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Short communication

Genetic variability, heritability and genetic advance for growth, yield and quality traits in chilli

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The improvement in any crop is proportional to the magnitude of its genetic variability present in the germplasm. Greater the variability in a population, greater is the chance for effective selection for desirable types (Vavilov, 11). Chilli (*Capsicum annuum* L.) has a wide range of variability for various characters, which can be further exploited by breeding. Therefore, the present study was aimed to assess the genetic variability of growth, yield and quality traits in chilli with the help of genetic parameters like phenotypic and genotypic coefficients of variation, heritability and genetic advance.

The experimental material for the present study comprised of 30 diverse chilli genotypes, *viz.* ACS 2000-02, ACS 98-9, Green Wonder, Red Star, Soldier, Pusa Sadabahar, Motikeera 39, Sel. 5, Rajasthan Local, RC 1-1, DCL 001, DCL 006, DCL 008, DCL 228, DCL 236, DCL 266, DCL 268, DCL 270, DCL 271, DCL 335, DCL 344, DCL 358, DCL 408, DCL 901, DKC 8, PMR 57, K 1, A 8, KDCS 810 and Phule Sai from different parts of India.

The experiment was laid out in a randomized block design with three replications at Vegetable Farm of the Division of Vegetable Science, IARI, New Delhi during *kharif* season. Spacing was maintained at 60 cm between the rows and 30 cm between the plants. The experimental data was collected on fourteen traits, *viz.*, plant height (cm), number of primary branches, number of secondary branches, days to flowering, days to first fruit harvest, fruit length (cm), fruit width (cm), number of fruits per plant, fruit weight (g), yield per plant (g), ascorbic acid (mg/100g), total carotenoids (µg/100g), capsaicin (%), and TSS (%). The mean values of five randomly selected plants from each treatment in each replication were used for data analysis.

The analysis of variance of design of experiment was carried out according to the standard procedure suggested by Panse and Sukhatme (9). The genotypic and phenotypic coefficients of variations were computed by using the formulae suggested by Burton and De Vane (4). Heritability in broad sense and expected genetic advance as per cent of mean were calculated according to the methods suggested by Allard (1) and Johnson *et al.* (7), respectively.

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Highly significant differences due to genotypes for the entire traits studied (Table 1), indicating sufficient genetic variability among the genotypes. The mean, range, coefficients of genotypic and phenotypic variation, heritability estimates and expected genetic advance as per cent of mean are given in Table 2. Total carotenoids was found as the maximum variable trait with the variability ranging between 1475.30 to 4208.10 µg, followed by yield per plant (75.00 to 259.33 g), ascorbic acid (78.30 to 188.00 mg) and number of fruits per plant (24.93 to 137.51). High variability might be due to the presence of high genetic variability and influence of environment on the expression of the traits. On the other hand, number of primary branches, fruit width, capsaicin, TSS, fruit weight and fruit length exhibited low variability.

Table 1. Analysis of variance for growth, yield and quality traits in chilli.

Trait	Source of variation		
	Replication	Treatment	Error
d.f.	2	29	58
Plant height (cm)	1.50	285.00**	8.98
Number of primary branches	0.03	1.30**	0.03
Number of secondary branches	1.87	42.40**	1.11
Days to flowering	3.82	106.60**	4.71
Days to first fruit harvest	22.18	100.30**	10.60
Fruit length (cm)	0.74	13.42**	0.74
Fruit width (cm)	0.02	0.20**	0.01
Number of fruits per plant	45.44	1594.37**	90.39
Fruit weight (g)	0.06	4.38**	0.06
Yield per plant (g)	629.20	4600.20**	432.68
Ascorbic acid (mg/100g)	32.31	2395.10**	25.27
Total carotenoids (µg/100g)	992.00	2188219.60**	12723.86
Capsaicin (%)	0.00	0.01**	0.00
TSS (%)	0.01	1.36**	0.03

** Significant at P = 0.01

Table 2. Genetic variability, heritability in broad sense and genetic advance as per cent of mean for different traits in chilli.

Trait	Range		Mean ± SE	Variability		Heritability (%)	GA as per cent of mean
	Min.	Max.		PCV	GCV		
Plant height (cm)	34.63	74.33	51.49 ± 2.45	19.52	18.63	91.10	36.62
Number of primary branches	2.00	4.97	3.31 ± 0.14	20.30	19.63	93.40	39.20
Number of secondary branches	5.53	22.53	10.17 ± 0.86	37.93	36.48	92.50	72.27
Days to flowering	44.00	64.67	56.21 ± 1.77	11.07	10.37	87.80	20.01
Days to first fruit harvest	78.33	100.00	86.71 ± 2.65	7.34	6.31	73.80	11.16
Fruit length (cm)	5.96	12.84	8.99 ± 0.70	24.76	22.85	85.20	43.49
Fruit width (cm)	0.78	2.11	1.09 ± 0.08	24.97	23.24	86.60	44.95
Number of fruits per plant	24.93	137.51	57.76 ± 7.96	43.52	40.06	84.70	75.97
Fruit weight (g)	1.79	6.10	3.14 ± 0.19	39.02	38.28	96.30	77.38
Yield per plant (g)	75.00	259.33	157.71 ± 16.90	26.77	23.28	76.30	42.06
Ascorbic acid (mg/100g)	78.30	188.00	130.01 ± 4.10	21.96	21.62	96.90	43.76
Total carotenoids (µg/100g)	1475.30	4208.10	2732.50 ± 92.10	31.44	31.16	98.90	63.64
Capsaicin (%)	0.33	0.49	0.41 ± 0.03	13.27	9.97	56.40	15.00
TSS (%)	6.30	8.90	7.72 ± 0.14	8.91	8.62	93.00	17.21

For all the traits, though the phenotypic coefficients of variation (PCV) were higher than their corresponding genotypic coefficients of variation (GCV), both showed a close relationship, indicating less influence of environment in the expression of these traits. The highest PCV (43.52) and GCV (40.06) were observed for number of fruits per plant followed by fruit weight, number of secondary branches and total carotenoids, indicating the possibility of obtaining high selection response in respect of these traits. Days to first fruit harvest showed the lowest coefficient of variation at both levels. Traits like plant height, number of primary branches, fruit weight and ascorbic acid exhibited nearly equal PCV and GCV values, indicating least influence of environment on expression of these traits. In this condition effective selection can be made on the basis of phenotype alone with a good probability of success. Genotypic coefficient of variation alongwith heritability estimates were more reliable parameters to give better idea about the amount of advance to be expected in next generation (Burton, 3). The data presented in Table 2 revealed that all traits except capsaicin content showed high heritability estimates. Least heritability was recorded for capsaicin (56.4%), while total carotenoids showed highest value (98.90%). Ascorbic acid, fruit weight, number of primary branches, TSS, number of secondary branches, plant height, days to flowering, fruit width, fruit length and number of fruits per plant exhibited very high heritability where as yield per plant and days to first fruit harvest showed moderately high estimates of heritability.

Heritability estimates together with genetic advance provides better response during selection than either of the parameters alone (Johnson *et al.*, 7). In the present study, high genetic advance coupled with high heritability was obtained for fruit weight, number of fruits per plant, number of secondary branches and total carotenoids, indicating pureline selection or individual plant selection could be effectively utilized for isolation of superior genotypes for these traits. Munshi and Behera (8), Gopalakrishnan *et al.* (6), and Bhavaji and Murthy (2) also reported high heritability and high genetic advance for number of fruits per plant, fruit weight and number of secondary branches, respectively. Traits with high heritability and moderate genetic advance, *viz.* plant height, number of primary branches, fruit length, fruit width, yield per plant and ascorbic acid content were governed by additive genes and could be equally improved through selection. Similar results were reported by Das and Choudhary (5), and Usharani and Singh (10) in chilli. On the other hand, days to flowering, days to first fruit harvest and TSS content exhibited high heritability with low genetic advance which indicated that these traits were governed by non-additive genes and heterosis breeding would be effective for improvement of these traits.

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