Pak. J. Bot., 43(6): 2717-2720, 2011.

GENETIC VARIABILITY AND CORRELATION ANALYSIS OF BREAD WHEAT (*TRITICUM AESTIVUM* L.) ACCESSIONS.

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Abstract

Experimental plot was conducted to test the variation with correlation of one hundred bread wheat (*Triticum aestivum* L.) germplasms under the area of Plant Breeding and Genetics department, Faculty of Agriculture, Gomal University, Dera Ismail Khan, in the year 2006. All the germplasms were evaluated for the traits, spike length (cm), number of spikelets spike^{-1}, grain yield plant^{-1}(gm), 1000-grain weight (gm) and grain yield (Kg ha^{-1}). Genetic diversity was statistically found for all the traits. Two germplasm [PARC/JICA 004275 (01)] had maximum spike length (cm) i.e., 22.4 (cm). Maximum variations were observed among the accessions for spike length (cm) with coefficient of variation 17.89%. The accession [PARC/JICA 004280 (01)] has maximum 31.8 number of spikelets spike^{-1} with coefficient of variation 18.45%. The entry [PARC/JICA 003845 (01)], [PARC/JICA 004279 (05)], [PARC/JICA 004274 (01)] and [PARC/JICA 004266 (04)] having greatest 1000-grain weight (g) i.e. (46.2, 46.1, 45.6 and 45.1 g) having greatest 1000-grain weight (g) with coefficient of variation 21.39%. The genotypes [PARC/JICA 004280 (01)], [PARC/JICA 004266 (05)] and [PARC/JICA 004267 (02)] had a maximum grain yield (kg ha^{-1}) i.e., (5185, 5061 and 5051 kg ha^{-1}) with coefficient of variation 11.75%. The spike length shows positive significant correlation with number of spikelets spike^{-1}, grain yield plant^{-1} and grain yield (kg ha^{-1}). While positive correlation was observed from spike length and 1000-grain weight. Number of spikelets spike^{-1} had highly significant correlation with grain yield plant^{-1} and grain yield (kg ha^{-1}). High significantly positive correlation was depicted from grain yield plant^{-1} and grain yield (kg ha^{-1}) while, 1000-grain weight had positive highly significant correlation with grain yield (kg ha^{-1}).

Introduction

Triticeae contains a large number of genera (*Triticum, Hordeum, Secale, Aegilops, Agropyron, Elymus, Eremopyron, Haynaldia* and many others). *Triticum, Aegilops, Agropyron, Haynaldia*, and *Secale* possess some common characteristics and to a separate Subtribe Triticinae. Genera *Triticum* and *Aegilops* (goat grasses), were certainly involved in the evolution of common hexaploid wheat possessing AABBDD genomes (Levy & Feldman (2002). However, the genus secale has been used as a parent in the development of the man-made cereal Triticale or Triticosecale or Tritosecale (Wittmack), a synthetic amphidiploid between wheat and rye. Whereas both *Triticum* and *Aegilops* have three ploidy levels (2x, 4x and 6x), secale has only 2x ploidy level.

Wheat is the staple food for 35% of the world's population and is grown on 17% of the cultivated area in the world (Kronstad, 1998). It provides more calories and protein to human diet than any other crop. There is also more wheat and wheat flour moving in the world trade than any other grain. It is but natural, that the domestication of wheat should have taken place in the Fertile Crescent, since this is the center of its wild progenitor's geographical distribution (Harlan & Zohary, 1966; Zohary, 1970). All the naturally distributed species were adapted to their changing environments through the conservation of high genetic variability in their natural populations, and this resulting variability was the promoting force behind the evolution of the species and speciation.

A good collection of wheat species (about 3000 accessions) from all over the country were held at the Gene bank of Institute of Agricultural Biotechnology & Genetic Resources (IABGR), National Agricultural Research Center (NARC), Islamabad. Therefore the present research project was carried out to evaluate genetic variability determined by morphological traits.

Materials and Methods

One hundred accessions of wheat (*Triticum aestivum* L.) were obtained from the Institute of Agriculture Biotechnology & Genetic Resources (IABGR) at NARC, Islamabad and sown in the research area of Department of Plant Breeding and Genetics, Faculty of Agriculture, Gomal University, Dera Ismail Khan on November 16, 2005 with augmented field design. Each accession was dibbled by hand in two meter long row. Plant to plant spacing was kept as 25cm and recommended cultural practices and fertilizer were used during the growing season. The climate was hot and dry in summer and moderate during monsoon season indicating arid to semi-arid. The latitude is 31° 49$^{'}$ N to 70° 55$^{'}$ E with 397 feet to 689 feet from above sea level. In summer and winter the maximum temperature respectively was 45^{o} C and 8^{o} C. The annual precipitation goes from 15 to 25 cm with maximum humidity ranges from 51% to 78% between June and October. All the accessions were evaluated and characterized for various traits i.e. Spike length (cm), Number of spikelets spike^{-1}. Grain yield plant^{-1}(gm), 1000-grain weight (gm), Grain yield (Kg ha^{-1}). All the data recorded were averaged and analyzed following the methods of Steel & Torrie (1981).

Results

Spike length (cm): The magnitude of genetic variability was ranged from 6.90 ~ 22.40(cm) with the mean value of 12.70 ± 2.27(cm) and coefficient of variation 17.89% (Table 1). The frequency distribution varied from 6.6 ~ 22.5(cm) (Fig 1). Two accessions [(PARC/JICA 003839 (02) and PARC/JICA 004310 (01)] have minimum spike length 8.3(cm) and 6.9(cm) and only one accession [PARC/JICA 004275 (01)] had maximum spike length i.e., 22.4(cm).

Table 1. Basic statistics of the quantitative traits of 100 wheat accessions during 2006.

Trait	Mean	Minimum	Maximum	Variance	SD	CV (%)	SE
Spike length	12.70	6.90	22.40	5.16	2.27	17.89	0.22
No. of spikelets spike^{-1}	19.19	10.50	31.80	12.54	3.54	18.45	0.35
Grain yield plant^{-1}	2.48	1.35	4.62	0.27	0.52	20.87	0.05
1000-grain weight	35.72	16.79	46.18	58.35	7.64	21.39	0.75
Grain yield (kg ha^{-1})	4241.27	2701.00	5185.00	248260.53	498.26	11.75	49.09

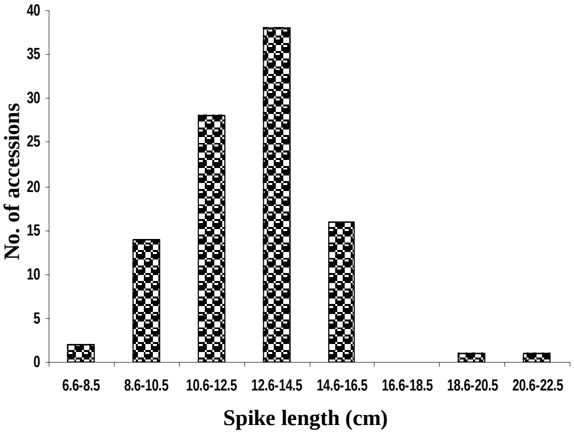

Fig. 1. Frequency distribution of spike length (cm).

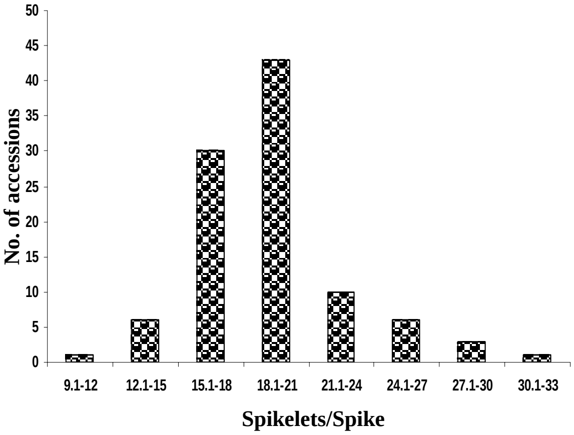

Fig. 2. Frequency distribution of number of spikelets spike^{-1}.

Number of spikelets spike^{-1}: Significant variability was depicted for this parameter, which ranged from 10.50 ~ 31.80 number of spikelets spike^{-1} with mean value of 19.19 ± 3.54 and coefficient of variation 18.45% (Table 1). The frequency distribution ranged from 9.1 ~ 33.00 (Fig. 2). The accession [PARC/JICA 004305 (01)] has minimum 10.5 number of spikelets spike^{-1} while, one accession [PARC/JICA 004280 (01)] has maximum 31.8 number of spikelets spike^{-1}.

Grain yield plant^{-1} (g): Significant variation was noted for grain yield plant^{-1}. It varied from 1.35 ~ 4.62(g) having mean value of 2.48 ± 0.52 and coefficient of variation for this parameter was 20.87% (Table 1). The frequency distribution (Fig. 3) shows range from 1.35 ~ 3.38(g). There is one germplasm [PARC/JICA 004354 (01)] which has a minimum grain yield plant^{-1} 1.35(g) while, only one germplasm [PARC/JICA 004280 (01)] had a maximum grain yield plant^{-1} 3.38(g).

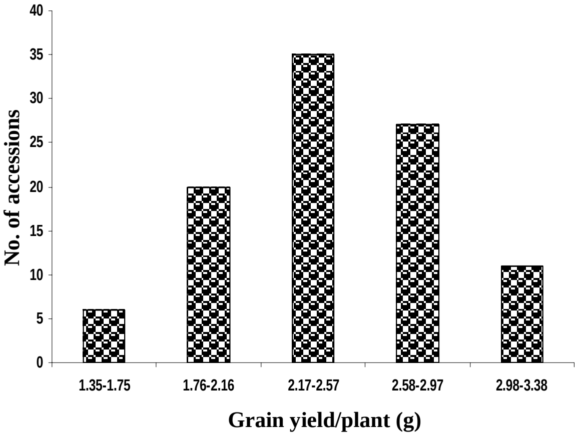

Fig. 3. Frequency distribution of grain yield plant^{-1} (g).

1000-Grain weight (g): A frequent variability was noted which ranged from 16.79 ~ 46.18 (g) with the mean value of 35.72 ± 7.64 and coefficient of variation was 21.39% (Table 1). The frequency distribution in (Fig. 4) varied from 15.50 ~ 47.49(g). The genotype [PARC/JICA 003831 (01)] has lowest 1000-grain weight (g) i.e. (16.8 g) while, four germplasms [PARC/JICA 003845 (01)], [PARC/JICA 004279 (05)], [PARC/JICA 004274 (01)] and [PARC/JICA 004266 (04)] having greatest 1000-grain weight (g) i.e. (46.2, 46.1, 45.6 and 45.1g).

Grain yield (kg ha^{-1}): A significant result was observed for this trait. It varied from 2701 ~ 5185 (kg ha^{-1}) with the mean value of 4241.27 ± 498.26 (kg ha^{-1}) and coefficient of variation 11.75% (Table 1). The frequency distribution ranged from 2701 ~ 5188.9 (kg ha^{-1}) (Fig. 5). The accessions [PARC/JICA 003823 (03)], [PARC/JICA 003831 (01)] and [PARC/JICA 004353 (04)] have lowest grain yield (kg ha^{-1}) i.e. (2947, 2874, 2701 kg ha^{-1}) while, the genotypes [PARC/JICA 004280 (01)], [PARC/JICA 004266 (05)] and [PARC/JICA 004267 (02)] had a maximum grain yield (kg ha^{-1}) (5185, 5061 and 5051 kg ha^{-1}). The noted findings for the said traits are at par with the work done by earlier scientists like Verma *et al*., (1998), Moghaddam *et al*., (1998), Daniel & Slafer (1999), Espitia-Rangel *et al.,* (1999), Khan *et al*., (2007 b). A moderate level of genetic variability were depicted in all these traits and these observations too agree with the statements reported by (Sharma & Grag, 2002; Khan *et al*., 200a; Talebi, 2009; Aqsa *et al*., 2011).

Correlation coefficients: The correlation coefficient among these five quantitative traits i.e. Spike length (cm), Number of spikelets spike^{-1}. Grain yield plant^{-1}(gm), 1000-grain weight (gm), Grain yield (Kg ha^{-1}) shows significantly positive correlation with one another (Table 2).Therefore spike length exhibit positive significant correlation with number of spikelets spike^{-1} (r = 0.22), grain yield plant^{-1} (r = 0.21) and grain yield (kg ha^{-1}) (r = 0.16). While positive correlation was found from spike length and 1000-grain weight (r = 0.01). In number of spikelets spike^{-1} highly significant correlation was noted with grain yield plant^{-1} (r = 0.66) and grain yield (kg ha^{-1}) (r = 0.60). While positive correlation was observed from number of spikelets spike^{-1} and 1000-grain weight (r = 0.13). High significantly positive correlation was noted from grain yield plant^{-1} and grain yield (kg ha^{-1}) (r = 0.64) and positive correlation for this trait was found with 1000-grain weight (r = 0.09). 1000-grain weight had positive highly significant correlation with grain yield (kg ha^{-1}) (r = 0.37). These statements are in agreement with Gandhi *et al*., (1964), Bhatt (1973), Belay *et al.,* (1993) and Khan *et al*., (2007 b) who reported that grain yield was positively correlated with number of tillers plant^{-1}, number of grains spike^{-1}.

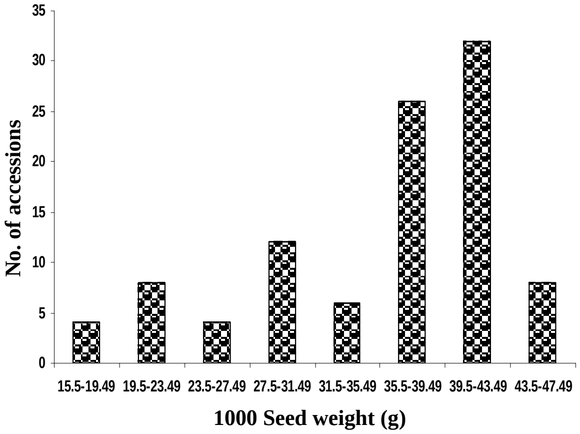

Fig. 4. Frequency distribution of 1000-grain weight (g).

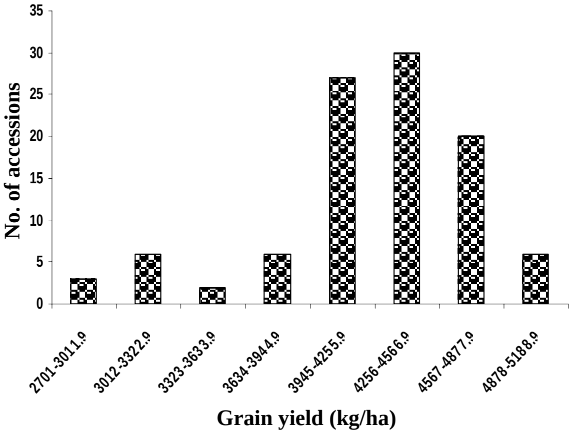

Fig. 5. Frequency distribution of grain yield (kg ha^{-1})

Table 2. Correlation coefficient of 100 accessions of wheat during 2006.

Traits	Spike length	No. of spikelets spike^{-1}	Grain yield plant^{-1}	1000-grain weight	Grain yield (kg ha^{-1})
Spike length	1.00				
No. of spikelets spike^{-1}	0.22*	1.00			
Grain yield plant^{-1}	0.21*	0.66**	1.00		
1000-grain weight	0.01	0.13	0.09	1.00	
Grain yield (kg ha^{-1})	0.16*	0.60**	0.64**	0.37**	1.00

The tendency of positive correlation between morphological traits, in spite of wide range of genetic diversity in landraces, could effectively be utilized to develop new wheat varieties. Simultaneously more selection pressure could be applied on more number of tillers plant^{-1}, greater number of grains spike^{-1} and larger grain size in segregating generations to maximize grain yield. These evaluations are at par with the results obtained by Arya *et al.,* (2005), Bede & Petrovic (2006), Xu *et al.,* (2005) and Khan *et al*., (2007a), Okuyama *et al*., (2005), Liatukas *et al*., (2007), Ochi-e-Ardabili *et al*., (2009), Gholamin, *et al*., (2010) and Oğuz *et al*., (2011) who showed that significant variation was observed for all the evaluated parameters.

Discussion

A high level of genetic variability were observed for one hundred accessions of wheat (*Triticum aestivum* L.) among various parameters i.e. Spike length (cm), Number of spikelets spike^{-1}. Grain yield plant^{-1}(gm), 1000-grain weight (gm), Grain yield (Kg ha^{-1}). These parameters had the highest contribution to phenotypic stability. The contribution of positive correlation of one hundred accessions of wheat (*Triticum aestivum* L.) among the desired traits, instead of high genetic variability indicates that it could effectively be utilized for further wheat breeding program. Hence therefore it can be applied on minimum Spike length (cm), Number of spikelets spike^{-1}, Grain yield plant^{-1}(gm), 1000-grain weight (gm), Grain yield (Kg ha^{-1}) in segregating generations to enhance the desired grain yield. These accessions according to the traits indicating significant positive correlation and high genetic variability which can be used for future crop improvement program to introduce new wheat varieties according to the need of basic agro-climatic condition of Dera Ismail Khan Zone, KPK, Pakistan.

Conclusion

The analysis of one hundred accessions of wheat (*Triticum aestivum* L.) and observations of research reports concludes that accession [PARC/JICA 004275 (01)] had maximum spike length i.e., 22.4(cm), [PARC/JICA 004280 (01)] has maximum 31.8 number of spikelets spike^{-1} and maximum grain yield plant^{-1} 3.38 (g) while [PARC/JICA 004280 (01)], [PARC/JICA 004266 (05)] and [PARC/JICA 004267 (02)] had a maximum grain yield (kg ha^{-1}) (5185, 5061 and 5051 kg ha^{-1}). Hence the germplasms [PARC/JICA 004275 (01)], [PARC/JICA 004280 (01)], [PARC/JICA 004266 (05)] and [PARC/JICA 004267 (02)] have the required characteristics for obtaining maximum grain yield and hence recommended for general cultivation under different agro-climatic conditions in the area of Dera Ismail Khan.

Acknowledgement

I acknowledge financial support from Higher Education Commission (HEC), Islamabad, Pakistan. I am also greatly thankful for helping to complete the laboratory experiments and data analysis at IABGR, National Agricultural Research Center (NARC), Islamabad, Pakistan.

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(Received for publication 03 February 2009)