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EVALUATION OF EXOTIC BREAD WHEAT GENOTYPES FOR YIELD AND ITS ASSOCIATED TRAITS

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ABSTRACT

The current research was carried-out to evaluate 19 exotic bread wheat genotypes for yield and its associated characters along with check variety (Imdad-05). The analysis of variance, mean performance and heritability (broad sense) were analyzed. Mean squares of the genotypes were differed significantly at $P \leq 0.01$ for all the traits except spikelets spike^{-1}, registering the significant genetic variability among the genotypes for further evaluation. With regards to mean performance, the Mex-line-19 not only showed better performance for various traits among the Mexican lines but also surpassed check variety (Imdad-05) for yield and its associated traits. It is suggested that the Mex-line-19 proved outstanding exotic wheat accession which can rather be released as pure line variety, after testing its stability in different conditions. Moreover, this superior line can also be used as one of the parents in hybridization programs in order to introduce promising characters in bread wheat cultivars. High and moderate heritability estimates were found for most of the studied traits, indicated that the variation observed was mainly under genetic control and was less affected by environment, referring the influence of additive gene action for these traits. Thus, the improvement of these traits can be made through direct phenotypic selection.

Key-words: Mexican wheat, grain yield, heritability, Pakistan.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most widely adapted crop to various agro climatic conditions, consequently, has got a major place among the cereal crops in the world, both in area and production. It is the chief cereal crop of the temperate region of the world; however, it is also cultivated on huge areas in the tropics. Worldwide, it occupies 216 million hectares with a production of 650 million tonnes (FAO, 2012). In Pakistan, efforts on wheat breeding have been focused on superior yields and development of cultivars showing resistance against various rust diseases. In this bidirectional breeding efforts of the past, many potential cultivars of bread wheat have been evolved. Wheat is supreme among grain crops, mainly due to the reason that grains possess protein with exceptional chemical and physical properties (Ali *et al*., 2013).

In wheat development programs, the evaluation and identification of superior lines from introduced plant materials, is the first and leading step in a crop improvement program. Promising genotypes with high yielding, good adaptation and agronomically desirable characteristics could reliably be exploited for commercial cultivation. Nevertheless, an efficient and immense hybridization program would be a feasible approach and for the success of such hybridization programs, the evaluation of the important traits and pattern of genetic variability of the existing germplasm keeps a promise (Sanghera *et al.,* 2014). Genetic variability is an important aspect for the successful breeding programs in any population. A wide range of variability will augment the chances of selection for a desirable genotype. For this fact, heritability is a good sign of the transfer of characters from generation to generation (Baloch *et al.,* 2014a). Keeping in view the fact of genetic variability, in the current study, the exotic germplasm was assessed for a variety of yield and its associated traits and also heritability of those traits was estimated.

MATERIALS AND METHODS

The present experiment was conducted at Southern Wheat Research Station, Tandojam during 2013-14. The research was aimed to assess exotic bread wheat for yield and its related traits and also to analyze heritability (broad sense). The plant material was sown with three replications in a randomized complete block design. The trial consisted of 5 rows in 3 meter length for each exotic bread wheat line per replication. The crop cultivated by dibbling method; the spacing was 20 and 30 cm between plant to plant and row to row, respectively. The recommended dose of fertilizer, number of irrigations, weedicide and interculturing was applied at appropriate time. For the recording of observations, per exotic bread wheat genotype, ten plants were randomly selected and labeled from each replication. Nineteen Mexican bread wheat genotypes (Mex-1, Mex-2, Mex-3, Mex-4, Mex-5, Mex-6, Mex-7, Mex-8, Mex-9, Mex-10, Mex-11, Mex-12, Mex-13, Mex-14, Mex-15, Mex-16, Mex-17, Mex-18, and Mex-19) and one check cultivar (Imdad-05) were used in the present experiment. Analysis of variances was done through Statistix 8.1 computer software, while the means were compared using Duncan's Multiple Range Test as suggested by Duncan (1955). The heritability in broad sense was estimated according to Allard (1960).

RESULTS AND DISCUSSION

The analysis of variance exhibited that all the genotypes performed significantly ($P \leq 0.05$) variable for plant height, tillers plant^{-1}, spike length, grains spike^{-1}, grain yield plant^{-1}, seed index, biological yield plant^{-1} and harvest index, with the exception of spikelets spike^{-1} (Table-1), signifying that studied materials hold valuable genetic resources for range of characters thus can comprehensively be used for upcoming breeding challenges. Similar results have also been penned by several other workers, namely, Baloch *et al.* (2014a) and Baloch *et al.* (2014b). These researchers also observed the considerable genetic variance for the various yield and its related traits.

Table 1. Mean squares from analysis of variance for various traits in bread wheat genotypes

Source of variance	D.F.	Characters								
		Plant height	Tillers Plant^{-1}	Spike length	Spikelets spike^{-1}	Grains spike^{-1}	Grain yield plant^{-1}	Seed index	Total Biomass plant^{-1}	Harvest index
Replication	2	16.3852	0.02373	0.6223	1.28184	0.927	4.11455	16.4745	2.1282	14.751
Genotypes	19	45.545**	1.607**	0.946**	3.010^{NS}	105.103**	3.541**	47.610**	81.630**	171.36**
Error	38	2.425	0.252	0.309	2.186	5.672	0.410	7.061	0.894	23.667

Mean performance of nineteen Mexican lines along with check variety (Imdad-05) is given in Table 2. According to plant height, the Mex-line-12 produced the tallest plants with height of 92.53 cm, while Mex-line-13 was the shortest accession, having plant height of 79.06 cm, indeed it is desirable, thus Mex-line-13 could be utilized in further breeding programs to achieve short stature plants since these genotypes do not lodge at great scale, consequently more yield is expected. Among the yield associated components, tillers plant^{-1} is an important attributes which can cause an enhancement in grain yield plant^{-1}. Tillers plant^{-1} ranged from 4.93 to 7.80, with an average of 6.18. The Mex-line-17 produced maximum tillers plant^{-1} (7.80); this line can be proved better for breeding the more tillers plant^{-1}. Spike length is a trait of more interest, because larger spike is considered to produce more grains, resulting in superior seed yield plant^{-1}. Considering the spike length, the Mex-line-1 grew the longest spike with the length of 10.79 cm, referring that this genotype may be registered as reliable breeding material, especially while breeding for the extension of spike length. Spikelets spike^{-1} is also an important trait in wheat, as more number of the spikelets spike^{-1}, more number of the grains spike^{-1}, thus higher grain yield plant^{-1} can be achieved. With regards to spikelets spike^{-1}, the Mex-line-19 set maximum spikelets spike^{-1} (19.93), indicating that Mex-line-19 would be proved choice parents for upcoming breeding programs. For the character grains spike^{-1}, the Mex-line-19 produced maximum grains spike^{-1} (58.66), however, the minimum grains spike^{-1} (36.33) produced by the accession number 7. Considering the grain yield plant^{-1}, the Mex-line-19 also demonstrated maximum grain yield plant^{-1} (11.84 g) than rest of the genotypes including check variety Imdad-05. Similarly, this genotype (Mex-line-19) also showed greater seed index and surpassed to all the tested genotypes including check variety, showing the maximum seed index of 62. 88 g. The Mex-line-10 and 1 showed minimum grain yield plant^{-1} and seed index, respectively. The check variety Imdad-05 produced maximum biological yield plant^{-1} (32.33 g), while minimum (13.60 g) was exhibited by Mex-line-7. Taking harvest index, the Mex-line-6 produced maximum harvest index (79.21 g), whereas the genotype 11 produced minimum harvest index of 53. 65 g. all in all, the Mex-line-19 not only showed better performance for various traits among the Mexican lines but also surpassed check variety (Imdad-05) for yield and its associated traits. It is recommended that the Mex-line-19 proved superior accession which can be released as pure line variety, after testing its stability in different environments. Second, this superior accession can be used as one of the parents in hybridization programs in order to introduce additional desirable characters in bread wheat cultivars.

Table 2. Mean performance of various traits in bread wheat genotypes.

Genotypes	Plant height (cm)	Tillers $plant^{-1}$	Spike length (cm)	Spikelets $spike^{-1}$	Grain $spike^{-1}$	Grain yield $plant^{-1}$ (g)	Seed index (1000 grain weight, g)	Total biomass $plant^{-1}$ (g)	Harvest index (%)
Mex-line-1	85.20	7.46	10.79	19.83	46.93	8.80	47.99	21.80	57.80
Mex-line-2	92.40	6.53	8.85	17.53	45.60	9.71	53.17	23.40	66.70
Mex-line-3	80.26	6.26	9.30	16.20	40.40	8.06	57.75	18.53	77.00
Mex-line-4	81.80	6.13	8.96	16.73	42.66	8.71	57.57	22.46	70.10
Mex-line-5	84.46	5.80	8.93	17.13	45.26	9.19	59.02	22.86	75.13
Mex-line-6	82.20	6.00	10.03	16.63	47.80	9.21	53.68	19.33	79.21
Mex-line-7	83.93	4.93	9.96	16.60	57.00	9.38	61.86	13.60	68.38
Mex-line-8	89.06	5.46	10.06	18.06	50.13	10.38	56.36	17.73	77.56
Mex-line-9	84.46	5.26	10.13	15.53	47.73	9.01	51.82	15.60	59.38
Mex-line-10	89.53	5.53	9.36	15.93	40.20	7.64	60.02	17.33	57.79
Mex-line-11	89.66	5.60	10.40	17.00	52.00	9.48	62.36	18.53	53.65
Mex-line-12	92.53	7.00	10.20	17.93	44.13	10.34	62.36	28.33	60.71
Mex-line-13	79.06	5.73	9.36	18.20	50.33	9.37	62.09	19.66	57.71
Mex-line-14	89.53	5.60	9.23	17.80	40.60	7.87	60.89	18.13	56.87
Mex-line-15	90.66	6.00	9.20	17.66	52.80	9.78	59.96	22.73	61.06
Mex-line-16	85.53	6.60	9.33	17.26	38.60	9.43	59.34	19.40	59.71
Mex-line-17	91.00	7.80	10.03	16.86	36.33	11.48	60.06	31.53	66.68
Mex-line-18	86.40	5.80	9.96	17.93	44.33	10.46	59.70	22.06	67.32
Mex-line-19	85.86	6.80	8.86	19.93	58.66	11.84	62.88	31.66	59.81
Imdad-05 (Check)	83.86	6.73	9.13	17.93	52.60	10.43	62.24	32.33	62.24
LSD (5%)	2.56	0.84	0.91	2.43	3.88	1.14	4.41	1.54	8.05

**= Significant at 1% of probability level; NS= Non-significant

Heritability estimates are helpful in choosing the characters to be focused while selection for the desirable traits is being operated. High heritability estimates (h^2 b.s.) (Table-3) were observed for tillers plant^{-1} (h^2= 90.60), spike length (h^2= 62.50), grains spike^{-1} (h^2= 81.03) and biological yield plant^{-1} (h^2= 97.71), whereas moderate heritability was found for plant height (h^2= 52.07) and grain yield plant^{-1} (h^2= 31.66), while the low heritability estimates shown by the characters spikelets spike^{-1} (h^2= 22.69), seed index (h^2= 25.84) and harvest index (h^2= 29.72). High heritability values for these traits demonstrate that the variability measured was largely under genetic control and a lesser amount of it was influenced by environment, representing the control of additive gene action for these traits. Therefore, the progress of these traits can be made via direct phenotypic selection. These findings are in accordance with previous reports of Khodadadi *et al.* (2011), Kaleemullah *et al.* (2015) and Rehman *et al.* (2015).

Table 3. Heritability analysis for various traits in Mexican wheat lines

Characters	Genotypic variance ($\delta^2 g$)	Phenotypic variance ($\delta^2 p$)	Heritability % (Broad sense)
Plant height	2.63	5.05	52.07
Tillers plant^{-1}	2.41	2.66	90.60
Spike length	0.50	0.80	62.50
Spikelets spike^{-1}	0.64	2.82	22.69
Grains spike^{-1}	24.19	29.86	81.03
Grain yield plant^{-1}	0.19	0.60	31.66
Seed index	2.46	9.52	25.84
Total biomass plant^{-1}	38.84	38.97	97.71
Harvest index	10.01	33.67	29.72

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