
LSD$_{(0.05)}$	2.71	0.21	2.71

Data regarding thousand grains weight, biological yield and grain yield is presented in table 3. Analysis of variance revealed significant differences among the hybrid wheat lines for thousand grains weight. Thousand grains weight ranged from 55.4-58.3. Maximum thousand grains weight was recorded by line 20BH001 (58.3 g) followed by line 20BH002 (55.4 g). Minimum thousand grains weight was recorded by line 20BH007 (22.3 g) followed by line 20BH004 (33 g).Our results are in accordance with Arya *et al.* (2017) who have also reported highly significant differences among wheat genotypes for 1000-grain weight. Uddin *et al*., (2015) have reported significant and positive impact of flag leaf area on plant height, 1000-grain weight and grains spike. Analysis of variance revealed significant differences among the hybrid wheat lines for biological yield. Biological yield ranged from 6667-7037 kg ha^{-1}. Maximum biological yield was recorded by line 20BH006 (7037 kg ha^{-1}) followed by line 20BH007 (6667 kg ha^{-1}). Minimum biological yield was recorded by line 20BH008 (3704 kg ha^{-1}) followed by line 20BH004 (5000 kg ha^{-1}). Khan *et al.* (2020) also reported highly significant differences among wheat genotypes for biological yield. Our research results are in accordance with the findings reported by Wajid *et al*. (2015), who reported varied quantities of total biomass for lines developed in the diversified region. Analysis of variance revealed significant differences among the wheat lines for grain yield. Grain yield ranged from 2478-2770 kg ha^{-1}. Maximum grain yield was recorded by line 20BH002 (2770 kg ha^{-1}) followed by line 20BH001 (2478 kg ha^{-1}). Minimum grain yield was recorded by line 20BH009 (1900 kg ha^{-1}) followed by local check Khaista-17 (2074 kg ha^{-1}). Aycicek and Yildirim (2006) also reported highly significant differences among wheat genotypes for grain yield. Present studies were in accordance with Malik *et al*. (2014), who reported the improvement in a number of spikelet's spike^{-1}, grain number per spike and ultimately higher grains yield of the wheat crop due to the result of best cultivar performance in favorable soil and climatic conditions.

Table 3. Thousand grain weight (g), biological yield and grain yield of different Chinese wheat lines.

Wheat Lines	Thousand grain weight(g)	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})
20BH001	56.3 a	5370.0 c	2395.3b
20BH002	53.5 b	5370.0 c	2677.7a
20BH003	37.3 f	4833.3 e	2252.3c
20BH004	31.9 g	4833.3 e	2155.7f
20BH005	53.1 b	5370.0 c	2101.7g
20BH006	39.9e	6802.3 a	2223.3d
20BH007	21.5h	6444.7 b	2198.3e
20BH008	51.3 c	3580.7 f	2381.0b
20BH009	51.7 c	5370.0 c	1836.7i
Khaista-17	48.8 d	5191.0 d	2005.0h
LSD$_{(0.05)}$	1.17	90	1.17

IV. CONCLUSION

It is concluded from the experimental results that wheat lines 20BH001 and 20BH002 performed well and recorded maximum yield as compared to other lines and check for yield related traits such as tillers m^{-2}, grains spike^{-1}, 1000-grain weight, biological and grain yield under agro-ecological condition of Peshawar valley. In this experiment, we recommend wheat lines 20BH001 and 20BH002 for the agro-ecological condition of Peshawar valley because they were found superior in yielding capabilities.

APPENDIX

Appendixes, if needed, appear before the acknowledgment.

REFERENCES

[1] (GOP). 2019-20. Economic survey of Pakistan 2019-20. Ministry of Food and Agriculture Islamabad, Pakistan. PP. 5-6.

[2] Aycicek, M., & Yildirim, T. (2006). Heritability of yield and some yield components in bread wheat (*Triticum aestivum* L.) Genotypes. *Bangladesh, Journal of Botony, 35*(1), 1722-1727.

[3] Baloch, A. W., Baloch, M., Baloch, I. A., Mari, S. N., Mandan, D. K., & Abro, S. A. (2012). Association and path analysis in advance Pakistani bread wheat genotypes. *Journal of Pure and Applied Biology, 3*(3), 115-120.

[4] Bayisa, T., Tefera, H., & Letta, T. (2020). Genetic variability, heritability and genetic advance among bread wheat genotypes at Southeastern Ethiopia. *Agriculture Forestry and Fisheries, 9*(4), 128-132.

[5] Devesh, P., Moitra, P. K., Shukla, R. S., Shukla, S. S., Pandey, S., & Arya, G. (2018). Analysis of variability, heritability and genetic advance of yield, its components and quality traits in wheat. *International Journal of Agriculture, Environment and Biotechnology, 17*(4), 855-859.

[6] Easterly, A. C., Garst, N., Belamkar, V., Ibrahim, A.M., Rudd, J.C., Sarazin, J.B., & Baenziger, P.S. (2020). Evaluation of hybrid wheat yield in Nebraska. *Journal of Crop Science, 60*(3), 1210-1222.

[7] Easterly, A. C., Garst, N., Belamkar, V., Ibrahim, A. M., Rudd, J. C., Sarazin, J. B., & Baenziger, P. S. (2020). Evaluation of hybrid wheat yield in Nebraska. *Journal of Crop Science, 60*(3), 1210-1222.

[8] Gupta, P. K., Balyan, H. S., Gahlaut, V., Saripalli, G., Pal, B., Basnet, B. R., & Joshi, A. K. (2019). Hybrid wheat: past, present and future. *Journal of Theoritical and Applied Genetics, 132*(9), 2463-2483.

[9] Khan, N., Hassan, G., Ahmad, N., Iqbal, T., Ahad, F., Hussain, I., & Hussain, Q. (2020). Estimation of heritability and genetic advance in F2 populations of wheat. *PSM Biological Research, 5*(2), 61-73.

[10] Malik, M. F. A., Awan, S. I., & Ali, S. (2014). Genetic behavior and analysis of quantitative traits in five wheat genotypes. *Journal of Agriculture and Social Sciences, 1*(4), 313-315.

[11] Mirbahar, A. A., Markhand, G. S., Mahar, A. R., Abroand, S. A., & Kanhar, N. A. (2009). Effect of water stress on yield and yield components of wheat (*Triticum aestivum* L.) varieties, *Pakistan Journal of Botony, 41*(3), 1303-1310.

[12] Olumekun V. O., Ajayi, A. T., Lawal, V. A., & Akingba, R. (2022). Estimates of genetic variability and correlation of traits among ten accessions of wheat (*Triticum aestivum* L.) evaluated under open field condition. *Journal of Agricultural and Food Chemical Engineering, 2*(1), 23-34.

[13] Piepho, H. P., Nazir, M. F., Qamar, M., Rattu, A. U. R., Hussain, M., Ahmad, G., & Imtiaz, M. (2013). Stability analysis for a country wide series of wheat trials in Pakistan. *Journal of Crop Science, 5*(2), 2465-2475.

[14] Pracha, A. S., & Timothy, A. V. (2011). An edible energy return on investment (EEROI) analysis of wheat and rice in Pakistan. *Journal of Sustainability, 3*(12), 2358-2391.

[15] Rehman, S. U., Abid, M. A., Bilal, M., Ashraf, J., Liaqat, S., Ahmed, R. I., & Qanmber, G. (2015). Genotype by trait analysis and estimates of heritability of wheat (*Triticum aestivum* L.) under drought and control conditions. *Basic Research Journal of Agricultural Science, 4*(4), 127-134.

[16] Sayar R., Bchini, H., Mosbahi, M., & Ezzine, M. (2010). Effects of salt and drought stresses on germination, emergence and seedling growth of Durum Wheat. *Journal of Agriculture Research, 5*(15), 2008-2016.

[17] Singh, S. K., Chatrath, R., & Mishra, B. (2010). Perspective of hybrid wheat research: A review. *Indian Journal of Agricultural Sciences, 80*(12), 1013-1027.

[18] Uddin, F., Mohammad, F., & Ahmed, S. (2015). Genetic divergence in wheat recombinant inbred lines for yield and yield components. *Academia Journal of Agriculture Research, 3*(10), 303-307.

[19] Ullah, R., Mohammad, Z., Khali, I. H., Ullah, l. A. (2007). Heritability for heading, maturity, plant height, spike length and tillers production in winter wheat (*Triticum aestivum* L.). *Pakistan Journal of Plant Science, 13*(1), 67-73.

[20] Wajid, A., Hussain, A., Maqsood, M., Ahmad, A., & Awais, M. (2015). Influence of sowing date and irrigation levels on growth and grain yield of wheat. *Pakistan Journal of Agricultural Sciences, 39*(1): 22-24.

[21] Whitford, R., Fleury, D., Reif, J. C., Garcia, M., Okada, T., Korzun, V., & Langridge, P. (2013). Hybrid breeding in wheat: technologies to improve hybrid wheat seed production. *Journal of Experimental Botony, 64*(18), 5411-5428.

[22] Yaqoob, M. (2016). Estimation of genetic variability, heritability and genetic advance for yield and yield related traits in wheat under rainfed conditions. Journal of Agriculture Research, 54(1), 61-68.

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