Original Article
DOI: https://doi.org/10.70749/ijbr.v2i02.280

INDUS JOURNAL OF BIOSCIENCES RESEARCH
https://induspublisher.com/IJBR
ISSN: 2960-2793/ 2960-2807

Comparative Study of Commercial Bread Wheat Varieties and Advance Wheat Lines to Explore Superior Attributes for Variety Development and Future Breeding Guidelines

Eman Fatima[1], Hazib Ali[2], Muhammad Faisal[3], Muhammad Waseem[4], Fajar Khurram[5], Zunaira Usman[6], Muhammad Loqman[7], Mohsin Ali[8], Mehmood Ul Hassan[2], Arshad Iqbal[9]

[1]Department of Bioinformatics and Biotechnology, Government College University Faisalabad, Punjab, Pakistan.
[2]Department of Agriculture, Hazara University, Mansehra, KP, Pakistan.
[3]Department of Botany, University of Agriculture, Faisalabad, Punjab, Pakistan.
[4]Institute of Plant Biology, National Taiwan University, Taipei, Taiwan.
[5]Department of Environmental Science, Government College University Faisalabad, Punjab. Pakistan.
[6]National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Punjab, Pakistan.
[7]Department of Chemistry, Superior University Lahore, Punjab, Pakistan.
[8]College of Chemistry and Chemical Engineering, Hubei University, Wuhan China.
[9]Agriculture Research Station Baffa, Mansehra, KP, Pakistan.

ARTICLE INFO

Keywords

Advanced Wheat Lines, Variety Development, Crop Performance, Growth Parameters, Agronomic Practices, Grain Quality Attributes, Yield Potential.

Corresponding Author: Hazib Ali, Department of Agriculture, Hazara University, Mansehra, KP, Pakistan.
Email: hazibali248@gmail.com

Declaration

Author's Contributions: All authors contributed to the study and approved the final manuscript.
Conflict of Interest: The authors declare no conflict of interest.
Funding: No funding received.

Article History

Received: 05-10-2024
Revised: 18-11-2024
Accepted: 29-11-2024

ABSTRACT

Knowledge about the potential and performance of advance wheat lines and commercial bread wheat varieties are vital for implicit variety adaptation. Comparative study was designed to quantify the performance of advance wheat lines, sixteen commercial wheat varieties and fourteen advance wheat lines were tested in randomized complete block design with 3 replications at Agricultural Research Station Baffa, Mansehra during wheat growing season 2022-23. The study evaluated wheat advance lines yield and resistance against powdery mildew disease, as compared to commercial varieties for adaptability and variety development. Days to 50% heading, plant height (cm), grain yield (kgha-1), disease scoring and % severity of disease data was subjected to analysis of variance using statistical software R. Analysis of variance revealed significant differences for all parameters. Advance wheat lines identified for early heading were PR-115 (131) and PR-106 (132). Similarly, commercial variety Hashim-2010 (133) showed early heading. Commercial wheat varieties PS2013 (95.6cm), Janbaz (96cm), PS2005 (96.6cm) and advance wheat lines PR106 (95.6cm), PR115 (95.6cm), IBGE (96.6cm) were found semi dwarf. Grain yield of commercial wheat variety Janbaz 6566.6 (kgha-1) was at par with advance wheat line PR118 6500(kgha-1). Commercial bread wheat varieties (PK2015, PS2005) and an advance line (PR115) showed lowest severity (2%) to powdery mildew disease. An advance line (PR115) and four commercial bread wheat varieties (PS-2005, PS-2008, PK-2015, Faisalabad-2008) were found resistant against powdery mildew disease. Commercial bread wheat varieties PS-2005, PS-2008, PK-2015, Faisalabad-2008 and advance wheat line PR115 can be utilized as resistant source of powdery mildew in future breeding programs.

INTRODUCTION

Wheat is closely related to food security, human nutrition and economic development (Li et al., 2012). It is an economically important cereal crop which serves as staple food for South Asia and

leading cereal crop in most of countries including Pakistan and cultivated under both irrigated and rainfed conditions (Shehzad et al., 2005). The low yield in Pakistan is mainly due to biotic and abiotic stresses. Leading biotic stresses in Pakistan are rust, karnal bunt, powdery mildew, smut, Fusarium head blight and spot blotch (Mujeeb-Kazi and Kimber, 1985; Asad et al., 2014). Among these the powdery mildew caused by *Blumeriagraminisf.sp.tritici* is considered as one of the devastating foliar biotic stress on bread wheat (*Triticum aestivum* L.). The wide spread presence of powdery mildew was regular feature of wheat during 90'sera. Its reoccurrence was observed again in early 2000 due to increased cultivation of wheat in diversified ecologies and climatic change (Rattu et al., 2009).

Development of improved resistant and high yielding varieties is the main objective of most breeding programs across the globe (Khan et al., 2015). However, the compatibility of developed varieties does not persist forever, Therefore, urge for high yielding advance lines and replacing the existing vulnerable commercial varieties is never ending. Standardized breeding programs always have active process of evaluating and advancing lines to combat existing and future challenges to wheat productivity. Higher grain yield is the prime focus during variety development cum improvement program specially when addressing climate change (Arain et al., 2017). Yield is mainly dependent on genetic potential, appropriate environment and yield related traits (Sial et al., 2013). Unfavorable environmental conditions suppress growth and yield as well as affect genetic potential of wheat varieties (Benson and Craig, 2014). Breeding for improved high yielding genetic resources can help in sustainable wheat production. Genetically advance improved developed lines are potential substitute for replacing widely cultivated existing commercial bread wheat varieties (Patel et al., 2018). This goal can possibly have achieved only by developing advance lines in breeding programs and their compatibility can be evaluated by comparing their yield and resistance potential with the existing wheat cultivars. The main objective of this study was to determine and compare the performance of newly developed advance wheat lines with the existing commercial bread wheat varieties widely cultivated in Pakistan mainly Khyber Pukhtunkhwa province. The other prime intent was to select resistant advance lines as well as commercial bread wheat varieties against powdery mildew disease. The prime objective of disease scoring was to screen these lines against powdery mildew disease and to identify source for adult resistance. Agricultural Research station Baffa Mansehra has very suitable climate for the development of powdery mildew disease under natural field conditions. This study will provide basic information relating genetic potential of advance wheat lines and resistant to powdery mildew disease as well to be exploited in future breeding programs.

MATERIALS AND METHODS

This study was conducted at Agricultural Research Station Baffa, Mansehra during wheat growing season from November 2022 to June 2023. Genetic material a total of thirty wheat varieties and lines comprising commercial bread wheat varieties (16) and advance lines (14) planted in Randomized complete block design (RCBD) with three replications having inter row spacing of 30 cm (Table 1). Each entry had 6 rows with a row length of 5m. Standard cultural practices were applied throughout the cropping season. Data were recorded on days to 50% heading, plant height and grain yield (kg ha^{-1}) along with powdery mildew disease scoring, %severity and disease reaction. Disease scoring was based on foliar infection mainly when plant material exposed to the naturally available innoculum. Moreover, disease was scored using modified version double digit scale of Saari and Prescott 1975 for foliar disease (Eyal et al., 1987; Neupane et al., 2007; Asad et al., 2014). Measurement was observed using double digit (DID2) where the first digit represented the height of infection while the second digit equated for the severity of infection. The gradation of scale was from 0 to 9. As for as height of infection is concerned, a score of 5 was given to the infection up to the center of the plant while a score of 9 was given to the infection up to the flag leaf. Regarding severity scoring of disease, a score of 1 was given when infected leaves showed low symptoms whereas a score of 9 was given to the complete destruction by the disease.

Table 1
List of wheat commercial varieties and Advance wheat lines compared for different traits in growing season 2022-23.

S.No	Name	Category	S.No	Name	Category
1	Shahkar13	Commercial variety	17	PR106	Advance line
2	PS-2013	Commercial variety	18	PR116	Advance line
3	Parula	Commercial variety	19	P-112	Advance line
4	Ujala	Commercial variety	20	AUP-00814	Advance line
5	Galaxy	Commercial variety	21	PR110	Advance line
6	Pakistan 13	Commercial variety	22	PR118	Advance line
7	Sehr2006	Commercial variety	23	AUP-00514	Advance line
8	PS-2015	Commercial variety	24	PR119	Advance line
9	Hashim-10	Commercial variety	25	PR115	Advance line
10	Faisalabad 2008	Commercial variety	26	IBGE	Advance line
11	Janbaz	Commercial variety	27	PR-119	Advance line
12	PK2015	Commercial variety	28	PR-115	Advance line
13	PS2008	Commercial variety	29	AUP-00914	Advance line
14	PS2005	Commercial variety	30	PR120	Advance line
15	Tatara	Commercial variety			
16	NIFA Lalma	Commercial variety			

Statistical Analysis
Data were subjected to statistical analysis including analysis of variance (ANOVA) appropriate for RCBD using R-software (Hussain et al., 2019). Means were separated using LSD test at 5% level of significance.
Severity of disease was calculated using the following formula:
%Severity=(D1/9×D2/9)×100

Reaction of severity was classified as:
1-10%=R, 11-30%=MR, 31-50%=MS, 51-60%=S, 61% and above=HS. (Asad et al., 2014).

RESULTS AND DISCUSSION
Analysis of variance depicted significant differences for days to 50% heading, plant height and grain yield ($kgha^{-1}$) among commercial bread wheat varieties and advance lines. Variations were also noticed regarding level of disease resistance among varieties and advance lines. These results are discussed in detail below:

Days to 50% heading
Heading is a vital phonological character that predicts the behavior of a variety in a particular environment (Arain et al., 2017). Mean values for days to heading of 30 bread wheat varieties and advance lines (Fig 1) ranged from 131 to 138 with a mean value of 135 days. Minimum days (131) to heading were recorded for wheat advance line PR115 followed by PR106 with 132 days while the maximum days (138) to heading were observed for commercial variety PS 2005. Six advance lines (PR120, AUP00814, PR115, PR119, AUP00514, PR119) took medium days to heading i.e.135. Similarly, only two commercial bread wheat varieties i.e. Tatara and Parula took 135 days to heading as well. PR115 and PR106 took lesser days to heading due to their genetic makeup and indicating spring type behavior. Similar differences in days to 50% heading were also mentioned by Bhatarai et al., 2017 and Bayisa et al., 2019.The temperature in late January starts rising above 25ºC and this boost spring type wheat to jump from node elongation to booting and heading stage. The lines having more spring type attribute starts heading earlier and this character is desired and programmed through selection method.

Figure 1

Days to 50% heading taken by wheat germplasm grown in wheat growing season 2016-17 Agriculture research Station Baffa, Mansehra.

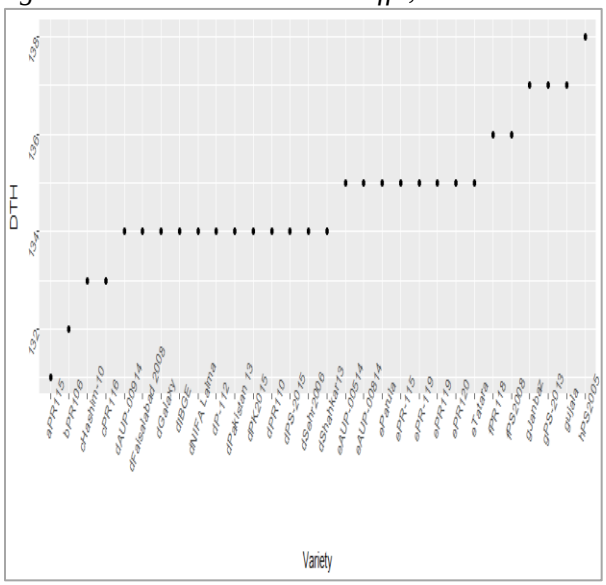
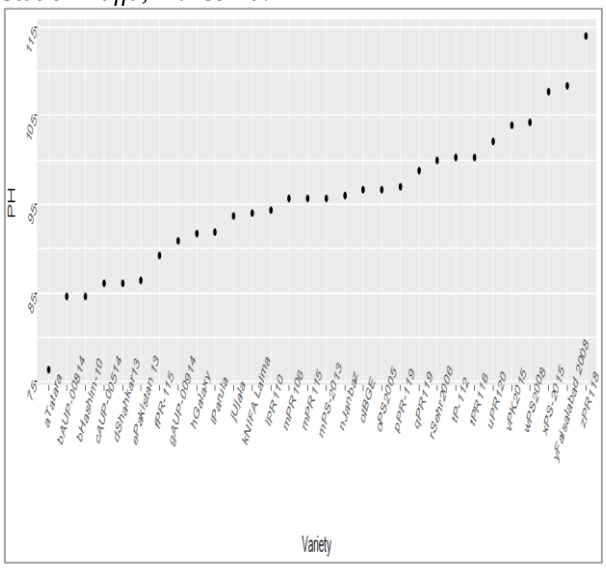


Figure 2

Plant height attained by wheat germplasm grown in wheat growing season 2016-17 Agriculture research Station Baffa, Mansehra.



Plant Height (cm)

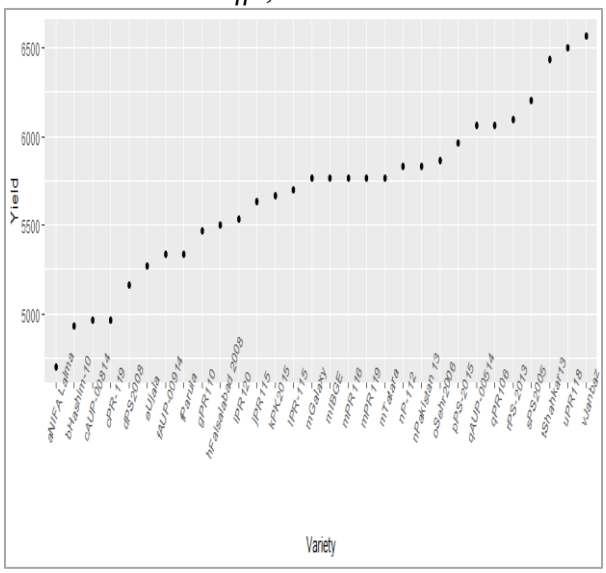
Height attained by wheat plant is an important morphological trait other than yield, yield associated traits and quality (Kun, 1996). It is directly related to biological yield and has positive effects (Ilyas et al., 2006). Mean values for plant height ranged from 76.4cm to 113.9cm (Fig.2). Commercial variety Tatara produced shortest plants with a plant height of 76.4cm. Tallest plants were produced by the wheat advance line (PR118). Commercial varieties including PS2013 (95.6cm), Janbaz (96cm), PS2005 (96.6cm) and advance lines PR106 (95.6cm), PR115 (95.6cm), IBGE (96.6cm) were found semi dwarf. Semi dwarf plant height is considered as positive trait for lodging resistance and harvest index (Arain et al., 2006). Due to this reason semi dwarf variety are preferred as this trait contributes significantly to yield (Arain et al., 2017). Significant differences show wide genetic diversity for plant height. It provides an opportunity for the selection of lines and varieties in various stature groups. Taller plants are related to the better straw yield which is also a required trait in most of the areas. Therefore, the selection of taller plants leads to vigorous biological yield (Azam et al., 2013). Significant differences for plant height were also reported by Bayisa et al., 2019.

Grain Yield (kgha^{-1})

Grain yield is a polygenic trait associated with genetic potential of the varieties, environmental conditions and use of inputs (Malik et al., 2009). Significant diversity for grain yield (kgha^{-1}) was observed among commercial bread wheat varieties and advance lines (Fig. 3). Grain yield ranged from 4700kgha^{-1} to 6566.6kgha^{-1}. Maximum grain yield was recorded for commercial variety Janbaz with 6566.6kgha^{-1}which is statistically at par with advance line PR118 having 6500kgha^{-1} grain yield. Advance lines PR-106 (6066.6 kgha^{-1}) and PR-112 (5833.3kgha^{-1}) were high yielding as well. Commercial varieties Shahkar13, PS-2005, PS-2008, PK-2015, Faisalabad-2008 gave grain yield of 6433.3 kgha^{-1}, 6200 kgha^{-1}, 5166.6kgha^{-1}, 5666.6kgha^{-1} and 5500kgha^{-1}, respectively. Commercial variety NIFA Lalma was found low yielding with grain yield of 4700 kgha^{-1} followed by Hashim-10 (4933.3kgha^{-1}). Significant difference in yield of different wheat lines and varieties were also depicted by Malik et al., 2009; Khan et al.,2015; Arain et al., 2017.Which reveal that the germplasm compatibility with environment and parentage influence the grain yield capacity. The advance wheat lines PR 118 and PR 106 are highly compatible to yield equally as commercial varieties and should be further proceeded for approval as commercial category.

Figure 3

Grain yield (kgha^{-1}) of wheat germplasm grown in wheat growing season 2016-17 Agriculture research Station Baffa, Mansehra

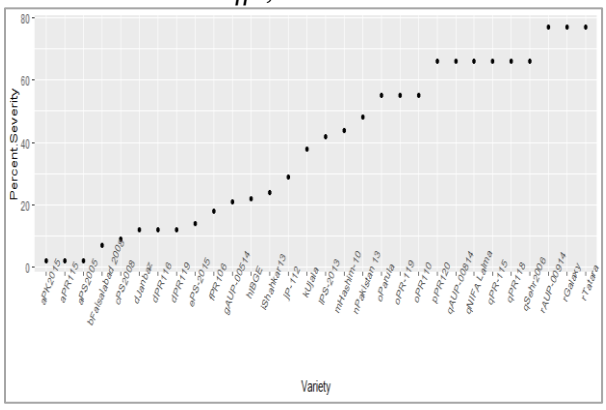


% Severity to powdery mildew disease

% severity of disease ranged from 2% to 77% (Fig.4). Two commercial bread wheat varieties (PK2015, PS2005) and one advance line (PR115) showed lowest severity (2%) of powdery mildew disease. Maximum disease severity (77%) was observed for two commercial bread wheat varieties (Galaxy, Tatara) and one advance line (AUP00914). Overall eleven commercial bread wheat varieties and seven advance lines showed less than 50% disease severity. These results are similar to findings of Mikulova et al., 2008; Asad et al., 2014.

Figure 4

% Severity recorded for wheat germplasm grown in wheat growing season 2016-17 Agriculture research Station Baffa, Mansehra.

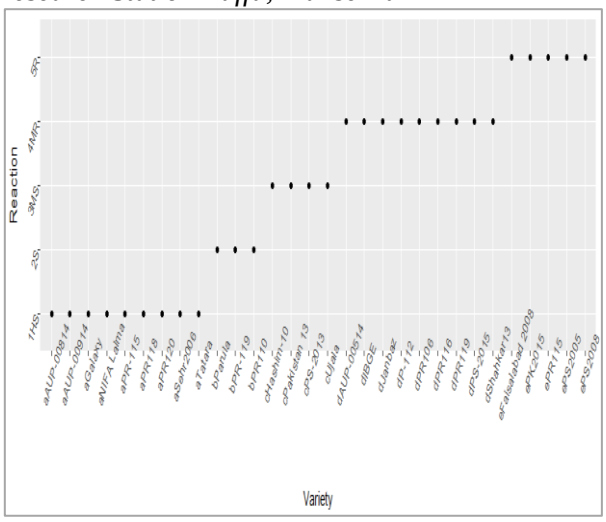


Reaction to powdery mildew disease

A variable field response of thirty bread wheat commercial varieties and advance lines was observed against powdery mildew disease (Fig. 5). Severity of reaction was different for each variety and line. 5 advance lines (AUP-00814, AUP-00914, PR-115, PR-118, PR-120) showed highly susceptible (HS) reaction. Similarly, 4 commercial bread wheat varieties (Galaxy, NIFA Lalma, Sehar-2006 and Tatara) were found highly susceptible (HS) against powdery mildew. 2 advance lines (PR-110, PR-119) and a commercial variety (Parula) were susceptible to said disease while 3 commercial varieties (PS-13, Ujala and Pakistan-13) showed moderately susceptible (MS) reaction. 6 advance wheat lines (AUP-00514, IBGE, P-112, PR-106, PR-116, PR-119) and 3commercial varieties (Janbaz, PS-15, Shahkar-13) showed moderately resistant (MR) reaction. Four commercial varieties (PS-2005, PS-2008, PK-2015, Faisalabad-2008) and only one advance line (PR115) were found resistant (R) against powdery mildew disease. Similar results regarding reaction to powdery mildew disease were reported by Asad et al., 2014.

Figure 5

Reaction to Disease by wheat germplasm grown in wheat growing season 2016-17 Agriculture research Station Baffa, Mansehra



CONCLUSION AND RECOMMENDATIONS

Comparing the wheat germplasm among each other and evaluating the performance of wheat advance line and commercial bread wheat varieties revealed that commercial bread variety Janbaz was found

high yielding with semi dwarf plant height and moderately resistant reaction to disease. Moreover, 4 commercial bread wheat varieties (PS-2005, PS-2008, PK-2015, Faisalabad-2008) showed resistant reaction with higher grain yield and can be recommended for general cultivation.

Wheat advance lines PR118 yielded high with taller plants. 6advance wheat lines (AUP-00514, IBGE, P-112, PR-106, PR-116, PR-119) were found moderately resistant and advance line (PR115) was resistant against powdery mildew disease. These advance wheat lines have the potential to yield equally to commercial varieties therefore are recommended to put forward for further evaluation and registration process. These advance wheat lines should be trialed at multi locations with diverse agro-climatic condition to confirm the traits and these can be further utilized in breeding programs as resistant source.

REFERENCES

Arain, S., Jamali, K. D., Naqvi, M. H., Soomro, A. M., Arain, M. A., & Ali, S. A. (2006). Genetic diversity for agronomic characters and their association with grain yield components in durum wheat. In *Proceedings of the International Wheat Seminar* (pp. 20-22).

Arain, S., Sial, M. A., Leghari, K. A., & Jamali, K. D. (2017). *COMPARATIVE PERFORMANCE OF PROMISING ADVANCED WHEAT GENOTYPES WITH COMMERCIAL WHEAT CULTIVARS IN SINDH*. *14*(2), 163–166. https://pjbt.org/index.php/pjbt/article/view/472

Asad, S., Fayyaz, M., Munir, A., & Atiq-ur-Rehman Rattu. (2014). Screening of wheat commercial varieties for resistance against powdery mildew (Blumeria graminis F. sp. tritici) at Kaghan Valley, Pakistan. *Pakistan Journal of Phytopathology*, *26*(1), 7–13.

Bayisa, T., Habte, E., & Amanuel, M. (2019). Evaluation of Bread Wheat (Triticum aestivum L.) Genotypes for Yield Potential and Related Traits Under High Temperature Stress Condition at Middle Awash, Ethiopia. *Advances in Crop Science and Technology*, *07*(01). https://doi.org/10.4172/2329-8863.1000410

Benson, M. H., & Craig, R. K. (2014). The end of sustainability. *Society & Natural Resources*, *27*(7), 777-782. https://doi.org/10.1080/08941920.2014.901467

Bhattarai, R. P., Ojha, B. R., Thapa, D. B., Kharel, R., Ojha, A., & Sapkota, M. (2017). Evaluation of Elite Spring Wheat (Triticum aestivum L.) Genotypes for Yield and Yield Attributing Traits under Irrigated Condition. *International Journal of Applied Sciences and Biotechnology*, *5*(2), 194–202. https://doi.org/10.3126/ijasbt.v5i2.17615

Eyal, Z., Scharen, A. L., Prescott, J. M., & Ginkel, M. V. (1987). The septoria diseases of wheat : concepts and methods of disease management. In *CIMMYT eBooks*. Mexico, D.F: CIMMYT.

Hossain, A., Islam, M. R., Rahman, K. A. M. M., Rashid, M. H., & Anwari, A. (2017). Comparative performance of three wheat (Triticum aestivum L.) varieties under heat stress. *International Journal of Natural and Social Sciences*, *4*(3), 26-42.

Hussain, M., Awais, M., Farhatullah, F., Bibi, S., Khan, M. R., Khalid, A., & Ali, S. (2019). Field Based Variability in Oat Crown Rust (Puccinia coronata f. sp. Avenae) Resistance in Exotic Oat Germplasm. *Sarhad Journal of Agriculture*, *35*(2), 459–466. https://doi.org/10.17582/journal.sja/2019/35.2.459.466

Khan, F. U. (2015). Evaluation of advance bread Wheat lines in preliminary Wheat yield trial. *Pure and Applied Biology*, *4*(3), 383–388. https://doi.org/10.19045/bspab.2015.43014

Li, J., Ye, X., An, B., Du, L., & Xu, H. (2012). Genetic transformation of wheat: current status and future prospects. *Plant Biotechnology Reports*, *6*(3), 183–193.

https://doi.org/10.1007/s11816-011-0213-0

Malik, A. U., Bukhsh, M. H. A., Hussain, I., Athar, M. A., & Ali, M. (2009). Comparative performance of some new wheat cultivars in agroecological zone of Dera Ghazi Khan. *Journal of Animal & Plant Sciences 19*(2), 78-81.

Mikulová, K., Bojnanská, K., & Červená, V. (2008). Assessment of partial resistance to powdery mildew in hexaploid wheat genotypes. *Biologia*, *63*(4), 477–481. https://doi.org/10.2478/s11756-008-0078-z

Mujeeb-Kazi, A., & Kimber, G. (1985). The Production, Cytology and Practically of Wide Hybrids in the Triticeae. *Cereal Research Communications*, *13*(2/3), 111–124. http://www.jstor.org/stable/23782990

Neupane, R. B., Sharma, R. C., Duveiller, E., Ortiz-Ferrara, G., Ojha, B. R., Rosyara, U. R., ... & Bhatta, M. R. (2007). Major gene controls of field resistance to spot blotch in wheat genotypes 'Milan/Shanghai# 7'and 'Chirya. 3'. *Plant disease*, *91*(6), 692-697.

Neupane, R. B., Sharma, R. C., Duveiller, E., Ortiz-Ferrara, G., Ojha, B. R., Rosyara, U. R., Bhandari, D., & Bhatta, M. R. (2007). Major Gene Controls of Field Resistance to Spot Blotch in Wheat Genotypes "Milan/Shanghai #7" and "Chirya.3." *Plant Disease*, *91*(6), 692–697. https://doi.org/10.1094/pdis-91-6-0692

Patel, M. D., Dabhi, M. S., Patel, A. K., Desai, H. A., & Ram, C. (2018). Response of Wheat Varieties (Triticum aestivum L. and Triticum durum Desf.) to Sowing Time. *International Journal of Current Microbiology and Applied Sciences*, *7*(10), 1555–1561. https://doi.org/10.20546/ijcmas.2018.710.174

Rattu, A. R., Asad, S., & Fayyaz, M. (2009). Status of foliar diseases in Punjab, Pakistan. *Report, CDRP, IPEP, NARC, Islamabad*.

Shehzad, T., Khalil, I. H., Shah, S. M. A., Ihsan, H., & Swati, M. S. (2005). Heterosis estimates for some morphological traits in spring wheatcrosses. *Sarhad Journal of Agriculture (Pakistan)*, *21*(1), 33-39.

Sial, M. A., Akhter, J., Mirbahar, A. A., Jamali, K. D., Ahmed, N., & Bux, H. (2013). Genetic studies of some yield contributing traits of F2 segregating generation of bread wheat. *Pak. J. Bot*, *45*(5), 1841-1846.