Biological Forum – An International Journal **15(7): 333-337(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Assessment of variability Parameters in Indigenous and Exotic Genotypes of Durum Wheat (*Triticum durum* Desf.)

Avadhoot B. Dharmadhikari[1*], Abhay Dashora[2], Urmila[3], Himansuman[4], Parul Gupta[4] and Payal Agarwal[1]

[1]M.Sc. Scholar, Department of Genetics and Plant Breeding,
Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India.
[2]Assistant Professor, Department of Genetics and Plant Breeding,
Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India.
[3]Technical assistant,AICRP on Wheat and Barley,
Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India.
[4]Ph.D. Scholar, Department of Genetics and Plant Breeding,
Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India.

(Corresponding author: Avadhoot B. Dharmadhikari)*
(Received: 02 May 2023; Revised: 23 May 2023; Accepted: 02 June 2023; Published: 05 July 2023)
(Published by Research Trend)

ABSTRACT: Durum wheat is a versatile cereal crop, offers a rich source of protein, carbohydrates and minerals making it a valuable addition to a balanced diet. To study the genetic variability, genotypic and phenotypic coefficient of variation, broad sense heritability and genetic advance in durum wheat, a field experiment was conducted during *Rabi*, 2022-23 at RCA, MPUAT, Udaipur to gain a deeper understanding of the genetic makeup of durum wheat. The experiment laid out in a Randomized Block Design (RBD) with three replications, comprised of 36 genotypes and observations on 15 traits of durum wheat were recorded. In this experiment, analysis of variance indicated that significant variation was present among the different genotypes of the durum for all the traits under study. Among the traits studied, grain yield per plant, grain weight per spike, number of grains per spike, peduncle length and 1000-grain weight displayed the highest values for both genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV). Additionally, traits such as days to maturity, number of grains per spike, 1000-grain weight and length of the main spike exhibited high heritability and high genetic advance. The combination of high heritability and high genetic advance provides a clear understanding of the potential of the traits for selection in crop improvement programs. These findings can help in the finding potential donor genotypes those can be further explored for hybridization and genetic improvement strategies to enhance the desired traits in durum wheat.

Keywords: *Triticum durum*, Variability, Heritability, Genetic gain, GCV, PCV.

INTRODUCTION

Durum wheat (AABB; 2n=4X =28) is the second most widely cultivated wheat species worldwide and within national agricultural landscapes, surpassed only by bread wheat. It holds a prominent position as the primary cereal crop in the Mediterranean region, accounting for approximately two-thirds of the global durum wheat production. This ancient crop has a long history of cultivation, dating back to ancient times and it is predominantly grown in the Middle East, Near East and North Africa regions which are considered the centres of origin and diversification (Harlan, 1986).

Although durum has a lesser growing area and lower annual production than hexaploid bread wheat, it still has worth as a considerable source of food for humans. It is utilized almost everywhere in the world to prepare various food products, including pasta, couscous, unleavened bread, bulgur and mote, among others (Nachit, 1992). Compared to the softer commercially available bread wheat, which lacks the strength and consistency of durum, durum is perfect for creating bread and pasta due to its high protein content, homogeneous golden colour from enhanced levels of yellow pigments and excellent gluten strength. Due to unique qualities like disease resistance, high yield and the possibilities for value addition through foods like pasta and traditional Indian recipes, durum wheat is growing more and more popular in India on a regular basis.

Sufficient genetic variability plays a crucial role in crop improvement programs and selecting appropriate parents is of utmost importance. In order to make effective selections, it is essential to gather information about the extent and nature of variation within the population, the relationship between different traits and grain yield and the influence of environmental factors on these traits' expression (Yagdi, 2009). Therefore, breeders need to assess variability using parameters such as phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. Consequently, studying the genetic variability of grain yield and its component traits among different genotypes of durum wheat provides a solid foundation for identifying and selecting promising genotypes that can contribute to improved yield and other desired agronomic characteristics.

MATERIAL AND METHODS

The field study was conducted at Instructional farm, Rajasthan College of Agriculture, Udaipur located at the southern parts of Rajasthan to analyse the genetic variability, GCV, PCV, broad sense heritability and genetic advance during *Rabi*, 2022-23. A total of 36 genotypes of durum wheat were obtained from various wheat research institutes *i.e*., IARI-RS Indore and MPUAT, Udaipur including some international organizations like CIMMYT and ICARDA. A list of genotypes with their places of origin is given in Table 1. The field experiment was conducted using a Randomized Block Design with three replications. Genotypes were planted, with a spacing of 20 cm between rows and 10 cm between plants. The cultivation followed all recommended agronomic practices and plant protection measures to ensure a healthy crop.

The recorded observations encompassed various traits for each genotype, including plant height (cm), number of effective tillers per plant, peduncle length (cm), awn length (cm), length of the main spike (cm), number of spikelets per spike, number of grains per spike, grain weight per spike (g), 1000-grain weight (g), biological yield per plant (g), grain yield per plant (g), harvest index (%) and protein content (%). The data for traits such as days to 50 per cent heading and days to maturity were noted on a whole plot basis. For each genotype, observations were recorded on five randomly selected competitive plants.

The analysis of variance was conducted for each character in accordance with the guidelines provided by Panse and Sukhatme (1985) for the Randomized Block Design. The genotypic and phenotypic coefficient of variation were estimated using the formula proposed by Burton and De Vane (1953). The expected genetic advance at a 5% selection intensity and the broad-sense heritability were determined using the formula suggested by Allard (1960). The genetic advance, expressed as a percentage of the mean, was calculated using the method recommended by Johnson *et al.* (1955).

Table 1: List of 36 durum wheat genotypes along with the places of their origin.

Sr. No.	Genotypes	Place of origin	Sr. No.	Genotypes	Place of origin
1.	HI- 8498	IARI-RS, Indore	19.	PWU-114	MPUAT. Udaipur
2.	HI-8627	IARI-RS, Indore	20.	PWU-115	MPUAT. Udaipur
3.	HI-8713	IARI-RS, Indore	21.	PWU-116	MPUAT. Udaipur
4.	HI-8737	IARI-RS, Indore	22.	GDP-79	CIMMYT
5.	HI-8759	IARI-RS, Indore	23.	GDP-92	ICARDA
6.	HI-8777	IARI-RS, Indore	24.	GDP-119	ICARDA
7.	HI-8802	IARI-RS, Indore	25.	GDP-120	ICARDA
8.	HI-8805	IARI-RS, Indore	26.	GDP-130	Australia
9.	HI-8823	IARI-RS, Indore	27.	GDP-168	Iran
10.	HI-8826	IARI-RS, Indore	28.	GDP-253	ICARDA
11.	HI-8830	IARI-RS, Indore	29.	GDP-327	Spain
12.	PWU-86	MPUAT. Udaipur	30.	GDP-333	CIMMYT
13.	PWU-87	MPUAT. Udaipur	31.	GDP-344	Italy
14.	PWU-88	MPUAT. Udaipur	32.	GDP-348	ICARDA
15.	PWU-110	MPUAT. Udaipur	33.	UAS-466	UAS, Dharwad
16.	PWU-111	MPUAT. Udaipur	34.	MACS-4058	ARI, Pune
17.	PWU-112	MPUAT. Udaipur	35.	AKDW299-16	PDKV, Akola
18.	PWU-113	MPUAT. Udaipur	36.	GW-1339	SDAU, Vijapur

RESULTS AND DISCUSSION

A total of 36 durum wheat genotypes were selected to investigate the genetic variability, genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) across 15 different traits. All the observations between the genotypes were highly significant for all the recorded traits which are depicted in Table 2. Table 3 displays the GCV, PCV, broad sense heritability and response to selection for the traits. The table reveals that significant variations exist among the genotypes for all the recorded traits. This variation is of great importance to plant breeders, as effective selection can only be achieved when there is an adequate level of variability within the breeding population.

The magnitude of the GCV varied from 5.19% to 15.31%. The GCV was recorded highest for the grain yield per plant (15.31%) followed by grain weight per spike (14.96%), number of grains per spike (14.14%), peduncle length (13.31%), awn length (11.28%) and 1000-grain weight (11.05%). Plant height (5.19%) and days to 50 per cent heading (5.47%) exhibited a low genotypic coefficient of variation.

The highest PCV was recorded for grain yield per plant (18.75%) followed by grain weight per spike (18.04%), number of grain per spike (14.55%), peduncle length (13.80%), harvest index (13.75%) and awn length (12.12%). The characters *viz*., days to 50 per cent heading (5.84%) and plant height (6.54%) showed a low phenotypic coefficient of variation.

In general, phenotypic coefficient of variation (PCV) is slightly higher than the genotypic coefficient of variation (GCV) for most of the traits indicating little effect of environmental variations on the characters (Fig. 1). High coefficient of variation in terms of both genotypic and phenotypic value was observed for number of grains per spike, grain weight per spike, peduncle length, grain yield per plant and harvest index. It indicates that selection can be applied on these traits to isolate more promising lines. Similar results for high GCV and PCV values for number of grains per spike and grain weight per spike per spike were reported by Raiyani *et al*. (2015); Malbhage *et al*. (2020), for grain yield per plant by Jat *et al*. (2018). Traits such as plant height and days to 50 percent heading showed low values for both PCV and GCV. These results suggest that breeders should focus on identifying genetic sources with high heritability for these traits in order to effectively improve them.

Table 2: Analysis of variance of the different characters among the genotypes of the Durum wheat.

Sr. No.	Characters	Replication	Genotype	Error
		[2]	[35]	[70]
1.	Days to 50 per cent heading	4.11	61.17**	2.74
2.	Days to maturity	0.86	180.70**	2.78
3.	Plant height (cm)	19.73	85.61**	14.08
4.	Number of effective tillers per plant	0.22	1.47**	0.17
5.	Peduncle length (cm)	2.21	88.34**	2.15
6.	Awn length (cm)	0.36	7.56**	0.37
7.	Length of main spike (cm)	0.04	2.20**	0.05
8.	Number of spikelets per spike	0.14	7.26**	0.35
9.	Number of grains per spike	1.17	151.27**	2.93
10.	Grain weight per spike (g)	0.09	0.50**	0.07
11.	1000-grain weight (g)	0.68	76.48**	1.56
12.	Biological yield per plant (g)	12.94	48.87**	5.69
13.	Grain yield per plant (g)	6.11	21.32**	3.05
14.	Harvest index (%)	5.55	57.85**	11.61
15.	Protein content (%)	0.28	2.02**	0.43

Phenotypic appearance is determined by the interaction of both genotype and environmental factors. Genetic variability, which is the heritable component passed from one generation to the next, plays a crucial role in this process. Heritability alone does not provide a clear indication of the expected gain in the next generation. It should be considered in conjunction with genetic advance. Traits that demonstrate high heritability and substantial genetic advance as a percentage of the mean are valuable tools in the selection process. These traits are typically governed by additive genes and are less influenced by environmental factors.

High heritability was observed for traits *viz*., days to maturity, number of grains per spike, 1000-grain weight, length of main spike, peduncle length, days to 50 per cent heading, number of spikelets per spike and awn length. High genetic advance was observed in traits *viz*., days to maturity, number of grains per spike and 1000-grain weight. These traits are highly reliable during selection process of the genotypes.

The highest genetic advance as a percent of the mean (genetic gain) was recorded for the number of grains per spike (28.30%) followed by peduncle length (26.45%), grain yield per plant (25.73%) and grain weight per spike (25.56%).

Traits such as days to maturity, number of grains per spike, 1000-grain weight and length of the main spike exhibit high heritability estimates coupled with high genetic gains (Fig. 2). This indicates that these traits are primarily governed by additive gene action, suggesting that direct selection would lead to improvements in these traits. The findings for 1000-grain weight are consistent with the research conducted by Patel *et al*. (2018), demonstrating that higher heritability estimates are correlated with genetic gain for days to maturity, number of grains per spike, 1000-grain weight and length of the main spike. In the present experiment, certain genotypes have been identified as potential donors for the enhancement of various traits, as indicated in Table 4.

Table 3: Genetic variability parameters for yield and its contributing traits in durum wheat.

Characters	Potential donors
Days to 50 per cent heading	MACS-4058, GW-1399, PWU-116
Days to maturity	MACS-4058, PWU-88, PWU-113, HI-8498
Plant height	HI-8823, HI-8759, PWU-86, HI-8737
Number of effective tillers per plant	GDP-120, PWU-87, MACS-4058, PWU-110
Peduncle length	MACS-4058, HI-8805, PWU-114, GDP-348
Awn length	MACS-4058, GDP-348, PWU-115, GDP-130
Length of main spike	PWU-87, HI-8713, GDP-130, MACS-4058
Number of spikelets per spike	GDP -333, AKDW299-16, PWU-87, GDP-168
Number of grains per spike	PWU-112, GDP-79, HI-8713, PWU-110
Grain weight per spike	PWU-115, PWU-87, GDP-120, PWU-116
1000-grain weight	PWU-116, MACS-4058, PWU-86, PWU-113
Biological yield per plant	HI-8805, PWU-115, PWU-87, HI-8498
Grain yield per plant	PWU-115, GDP-120, PWU-87, PWU-110
Harvest index	PWU-110, PWU-111, GW-1339, PWU-86
Protein content	UAS-466, HI-8498, HI-8627, HI-8713

Table 4: Potential donor genotypes for yield and other recorded traits.

Sr. No.	Characters	Mean	Range		GCV	PCV	H^2(%)	GA(%)	GG(%)
			Min.	Max.					
1.	Days to 50 per cent heading	80.69	70.33	91.33	5.47	5.84	87.67	8.51	10.55
2.	Days to maturity	119.5	111.33	136.67	6.44	6.59	95.51	15.5	12.97
3.	Plant height (cm)	94.1	74.23	101.90	5.19	6.54	62.87	7.98	8.48
4.	Number of effective tillers per plant	6.52	5.33	7.97	10.11	11.89	72.23	1.15	17.69
5.	Peduncle length (cm)	40.27	30.47	56.77	13.31	13.8	93.04	10.65	26.45
6.	Awn length (cm)	13.72	10.20	16.83	11.28	12.12	86.5	2.96	21.6
7.	Length of main spike (cm)	7.79	6.33	9.77	10.86	11.24	93.34	1.68	21.61
8.	Number of spikelets per spike	18.51	14.67	21.60	8.2	8.8	86.92	2.91	15.75
9.	Number of grains per spike	49.73	35.47	66.40	14.14	14.55	94.4	14.07	28.3
10.	Grain weight per spike (g)	2.55	1.90	3.63	14.96	18.04	68.76	0.65	25.56
11.	1000-grain weight (g)	45.23	34.80	54.77	11.05	11.39	94.13	9.99	22.08
12.	Biological yield per plant (g)	42.53	34.07	51.13	8.92	10.54	71.67	6.62	15.56
13.	Grain yield per plant (g)	16.12	11.43	20.77	15.31	18.75	66.59	4.15	25.73
14.	Harvest index (%)	37.8	30.00	45.00	10.39	13.75	57.03	6.11	16.16
15.	Protein content (%)	11.36	9.47	13.03	6.41	8.64	55.01	1.11	9.79

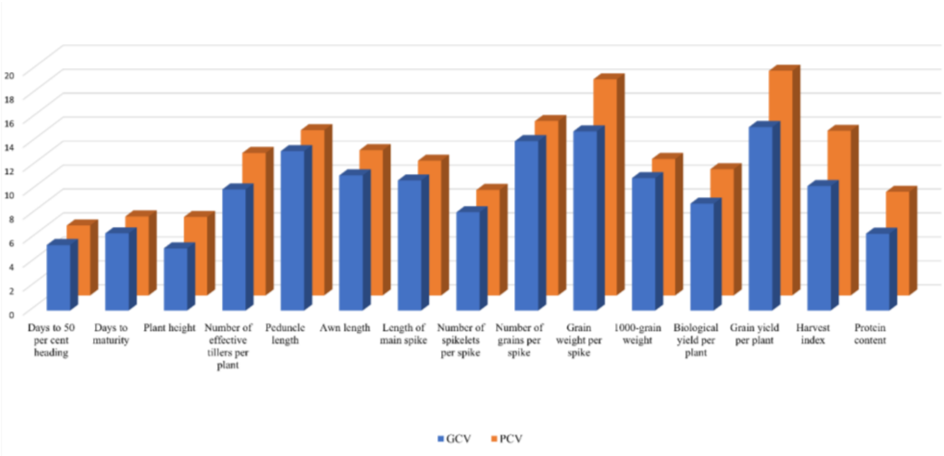

Fig. 1. Genotypic and phenotypic coefficient of variation in 36 genotypes of durum wheat.

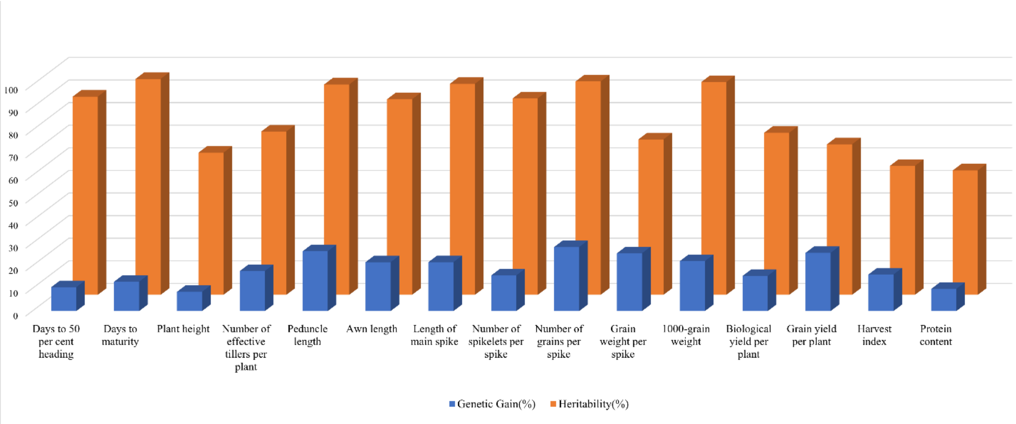

Fig. 2. Heritability and genetic gain for 15 characters in durum wheat.

CONCLUSIONS

Based on the findings of the present study, it can be concluded that the phenotypic coefficient of variation (PCV) slightly surpasses the genotypic coefficient of variation (GCV) for most traits, indicating minimal influence of environmental variations on these characteristics. The traits exhibiting the highest values for both GCV and PCV include the number of grains per spike, grain weight per spike, peduncle length, grain yield per plant and harvest index indicates the presence of wider variability for these traits in the genotypes studied. The combination of the high heritability and high genetic advance provide a clear image of the traits in the selection process for crop improvement programme.

FUTURE SCOPE

The identified potential donor genotypes could be further explored for hybridization and genetic improvement strategies to enhance the desired traits in durum wheat, aiming for increased grain yield, spike characteristics and overall plant performance.

Acknowledgement. The authors are thankful to AICRP on Wheat and Barley, RCA, MPUAT, Udaipur for providing all the research facilities to conduct the experiment.
Conflict of Interest. None.

REFERENCES

Allard, R. W. (1960). Principles of Plant Breeding. John Wiley and Sons, New York, 8-481.

Burton, G. W. and De-Vane, D. E. (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agronomy Journal*, *45*, 478-481.

Harlan, J. R. (1986). Plant Domestication: Diffuse Origin and Diffusion. In: Barigozzi C. ed. *The Origin and Domestication of Cultivated Plants*. Elsevier, Amsterdam: 22-34.

Jat, A., Prasad, S. V., Ambati, D., Singh, J., Gautam, A. and Dubey, V. G. (2018). Genetic variability, heritability and diversity for yield contributing traits in reference varieties of wheat. *Indian Journal of Plant Genetic Resources*, *31*(1), 11-16.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955). Estimates of genetic and environmental variability in soybeans. *Agronomy Journal*, *47*, 14-318.

Malbhage, A. B., Talpada, M. M., Shekhawat, V. S. and Mehta, D. R. (2020). Genetic variability, heritability and genetic advance in durum wheat (*Triticum durum* L.). *Journal of Pharmacognosy and Phytochemistry*, *9*(4), 3233-3236.

Nachit, M. M. (1992). Durum wheat breeding for Mediterranean Dryland of North Africa and West Asia. In: Rajaram, S., Saari, E.E., Hettel, G.P. (eds.). Durum Wheats: Challenges and Oportunities. CIMMYT. *Ciudad Obregon, Mexico*, 14-27.

Panse, V. G. and Sukhatme, P. V. (1985). Statistical Methods for Agricultural Workers, ICAR New Delhi.

Patel, N. S., Raval, L. J. and Shah, S. H. (2018). Selection indices in bread wheat (*Triticum aestivum* L.) under very late sown condition. *Indian Journal of Pure and Applied Biosciences*, *6*(5), 426-429.

Raiyani, G. D., Patel, K., Javia, R. M., Bhatiya, V. J. and Ramani, V. V. (2015). Selection indices for yield improvement in bread wheat under late sown condition. *Asian Journal of Biological Sciences*, *10*(2), 148-152.

Yagdi, K. (2009). Path coefficient analysis of some yield components in durum wheat (*Triticum durum* Desf.). *Pak. J Bot.*, *41*(2), 745-751.

How to cite this article: Avadhoot B. Dharmadhikari, Abhay Dashora, Urmila, Himansuman, Parul Gupta and Payal Agarwal (2023). Assessment of variability Parameters in Indigenous and Exotic Genotypes of Durum Wheat (*Triticum durum* Desf.). *Biological Forum – An International Journal*, *15*(7): 333-337.