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ASSESSMENT OF GENETIC VARIABILITY AND CHARACTER ASSOCIATION AMONG INTRASPECIFIC F_5 FAMILIES IN CHILLI (*Capscicum annum* L.)

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ABSTRACT

The present investigation was conducted to assess the extent of genetic variability and character association for yield and its component traits in advanced breeding lines of chilli (*Capsicum annuum* L.) derived from the cross JNA1 × Byadagi Dabbi. A total of 45 advanced breeding lines along with four checks were evaluated in an augmented block design during late *Kharif* 2025-26. Analysis of variance revealed significant differences among the genotypes for all the quantitative traits studied, indicating the presence of substantial genetic variability for effective selection. High genotypic and phenotypic coefficients of variation were observed for number of fruits per plant, fruit diameter, dry fruit yield per plant and fruit weight per plant. High heritability coupled with high genetic advance as per cent of mean was recorded for number of fruits per plant, dry fruit yield per plant, fruit diameter, fruit length and plant height, suggesting the predominance of additive gene action and the effectiveness of selection for these traits. Correlation analysis revealed that dry fruit yield per plant was positively and significantly associated with fruit weight per plant, number of fruits per plant, fruit length and test weight of seeds, indicating their importance in yield improvement. The results indicate that these traits can serve as reliable selection criteria for developing high-yielding chilli genotypes and provide useful information for future chilli breeding programme.

***Key words*:** Chilli, Genetic variability, Correlation, Genetic advance

Introduction

Chilli (*Capsicum annuum* L.) commonly known as hot pepper, is an important annual herbaceous crop belonging to the family Solanaceae. It is indigenous to Tropical America and has a diploid chromosome number of 2n = 24. The genus *Capsicum* comprises about 30 species, of which five species, namely *C. annuum*, *C. frutescens*, *C. chinense*, *C. pubescens* and *C. baccatum*, are cultivated. Among these, *C. annuum* is the most widely cultivated and economically important species in India (Saxena *et al*., 2016; Chhapekar *et al*., 2016). Chilli is cultivated for both green and dry fruit purposes and is valued for its pungency, colour, flavour and aroma. The pungency is mainly attributed to capsaicin, while carotenoids such as capsanthin and capsorubin are responsible for the characteristic red colour of mature fruits. Chilli is also a rich source of vitamins, particularly A, C, E and serves as an important raw material for chilli powder, oleoresin and natural food colourants, besides its medicinal and culinary uses (Herath *et al*., 2021).

India is one of the leading producers, consumers and exporters of chilli, with Andhra Pradesh as the major producing state and Karnataka also contributing significantly to its production. Among the important commercial types, Byadagi Dabbi is valued for its high colour intensity, low pungency, flavour aroma and is

suitable for both green and dry chilli purposes. Its desirable quality characteristics make it an important type for processing and value-added products. Therefore, improvement of productivity and quality is an important objective in chilli breeding programmes (Anonymous, 2025; Herath *et al*., 2021).

Assessment of genetic variability is a prerequisite for successful crop improvement, as it facilitates the identification and selection of superior genotypes. Yield is a complex quantitative trait governed by several component characters and influenced by environmental conditions. Therefore, understanding the magnitude of variability and the association among yield and its related traits is essential for effective selection. Correlation analysis helps identify traits associated with yield and provides important criteria for selection.

Considering all the above aspects, the present study is undertaken to evaluate the genetic variability and assess the correlation among yield and its associated traits.

Material and Methods

The present investigation was conducted during the late *Kharif* season of 2025-26 at the Postgraduate Research Block, Main Agricultural Research Station (MARS), University of Agricultural Sciences, Raichur, Karnataka, in red sandy loam soil. The experimental material consisted of 45 F_5 families derived from the cross JNA1 × Byadgi Dabbi, along with four check varieties. The experiment was laid out in an Augmented Block Design with five blocks, each containing nine F_5 lines and four checks. The check entries were randomized to maintain a minimum of 12 degrees of freedom, and observations were recorded on five plants from each F_5 line. Seeds were sown in protrays under glasshouse conditions and 45-day-old seedlings were transplanted to the field at a spacing of 60 × 45 cm. Recommended agronomic practices were followed throughout the crop period.

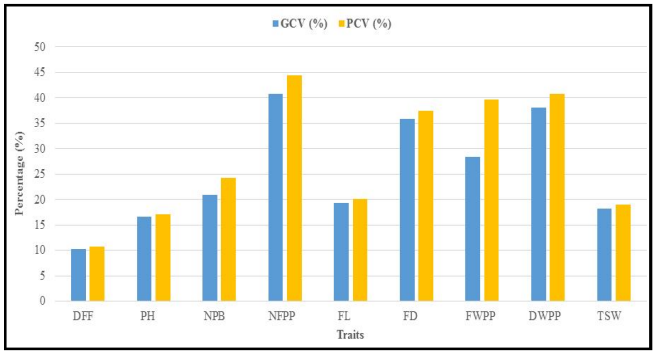


Fig. 1a: Genotypic and phenotypic coefficients of variation for different characters in F_5 population of JNA1×Byadgi dabbi in Chilli. [**DFF –** Days to 50 per cent flowering; **PH –** Plant height (cm); **NPB –** Number of primary branches **; FL –** Fruit length (cm); **FD –** Fruit diameter (cm); **NFPP –** Number of fruits per plant; **FWPP –** Fruit weight per plant (g); **DWPP –** Dry fruit weight per plant(g); **TSW –** Test weight of seeds (g)].

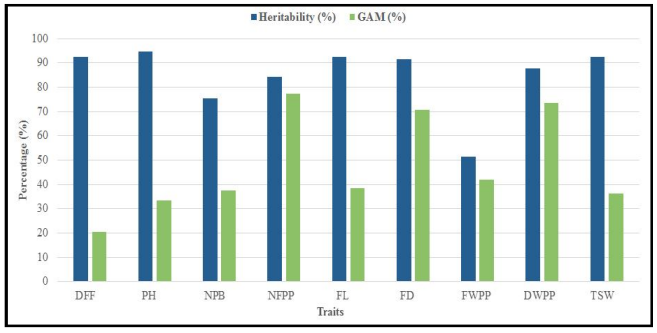


Fig. 1b: Broad sense heritability and genetic advance as percent of mean for different characters in F_5 population of JNA1×Byadgi dabbi in chilli. [**DFF –** Days to 50 per cent flowering; **PH –** Plant height (cm); **NPB –** Number of primary branches **; FL –** Fruit length (cm); **FD –** Fruit diameter (cm); **NFPP –** Number of fruits per plant; **FWPP –** Fruit weight per plant (g); **DWPP –** Dry fruit weight per plant(g); **TSW –** Test weight of seeds (g)].

Observations were recorded for plant height, days to 50 per cent flowering, number of primary branches, fruit length, fruit diameter, number of fruits per plant, test weight, fruit weight per plant and dry fruit yield per plant. Mean values based on five plants per F_5 line were used for statistical analysis. Analysis of variance was performed following Federer (1977), while genotypic and

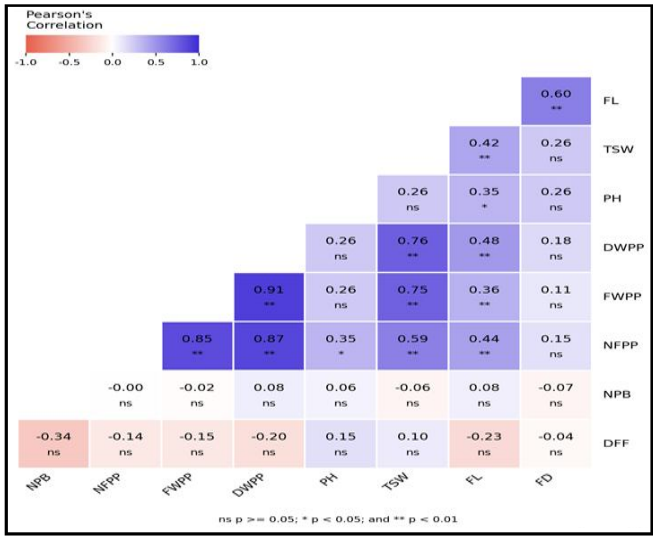


Fig. 2: Pearson's correlation and distribution matrix for quantitative traits in F_5 population of JNA1×Byadgi dabbi in chilli. [**DFF –** Days to 50 per cent flowering; **PH –** Plant height (cm); **NPB –** Number of primary branches **; FL –** Fruit length (cm); **FD –** Fruit diameter (cm); **NFPP –** Number of fruits per plant; **FWPP –** Fruit weight per plant (g); **DWPP –** Dry fruit weight per plant(g); **TSW –** Test weight of seeds (g)].

Table 1: Analysis of variance (ANOVA) for yield and yield related traits in Chilli.

Source of Variation	Df	DFF	PH	NPB	NFPP	FL	FD	FWPP	DWPP	TSW
Treatment (ignoring Blocks)	48	32.84**	254.78**	0.8**	2687.43**	2.14**	0.1**	34115.06**	2927.41**	46.54**
Treatment: Check	3	93.67**	969.62**	0.15	11033.34**	5.31**	0.79**	181834.37**	16213.76**	367.19**
Treatment: Test	44	21.95**	140.75**	0.76**	397.39**	1.58**	0.06**	2833.31 *	383.4**	2.2**
Treatment: Test vs. Check	1	329.44**	3127.79**	4.33**	78411.43**	17.28**	0.21**	967353.86**	75004.74**	1035.79**
Block (eliminating Treatments)	4	1.83	24.36	0.08	48.45	0.04	0.01	1517.81	66.88	0.11
Residuals	12	1.63	7.62	0.19	62.14	0.12	0	1381.69	47.74	0.17

* p <= 0.05; ** p <= 0.01; Df – Degrees of freedom; DFF – Days to 50 per cent flowering; PH – Plant height (cm); NPB – Number of primary branches;NFPP – Number of fruits per plant; FL – Fruit length (cm); FD – Fruit diameter (cm); FWPP – Fruit weight per plant (g); DWPP – Dry fruit weight per plant (g); TSW – Test weight of seeds (g)

phenotypic coefficients of variation were estimated as per Burton and Devane (1953), broad-sense heritability following Lush (1945) and genetic advance as per Johnson *et al.,* (1955). Phenotypic correlation coefficients among the quantitative traits were estimated following Singh and Choudhary (1979).

Results and Discussion

The analysis of variance revealed highly significant differences among treatments and F_5 families for all nine quantitative traits, indicating substantial genetic variability within the population, while the non-significant block effects suggested relatively uniform experimental conditions. Significant differences among checks for most traits and between test genotypes and checks further confirmed the diversity present in the experimental material. Similar variability among chilli genotypes has been reported by Sushmitha *et al.,* (2024), Panja *et al.* (2025), Lata *et al.,* (2022), Krishna *et al.,* (2021) and Baruah *et al.,* (2023). The descriptive statistics further indicated considerable variation among F_5 families, with comparatively greater variability for number of fruits per plant, fruit diameter and dry fruit yield per plant, whereas days to 50 per cent flowering and plant height showed relatively lower variation. Similar variability for yield and yield-attributing traits was reported by Kannan *et al.,* (2016), Kumar *et al.,* (2020), Zehra *et al.,* (2017) and Sushmitha *et al.,* (2024).

The estimates of GCV and PCV revealed considerable genetic and phenotypic variability among the F_5 families, with relatively close correspondence between the estimates for most traits, indicating comparatively lower environmental influence. High heritability coupled with high genetic advance as per cent of mean was observed for several traits, suggesting the predominance of additive gene action and good scope for direct selection. Similar findings regarding favourable heritability and genetic advance in chilli were reported

Table 2: Descriptive statistics for yield and its attributing traits in advanced breeding lines of Chilli.

S. No.	Trait	Mean	Standard error	Range		Coefficient of variance	Standard deviation
				Minimum	Maximum		
1	Days to 50% flowering	43.62	0.67	35.60	56.10	2.85	4.69
2	Plant height (cm)	69.24	1.72	41.16	99	3.80	12.01
3	Number of primary branches	3.61	0.13	2.06	6.51	12.43	0.89
4	Number of fruits per plant	44.9	4.39	0.76	166.20	12.73	30.75
5	Fruit length (cm)	6.25	0.18	2.49	8.90	5.34	1.28
6	Fruit diameter (cm)	0.63	0.03	0.26	1.33	10.43	0.24
7	Fresh fruit weight per plant (g)	134.11	14.43	10.37	587.27	19.17	100.98
8	Dry fruit yield per plant (g)	48.05	4.41	16.69	184.75	10.68	30.89
9	Test weight of seeds	7.82	0.50	4.42	25.28	4.18	3.51

Table 3: Estimates of genetic variability parameters for yield and its attributing traits in advanced breeding lines of the JNA1 × Byadagi Dabbi in Chilli.

Sl. No.	Trait	Mean	GCV (%)	PCV (%)	h^2 (%)	GA	GAM (%)
1	Days to 50% flowering	43.62	10.34	10.74	92.6	8.95	20.52
2	Plant height (cm)	69.24	16.66	17.13	94.59	23.15	33.43
3	Number of primary branches	3.61	20.99	24.18	75.4	1.36	37.61
4	Number of fruits per plant	44.9	40.78	44.4	84.36	34.69	77.27
5	Fruit length (cm)	6.25	19.33	20.11	92.36	2.39	38.32
6	Fruit diameter (cm)	0.63	35.82	37.44	91.54	0.45	70.7
7	Fresh fruit weight per plant (g)	134.11	28.41	39.69	51.23	56.26	41.95
8	Dry fruit yield per plant (g)	48.05	38.13	40.75	87.55	35.36	73.59
9	Test weight of seeds	7.82	18.21	18.94	92.39	2.82	36.11

GCV: Genotypic Coefficient of Variation; **PCV**: Phenotypic Coefficient of Variation; **GA:** Genetic Advance; **h^2**: Broad Sense Heritability; **GAM**: Genetic Advance as Percent of Mean

by Gupta *et al.*, (2009), Bhoomika *et al.*, (2021), Thirupathamma *et al.*, (2021) and Yadav *et al.*, (2024). Traits related to fruit production, fruit size and dry fruit yield exhibited favourable genetic parameters and may therefore serve as useful selection criteria. Fresh fruit weight per plant showed comparatively greater environmental influence, as reflected by the difference between GCV and PCV and moderate heritability. However, its appreciable genetic advance indicated scope for improvement through selection, consistent with the findings of Bekele *et al.*, (2023), Patel *et al.*, (2015) and Sai *et al.*, (2023).

The phenotypic correlation analysis revealed varying degrees and directions of association among the nine quantitative traits. Plant height showed positive associations with major fruit and yield-related traits, consistent with the findings of Rahevar *et al.*, (2019). Fruit length showed positive associations with fruit diameter, number of fruits per plant, fresh fruit weight, test weight and dry fruit yield, indicating its importance as a yield-contributing trait, as also reported by Hasanuzzaman and Golam (2011) and Bekele *et al.*, (2023). Number of fruits per plant exhibited strong positive associations with fresh fruit weight and dry fruit yield, emphasizing its importance in determining yield (Pandit and Adhikary 2014 and Bekele *et al.*, 2023). Test weight also showed positive associations with important yield components and dry fruit yield, in agreement with Sarkar *et al.*, (2009). In contrast, days to 50 per cent flowering and number of primary branches showed weak or non-significant associations with most traits, suggesting their comparatively limited association with yield, similar to the findings of Ajjapplavara *et al.*, (2005). Fruit diameter showed relatively weaker associations with yield traits but remained relevant as an important fruit-quality character (Belay and Tsehaye 2020; Pandit and Adhikary 2014). Overall, fresh fruit weight per plant, number of fruits per plant and test weight of seeds emerged as important traits positively associated with dry fruit yield, while fruit length and plant height also showed favourable associations. These traits may therefore be useful as selection criteria for improving yield in chilli, in agreement with Yadav *et al.*, (2024) and Patel and Chaurasiya (2023).

Table 4: Estimation of phenotypic correlation coefficients for yield attributing traits in advanced breeding lines of the JNA1 × Byadagi Dabbi in Chilli.

Traits	DFF	PH	NPB	FL	FD	NFPP	FWPP	TSW	DWPP
DFF	1								
PH	0.151	1							
NPB	-0.343	0.056	1						
FL	-0.229	0.35 *	0.076	1					
FD	-0.041	0.257	-0.065	0.605 **	1				
NFPP	-0.138	0.346 *	-0.004	0.443 **	0.148	1			
FWPP	-0.153	0.257	-0.022	0.365 **	0.11	0.846 **	1		
TSW	0.096	0.264	-0.064	0.419 **	0.26	0.595 **	0.748 **	1	
DWPP	-0.199	0.262	0.079	0.481 **	0.176	0.872 **	0.911 **	0.756 **	1

DFF – Days to 50 per cent flowering; **PH –** Plant height (cm); **NPB –** Number of primary branches **;** **FL –** Fruit length (cm); **FD –** Fruit diameter (cm); **NFPP –** Number of fruits per plant; **FWPP –** Fruit weight per plant (g); **DWPP –** Dry fruit weight per plant(g); **TSW –** Test weight of seeds (g)

Conclusion

The evaluation of 45 F_5 chilli families derived from the cross JNA1 × Byadgi Dabbi revealed substantial genetic variability for yield and yield-attributing traits. Analysis of variance showed highly significant differences among treatments and F_5 families for all nine quantitative traits, while the non-significant block effects indicated relatively uniform experimental conditions. The estimates of GCV, PCV, heritability and genetic advance further confirmed considerable exploitable genetic variation, with high heritability coupled with high genetic advance as per cent of mean for most traits, indicating the predominance of additive gene effects and good scope for improvement through direct selection. Although fresh fruit weight per plant showed comparatively greater environmental influence and moderate heritability, its appreciable genetic advance indicated potential for improvement through selection. Phenotypic correlation analysis revealed strong positive associations of dry fruit yield per plant with fresh fruit weight per plant, number of fruits per plant and test weight of seeds, while fruit length also showed favourable associations with major yield components. Therefore, these traits can be effectively considered in selection programmes for improving dry fruit yield, and the identified superior F_5 families provide useful breeding material for further genetic improvement in chilli.

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