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Estimation of Genetic Variation for Agro-Economic Traits in Wheat (*Triticum aestivum L.*)

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Abstract: Five wheat lines viz. DN-89, DN-88, DN-84, DN-76 and DN-69 were evaluated to test the genetic variation for agronomic traits to identify the lines with best genetic constitution and capable of best results under agro-climatic conditions of Dera Ismail Khan. The experiment was carried out using RCBD design with three replications at Department of Plant Breeding & Genetics, Faculty of Agriculture, Gomal University Dera Ismail Khan, Pakistan. Results showed that the agronomic characters i.e. number of tillers plant^{-1}, spike length (cm), 1000-grain weight and yield kg ha^{-1} are major yield contributory parameters. The line DN-76 produced significantly highest grain yield (5842 kg ha^{-1}. The other traits viz number of tillers plant^{-1}, spike length (cm), 1000-grain weight and yield kg ha^{-1} the same line was found highest and significant than the other lines. Therefore, DN-76 is best suited for general cultivation in agro-climatic conditions of Dera Ismail Khan Zone.

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1. Introduction

Wheat (*Triticum aestivum L.*) is the most important food crop of the world. Being staple food wheat occupies an important place in the crop husbandry of Pakistan (Laghari et al., 2010). In Pakistan, it occupies around 9.039 million hectares with annual production of 25.286 million tones and average yield of 2797 kg ha^{-1} (Economic Survey of Pakistan, 2013-14). It plays a remarkable role in meeting the diversified food requirements of both the Urban and Rural population of the country. Efforts have moreover been made to increase wheat yield. Although wheat production in Pakistan has been better during recent years than it was previously. Continued improvement in productivity is highly desirable because of increasing demand by the still growing human population (Zaazaa et al., 2012). Therefore production of new improved varieties with maximum resistance to biotic and a biotic stresses and high yield have become necessary to meet the food requirements that are enhancing day by day by the rapid increase in population (Sial et al., 2012).

The existence of genetic variability for yield and related agronomic traits in wheat have previously been reported by various workers (Gupta et al. 1997). New varieties with improved agronomic traits have been the major contributing factor to increase food production. The estimate of genetic variability and evaluation are useful for facilitating efficient germplasm collection, management and utilization (Nisar et al., 2008). Genetic variability is an important source of high yielding genes hence, crop improvement mainly depends on the extent of heritable diversity existing in crop species. Frequent use of few parents in breeding program causes genetic erosion. Diverse genetic background provides desirable allelic variation among parental lines to produce new and valuable combinations (Tar'an et al., 2005). To develop high yielding and resistant varieties it is necessary to utilize the various existing genetic resources with maximum genetic diversity.

The need for a continuous evolution of varieties with improved productivity is obvious from the fact that cultivars deteriorate due to various reasons and goes out of cultivation. Therefore, the breeder has to be ever vigilant and keep his program attuned to the development of new varieties capable of maintaining yield stability (Rane and Chauhan, 2002).

The early breeding efforts largely focused on the selection of local types for yield. After 1965, the efforts were shifted to the introduction of dwarfing genes into local types for yield increase. In the last two decades, the emphasis of breeding was given to the crossing of exotic parents introduced from

International Center for Improvement of Wheat and Maize, CIMMYT, Mexico or the genotypes derived from the exotic materials and to the selection of genotypes superior for yield as well as resistance to biotic and a biotic stresses. These efforts have made significant impacts on the agricultural production and economy of Pakistan. The genetic diversity is the backbone of crop improvement and the traits showing genetic variability can be utilized for further breeding program to synthesize a new wheat variety (Gorney et al., 2006).

The success of breeding program depends on kind and quantity of genetic variation. The greater the genetic variation the greater the chances for bringing about sustainable improvement through selection. The measurement of genetic variation as well as the mode of inheritance of various genetic characters are thus of prime importance (Degewione et al., 2013).

The present study was also planned to estimate the genetic variation for agronomic traits among different lines of wheat (*Triticum aestivum L.).* The information acquired from this study appears to be of great value for the development of such varieties, which are capable of better yield and best adapted to agro-climatic conditions of Dera Ismail Khan..

2. Materials and Methods

A field study was conducted at research area of Department of Plant Breeding and Genetics, Faculty of Agriculture, Gomal University D.I. Khan during winter season 2014-2015. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The plot size was 2x6 m^2 using lines DN-89, DN-88, DN-84, DN-76 and DN 69 as test. These lines were introduced from International Center for Improvement of Wheat and Maize, CIMMYT, Mexico. DN 69 and DN-88 were drought resistant and DN-76, DN-84 and DN-89 were selected on the basis of better yield per acre. Fertilizer and herbicide (Buctril-M) was applied equally to all respective plots according to standard recommendations for the locality. Data were recorded on number of tillers plant^{-1},days to maturity, spike length (cm),number of grains spike^{-1}, plant height at maturity (cm), 1000-grain weight(g) and grain yield (kg ha^{-1}).

Numbers of tillers were counted from 10 randomly selected plants from each plot and were averaged for each line. Spike length of 10 spikes in each plot was measured at harvest from fixed places earmarked randomly and was averaged. Days to maturity were recorded at the stage of development of spike at its maximum size and growth by counting total days from date of sowing up to the maturity of crop. Ten spikes were selected randomly from each experimental plot. Numbers of grains were counted from each selected spike and average of ten spikes was recorded and used for further analysis. At crop maturity ten plants were randomly selected from each experimental plot to measure the plant height. Their heights were measured from the soil surface to the tip of panicle/ flag leaf with the help of a meter rod and were averaged for each experimental plot. From the dry seed lot of each experimental plot, 1000-grain were randomly counted and weighed, using Mettler Electronic Precision Balance (PE 1600 USA). Area of 2x6 m^2 was harvested from each experimental plot. Grain yield was weighed by triple beam balance at 14% moisture level. The yield was expressed as kg ha^{-1}. The data were analyzed statistically using analysis of variance technique and subsequently least significance difference test (LSD) was applied for comparing the treatment means by MSTATC computer software (Steel and Torrie, 1980).

3. Results and Discussion

3.1 Number of Tillers plant $^{-1}$

Number of productive tillers plant^{-1} is one of the important agronomic characters contributing towards maximum yield. More number of tillers plant^{-1} ultimately increases yield ha^{-1}.

Table. 1. Mean performance for various agronomic traits in wheat.

Genotypes	Tillers plant^{-1}	Spike length (cm)	Days to maturity	Grains spike^{-1}	Plant height (cm)	1000-grain weight (g)	Grain yield kg ha^{-1}
DN-84	8.23 c	13.10 c	150.3 b	66.93 b	105.9 a	46.00 b	4793 b
DN-76	9.80 a	14.61 a	154.0 a	75.10 a	98.06 b	49.00 a	5842 a
DN-69	9.03 b	13.80 b	141.3 d	57.97 c	97.69 b	41.67 c	4517 c
DN-89	8.50 bc	14.43 ab	141.7 d	49.93 d	97.33 b	46.67 b	4828 b
DN-88	8.73 bc	14.19 ab	146.0 c	58.83 c	88.30 c	43.00 c	4761 b
LSD	0.5711	0.6468	3.279	1.985	1.150	1.975	123.3

Mean followed by different letters are significant at 0.05 % probability level.

Table 2. Mean square values for various agronomic traits in wheat.

Sources of variation	d.f.	Tillers plant $^{-1}$	Spike length	Days to maturity	Grains spike^{-1}	Plant height	1000-grain weight	Grain yield Kg ha^{-1}
Replication	2	0.122	0.144	1.867	0.305	0.138	5.267	182.867
Genotype	4	1.089**	1.079**	90.833**	275.658**	116.845**	25.900**	7938.233**
Error	8	0.092	0.118	3.033	1.112	0.373	1.100	4285.283
CV%		3.42	2.45	1.19	1.71	0.63	2.32	1.32

It is clear from the Table 1 that maximum number of tillers plant^{-1}were observed in DN-76 (9.80), which differed significantly from DN-69 (9.033), DN-89 (8.500) and DN-88 (8.733). The minimum number of tillers plant^{-1} was observed in DN-84 (8.233). These results agree with Cooper et al., 2013; Baker et al., 2000; Pawar et al., 2002; Patil and Jain, 2002; Ghimiray and Sarkar, 2002; Arya et al., 2005; Shahnaz et al., 2005 and Bhutta et al., 2006, who concluded that maximum number of productive tillers plant^{-1} is major yield contributory parameter. It might be due to the variation in genetic constitution of different lines.

3.2. Spike Length (cm)

Spike length is also a parameter representing the yield potential of a line/variety. Data recorded showed a considerable variation among different lines of wheat as shown in Table 1. The maximum spike length was recorded in DN-76 (14.61 cm) and minimum spike length was recorded in DN-84 (13.10 cm). The differences observed were due to variation in genetic constitution. These results agree with Ashraf et al., 2002; Pawar et al., 2002; Shahid et al., 2002; Golabady and Arzani, 2003, Xu et al., 2005, they also observed significant differences in spike length of different varieties.

3.3. Days to maturity

Data regarding days to maturity are presented in Table 1. It is clear from the data that number of days to maturity significantly varied in different lines. Maximum numbers of days for maturity were recorded in DN-76 (154.0) which significantly differed from all other lines. Minimum numbers of days to maturity were observed for DN-89 (141.7). For Dn-84 were 150.3, for DN-69 were 141.3 and for DN-88 146.0 were recorded. Patil and Jain, 2002; Golabady and Arzani, 2003; Munawar et al., 2003 and Singh et al., 2003, who also recorded significant differences among varieties/lines.

3.4. Number of grains Spike^{-1}

The number of grains spike^{-1} also varied significantly among the tested lines. The data given in the Table 1 revealed that DN-76 showed maximum number of grains spike^{-1} (75.10). While DN-84 has 66.93 grains spike^{-1} in DN-88 were 58.83, in DN-69 were 57.97. Minimum numbers of grains spike^{-1} were recorded in DN-89 (49.93). Significant variation in number of grains spike^{-1} were also observed by Liu , 1989; Phadnawis et al., 2002; Munawar et al., 2003; Jamali et al., 2003; Arya et al., 2005; Shahnaz et al., 2005.

3.5. Plant Height at Maturity (cm)

The data recording plant height among the lines have been presented in Table 1. The maximum plant height was observed in DN-84 (105.9 cm), which significantly differed from all lines. The minimum plant height was observed in DN-88 (88.30 cm). Plant height in DN-76 was recorded 98.06 which was significantly similar to DN-69 having plant height 97.69 cm and in DN-89 plant height was 97.33 cm. These results agree with Shah et al., 1988; Akber et al., 1995; Pawar et al., 2002; Kumar and Shukla, 2002; Munawar et al., 2003; Okuyama et al., 2004; Asif et al., 2004; Shahnaz et al., 2005; Xu et al., 2005, who found significant differences in plant height. However these results are contradictory of those of Liu (1989) and Patil and Jain (2002) who found non-significant differences in plant height at maturity.

3.6. 1000-grain weight (g)

The data presented in Table 1 indicates that maximum grain weight was recorded in DN-76 (49.00) which significantly varied from DN-84 (46.00), DN-89 (46.67), DN-88 (43.00), DN-69 (41.67) and in DN-88 (43.00). The minimum 1000-grain weight was recorded in DN-69 (41.67). Statistical analysis indicated that non-significant differences were observed between DN-84 and DN-89 and also between DN-88 and DN-69 for thousand grain weight. These results agree with Baker et al., 2000; Phadnawis et al., 2002; Singh et al., 2003, who reported significant differences among tested varieties which were contributing towards yield. However these results were contradictory with the results of Patil and Jain (2002) who found non-significant variation in 1000-grain weight.

3.7. Grain yield (kg ha^{-1})

The data in Table 1 is evident that significant variation in grain yield (kg ha^{-1}) was observed among different lines. DN-76 produced maximum grain yield

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(5842 kg ha^{-1}), which significantly varied from all other lines. The minimum grain yield kg ha^{-1} was recorded in DN-69 (4517 kg ha^{-1}) . The statistical analysis showed that variation among lines DN-84 , DN-89 and DN-88 was non-significant. The results of this experiment are quite in line with the findings of Pawar et al., 2002; Jagdish and Harsh (2002); Munawar et al., 2003; Asif et al., 2004; Arya et al., 2005; Bhutta (2006), who recorded significant differences in grain yield. These results are contradictory to the findings of Ghimiray and Sarkar (2002) and Singh et al., 2003, who found non-significant differences in grain yield among tested varieties. DN-76 produced maximum number of tillers $plant^{-1}$, number of grains $spike^{-1}$, 1000-grain weight which ultimately resulted in maximum yield kg ha^{-1}.

4. Conclusion

The differences observed in the present study for all investigated traits are the result of genetic variability of cultivars. The results in the present research study showed moderate to high genetic variation for most of characters studied. From the summarized results it is clear that DN-76 has best genetic constitution of yield contributory agronomic traits i.e. number of tillers $plant^{-1}$, spike length, number of grains $spike^{-1}$, 1000-grain weight and grain yield kg ha^{-1} resulting in maximum yield that showed significant and positive variation in all the traits tested . It showed most suitability for selection among all the lines tested under the agro-climatic conditions of Dera Ismail Khan. The present study delivered considerable information which could be very useful in genetic improvement of bread wheat. The information acquired from this research study appears to be of great value for the development of high yielding wheat genotype having better genetic constitution and best adapted to agro-climatic conditions of a specific region..

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