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**AB Malbhage**
Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat, India

**MM Talpada**
Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat, India

**VS Shekhawat**
Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat, India

**DR Mehta**
Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat, India

**Corresponding Author:**
**AB Malbhage**
Department of Genetics and Plant Breeding, Junagadh Agricultural University, Junagadh, Gujarat, India

# Genetic variability, heritability and genetic advance in durum wheat (*Triticum durum* L.)

**AB Malbhage, MM Talpada, VS Shekhawat and DR Mehta**

## Abstract
An experiment was carried out to assess genetic variability with respect to grain yield and its attributes with a set of 40 genotypes of durum wheat (*Triticum durum* L.). The analysis of variance revealed highly significant differences among the mean square due to genotypes for all the characters studied. The values of phenotypic coefficient of variation were slightly higher than that of genotypic coefficient of variation for all the traits studied, indicating less effect of environment on the expression of characters studied. High genotypic and phenotypic coefficient of variation were observed for grain yield per plant followed by grain weight per main spike, number of grains per main spike, 100-grain weight, number of productive tillers per plant and biological yield per plant. High heritability coupled with high to moderate genetic advance expressed as per cent of mean were observed for days to 50% flowering, number of productive tillers per plant, plant height, ear length, grain yield per plant, biological yield per plant and 100-grain weight, which may be attributed to the preponderance of additive gene action and possessed high selective value and thus, more emphasis should be given to these characters for genetic improvement of grain yield.

**Keywords:** Variability, heritability, genetic advance, *triticum durum*.

## Introduction
Wheat (*Triticum spp*.) is accorded a premier place among the cereals because of the vast acreage devoted to its cultivation, its high nutritive value and its association with some of the earliest and most important civilization of the world. Three species of wheat *viz*., *Triticum aestivum* (bread wheat), *Triticum durum* (macaroni wheat) and *Triticum dicoccum* (emmer wheat) are presently grown as commercial crop in India. For commercial production and human consumption, durum wheat is the second most important *Triticum* species, next to common wheat (*Triticum aestivum*). Tetraploid wheat has been under cultivation in Ethiopia since ancient times. Among the tetraploid, durum wheat (*Triticum turgidum* L. var. *durum*) is the predominant species. Durum wheat (*Triticum durum*) is a monocotyledonous plant of the Poaceae family. It is the only tetraploid (AABB, 2n=4x=28) species of wheat which has commercially a great importance and carries raw material of numerous foods such as macaroni and semolina in alimentation of world population and is a promising and viable alternative crop for farmers (Shewry, 2009) [22]. It is cultivated on 10 to 11 per cent of the world wheat areas and accounting about 8 per cent of the total wheat production (Ganeva *et al*., 2010) [9]. The average world productivity of durum wheat is 25 quintals per hectare (CSA, 2011) [6]. The nutritional composition indicated that 100 g of durum wheat provides 339 calories and it consisted carbohydrate 71 g, protein 14 g, fat 2.5 g, minerals 2 g and considerable proportions of vitamins (thiamine and vitamin-B) and minerals like zinc and iron (Wolde *et al*., 2016) [30].
Availability of sufficient genetic variability is very important in crop improvement programme. The choice of parents is of paramount importance in breeding programme. For effective selection, information on nature and magnitude of variation in population, association of characters with grain yield and among themselves and the extent of environmental influence on the expression of these characters are necessary (Yagdi, 2009) [33]. Therefore, it is essential for a breeder to measure the variability with the help of parameters like phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. Therefore, study of genetic variability of grain yield and its component characters among durum wheat genotypes provides a strong basis for selection of desirable genotypes for augmentation of yield and other agronomic characters.

## Materials and Methods
The experimental material consisted of 40 diverse genotypes of wheat (*Triticum durum*) representing different geographic origin were sown in a randomized block design with three

replications at Wheat Research Station, Junagadh Agricultural University, Junagadh. Each line was sown in a single row plot of 3.0 m length with a spacing of 22.5 cm × 10 cm. The genotypes were randomly allotted to the plots in each replication. All the recommended agronomical practices along with necessary plant protection measures were followed timely for the successful raising of the crop.

Five competitive plants per genotype in each replication were randomly selected for recording observations on different characters *viz*., days to 50% flowering, days to maturity, grain filling period (Days), plant height (cm), number of productive tillers per plant, ear length (cm), number of grains per main spike, grain weight per main spike (g), grain yield per plant (g), biological yield per plant (g), harvest index (HI) (%), 100-grain weight (g) and replication-wise mean values of five randomly selected plants in each entry were used for the statistical analysis. The analysis of variance for randomized block design (RBD) was done for each character as per Panse and Sukhatme (1967) [14]. The genotypic and phenotypic coefficient of variation, which measures the magnitude of genotypic variation and phenotypic variation, respectively present in a particular character, were estimated as per the formula suggested by Burton and De Vane (1953) [5]. The expected genetic advance at 5% selection intensity and heritability in broad sense was estimated by using formula as suggested by Allard (1960) [2]. The genetic advance expressed as per cent of mean was computed by method suggested by Johnson *et al.,* (1955) [10].

**Results and Discussion**

The present experimental material showed wider range of phenotypic variation for grain weight per main spike, grain yield per plant and number of grains per main spike as revealed by high values of coefficient of range. The better index for measuring the genetic variation is genetic coefficient of variation (GCV) as described by Burton and De Vane (1953) [5] for comparing the genetic variability present in different traits. The estimates of genotypic and phenotypic coefficient of variability indicated that the values of phenotypic coefficient of variation were slightly higher than that of genotypic coefficient of variation for all the traits studied, indicating less effect of environment on the expression of characters studied. Similar results have also been reported by Shah *et al*. (2015) [20]; Wolde *et al.* (2016) [30] and Kabir *et al.* (2017) [11]. The highest genotypic coefficient of variation and phenotypic coefficient of variation was observed for grain yield per plant followed by grain weight per main spike, number of grains per main spike, 100-grain weight, number of productive tillers per plant and biological yield per plant. High magnitude of genotypic coefficient of variation indicated the presence of wide variation for the characters under study to allow further genetic improvement by selection of the individual traits. High estimates of genotypic coefficient of variation in wheat have been reported for grain yield per plant by Demelash *et al*. (2013) [8] and kumar *et al*. (2014) [12]. High estimates of GCV for number of grains per spike were reported by Yadav *et al*. (2006) [31]; Sharma *et al.* (2006) [21] and Sidharthan and Malik (2006) [23] as well as for 100-grain weight by Das and Rahman (1984) [7] and Pathak and Neema (1985) [16].

The very high heritability (broad sense) was observed for days to 50% flowering followed by days to maturity, grain filling period, number of productive tillers per plant and plant height. High heritability estimates were observed for ear length, grain yield per plant, biological yield per plant and 100-grain weight. The high heritability values for different traits indicated that heritability may be due to higher contribution of genotypic component in these traits and also reported by Patel and Jain (2002) [15], Abinasa *et al*. (2011) [1], Thanna *et al.* (2011) [29], Wolde *et al*. (2016) [30] and Rathwa *et al*. (2018) [18]. High magnitude of heritability has also been reported for days to 50% flowering (Singh *et al*., 2001 and Pawar *et al*., 2003) [27, 17]; days to maturity (Sidharthan and Malik, 2007 and Singh *et al.*, 2013) [24, 26]; plant height (Bhusan *et al.*, 2013 and Kumar *et al*., 2014) [4, 12]; grain yield per plant (Thanna *et al*., 2011 and Bhusan *et al.*, 2013) [29, 4]; and biological yield per plant (Sidharthan and malik, 2007 and Bhusan *et al.*, 2013) [24, 4].

The genetic advance expressed as per cent of mean was the highest for grain yield per plant followed by number of productive tillers per plant and 100-grain weight. Grain weight per main spike, number of grains per main spike, biological yield per plant, plant height, ear length, harvest index and days to 50% flowering recorded moderate values of genetic advance expressed as percentage of mean. High values of genetic advance expressed as percentage of mean have been reported in wheat for grain yield per plant (Singh *et al*., 2012 and Bhushan *et al.*, 2013) [25, 4]; number of grain per main spike (Singh and Sharma, 2007 and Barnwal *et al.*, 2012) [28, 3]; and biological yield per plant (Singh *et al.*, 2012 and Bhushan *et al.*, 2013) [25, 4].

Heritability in broad sense and genetic advance as per cent of mean are direct selection parameters that provide index of transmissibility of traits which gives indication about the effectiveness of selection in improving the characters. The heritability of a character describes the extent to which it is transmitted generation after generation. The genetic advance is the further estimation of expected gain resulting from selection pressure in breeding material. High heritability associated with high genetic advance for different yield components have a better scope for selecting high yielding genotypes (Yadawad *et al*., 2015) [32]. In the present study, high estimates of heritability coupled with high to moderate genetic advance as per cent of mean was observed for days to 50% flowering, number of productive tillers per plant, plant height, ear length, grain yield per plant, biological yield per plant and 100-grain weight which may be attributed to the preponderance of additive gene action and possess high selective value and thus, selection pressure could profitably be applied on these characters for their rationale improvement (Panse, 1957) [13]. Similar kinds of results were also reported by Sen and Toms (2007) [19] for grain yield per plant and Singh and Sharma (2007) [28] for plant height and biological yield per plant. High estimates of heritability coupled with low genetic advance as per cent of mean was expressed by days to maturity and grain filling period inferred that both traits were regulated by non-additive gene action and presence of high genotype x environment interaction.

**Table 1:** Phenotypic range, coefficient of range, phenotypic and genotypic coefficients of variation, heritability and genetic advance for various characters in durum wheat

| Sr. No. | Characters | Phenotypic range | Coefficient of range (%) | Mean ± S.E. | Phenotypic coefficients of variation (%) | Genotypic coefficients of variation (%) | Heritability in broad sense (%) | Genetic advance | G. A. expressed as per cent of mean (%) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Days to 50% flowering | 56.00-71.67 | 12.27 | 61.23 ± 0.41 | 6.51 | 6.40 | 96.83 | 7.95 | 12.98 |
| 2 | Days to maturity | 92.33-101.00 | 4.48 | 95.63 ± 0.51 | 2.65 | 2.48 | 87.89 | 4.59 | 4.80 |
| 3 | Grain filling period (days) | 27.33-34.33 | 11.35 | 30.75 ± 0.37 | 5.43 | 5.00 | 84.87 | 2.92 | 9.49 |
| 4 | Plant height (cm) | 61.49-92.57 | 20.17 | 74.96 ± 1.58 | 8.61 | 7.80 | 82.03 | 10.90 | 14.55 |
| 5 | No. of productive tillers per plant | 2.60-4.20 | 23.53 | 3.38 ± 0.11 | 13.61 | 12.34 | 82.18 | 0.78 | 23.04 |
| 6 | Ear length (cm) | 5.96-9.28 | 21.78 | 7.23 ± 0.19 | 8.95 | 7.69 | 73.85 | 0.98 | 13.61 |
| 7 | No. of grains per main spike | 29.53-59.13 | 33.38 | 43.37 ± 3.35 | 18.57 | 12.88 | 48.15 | 7.99 | 18.42 |
| 8 | Grain weight per main spike (g) | 1.05-2.55 | 41.56 | 1.94 ± 0.18 | 21.00 | 13.57 | 41.74 | 0.35 | 18.05 |
| 9 | Grain yield per plant (g) | 4.01-9.45 | 40.46 | 6.56 ± 0.39 | 19.18 | 16.23 | 71.57 | 1.86 | 28.28 |
| 10 | Biological yield per plant (g) | 11.37-17.54 | 21.33 | 13.99 ± 0.57 | 12.95 | 10.89 | 70.61 | 2.64 | 18.84 |
| 11 | Harvest index (%) | 0.35-0.54 | 20.81 | 0.47 ± 0.02 | 11.59 | 8.15 | 49.44 | 0.06 | 11.80 |
| 12 | 100-grain weight (g) | 2.87-5.17 | 28.55 | 4.36 ± 0.22 | 15.51 | 12.74 | 67.41 | 0.94 | 21.55 |

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