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Evaluation of genetic variability in durum wheat (*Triticum durum* L.)

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ABSTRACT

Estimation of the variability, heritability and genetic advance in the durum wheat genotypes (*Triticum durum* L.) plays vital role in the plant breeding. Thirty durum wheat genotypes were evaluated at the Wheat Research Station, Vijapur during rabi season of 2016-2017 in a randomized block design with two replications for the estimation of the variability parameters, heritability and genetic advance. The result showed, all the genotypes exhibited wide range of variation for all the traits except for number of tillers per meter, indicating the presence of enough genetic variability in the material under study. In variability analysis of the genotypic coefficient of variation were moderate for grain yield per plot and number of grain per spike, while the estimates of phenotypic coefficient of variation were high for grain yield and moderate for number of tillers per meter, number of grain per spike and spike length. Heritability estimates were highest for days to heading, number of grain per spike, thousand grain weight, spike length, grain yield per plot and days to maturity and the Genetic advance percent of mean were highest for grain yield per plot and number of grain per spike. In the present study, result based on high variability and high heritability coupled with high genetic advance percent of mean for grain yield per plot and number of grain per spike suggesting selection for these traits would give good response.

Key words: *Triticum durum*, PCV, GCV, Heritability, Genetic advance

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Wheat is one of the most important and widely cultivated crops in the world, used mainly for human consumption and support nearly 35% of the world population (Mohammadi-joo *et al.*, 2015) and providing 20 per cent of the total food calories. Wheat is the second most important staple food next to rice. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. It is known for its remarkable adoption to a wide range of environments and its role in the world economy.

Durum wheat (*Triticum durum L.*) belonging to tetraploid group, is the second most important wheat species, and widely grown in the semi-arid tropics of most parts of the world, including India. It is being cultivated in an approximate 10 to 11% of the world wheat area and accounting for about 8% of the total wheat production (Ganeva *et al.*, 2011). World production of durum wheat ranges from 30-35 million tonnes. More than 80 per cent of the total product is consumed in the country of production, with only Canada, USA and Argentina being mainly exporters. Durum wheat accounts for only 4 per cent of the total world production. Nearly 10-12 million tonnes of durum, valued around US $ 2600 million is traded annually (Singh *et al.*, 2011).

Durum wheat serves as the raw material for numerous foods, such as, macaroni, semolina and pasta products in the nourishment of world population. Normally, durum wheat has higher feeding value in terms of quality traits compared to bread wheat.

The study of genetic variability reveals about the presence of variation in their genetic constitution

and provides the basis for effective selection. Reduction in the genetic variability makes the crops increasingly vulnerable to diseases and adverse climatic changes (Aremu, 2012). Therefore, the information about degree of genetic variability and divergence present in wheat help in selecting the parents for evolving superior varieties. In successful breeding program, genetic variability play a vital role, as we know the plant with more diversity or variability has the greater chance of exploiting, to generate productive recombination and the broad sense variability in segregating generation during genetic improvement. Hence, heritability estimates provide an indication of the expected response to selection in a population. Information on the nature and magnitude of heritability in a population is one of the prerequisites for successful breeding programs in selecting genotypes with desirable characters (Amin *et al.*, 1992). There is a direct relationship between heritability and response to selection, which is referred to as genetic progress. Moreover, genetic advance estimates give a clear picture of segregating generations, to make selection effective (Saleem *et al*, 2016).

This study is aimed to estimate variability and genetic parameters, for yield and its component characters. These values will help in making effective selection for the improvement of the characters under study.

MATERIALS AND METHODS

Thirty durum wheat genotypes (Table 3) were evaluated for variability, heritability and genetic advance, for eight yield contributing traits. The experiment was conducted at the research farm, Wheat Research Station, Vijapur (latitude 23.350 N, longitude 072.550 E and altitude 126 m above sea level) in rabi season of 2016 to 2017. The annual average temperature of the study area was 31.8°C and 15.9°C with maximum and minimum temperature, respectively, with the soil type classified as sandy loam soil with a pH of 7.74. They were evaluated in randomized block design with two replications. In this experiment, each genotype was sown in four rows of 5.0 meter length and 20 cm apart, with seed rate of 120 kg/ha. Standard agronomic practices were adopted in experiment to raise a good crop. Observations were recorded at maturity, in which five plants were selected randomly from each genotype per replication for agronomic data and observations on days to heading and days to maturity were recorded on plot basis.

The analysis of variance for RBD was carried out by linear model suggested by Panse and Sukhatme (1985). The GCV and PCV, which measures the magnitude of genotypic and phenotypic variation present in a particular character, were estimated as per the formula suggested by Burton and DeVane (1953). The expected genetic advance under selection (GA) and heritability were estimated as per the formula described by Allard (1960).The genetic advance expressed as percentage of mean was computed by method suggested by Johnson *et al.*, (1955).

RESULTS AND DISCUSSION

Mean values:

For days to heading, three genotypes viz., VD 16-11, VD 16-21 and VD 16-9 showed earlier heading than other genotypes. Three genotypes viz., VD 16-13, VD 16-30 and VD 16-26 recorded more number of tillers per meter (> 80) and for spike length, the strains VD 16-19, VD 16-26 and VD 16-4 produced more spike length (> 8.5 cm) as compared to other genotypes.

For Number of grain per spike, three genotypes viz., VD 16-4, VD 16-7 and VD 16-6 recorded more number of grains per spike (> 40). Three strains viz., VD 16-22, VD 16-9 and VD 16-17 showed high thousand grain weight (> 60.0 g).

For grain yield per plot VD 16-19 recorded highest grain yield (1.828 Kg) followed by VD 16-29 (1.605 Kg) and VD 16-8 (1.598 Kg).

Analysis of variance

In present study, 30 genotypes of durum wheat were studied to assess their genetic potential. Analysis of variance (ANOVA) Table 1 for days to heading, days to maturity, plant height, spike length, number of grain per spike, thousand grain weight and grain yield per plot showed highly significant differences between genotypes indicated the presence of sufficient variability among the genotypes (Alam *et al.*, 2013; Desheva & Cholakov, 2014).

The mean values of days to heading, ranged from 51.00 to 67.00 with the mean value of 58.15, days to maturity 102.00 to 108.00 with the mean value of 105.91, plant height 50.50 to 90.25 cm with the mean value of 71.38 cm, number of tillers per meter 51.00 to 90.00 with the mean value of 70.52, spike length 6.40 to 9.30 cm with the mean value of 7.39 cm, number of grain per spike ranged from 17.00 to 51.00 with the mean value of 36.51, thousand grain weight varied from 47.80 to 65.00g with the mean value of 55.57g and grain yield per plot varied from 0.858 to 1.828 kg with the mean value of 1.220 kg. Thus, these results indicate the presence of wide range of phenotypic variability in the material.

The genotypic coefficient of variability (GCV) ranged from 1.40% for days to maturity to 19.17% for grain yield per plot, whereas, phenotypic coefficient of variability (PCV) ranged from 1.73% days to maturity to 23.00% for grain yield per plot (Table 2). The values of GCV were moderate for grain yield per plot (19.17%) and number of grain per spike (14.70%) and low for days to maturity (1.40%), plant height (5.78%), thousand grain weight (5.86%), number of tillers per meter (6.62%), days to heading (8.01%) and spike length (9.91%). The values of PCV was high for grain yield per plot (23.00%), moderate for number of tillers per meter (16.95%), number of grain per spike (16.58%) and spike length (11.78%) and low for days to maturity (1.73%), thousand grain weight (6.93%), days to heading (8.28%) and plant height (9.74%) (Table 2).

Genotypic and phenotypic coefficients of variation are used to measure the variability that exists in a given population (Abinasa *et al.*, 2011). Phenotypic coefficient of variability and GCV values of approximately more than 20% are regarded as high whereas values less than 10% are considered low and values in between are as medium (Deshmukh *et al.*, 1986).

The high PCV and moderate GCV observed for grain yield per plot and number of grain per spike and grain yield per plot are evident of their high variability that in turn it offers good scope for selection. The lowest GCV and PCV indicating difficulty of improvement for days to heading, days to maturity, plant height and thousand grain weight through selection. The value PCV were higher than GCV indicates role of environmental factors in the expression of the traits under study. These findings were in agreement with those of Gashaw *et al.* (2010), Abinasa *et al.* (2011), Desheva & Cholakov (2014), Kumar *et al.* (2014), Desheva & Kyosev (2015).

Heritability and Genetic Advance expressed as percentage of mean

In the present study heritability estimated ranged from 15.25% to 93.68 % (Table 2). High estimates of heritability (above 60%) in broad sense were recorded for six characters studied (days to heading – 93.68%, number of grain per spike – 78.59%, thousand grain weight – 71.66%, spike length – 70.76%, grain yield per plot – 69.48% and days to maturity – 65.58%). The expected genetic advance expressed as a percentage of the mean varied between 2.34% for days to maturity and 32.92% for grain yield per plot. Genetic advance as percentage of mean was high for grain yield per plot (32.92%) followed by number of grain per spike (26.85%). Genetic advance as percentage of mean was moderate for spike length (17.17%), days to heading (15.97%) and thousand grain weight (10.23%) (Table 2).

High heritability along with high genetic advance as percent of mean was noticed for number of grain per spike and grain yield per plot suggesting predominance of additive genetic effects and selection could be effective in early segregating generations for these traits and the possibility of improving durum wheat grain yield through direct selection for grain yield related traits.

High heritability along with moderate genetic advance percent of mean was noticed for days to heading, spike length and thousand grain weight suggesting predominance of additive and non-additive gene action in the expression of these traits. Therefore, these traits can be improved by mass selection. High heritability accompanied by low genetic advance percent of mean was recorded for days to maturity indicates predominance of non-additive genetic source of variation and improvement of the trait through selection may not be effective in this population, which could be exploited through heterosis breeding.

Naik *et al.* (2015) reported that high genotypic coefficient of variation along with high heritability

and genetic advance percent of mean provide better information than other parameters alone. In the present study, grain yield per plot showed high genetic advance percent of mean in conjunction with high heritability and moderate genotypic coefficient of variation (Table 2). Similar results have been reported by Ali *et al.* (2008). The knowledge on heritability of traits is helpful to decide the selection procedure to be followed to improve the trait in a situation. On the basis of results as summarized above, it is concluded that traits like grain yield per plot and number of grains per spike can be considered as suitable selection criteria for the development of high yielding durum wheat varieties.

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Table 1 Analysis of variance for morphological characters in durum wheat

Source of Variation	d.f.	Days to heading	Days to maturity	Plant height (cm)	Number of tillers/m	Spike length (cm)	Number of grains/ spike	Thousand grain weight (g)	Grain yield/ plot (Kg)
Replication	1	0.02	2.02	0.82	608.02	0.22	294.82	31.72	0.00
Treatments	29	44.87**	5.56**	65.40*	164.70	1.29**	66.93**	25.43**	0.13**
Error	29	1.46	1.15	31.33	121.12	0.22	8.02	4.19	0.02

* and ** indicates Significant at 5% and 1% levels of probability respectively

Table 2 Genetic parameters for yield and its attributing characters in durum wheat

Variability parameters	Mean	Range		PCV (%)	GCV (%)	H^2 bs (%)	GA	GAM (%)
		Min	Max					
Days to heading	58.15	51.00	67.00	8.28	8.01	93.68	9.29	15.97
Days to maturity	105.91	102.00	108.00	1.73	1.40	65.58	2.47	2.34
Plant height (cm)	71.38	50.50	90.25	9.74	5.78	35.82	5.04	7.07
Number of tillers/m	70.52	51.00	90.00	16.95	6.62	15.25	3.75	5.32
Spike length (cm)	7.39	6.40	9.30	11.78	9.91	70.76	1.27	17.17
Number of grain/spike	36.91	17.00	51.00	16.58	14.70	78.59	9.91	26.85
Thousand grain weight (g)	55.57	47.80	65.00	6.93	5.86	71.66	5.68	10.23
Grain yield/ plot (Kg)	1.22	0.858	1.828	23.00	19.17	69.48	0.40	32.92

Table 3 Mean morphological performance of different genotypes of *T.durum* wheat

S. N.	Genotype	Characters							
		Days to heading	Days to maturity	Plant height (cm)	Number of tillers/m	Spike length (cm)	Number of grains/ spike	Thousand grain weight (g)	Grain yield/ plot (Kg)
1	VD 16-4	63	106	51.50	52.00	8.90	51	53.50	1.175
2	VD 16-5	58	107	63.25	63.00	7.50	37	53.00	1.220
3	VD 16-6	58	103	61.50	62.00	7.00	42	54.70	0.958
4	VD 16-7	64	107	50.50	51.00	7.30	43	55.60	0.858
5	VD 16-8	55	103	73.50	74.00	6.40	37	55.00	1.598
6	VD 16-9	52	106	59.75	60.00	7.20	33	64.30	1.045
7	VD 16-10	58	107	71.25	71.00	6.80	27	57.50	1.400
8	VD 16-11	51	106	66.50	67.00	6.80	34	57.80	0.910
9	VD 16-12	66	108	69.25	69.00	7.60	36	47.80	0.928
10	VD 16-13	61	106	90.25	90.00	7.20	35	52.80	1.590
11	VD 16-14	67	108	73.75	74.00	6.60	17	60.10	1.090
12	VD 16-15	56	105	77.00	77.00	7.50	30	53.80	0.990
13	VD 16-16	63	108	76.75	77.00	6.50	32	54.40	1.200
14	VD 16-17	53	104	61.50	62.00	7.30	42	61.70	0.943
15	VD 16-18	53	103	74.50	75.00	6.90	33	54.40	1.060
16	VD 16-19	56	107	81.25	81.00	9.30	40	56.80	1.828
17	VD 16-20	55	105	75.25	75.00	6.60	34	61.30	1.478

18	VD 16-21	51	104	68.25	68.00	6.90	27	56.50	1.428
19	VD 16-22	55	105	66.50	67.00	8.50	34	65.00	1.515
20	VD 16-23	65	108	74.00	74.00	6.40	28	49.90	1.118
21	VD 16-24	58	106	69.25	69.00	6.90	26	57.20	1.053
22	VD 16-25	53	103	65.25	65.00	7.70	35	56.00	1.073
23	VD 16-26	58	106	83.50	84.00	9.00	30	53.10	1.558
24	VD 16-27	53	102	70.75	71.00	7.90	40	53.00	0.928
25	VD 16-28	56	105	69.75	70.00	8.20	31	57.60	1.008
26	VD 16-29	58	105	68.25	68.00	7.50	41	53.40	1.605
27	VD 16-30	59	107	85.00	85.00	7.10	33	59.10	1.205
28	VD 16-31	55	106	60.00	60.00	7.80	42	58.90	1.200
29	GDW 1255	62	107	81.25	81.00	6.50	38	57.80	1.283
30	HI 8737	66	108	68.75	69.00	6.90	33	56.80	1.283