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EVALUATION OF F_2 POPULATION FOR GENETIC VARIABILITY IN CHILLI (*CAPSICUM ANNUUM* L.)

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ABSTRACT

Genetic variability, heritability and genetic advance for 19 growth, yield and quality traits were studied in F_2 population obtained from the cross of LCA-657 X LCA-481. The study indicated existence of considerable amount of genetic variability for all the characters studied. Higher GCV and PCV were recorded for characters number of primary branches per plant, total colour value, average dry fruit yield per plant, ascorbic acid, capsaicin, yellow carotenoids, plant spread, no. of seeds per fruit, average fresh fruit yield per plant, seed weight, red carotenoids, no. of fruits per plant indicating higher magnitude of variability for these characters and high estimates of heritability with high genetic advance as percent of mean were recorded red carotenoids, total colour value, yellow carotenoids, ascorbic acid , average fresh fruit yield per plant , average dry fruit yield per plant, number of fruits per plant, oleoresin, plant spread, seed weight, plant height, fruit length, number of primary branches per plant, number of seeds per fruit, capsaicin, fruit diameter, days to fruit maturity, days to 50 % flowering. These characters can be effectively improved through selection.

***Key words*:** Genetic variability, heritability, genetic advance, Chilli (*Capsicum annuum* L.)

Introduction

Chilli (*Capsicum annuum* L.) is one of the important commercial crops of India. It is a widely cultivated vegetable cum spice crop and plays an important role as a constituent in many of the world food industries (Basland and Votava, 2000). It belongs to the family Solanaceae and it is native to Mexico, having a secondary centre of origin in Guatemala. Chillies are in different sizes, shapes and colours and have important qualities, the presence of biting pungency attributed to an alkaloid capsaicin. Chilli being an often-cross pollinated vegetable (Murthy and Murthy, 1962), exhibits wide variability for yield and its components under diverse conditions. Crop improvement mainly depends on the magnitude of genetic variability and the extent to which the desirable characters are inherited. F_2 generation obtained from selfing of F_1 hybrid provides all possible variations. So, selection with particular objectives in F_2 generation is very much effective and selfing of those selected genotypes generation after generation helps to develop inbred lines (similar to the parental lines of the exotic hybrids). While initiating our breeding programme we should also be aware of the fact that our selection for the desired traits may be under the influence of environment *i.e.* the variability in the population may be environmental instead of genetic consequently the selection may not gain positive results in next generation therefore we should have knowledge of existing genetic variability in order to develop high yielding varieties (Reddy *et al*. 2013). The studies on genetic variability are very important since the individual plant selection is solely dependent upon it. The mean and heritability estimates of the quantitative character are useful for predicting the progress from selection and an estimate based on single plant will be most reliable (Johnson *et al.,* 1955). Besides knowing the extent of genetic variability and heritability, it is essential to estimate

genetic advance which may highly useful to conform. Estimation of coefficient of variation helps to assess the variability in the population (Manikandan *et al.*, 2018).

Materials and Methods

The experiment was carried out at Dr.YSRHU, College of Horticulture, Anantharajupeta, during Summer 2024 in F_2 population of cross LCA-657 × LCA-481. The crop received timely management practices as per recommended package of practices. The crop was maintained properly till last harvest and observations on yield as well as yield contributing characters was noted and biochemical parameters were analysed on F_2 populations along with parents. 100 plants were studied and taken data from all the plants. The observation were recorded for 19 characters, plant height (cm), plant spread (cm), number of branches per plant, days to 50% flowering, days to fruit maturity, Number of fruits per plant, fruit length(cm), fruit diameter (cm), fruit weight (g), Average fresh fruit yield per plant (g), Average dry fruit yield per plant (g), No. of seeds per fruit, Seed weight (g/1000 seed), Total color value (ASTA units), Red carotenoids (mg/100g), Yellow carotenoids (mg/100g), Ascorbic Acid (mg/100g), Capsaicin (%) and Oleoresin. Genotypic and phenotypic coefficient of variation were calculated as per the formula suggested by Burton and Devane (1953). Heritability and expected genetic advance were calculated as per formula given by Johnson *et al.*, (1955).

Genotypic and phenotypic coefficients of variation

Genotypic and phenotypic coefficients of variation were estimated according to Burton and Devan (1953) by using the following formulae.

$$PCV\ (\%) = \frac{\sqrt{\sigma_p^2}}{\overline{X}} \times 100$$

$$GCV\ (\%) = \frac{\sqrt{\sigma_g^2}}{\overline{X}} \times 100$$

Where,

σ_g^2 = Genotypic variance = T_rMSS - EMSS / r

σ_e^2 = Environmental variance = EMSS / r

σ_p^2 = Phenotypic variance = $\sigma_g^2 + \sigma_e^2$

$\overline{X}$ = General mean

Heritability

Heritability in broad sense was estimated as per the formulae suggested by Lush (1940) and expressed in per cent.

$$h^2(BS) = \frac{\sigma_A^2}{\sigma_p{}^2} \times 100$$

Where, h^2 (BS) = Heritability estimates in broad sense,

σ_g^2 = Additive genetic variance,

σ_p^2 = Phenotypic variance

Genetic advance as per cent of mean (GAM)

Genetic advance as per cent of mean (GAM) was calculated using the following formula and was expressed in percentage.

$$GAM = \frac{GA}{\overline{X}} \times 100$$

Where,

GA = Genetic advance

$\overline{X}$ = General mean of the character

The coefficients of variation were categorized as high (>20 %), moderate (10- 20 %) and low (<10 %), Similarly, heritability was categorized as high (>80 %), moderate (50-80 %), and low (<50 %) and genetic advance as per cent over the mean categorized as low (0-10 %), moderate (11-20 %), high (>21 %).

Results and Discussion

Phenotypic and genotypic coefficient of variation

The phenotypic coefficient of variation was observed highest in number of primary branches per plant (34.19%), total colour value (33.52%), Average dry fruit yield per plant (31.01%), ascorbic acid (30.50%), Capsaicin (29.94%), yellow carotenoids (27.44%), plant spread (25.56%), number of seeds per fruit (25.41%), Average fresh fruit yield per plant (24.83%), Seed weight (24.73%), red carotenoids (23.37%), number of fruits per plant (20.40%) moderate PCV observed in fruit diameter (17.72%) followed by fruit length (12.06%), fruit weight (11.40%), plant height (10.86%), days to 50 % flowering (10.14%) and lowest recorded in days to fruit maturity (5.89%) as shown in Table. 1.

The genotypic coefficient of variation was observed highest for total colour value (33.43%), followed by number of primary branches per plant (30.66%), average dry fruit yield per plant (30.66%), ascorbic acid (30.33%), yellow carotenoids (27.36%), capsaicin (25.65%), average fresh fruit yield per plant (24.65%), plant spread (24.62%), seed weight (23.76%) red carotenoids (23.35%), number of seeds per fruit (22.67%), oleoresin (20.92%), Moderate GCV observed in number of fruits per plant (19.95%) followed by fruit diameter (14.91%), fruit length (11.22%), plant height (10.17%) and the lowest GCV observed in days to 50% flowering (8.04%), followed by fruit weight (7.67%) and days to fruit maturity 4.79, as shown in Table. 1.

Table 1: Genetic parameters for growth, yield and quality attributes in F_2 Segregating population of chilli cross LCA-657 × LCA-481.

S. No.	Character	Range		Mean	PCV %	GCV %	Heritability	GAM (%)
		Min	Max					
1	Plant height (cm)	77.00	130.00	93.52	10.86	10.17	87.67	19.62
2	Plant spread (cm)	26.50	86.50	47.98	25.56	24.62	92.80	48.86
3	No. of primary branches per plant	1.00	4.00	2.38	34.19	30.66	80.43	56.65
4	Days to 50 % flowering	37.00	65.00	50.99	10.14	8.04	62.83	13.12
5	Days to fruit maturity (red)	88.00	125.00	113.62	5.89	4.79	66.16	8.03
6	No. of fruits per plant	88.00	210.00	156.13	20.40	19.95	95.60	40.18
7	Fruit length (cm)	7.50	13.50	10.48	12.06	11.22	86.62	21.51
8	Fruit diameter (cm)	0.56	1.81	1.03	17.72	14.91	70.77	25.83
9	Fruit weight(g)	3.27	6.12	5.14	11.40	7.67	45.25	10.62
10	Average fresh fruit yield per plant (g)	393.36	1217.16	805.82	24.83	24.65	98.58	50.42
11	Average dry fruit yield per plant (g)	64.15	333.04	182.98	31.01	30.66	97.77	62.45
12	No. of seeds per fruit	19.00	79.00	53.33	25.41	22.67	79.63	41.68
13	Seed weight (g/1000 seed)	2.17	8.29	5.68	24.73	23.76	92.29	47.01
14	Total color value (ASTA units)	71.18	324.24	154.03	33.52	33.43	99.46	68.69
15	Red carotenoids (mg/100g)	68.94	357.82	218.71	23.37	23.35	99.82	48.06
16	Yellow carotenoids (mg/100g)	50.63	203.38	125.32	27.44	27.36	99.39	56.19
17	Ascorbic Acid (mg/100g)	76.32	257.22	158.51	30.50	30.33	98.86	62.11
18	Capsaicin (%)	0.20	0.85	0.47	29.94	25.65	73.38	45.26
19	Oleoresin (%)	5.60	19.60	12.99	21.54	20.92	94.33	41.86

Higher GCV and PCV was recorded in number of primary branches per plant, total colour value, average dry fruit yield per plant, ascorbic acid, capsaicin, yellow carotenoids, plant spread, no. of seeds per fruit, average fresh fruit yield per plant, seed weight, red carotenoids, no. of fruits per plant and indicating higher magnitude of variability for these characters. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters in three crosses, and the difference between PCV and GCV was narrow indicating the little influence of environment on the expression of these characters and considerable amount of variation was observed for all the characters. These results were suggesting that, little contribution of environmental effect on population. Similar findings were observed by Rohini *et al.,* (2017), Manikandan *et al.,* (2018), Kabilan *et al.,* (2021) and Tirupathamma *et al.,* (2021).

Heritability

Heritability in broad sense was high in red carotenoids (99.82%) followed by total colour value (99.46%), yellow carotenoids (99.39%), ascorbic acid (98.86%), average fresh fruit yield per plant (98.58%), average dry fruit yield per plant (97.77%), number of fruits per plant (95.6%), oleoresin (94.33%), plant spread (92.80%), seed weight (92.29%), plant height (87.67%), fruit length (86.62%), number of primary branches per plant (80.43%), number of seeds per fruit (79.63%), capsaicin (73.38%), fruit diameter (70.77%), days to fruit maturity (66.16 %), days to 50% flowering (62.83%) and medium broad sense of heritability recorded in fruit weight (45.25%) as shown in Table. 1.

Genetic advance as per cent of mean

The genetic advance as per cent mean was high for the characters under study *viz.,* total colour value (68.69%) followed by average dry fruit yield per plant (62.45%), ascorbic acid (62.11%), no. of primary branches per plant (56.65%), yellow carotenoids (56.19%), average fresh fruit yield per plant (50.42%), plant spread (48.86%), red carotenoids (48.06 %), seed weight (47.01%), capsaicin (45.26%), oleoresin (41.86%), no. of seeds per fruit (41.68%), no. of seeds per fruit (40.18%), fruit diameter (25.83%), fruit length (21.51%) and plant height (19.62%), days to 50% flowering (13.12%), fruit weight (10.62%) and days to fruit maturity (8.03%) recorded moderate genetic advance as per cent of mean as shown in Table. 1.

High heritability with a high genetic advance of per cent of mean might be due to additive gene effect. So, these characters could be considered as reliable selection indices and selection based on these characters might be rewarding. Similar findings were obtained by Rohini *et al.,* (2017), Manikandan *et al.,* (2018), Kabilan *et al.,* (2021) and Tirupathamma *et al.,* (2021).

Conclusions

Analysis of variance revealed the presence of considerable amount of genetic variability for growth, yield and quality traits of chilli genotypes. The genotypes expressed high genotypic and phenotypic coefficient of variation, heritability and genetic advance for number of primary branches per plant, total colour value, average dry fruit yield per plant, ascorbic acid, capsaicin, yellow carotenoids, plant spread, no. of seeds per fruit, average fresh fruit yield per plant, seed weight, red carotenoids, no. of fruits per plant. revealed these traits are under the control of additive gene action. This indicated high response to selection for genetic improvement of chilli genotypes under study.

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