Evaluation Of Wheat (*Triticum aestivum* L.) Genotypes For Morphological Traits Under Rainfed Conditions

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Abstract: Wheat is an important cereal crop and is used as staple food in Pakistan. It is important task for plant breeders to improve the yield and quality of wheat to fulfill the food supply of increasing population of the country. Present study was conducted in the Department of Plant Breeding and Genetics, PMAS- Arid Agriculture University Rawalpindi to identify potential genotype among thirty different wheat cultivars for yield related traits. The analyses of variance showed significance variations among wheat genotypes for morphological traits under study. From the results of experiment it was concluded that in future the genotypes AUR-809, Lasani-2008, Fakhr-e-Sarhad, Bakhar-1, Saleem-2000, ZAM-2004 and GA-2002 may be used by the breeders of Pakistan in wheat improvement programs under rainfed conditions which would help in developing genetically improved new cultivars for higher grain yield.
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1. Introduction

Wheat is called king of cereals and is being grown throughout the world, including irrigated, arid and semi-arid areas. In Pakistan wheat is an important source of income for farmers living in rural areas of the country (Aujla, 2010) but in the country per unit area production of wheat is very low than its potential (Haq *et al,* 2014). In the world largest crop area is devoted to wheat with largest production quantity to any other crop (Ahmad *et al*, 2014). Due to rapid increase in world population, the requirement of the wheat has been increased. However, during last 50 years the yield remained stagnant due to various biotic and abiotic factors. To enhance the crop yield plant breeders must have to produce the genotypes which could face the environmental stresses because crop production is inherently sensitive to climatic variations (Ahmad *et al*., 2015; Bhutta *et al*., 2015; Pasha *et al.,* 2015). Current estimates showed that 40% more wheat would be required up to 2025 to feed the rapidly growing population (Sial *et al*., 2009; Fawad *et al*., 2015). Selection of wheat genotypes having desirable combination of traits and good yield potential is always main focus of plant breeders (Ashfaq *et al.,* 2014). It has been observed that selection efficiency for higher yield is dependent to the knowledge of plant morphological traits and their interaction with grain yield (Ali *et al*., 2014abcd; Awan *et al*., 2015; Naseem *et al*., 2015ab; Saeed *et al*., 2014; Khan *et al*., 2014; Masood *et al*., 2015ab; Waseem *et al*., 2014; Zameer *et al*., 2015ab; Bibi *et al*., 2015). The main objective of present study was to identify best wheat genotypes regarding yield on the basis of morphological traits.

2. Materials and methods

The present study was conducted in the Department of Plant Breeding and Genetics, PMAS-Arid Agriculture University Rawalpindi during the years 2011-2012. The research material was comprised of thirty potential wheat genotypes grown under uniform agronomic practices to achieve the research aims. Ten plants were selected randomly from each entry and following morphological traits were studied, Plant height (cm), Days to flowering, Number of days to maturity, Number of tillers (m^{-2}), Number of spikes per plant, Spikelets per spike (Nos.), Number of grains per spikelet, 1000 grain weight (g), Grain yield per plot (g m^{-2}), Biological yield per plot (g m^{-2}). For statistical analysis of morphological traits analysis of variance (ANOVA) was carried out according to (Steel *et al.,* 1997) and means was compared at 5%LSD.

3. Results and discussion

The study was designed to identify promising wheat genotypes for yield related traits, conducted in the Department of Plant Breeding and Genetics, PMAS- Arid Agriculture University Rawalpindi during the years 2011-2012. The plant material was comprised of 30 new promising wheat genotypes. The analysis of variance provided the information on the relative contribution of various components of morphological traits.

To study the morphological traits plants were selected randomly and were assessed phenotypically. According to table 1 analysis of variance showed highly significant variation among studied traits such

as, plant height (cm), number of days to flowering, number of days to maturity, Spikelets per spike, Number of grains per spikelet and tillers per plants at $p \leq 0.05$ among wheat genotypes.

Table 2. Name of wheat genotypes used in the present study

Sr.No	Name of genotypes	Sr. No	Name of genotypes
1	Suleman-96	**16**	03fj26
2	Chenab-70	**17**	Abadgar
3	ZAM-2004	**18**	Lasani-2008
4	GA-2002	**19**	Tatara
5	Chakwal-97	**20**	Sarsabz
6	Satluj-86	**21**	Shaheen
7	Bakhar-1	**22**	WC-24
8	Fakh-E-Sarhad	**23**	AUR-809
9	WC-20	**24**	Punjab-96
10	Mexi-Pak	**25**	Saleem-2000
11	Daman-98	**26**	Fareed-2006
12	Triticale	**27**	CH-50
13	WC-25	**28**	Shafaq-06
14	Shalimar	**29**	WC-19
15	Wafaq-2001	**30**	WC-23

Table 1. Analysis of variance for morphological traits in wheat genotypes

SOV	DF	PH	DTF	DM	T/M2	SP	SS	GS	1000GW	GY/PLOT	BY/PLOT
REPLICATION	2	153.02	94.033	212.433	24.844	8.844	96.968	886.978	660.802	79636.8	403740
GENOTYPES	29	2188.98**	101.048**	192.009**	533.856**	1.602**	13.337**	118.830**	90.869**	34428.4**	155479**
ERROR	58	6.28	6.171	7.801	21.063	0.454	0.040	1.403	0.274	104.5	475
TOTAL	89										

Where, PH=Plant height (cm), DTF=Days to flowering, DM=Number of days to maturity, T/m^2=Number of tillers (m^{-2}), SP=Number of spikes per plant, SS=Spikelets per spike, GS = Number of grains per spikelet, 1000GW= 1000 grain weight (g), GY/Plot=Grain yield per plot (g m^{-2}), BY/Plot= Biological yield per plot (g m^{-2}).

3.1 Plant Height: Plant height is an important factor for wheat and its contribution towards yield is indirect. More plant height causes yield losses, as tall stature plants become more susceptible to lodging problem hence moderate to short plant height is good for crops as it contributes towards making the mechanical operation and handling of crop easy, also reduced the chances of losses due to lodging. Ahmad *et al.,* (2012) has reported that plant height is affected by genetic makeup, environmental conditions and cultural practices. The use of plant height trait to predict the yield improvement is dependent on other morphological parameters that account the spatial variation in plant height (Machado *et al.,* 2002). The value of plant height was ranged from 76.2 cm to 111.8 cm. The selected genotypes were statistically different from each other as shown in fig.1. The maximum plant height (111.8 cm) was found in genotype Triticale followed by WC-25 (107.8 cm), Tatara (105 cm) and Wafaq-2001(103.2 cm) while minimum (76.2 cm) was observed in genotype Fareed-2006. The results are similar with Ashfaq *et al* (2014) who reported the lowest mean for genotype Freed-2006.

3.2 Number of days to flowering: Plant traits showing positive direct effect on grain yield mean that selection of the trait can be helpful for improvement of wheat yield. Days to flowering is key parameter being studied in relation to quality parameter which contributes directly towards early maturity. Days to flowering causes to avoid drought and abiotic stresses in rainfed areas of Rawalpindi. The present result demonstrated significant variation for mean values of days to flowering. Days to flowering was calculated by visual observation of wheat plants. The average value of number of days to flower initiation was ranged from 107 days to 133 days. The maximum days to flowering (133) was recorded in genotype Chakwal-97 while minimum days to flowering (107) were found in genotype Fareed-2006. However, genotypes Wafaq-2001, GA-2002, Suleman-96, Satluj-86 and Bakhar-1showed similar behavior for days to flowering where it was observed (126) days as presented in figure 2.

3.3 Days to maturity: Early maturity is an important plant breeding objective because of its contribution to better survival of plant. Days to maturity is direct measure of earliness of a genotype which allows a

farmer to sow the next crop on its optimum sowing time and it also minimizes input cost of crop production. The present studied results showed a significant variation among genotypes for days to maturity as depicted in table 1. Data analysis showed that genotypes ranged from 179 to 143 for days to maturity. Results in fig. 3 demonstrated that genotype Suleman-96 took maximum days to maturity (179) followed by Chenab-70 (172), ZAM-2004 (171) and GA-2002 (169) while minimum days (143) were taken by genotype WC-23. Triticale, Daman-98, WC-25, and Shalimar showed same number of days (165) to maturity.

3.4 Number of tillers per square meter: Tillers per square meter contribute significantly towards the increase in yield. Grain yield is consisting of combined production of main stem and tillers per plant. Number of tillers are directly linked with spikes per plant which determine the grain yield in wheat thus it can be concluded that this trait have important role for increase in yield (Masood *et al*., 2014abc).The present investigation depicts significant variation among genotypes for tillers per m^{-2} as shown in table 1. It was found that maximum 109 tillers per m^{-2} were recorded in genotype Daman-98 followed by Chenab-70, Bakhar-1 and GA-2002while minimum were 54 recorded in genotype Shalimar as presented in figure 4.

3.5 Number of Spikes per plant: Analysis of data revealed significant variation among wheat cultivars for spikes per plant. Data in figure 5 demonstrated that maximum (5.33) spikes per plant were recorded in genotype Lasani-2008 followed by Fareed-2006 with 5 spikes per plant. However minimum numbers of spikes per plant were 2.33 found in genotype WC-23. Saleem-2000, Sarsabz, Suleman-96, Chakwal-97, Mexi-Pak and Daman-98 showed statistically same results regarding spikes per plant. Javed *et al.,* (2014) has reported the positive association of spike per plant with seed yield, 1000 grain weight and biological yield.

3.6 Spikelets per spike (Nos.): Increased spikelets per spike resulted in increased number of seeds per spike, ultimately contributing towards yield Dogan, (2009) and Mahmood *et al.* (2006). Data regarding spikelets showed significant variations among selected varieties. Results demonstrated that maximum number of spikelets per spike (22.77) were found in genotype Lasani-2008 followed by Bakhar-1 and Tatara where it were 22.57 and 22.47 respectively. However, minimum numbers of spikelets per spike were 15.89 recorded in genotype Mexi-pak as shown in figure 6.

3.7 Number of grains per spike: Basirat (1994) suggested that number of grain per spike have highest effect on grain yield. Similarly Ijaz *et al.,* (2015) and Soghi *et al*. (2006) reported that number of grain per spike is an important trait which directly effects the crop yield. Statistical analysis of data revealed the significant differences among genotypes selected for research. The present studied results expressed that maximum grains per spike were 67.33 found in genotype Sarsabz and Fakhr-e-Sarhad followed by Shafaq-06 and Shalimar where both genotypes have 67.00 grains per spike. However, minimum numbers of grains per spike were 47.33 recorded in genotype Satluj-86 as indicated in figure 7.

3.8 1000 grain weight (gm): High yield performance is attributed to high thousand grain weight (Del-Balanco *et al*., 2001) and it is the most important yield component which contributes in plant yield. Losses in grain yield occur due to decrease in 1000 grain weight (Akram *et al*., 2004). Almadzadeh (1998) reported that there is positive effect of thousand grain weight on crop yield. Variation among wheat genotypes regarding 1000 grain weight has been reported by Ijaz *et al*., (2015) in wheat. Results represented in figure 8 showed that maximum 1000 grain weight was (59.43 gm) measured in genotype Suleman-96 followed by Chenab-70 and ZAM-2004 where it was 58.91 gm and 58.64 gm respectively. However**,** minimum 1000 grain weight was 41.47 gm observed in genotype Fareed-2006. Farooq *et al.,* 2011ab, Anwar *et al.,* 2013, Ali *et al.,* 2014 reported that genotypes having more 1000 grain weight can be used to select for enhancement of wheat yield.

3.9 Yield per plot (gm): Ultimate goal of plant breeders is to boost up the crop yield by incorporating the stress against environmental conditions in plants. Results presented in figure 9 showed that maximum grain yield per plot was (165.2 gm) in genotypes Srsabz and Lasani-2008 while minimum was recorded in Bakhar-1 (66.33gm). Analysis of variance for grain yield per plot showed significant differences among all the genotypes. The results are agreed with findings of Mahmood *et al.,* (2006) and Dogan (2009).

3.10 Biological yield per plot (gm): Maximum (1705 gm) biological yield per plot was observed in genotypes Triticale and WC-25 followed by Tatara (1529.67 gm) and Wafaq-2001 (1529.67 gm) while minimum was recorded in Fareed-2006 and WC-19 where both have 794.33 gm biological yield per figure 10. Ahmed *et al.* (2001) reported that days to flowering, tillers per plant, spikes per plant, spikelets per spike, thousand grain weights and yield can serve as criteria to select wheat genotypes with high yield in Pakistan. It has been observed that with the increase of biological yield, seed yield also increases (Javed *et al.,* 2014, Ali and Ahsan 2015) so this trait can be included in selection to enhance the in wheat.

Conclusion:

Selection of wheat genotypes with desirable combination of traits is an important task for plant breeders. Morphological traits directly effect the production of crop so it is basic goal for researchers to select the appropriate traits causing to enhance the crop yield. From the experiment results it is suggested that under rainfed conditions genotypes Sarsabz, AUR809, Lasani-2008 and Fakhr-e-Sarhad performed best regarding yield however genotype Chakwal-97 is considered to use where early maturity off crop is required. However genotype Freed-2006 was late maturing, low in biological yield and not suitable for cultivation in rainfed areas.

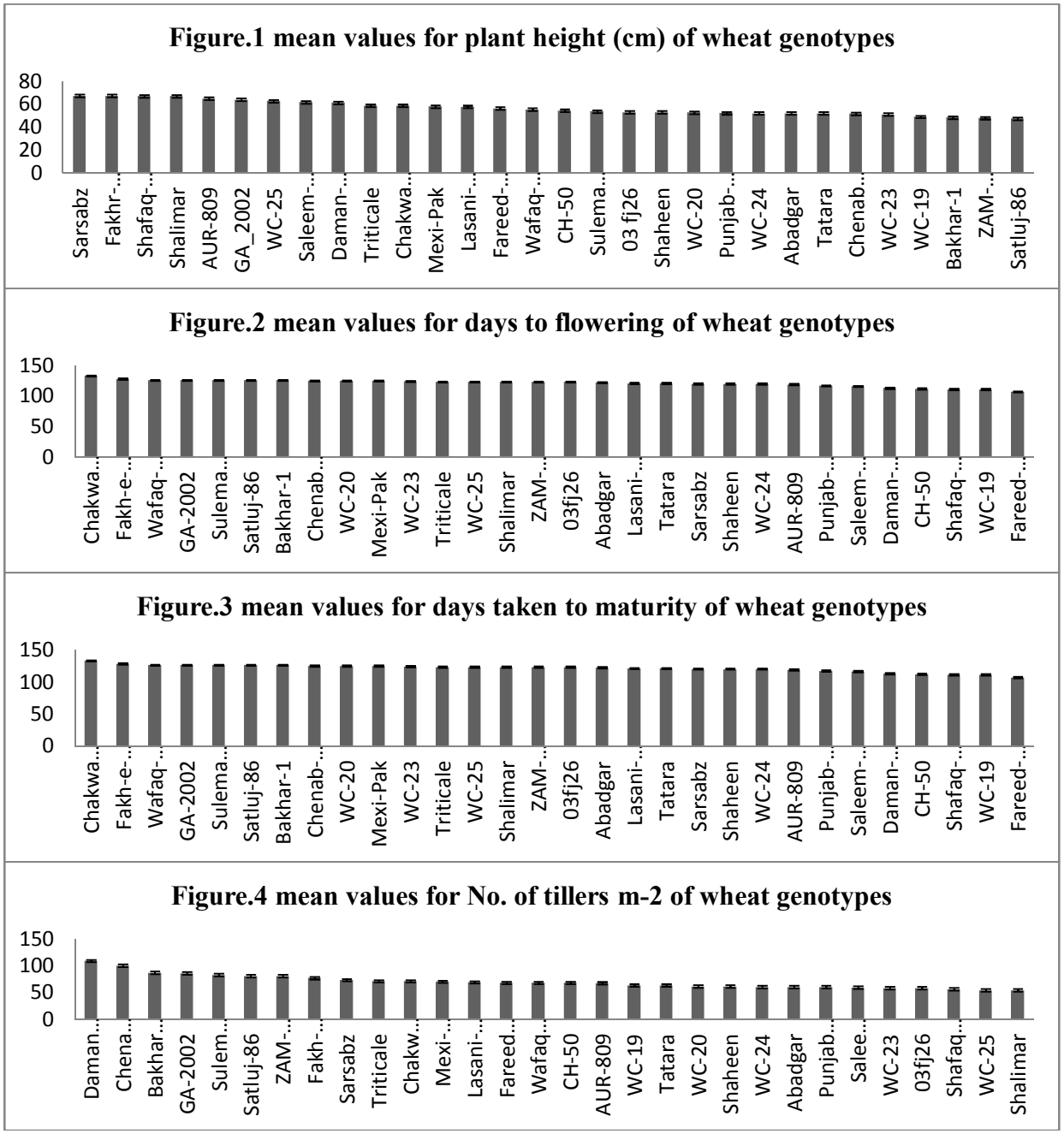


Figure.5 mean values for No. of spike per plant of wheat genotypes

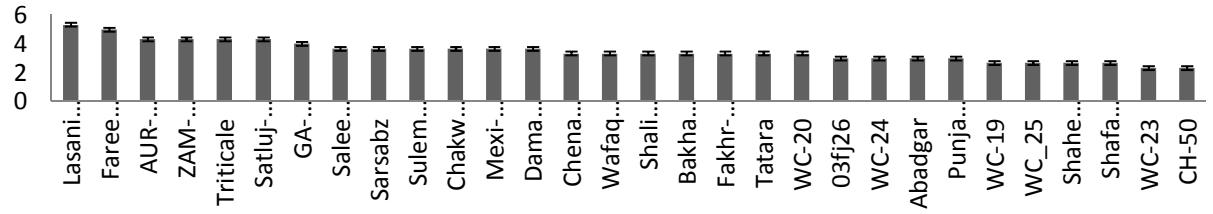


Figure.6 mean values for No. of spikelets per spike of wheat genotypes

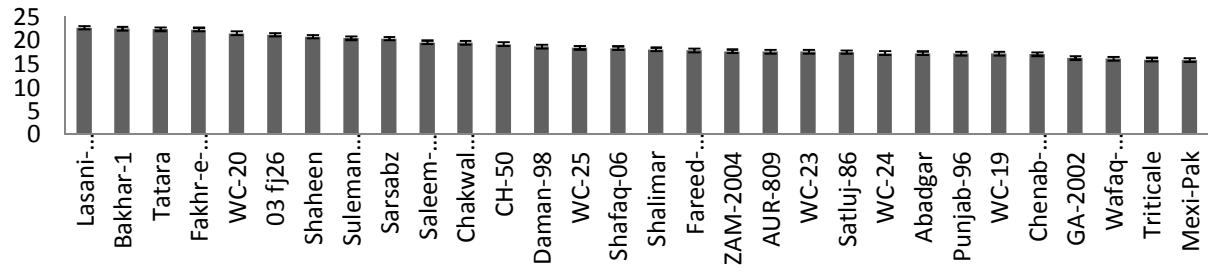


Figure.7 mean values for No. of grains per spike of wheat genotypes

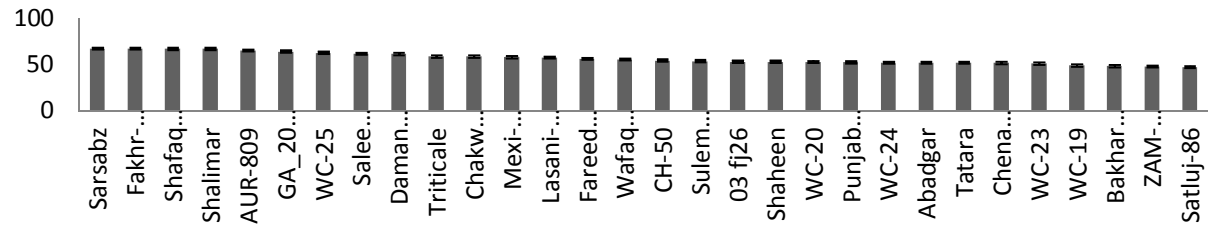


Figure.8 mean values of wheat genotypes for 1000 grain weight (gm)

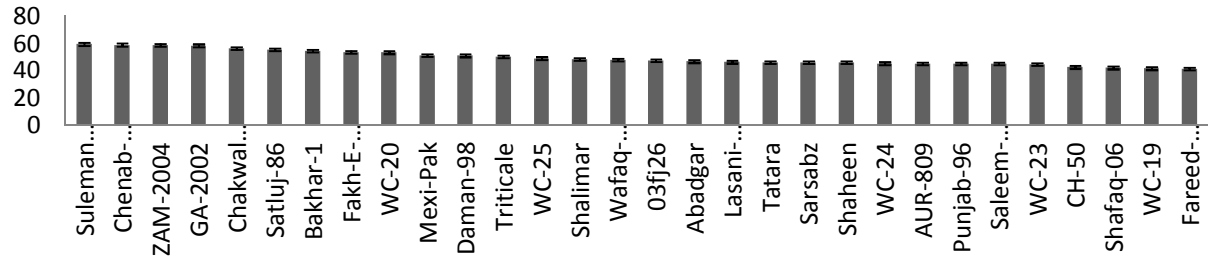
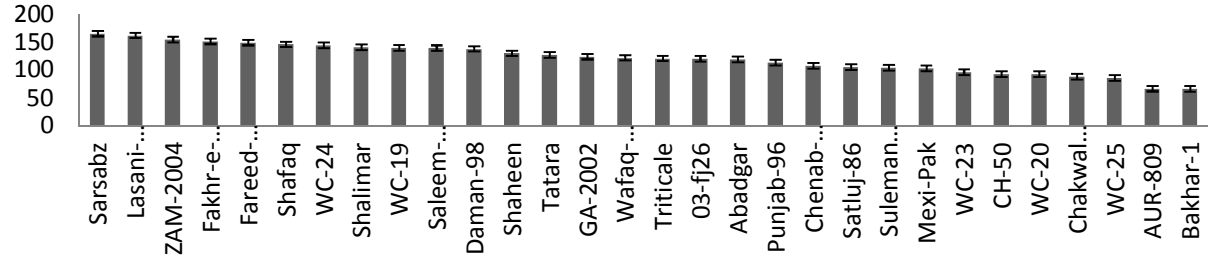
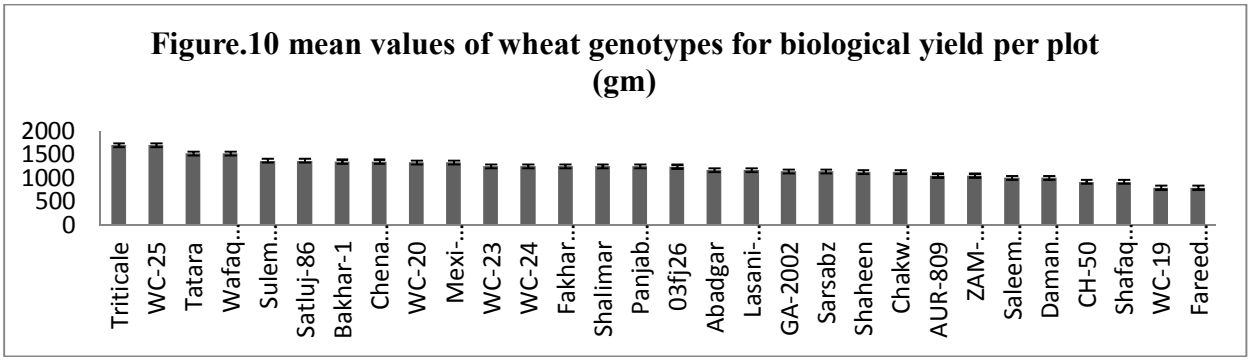


Figure.9 mean values for grain yield per plot (gm) of wheat genotypes





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