

VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN CHILLI

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Abstract: Different parameters were estimated to assess the magnitude of genetic variability in 43 genotypes of chilli (*Capsicum annuum* L.). The analysis of variance indicated the prevalence of sufficient genetic variation among the genotypes from all the characters studied. The high phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for fruit set per cent, number of fruits per plant, dry fruit yield per plant, number of seeds per fruit and average dry fruit weight. High heritability coupled with high genetic advance were observed for yield per plant, plant spread, fruit set per cent, days to first picking, number of fruits per plant, fruit weight, dry fruit recovery and number of seeds per fruit indicating these characters are governed by additive gene action. Hence, direct selection may be followed for the improvement of chilli for these characters.

Keywords: Chilli, Variability, Heritability, Genetic advance

INTRODUCTION

Chilli is the universal spice of India. Being an important commercial crop, it finds diverse utilities as a spice, condiment, culinary supplement, medicine, vegetable and ornamental plant. The important states growing chilli are Andhra Pradesh, Orissa, Maharashtra, West Bengal, Karnataka, Rajasthan and Tamil Nadu. Chilli has two important commercial qualities, red colour due to pigment capsanthin and biting pungency attributed by capsaicin. Importance of genetic variability in any breeding material is a pre-requisite as it provides not only a basis for selection but also some valuable information regarding selection of diverse parents for use in hybridization programme. The plant breeder has to identify the sources of favourable genes, incorporate them in breeding populations and aim for isolation of productive genotypes and cultivars. Thus, improvement in any crop is based on the extent of genetic variation and the degree of improvement depends upon the magnitude of available beneficial genetic variability. Hence, the present study was undertaken to analyse the extent of variability present in forty three genotypes of chilli in respect of traits contributing to yield and quality of chilli fruits.

The genotypic and phenotypic coefficient of variation, heritability and genetic advance enable the breeders to study its genetic variability and potential genotypes. Since, many economic traits are quantitative in nature and highly influenced by the environment, the progress of breeding is governed by the nature of genetic and non genetic variations, it

will be useful to partition the overall variability into its heritable and non heritable components to know whether superiority of selection is inherited by the progenies. Therefore, the present investigation was undertaken to estimate the variability, heritability and genetic advance in 43 chilli genotypes.

MATERIAL AND METHOD

The experiment was carried out at Horticultural Research Station, Lam during 2013-2014 with 43 chilli genotypes. The trial was laid out in a randomized block design with three replications. Seedlings were transplanted at a spacing of 75 x 30 cm. The crop received timely management practices as per recommended package of practices. The crop was maintained properly till last harvest and observations on growth, yield as well as yield contributing characters was noted on five randomly selected plants in each plot at different stages of the crop. The analysis of variance were carried out as suggested by Snedecor and Cochran (1967) and were used for calculating other genetic parameters. Genotypic and phenotypic coefficient of variation were calculated as per the formula suggested by Comstock and Robinson (1952) Heritability in broad sense and expected genetic advance were calculated as per formula given by Allard (1960) and Jhonson *et al.* (1955) respectively.

RESULT AND DISCUSSION

The extent of variability present in the chilli genotypes was measured in terms of mean, range,

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phenotypic and genotypic coefficient of variation, heritability (broad sense) and genetic advance (GA). All the genotypes differ significantly with respect to different characters studied. A wide range of variation was observed in all the characters (Table 1 and 2)). Plant height varied from 83.40 cm (LCA 315) to 114.80 cm (Tejaswini), plant spread from 69.93 cm (LCA 710) to 89.33 cm (G4), no. of primary branches per plant 2.53 (LCA 315) to 4.47 (LCA 764), no. of secondary branches per plant 7.20 (LCA 625x LCA 315) to 11.93 (LCA 764), days to 50% flowering from 26.33 (LCA 712x LCA 703) to 40.00 (LCA 764x LCA 763), fruit set per cent from 19.33 LCA (625) to 52.67 (LCA 764 x LCA 706), days to first picking from 65.00 (LCA 764x LCA 763) to 92.33 (LCA 704), no. of fruits per plant from 171.87 (LCA 763) to 544.60 (LCA 764x LCA 315), fruit length 7.29 cm (LCA 703) to 11.32 cm (LCA 704 x LCA 315), fruit diameter from 0.77 cm (LCA 710) to 1.30 cm (Indam-5), average dry fruit weight from 0.72g (LCA 710) to 1.49g (Indam-5), dry fruit yield per plant from 108.12g (LCA 710) to 277.33 g (LCA 704 x LCA 315), dry fruit recovery from 20.76% (LCA 704) to 35.98% (Tejaswini), no. of seeds per fruit from 28.99 (LCA 710) to 80.38 (Indam-5) and seed weight 6.96g (LCA 763) to 9.53g (LCA 704x LCA 315).

In the present investigation, for majority of the characters, magnitude of GCV and PCV were closer, suggesting greater contribution of genotype rather than environment (Table 3). So, the selection can be very well based on the phenotypic values. Such a closer PCV and GCV for different characters were earlier reported by Arun Kumar *et al.*, 2013 and Datta and Das (2013). High values of PCV with corresponding high values of GCV for fruit set per cent, number of fruits per plant, dry fruit yield per plant, number of seeds per fruit and average dry fruit weight indicated greater extent of variability that could be ascribed to genotype. Similar results were obtained for number of fruits per plant, fruit weight and yield per plant by Singh and Singh (2011) and Krishnamurthy *et al.* (2013). From the foregoing discussions, it is clear that the characters viz., fruit set per cent, number of fruits per plant, dry fruit yield per plant, number of seeds per fruit and average dry fruit weight offer good scope for selection in chilli.

The variability existing in a population is the sum total of heritable and non heritable components. A high value of heritability indicates that the phenotype of that trait strongly reflects its genotype. In the present investigation, the heritability estimates were high for all characters studied except number of primary, secondary branches and fruit diameter. High heritability for yield and yield attributes in chilli were reported by many workers (Manju and Sreelathakumari, 2002 and Munshi *et al.*, 2010).

Environment has least influence for the characters with high heritability and there could be greater correspondence between phenotypes and breeding value while selecting individuals. High heritability estimates indicate the effectiveness of selection based on good phenotypic performance but does not necessarily mean high genetic gain for the particular character. High values of genetic advance as percentage of mean (> 20 %) were obtained in the present study for plant spread, fruit set per cent, number of fruits per plant, average dry fruit weight, dry fruit yield per plant, dry fruit recovery and number of fruits per plant. The results are in line with the findings of Krishna (2007) and Sandeep *et al.* (2013).

In present study yield per plant, plant spread, fruit set per cent, days to first picking, number of fruits per plant, fruit weight, dry fruit recovery and number of seeds per fruit recorded high heritability coupled with high genetic advance. These results confirm the findings of Shirshat *et al.* (2007) and Datta and Das (2013). Shrelekha *et al.* 2011 and Arun Kumar *et al.* (2013) who reported high heritability coupled with high genetic advance for plant height, number of branches, fruit length, fruit girth, fruit weight, fruits per plant and yield per plant. High heritability coupled with high genetic advance indicates the presence of flexible additive gene effects and will be a useful criterion for selection.

Enough variability among genotypes has indicated that there is a scope for these characters by selection. From the mean performance of accessions, LCA 704 x LCA 315, LCA 764 x LCA 315, LCA 704 x LCA 703 and LCA 712 x LCA 703 were identified as superior lines in terms of yield and yield attributing characters and may be promoted as promising lines for cultivation after further confirmation studies.

Table 1. Mean performance of chilli genotypes for yield and yield attributes

Cross combinations	Plant height (cm)	Plant spread (cm)	No. of primary branches per plant	No. of secondary branches per plant	Days to 50% flowering	Fruit set (%)	Days to first picking	No. of fruits per plant
LCA 625 x LCA 315	96.57	86.13	2.53	7.20	33.33	30.67	68.33	313.20
LCA 625 x LCA 706	113.93	108.27	3.60	10.20	28.33	31.33	84.33	417.20
LCA 625 x LCA 763	101.53	96.63	3.33	7.93	36.67	26.00	77.33	339.20
LCA 625 x LCA 703	103.93	107.13	3.00	8.27	27.33	26.67	87.67	390.07
LCA 625 x G4	103.67	108.63	3.27	8.60	31.33	46.00	76.00	397.60
LCA 764 x LCA 315	93.93	87.80	2.87	8.53	33.33	36.67	68.00	544.60
LCA 764 x LCA 706	112.93	116.90	3.33	9.73	27.33	52.67	73.67	457.40
LCA 764 x LCA 763	96.63	113.73	4.33	11.47	40.00	50.67	65.00	443.47

LCA 764 x LCA 703	99.57	104.90	3.07	10.53	30.33	44.00	73.00	343.40
LCA 764 x G4	92.67	101.40	3.20	8.60	31.00	30.67	80.33	325.87
LCA 704 x LCA 315	82.60	88.57	2.80	9.13	35.67	38.00	68.67	302.87
LCA 704 x LCA 706	115.57	117.13	4.13	11.13	30.33	29.33	81.33	481.80
LCA 704 x LCA 763	97.17	100.80	3.80	10.87	31.67	51.33	76.33	510.00
LCA 704 x LCA 703	105.73	115.73	3.93	9.87	26.67	35.33	86.67	506.53
LCA 704 x G4	98.87	111.53	2.93	8.67	35.33	32.67	68.00	404.00
LCA 710 x LCA 315	93.73	85.00	3.07	8.53	31.33	46.67	70.00	457.60
LCA 710 x LCA 706	100.90	111.93	3.33	10.27	28.33	47.33	72.00	308.13
LCA 710 x LCA 763	105.60	97.60	4.00	9.80	28.33	25.67	84.67	317.53
LCA 710 x LCA 703	97.80	111.47	3.93	8.87	34.67	22.00	79.00	425.67
LCA 710 x G4	96.82	104.27	3.60	9.20	27.33	30.67	87.67	357.87
LCA 718 x LCA 315	98.57	90.13	3.87	9.47	36.33	28.00	78.33	307.27
LCA 718 x LCA 706	102.70	110.53	4.33	9.60	35.33	45.33	77.00	327.73
LCA 718 x LCA 763	108.43	88.53	4.07	9.33	29.00	21.67	73.33	280.80
LCA 718 x LCA 703	100.43	99.20	3.73	9.00	27.67	20.67	76.67	377.60
LCA 718 x G4	96.40	101.73	4.00	10.33	32.33	25.33	80.00	363.53
LCA 712 x LCA 315	101.37	95.93	3.20	9.27	34.00	25.00	83.67	298.07
LCA 712 x LCA 706	104.53	104.67	4.20	10.40	31.67	32.33	80.00	381.13
LCA 712 x LCA 763	109.50	87.87	3.67	9.47	28.33	28.00	88.33	309.47
LCA 712 x LCA 703	104.23	115.47	4.20	11.47	26.33	35.00	87.67	408.00
LCA 712 x G4	91.27	99.60	3.60	9.60	27.33	25.00	86.67	427.33
LCA 625	111.97	105.33	3.80	9.47	32.00	19.33	89.00	423.60
LCA 764	91.97	101.60	4.47	11.93	34.67	34.00	76.67	309.87
LCA 704	90.33	112.67	4.33	11.00	28.67	33.33	92.33	304.67
LCA 710	85.13	69.93	3.73	8.13	30.00	27.67	88.67	212.47
LCA 718	99.73	99.20	3.67	8.87	32.00	33.33	81.00	344.60
LCA 712	98.33	114.07	4.00	11.60	27.33	34.33	77.67	388.00
LCA 315	83.40	75.27	2.53	7.47	31.00	24.33	72.00	257.87
LCA 706	108.83	110.27	3.13	9.60	29.33	25.00	85.67	399.00
LCA 763	97.33	85.87	2.93	8.27	33.33	24.67	72.33	171.87
LCA 703	103.63	123.40	3.80	11.73	33.00	25.33	69.33	194.60
G4	119.13	89.33	3.27	8.87	32.00	23.33	71.67	222.93
Indam-5	96.57	82.53	3.13	8.27	28.00	32.00	79.00	244.00
Tejaswini	114.80	104.53	3.60	8.33	32.33	38.33	71.67	485.27
Grand Mean	100.67	101.01	3.57	9.51	31.18	32.46	78.29	360.09
C.D. 5%	7.76	10.94	0.68	1.45	2.68	5.68	4.49	78.56
S.E.								

Table 2. Mean performance of chilli genotypes for yield and yield attributes

Cross combinations	Fruit length (cm)	Fruit diameter (cm)	Average dry fruit weight (g)	Dry fruit yield per plant (g)	Dry fruit recovery (%)	No. of seeds per fruit	Seed weight (g/1000)
Lines							
LCA 625	9.22	0.97	0.92	219.00	23.39	44.47	8.31
LCA 764	8.64	1.06	1.04	240.11	21.37	54.28	9.09
LCA 704	9.36	0.99	1.13	199.44	20.76	65.67	8.95
LCA 710	8.52	0.77	0.73	108.12	33.23	28.99	7.07
LCA 718	9.14	0.96	0.97	197.84	24.53	66.09	7.19
LCA 712	9.48	1.00	0.94	226.94	21.17	38.54	8.01
Mean	8.94	0.97	0.96	165.37	21.23	49.42	9.36
Testers							
LCA 315	10.49	1.06	1.10	159.89	30.83	64.52	8.58
LCA 706	8.15	0.89	0.87	207.44	32.33	54.44	6.99
LCA 763	10.47	1.05	1.31	171.07	35.63	46.36	6.96
LCA 703	7.29	0.89	0.80	113.71	30.56	37.41	7.36
G4	7.99	0.93	0.84	140.06	24.54	44.54	8.30
Mean	8.88	0.96	0.98	158.43	30.78	49.46	7.64
Parental Mean	8.91	0.97	0.97	161.90	26.00	49.44	8.50
Crosses							
LCA 625 x LCA 315	10.67	1.10	1.16	156.22	30.55	76.23	8.44
LCA 625 x LCA 706	8.99	0.96	1.03	190.16	35.32	59.83	8.23
LCA 625 x LCA 763	9.87	1.07	1.13	157.28	29.23	65.28	8.20
LCA 625 x LCA 703	9.22	1.05	1.03	183.36	31.13	60.25	8.96
LCA 625 x G4	9.86	0.99	1.04	139.39	32.02	66.72	8.60
LCA 764 x LCA 315	10.31	1.11	1.24	262.94	28.83	72.43	9.21
LCA 764 x LCA 706	8.68	1.01	0.95	181.23	30.64	62.89	8.09
LCA 764 x LCA 763	9.93	1.06	1.15	206.72	29.47	60.86	9.00
LCA 764 x LCA 703	8.73	1.01	1.04	204.56	29.02	68.44	8.54
LCA 764 x G4	9.06	1.02	1.11	166.17	27.50	62.85	8.51
LCA 704 x LCA 315	11.32	1.13	1.28	277.33	27.91	79.47	9.53

LCA 704 x LCA 706	8.88	0.96	0.96	209.22	27.81	62.62	8.13
LCA 704 x LCA 763	9.69	1.17	1.19	199.50	29.95	64.92	9.02
LCA 704 x LCA 703	8.88	1.06	1.10	263.56	30.53	55.57	8.44
LCA 704 x G4	9.23	1.12	1.08	237.22	28.66	66.94	9.19
LCA 710 x LCA 315	9.63	0.96	1.06	184.44	33.07	54.22	8.30
LCA 710 x LCA 706	8.75	0.89	0.86	206.19	34.36	60.98	7.45
LCA 710 x LCA 763	10.25	0.97	1.01	154.56	29.43	52.66	7.72
LCA 710 x LCA 703	8.76	0.94	0.92	187.37	28.96	53.25	7.66
LCA 710 x G4	9.20	0.92	0.85	184.50	29.84	49.97	7.95
LCA 718 x LCA 315	10.18	1.10	1.11	136.78	25.92	66.53	7.99
LCA 718 x LCA 706	9.16	1.01	0.92	136.84	28.91	51.85	7.30
LCA 718 x LCA 763	10.26	1.02	1.13	157.11	26.12	56.23	7.64
LCA 718 x LCA 703	9.04	1.04	1.01	181.23	28.96	64.57	8.30
LCA 718 x G4	9.38	1.00	1.06	173.52	30.12	66.21	8.03
LCA 712 x LCA 315	9.68	0.94	1.06	148.51	26.39	51.22	7.94
LCA 712 x LCA 706	8.53	0.93	0.93	168.94	29.18	56.53	8.32
LCA 712 x LCA 763	10.66	1.07	1.04	187.29	26.32	48.84	8.48
LCA 712 x LCA 703	9.45	1.01	1.02	225.56	28.71	56.13	8.33
LCA 712 x G4	9.54	0.95	0.96	168.92	28.40	53.18	7.78
Crosses Mean	9.53	1.02	1.05	187.89	29.44	60.92	8.31
Checks							
Indam-5	8.95	1.30	1.49	145.44	30.58	80.38	9.51
Tejaswini	8.06	0.82	0.84	178.44	35.98	59.14	7.58
Grand Mean	9.34	1.01	1.03	184.75	29.03	58.43	8.21
C.D. 5%	0.60	0.09	0.11	32.26	5.51	8.97	0.70
S.E.	0.22	0.03	0.04	11.60	1.98	3.22	0.25

Table 3. Estimates of genetic parameters for various characters in chilli

Characters	Range	Mean	GCV	PCV	Heritability (Broad sense)	Genetic advance at 5%	Genetic advance as percentage of mean
Plant height (cm)	82.60-119.13	100.67	7.87	9.19	0.73	13.98	13.89
Plant spread (cm)	69.93-123.40	101.01	11.50	13.29	0.75	20.69	20.48
No. of primary branches per plant	2.53-4.47	3.57	12.60	17.23	0.53	0.68	18.98
No. of secondary branches per plant	7.20-11.93	9.51	11.28	14.67	0.59	1.70	17.86
Days to 50% flowering	26.33-40.00	31.18	9.84	11.18	0.78	5.57	17.86
Fruit set %	19.33-52.67	32.46	26.71	28.80	0.86	16.56	51.02
Days to first picking	65.00-92.33	78.29	8.88	9.55	0.86	13.30	16.99
No. of fruits per Plant	171.87-544.60	360.09	23.03	26.67	0.75	147.57	40.98
Fruit length (cm)	7.05-11.68	9.36	8.86	11.27	0.62	1.34	14.34
Fruit diameter (cm)	0.71-1.33	0.98	8.72	14.15	0.38	0.11	11.08
Average dry fruit weight (g)	0.72-1.43	1.00	14.06	16.24	0.75	0.25	25.07
Dry fruit yield per plant (g)	116.67-336.67	230.64	20.74	22.64	0.84	90.21	39.11
Dry fruit recovery (%)	12.51-37.21	27.21	14.21	20.16	0.50	5.61	20.63
No. of seeds per fruit	29.67-87.33	52.98	18.50	21.28	0.76	17.55	33.12
Seed weight (g/1000)	6.12-9.02	7.40	9.48	12.45	0.58	1.10	14.88

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