



# International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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2024; SP-7(10): 527-530

Received: 18-06-2024

Accepted: 23-07-2024

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

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DOI: <https://doi.org/10.33545/2618060X.2024.v7.i10Sh.1834>

### Abstract

A study was undertaken to estimate the genetic variability, heritability and genetic advance in 50 *dicoccum* wheat genotypes grown in randomized block design with two replications at Experimental Farm of Wheat and Maize Research Unit, VNMKV, Parbhani (Maharashtra) during *rabi* season 2023-24. The analysis of variance showed highly significant differences among the genotypes for all the characters. In present investigation phenotypic coefficient variation (PCV) was greater than genotypic coefficient variation (GCV) for all the traits studied and there was a little difference between the values of GCV and PCV. High PCV and GCV recorded for number of productive tillers per plant, harvest index and grain yield per plant. Number of productive tillers per plant, harvest index and grain yield per plant showed high heritability coupled with high genetic advance as percent of mean indicating the influence of additive gene effects.

**Keywords:** *Dicoccum* wheat, variability, heritability and genetic advance

### Introduction

*Dicoccum*, locally known as Khapli wheat (*Triticum dicoccum* L.), is an annual, predominantly self-pollinated plant with large elongated grains and brittle ears. In the quest for understanding agricultural diversity and exploring nutrient-rich food sources, *Triticum dicoccum* commonly has emerged as a focal point of research. This ancient cereal grain is rich in more than 16% dietary fibre. It contains protein and total carbohydrates ranging from 11.8% to 15.3% and 78.7% to 83.2%, respectively.

The wheat species can be divided into three classes on the basis of the ploidy level as, diploid  $2n = 2x = 14 =$  einkorn wheat; tetraploid  $2n = 4x = 28 =$  *dicoccum* wheat; and hexaploid  $2n = 6x = 42 =$  common wheat or bread wheat. *Triticum dicoccum* is a member of the family *Poaceae*, subfamily *Pooideae*, order *Poales*, genus *Triticum* and species *dicoccum*. The *dicoccum* wheat is supposed to be originated in Abyssinia and was possibly introduced in India by the Arabian traders in the Western Ghat region. In 2% of India's total wheat region, *dicoccum* wheat is presently grown (Zaharieva *et al.* 2010) [18]. It has historically been grown in the hilly regions of Tamil Nadu, the southern Maharashtra region, the Sourashtra region of coastal Gujarat, the northern Karnataka region, and the Telangana region. (Hanchinal *et al.* 2005) [7].

The global production of *dicoccum* wheat is relatively small compared to modern wheat varieties. According to the Food and Agriculture Organization (FAO), the total production of *dicoccum* wheat is estimated to be in the range of several hundred thousand metric tons annually. This is the fraction of the total global wheat production which exceeds 750 million metric tonnes. *Dicoccum* wheats appear to be more suited to higher temperatures (Yenagi *et al.* 1999) [17]. With respect to its inbuilt genetic makeup and morpho-physiological mechanism, *dicoccum* wheat is more important in this situation than *durum* and *aestivum* because it responds well to high temperature stress and is resistant to rust diseases (leaf and stem) (Tandon and Hanchinal, 1992) [16]. Through successful interspecific hybridization, *dicoccum* wheat's favorable features have been applied to develop *aestivum* and *durum* wheat varieties.

As the demand for nutritious and sustainable food sources rises, *Triticum dicoccum* or *dicoccum* wheat, emerges as a fascinating candidate. By conducting a variability parameter analysis, correlation and path analysis of this ancient crop, we can unlock its hidden potential and promote its cultivation in diverse agro-climatic regions of India.

## Material and Methods

The present investigation entitled “Genetic Variability, heritability and genetic advance in *dicoccum* wheat (*Triticum dicoccum* L.)” has been conducted at Experimental Farm of Wheat and Maize Research Scheme, VNMKV Parbhani during *rabi* 2023-24. Forty six genotypes as the source material for the experiment were provided by NBPGR, New Delhi, were evaluated along with 4 checks including MACS 4049(D), DDK 1056 (dic), DDK 1057 (dic) and MACS 5052 (D), for various morphological traits. The material was evaluated in Randomized Block Design (Fisher, 1925) with two replications. The investigation was carried out for traits *viz.*, days to 50 per cent heading, days to 50 per cent maturity, plant height, number of productive tillers per plant, spike length, number of grains per spike, biological yield per plant, thousand grain weight, harvest index and grain yield per plant. The calculation of genotypic and phenotypic coefficient of variation (PCV and GCV) was estimated by the method suggested by the Burton, (1952) [3] and genetic advance (at 5 per cent selection intensity)

plant showed highly significant differences between genotypes (Table 2). ANOVA is in accordance with Koysev & Desheva, (2015) [11].

### Variability Heritability and genetic advance as percent of mean

Phenotypic variance ranged from 1.27 (spike length) to 96.24 (harvest index). Values of genotypic variance ranged between 0.47 (biological yield) and 87.00 (harvest index). The highest phenotypic and genotypic variance values of 96.24, 87.00 for harvest index and 96.68 (Plant height), 70.09 (thousand grain weight) (Table 3).

The genotypic coefficient of variability (GCV) ranged from 2.42% for days to 50 per cent maturity to 23.98% for number of productive tillers per plant, whereas, phenotypic coefficient of variation (PCV) ranged from 2.88% for days to 50 per cent maturity to 24.91% for number of productive tillers per plant. The recorded values of GCV were high (above 20%) for three investigated characters, moderate for three characters and low for days to 50 per cent maturity (2.42%), biological yield (3.66%). The recorded PCV was high for harvest index (24.62%) and low for days to 50 per cent maturity (2.88%) (Table 3). Genotypic coefficients of variability (GCV) would be more useful for the assessing inherent or real variability as it exhibits the heritable portion only (Allard, 1960) [2]. Phenotypic coefficient of variability and genotypic coefficient of variability values of approximately more than 20% are considered as high whereas values less than 10% regarded as low and values in between as medium. GCV and PCV were recorded low for days to 50 per cent heading, days to maturity and biological yield, which is in conformity with findings of Chaturvedi and Gupta (1995) [4], Hokrani *et al.* (2013) [9]. Moderate GCV and PCV were for thousand grain weight, spike length and number of grains per spike, which is in accordance with the findings of, Naik *et al.* (2015) [13] and Heidari *et al.* (2020) [8].

In the present investigation heritability estimated ranged from 31% for biological yield to 93% for number of productive tillers per plant. High estimates of heritability (>60%) for all characters except for biological yield. Genetic advance as per cent of mean was high for six characters and moderate for days to 50 per cent heading (11.35%) and low for the traits like biological yield (4.16%) and days to 50 per cent maturity (4.21%) (Table 3). In present investigation high heritability coupled with high genetic advance over the mean was observed for the traits like, number of productive tillers per plant, spike length, number of grains per spike, thousand grain weight, harvest index and grain yield per plant. This indicates the prevalence of additive gene action in their inheritance, hence are amenable for phenotypic selection. Heritability estimates were high for all the characters studied, *viz.*, grain yield per plant, thousand grain weight, spike length and tillers per plant. These results are in accordance with the findings of Ajmal *et al.* (2009) [1], Ramya *et al.* (2013) [14], Koysev & Desheva (2015) [11], Dashora *et al.* (2022) [5] and Malipatil *et al.* (2023) [12].

**Table 1:** List of Forty-Six wheat genotypes along with four checks studied for morpho-physiological and yield contributing traits.

Sr. No.	Genotypes	Sr. No.	Genotypes
1	EC 660576	26	EC 660871
2	EC 660651	27	EC 660872
3	EC 660654	28	IC 107398
4	EC 660655	29	IC 118727 B
5	EC 660658	30	IC 118772
6	EC 660659	31	IC 118774
7	EC 660661	32	IC 118796
8	EC 660663	33	IC 138845
9	EC 660665	34	IC 138883
10	EC 660667	35	IC 138896
11	EC 660672	36	IC 212164
12	EC 660675	37	IC 212165
13	EC 660678	38	IC 212167
14	EC 660689	39	IC 36780
15	EC 660705	40	IC 47040
16	EC 660707	41	IC 534811
17	EC 660710	42	IC 534856
18	EC 660711	43	IC 539261
19	EC 660721	44	IC 539287
20	EC 660791	45	IC 138849
21	EC 660802	46	IC 138900
22	EC 660803	47	C. MACS 4049(D)
23	EC 660820	48	C. DDK 1056 (dic)
24	EC 660837	49	C. DDK 1057 (dic)
25	EC 660852	50	C. MACS 5052 (D)

## Results and discussion

### Analysis of Variance

Mean squares of days to 50 per cent heading, days to 50 per cent maturity, plant height, number of productive tillers per plant, spike length, number of grains per spikes, biological yield per plant, thousand grain weight, harvest index and grain yield per

**Table 2:** Analysis of Variance for ten characters of *dicoccum* wheat.

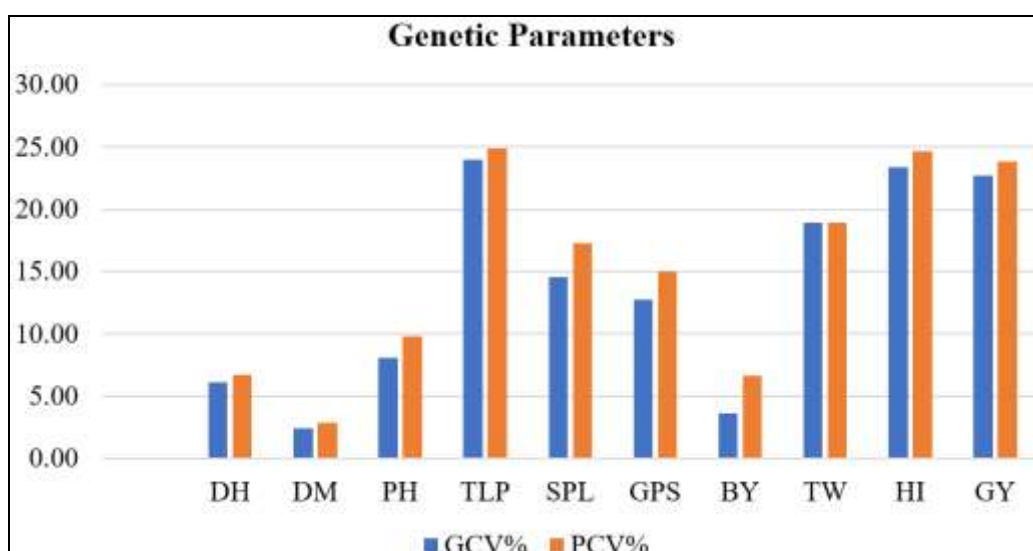
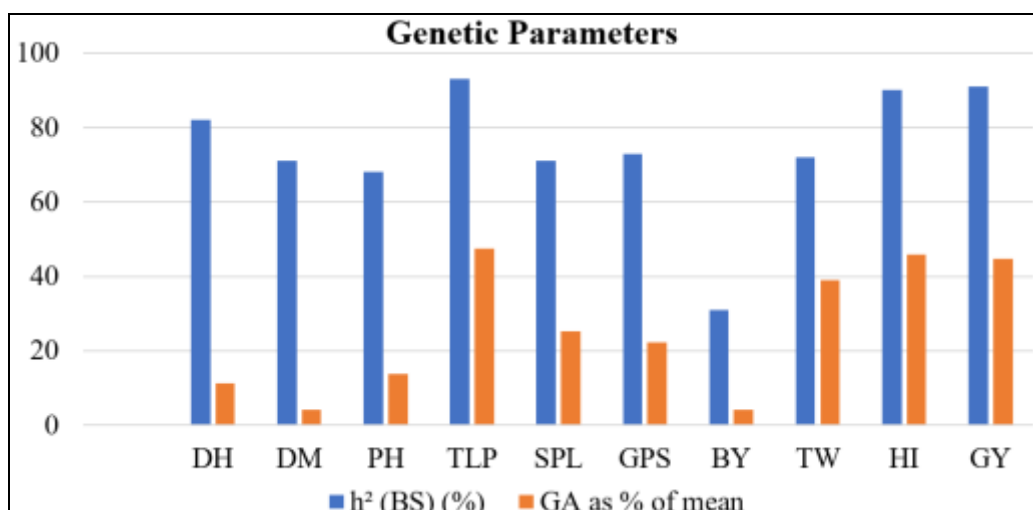
Source	df	DH	DM	PH	TLP	SPL	GPS	BY	TGW	HI	GY
Replication	1	15.21	4	21.492	0.063	0.16241	0.0949	0.53261	0.848	9.132	0.3708
Genotype	49	48.447**	17.101**	161.133**	2.90789**	2.15997**	17.1004**	2.02613**	140.442**	183.236**	6.0876**
Error	49	4.822	2.898	30.236	0.11098	0.37327	2.7648	1.07724	0.269	9.235	0.2808

**DH:** Days to 50 per cent heading, **DM:** Days to 50 per cent maturity, **PH:** Plant height, **TLP:** Number of productive tillers per plant, **SPL:** Spike length, **GPS:** Number of grains per spike, **BY:** Biological yield per plant, **TGW:** Thousand grain weight, **HI:** Harvest index, **GY:** Grain yield per plant.

**Table 3:** Variability parameters for the grain yield and its attributing parameters in *dicoccum* wheat.

Character	Range		MEAN	Genotypic variance	Phenotypic variance	GCV%	PCV%	h <sup>2</sup> (BS) (%)	GA	GA as % of mean
	min	max								
DH	71	92	76.69	21.81	26.63	6.09	6.73	82	8.71	11.35
DM	105.5	118	109.98	7.1	10	2.42	2.88	71	4.63	4.21
PH	78.83	117.3	99.96	65.45	95.68	8.09	9.79	68	13.8	13.79
TLP	2.6	7.4	4.93	1.4	1.51	23.98	24.91	93	2.34	47.55
SPL	3.58	8.9	6.51	0.89	1.27	14.53	17.3	71	1.64	25.13
GPS	9.83	27.08	21.05	7.17	9.93	12.72	14.97	73	4.69	22.26
BY	17.07	22.33	18.84	0.47	1.55	3.66	6.61	31	0.78	4.16
TGW	18.79	55.96	44.26	70.09	70.36	18.92	18.95	72	17.2	38.89
HI	21.69	57.01	39.85	87	96.24	23.41	24.62	90	18.3	45.85
GY	3.89	10.33	7.5	2.9	3.18	22.73	23.8	91	3.35	44.71

**DH:** Days to 50 per cent heading, **DM:** Days to 50 per cent maturity, **PH:** Plant height, **TLP:** Number of productive tillers per plant, **SPL:** Spike length, **GPS:** Number of grains per spike, **BY:** Biological yield per plant, **TGW:** Thousand grain weight, **HI:** Harvest index, **GY:** Grain yield per plant.

**Fig 1:** Genotypic and Phenotypic coefficient of variation for ten characters in wheat**Fig 2:** Heritability and Genetic Advance as per cent of mean for ten characters in wheat

### Conclusion

From the present study it is concluded that the analysis of variance showed highly significant differences among the genotypes for all the characters studied. PCV values were higher than GCV values but the difference variability between these two estimates for all the characters was very close. High heritability in broad sense coupled with high genetic advance as per cent of mean recorded for number of productive tillers per plant, spike length and number of grains per spike.

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