Plant Archives Volume 20 No. 1, 2020 pp. 686-690 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

GENETIC VARIABILITY AND CORRELATION STUDIES IN CHILLI (*CAPSICUM ANNUM* L.)

J. Gokulakrishnan[1]*, C. Nagaraja[2], S. Ranjith rajaram[1] and M. Prakash[1]

[1*]Depart. of Genetics and Plant Breeding, Faculty of Agri., Annamalai University, Annamalainagar-608002 (TN)
[2]Breeder Nuziveedu Seed Company, Hyderabad (Telangana), India.

Abstract

Forty eight chilli genotypes were evaluated for variability, heritability, genetic advance and correlation studies under four locations. Analysis of variance indicated that significant differences exists among the genotypes with respect to both quantitative and qualitative characters. Correlation studies revealed that, plant height, number of fruits per plant, average seed count per fruit, leaf curl virus incidence and total colour value had positive significant association, with yield per plant indicating the importance of these traits in selection for yield because of their direct contribution to yield.

Key words: Chilli, Heritability, Genetic advance, Variability, correlation.

Introduction

Chilli (*Capsicum annum* L.) is one of the domesticated and most cultivated species from the economic and nutritional point of view in the world. Capsicum species are diploid having 2n=24 chromosomes. The fruits are consumed fresh, processed (or) when dried as spice (or) condiment. Information on its genetic architecture (*i.e.*) variability and heritability of plant characters and association with yield and its component traits are of vital importance in breeding programme. Hence, the present study was taken up to estimate the variability, heritability and correlation between yield and other attributes in chillis.

Materials and Methods

The experimental material consisted of six CMS A/B lines and six entire restorer lines, planted in rainy seasons of 2014-15 at Hyderabad, which generated 36 F1 crops in line × tester method. The 36 F1 hybrids generated were evaluated in rainy season of 2015-16 at four locations namely Hyderabad, Warangal, Guntur and Bhadrachalam. The basic material for the study involved 48 chilli genotypes raised in three replications. The data were recorded on both quantitative and qualitative traits. The analysis of variance was done as suggested by Snedecor and Cochran (1967). Variability for different characters were estimated as suggested by Burton, (1952) expected genetic advance was calculated according to Johnson *et al.*, (1955) and correlation of various biochemical characters was undertaken as per the procedure suggested by Singh and Chowdry, (1979).

***Author for correspondence :** E-mail: gokulayamuna@gmail.com

Results and Discussion

Variability studies

Forty eight genotypes of chilli were evaluated to estimate, variability, heritability, genetic advance and correlation efficient. Higher genotype and phenotypic coefficients of variation were observed for, plant height, fruit length, number of fruits per plant and yield traits. Heritability and genetic advance were also higher for these characters indicating the possibility of selection to improve these characters. A significant positive correlation of economic traits like (plant height, number of fruits per plant, average seed count per fruit, with yield was recorded suggesting that selection for these characters would lead to crop improvement. The analysis of variance revealed existence of significant differences among the genotypes, for all the characters studied, indicating the presence of variability in the study material (Table 1).

The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the interaction of genotypes with environment. High magnitude of PCV

Table 1: Pooled analysis of variance for yield and yield components in hot pepper.

Source of variation	df	DFF	PH	PW	FL	FW	NFPP	ASC	TSW	DCY	LCV	SHU	ASTA
Replicate	2	6.36	6.05	11.43	0.03	0	525.46	28.39	0.07	69000.81	1.9	35.0	96.2
Environment	3	52.58**	718.67**	163.47**	3.27**	0.01**	107668.38**	543.82**	0.20**	8073483.50**	2.437*	11996.8**	3519.8**
Interactions	6	3.64	15.1	1.86	0.03	0	173.34	16.67	0.01	33172.24	0.161	27.408	33.47
Treatments	49	91.45**	5786.70**	628.65**	34.31**	0.17**	26983.91**	2875.90**	1.14**	9263464.00**	4.049**	11016.9**	7756.19****
Error	539	7.77	39.55	13.3	0.15	0	1465.41	49.9	0.04	181892.28	0.513	38.19	40.9

DFF-days to 50 percent flowering, PH-plant height, PW- plant canopy width, FL-fruit length, FW-fruit width, NFPP-number of fruits per plant, ASC-average seed count, TSW-thousand seed weight, DCY-dry chilli yield per plant, LCV-leaf curl virus incidence, SHU-capsaicin value, ASTA-total colour value.

and GCV were observed for plant height, fruit length, number of fruits per plant, dry chilli yield per plot, capsaicin value and total colour value indicating the existence of wide range of genetic variability.

All the twelve characters under the study exhibited low GCV and PCV differences indicating the inheritance of plant genetic system and the role of environment influencing the characters is minimum. The traits, plant height (22.52), number of fruits per plant (32.25), dry chilli yield per plot (28.65), capsaicin value (000’ SHU) (31.68) and total colour value (ASTA) (21.40) were observed to have high phenotypic and genotypic coefficient of variation (21.64, 24.82, 25.72, 31.08), Plant canopy width (16.19), fruit length (19.76) and fruit width (16.59), average seed count per fruit (11.62) and leaf curl virus incidence were found to have moderate PCV and GCV values (14.43, 19.27, 15.07, 7.57), thousand seed weight recorded the lowest PCV (8.12) and GCV (6.73) values followed by days to 50 percent flowering and fruit width narrow differences between PCV (9.92, 10.50) and GCV (6.82, 9.61) values of all these characters indicated the predominance of additive gene effects. Similar reports on hot pepper were made by Rani *et al.*, (1996); Sreelatha Kumary and Rajmony, (2002); Verma *et al.*, (2004); Lakshmi and Praba, (2012); Kumar *et al.*, (2012); Shimlessakula *et al.*, (2016) and Meena *et al.*, (2016).

Heritability and genetic advance

Consistency in the performance of selection of succeeding generations depends on the magnitude of heritable variation present in relation to observed variation. Since high heritability accompanied by high genetic advance as percentage of mean shows that there is additive gene effect on the characters under study, if high heritability is accompanied by low genetic advance, it indicates predominance of non-additive gene action. In this study, nine characters recorded higher values for heritability, among them capsaicin values showed highest heritability followed by total colour value (95.0), fruit length (95.0), plant height (92.0), fruit width (84.0), average seed count per fruit (83.0), dry chilli yield per plot (81.0), plant canopy width (79.0) and thousand seed weight (69.0). The higher values of heritability coupled with high genetic advance as percentages of mean was recorded for the character *viz.*, capsaicin value. The traits *viz.* plant height, plant canopy width, fruit length and total colour values recorded high heritability with a moderate genetic advance as percentage of mean indicating predominance of non-additive gene action and hence, improvement of such traits is possible through heterosis breeding programme. Fruit width, average seed count

per fruit, thousand seed weight and dry chilli yield per plot recorded high heritability with low genetic advance percentage of mean, revealing the role of non-additive gene action.

In the present study, the PCV was significantly higher than GCV for all the traits. It is obvious because PCV includes variability due to genotype and genotype and environment interaction.

The difference between the phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) was found to be narrow for plant height, fruit length, fruit width, capsaicin value and total colour values suggesting that, these traits were least affected by environment and selection of these traits based on phenotypic would be rewarding. The difference between PCV and GCV was found wide for rest of the characters indicating that the apparent variation was not only due to genotypes but also due to influence of environment.

High heritability coupled with high genetic advance as percent of mean was recorded for capsaicin value and high heritability coupled with moderate genetic advance as percent of mean was recorded for plant height, fruit length, plant canopy width and total colour values indicating the preponderance of additive gene action making selection more effective. However, operation of both additive and non-additive gene action was indicated for days to 50 percent flowering, fruit width and leaf curl virus incidence. Further improvement of characters would be easier through mass selection, progeny selection or any modified selection procedure aiming to exploit the additive gene effects rather than simple selection.

High heritability coupled with high genetic advance as percent of mean was observed for capsaicin value, indicating the predominance of additive gene action. Hence direct phenotypic selection is useful with respect to these traits. High heritability coupled with moderate genetic advance as percent of mean was observed for plant height plant canopy width fruit length and total colour value indicating the role of additive and non-additive gene action and further improvement of these character would be easier for selection. High heritability in conjunction with genetic advance was reported for capsaicin value by Munshi *et al.,* (2010); Arup *et al.,* (2011) and Kumar *et al.,* (2012) which supported the present findings.

Correlation Studies

Simple correlation coefficients (phenotypic and genotypic) were calculated to determine the association between yield and its components in addition to quality parameters. The results revealed that the genotypic correlations were higher than the phenotypic correlations for all the characters and in general, found to exhibit a similar trend. Hence, the phenotypic correlations, alone are discussed hereunder.

Fruit length showed significant and positive correlation with fruit width (0.34), number of fruits per plant (0.36), thousand seed weight (0.37) and total colour value (0.41). And also average seed count per fruit (0.13), dry chilli yield per plot (0.12) showed positive and non-significant correlation with fruit length. Leaf curl virus incidence showed negative and significant correlation with fruit length.

Number of fruits per plant showed significant and positive correlation with dry chilli yield per plot (0.49) and total colour value (0.49). And also average seed count per fruit (0.14), thousand seed weight (0.01) and leaf curl virus incidence (0.02) showed positive and non-

Table 2: The estimates of variability parameters for different characters in hot pepper.

Traits/ Parameters	Variance		Coefficient of variation (%)		Heritability (h2) (%)	Genetic Advance	Genetic Advance (% of mean)
	Vp	Vg	PCV	GCV			
DFF	14.74	6.97	9.92	6.82	47.30%	3.74	9.66
PH	518.48	478.93	22.52	21.64	92.37%	43.33	42.85
PW	64.58	51.28	19.19	14.43	79.41%	13.15	26.49
FL	2.99	2.85	19.76	19.27	95.06%	3.39	38.70
FW	0.02	0.01	10.50	9.61	83.88%	0.22	18.14
NFPP	3591.95	2126.54	32.25	24.82	59.20%	73.09	39.33
ASC	285.40	235.50	16.59	15.07	82.52%	28.72	28.21
TSW	0.13	0.09	8.12	6.73	68.61%	0.52	11.48
DCY	938689.94	756797.63	28.65	25.72	80.62%	1609.11	47.58
LCV	0.85	0.36	11.62	7.57	42.44%	0.81	10.16
SHU	1007.72	970.17	31.08	31.08	96.27%	62.93	62.82
ASTA	775.21	734.89	20.83	20.83	94.77%	54.35	41.81

DFF-days to 50 percent flowering, PH-plant height, PW- plant canopy width, FL-fruit length, FW-fruit width, NFPP-number of fruits per plant, ASC-average seed count, TSW-thousand seed weight, DCY-dry chilli yield per plant, LCV-leaf curl virus incidence, SHU-capsaicin value, ASTA-total colour value.

significant correlation with number of fruits per plant. Capsaicin value showed negative and non-significant correlation with number of fruits per plant.

For days to 50 percent flowering, both phenotypic and genotypic levels this trait showed positive and non-significant association with dry chilli yield per plot and clearly indicating the independent nature of those two characters and selection for dry chilli yield per plot based on days to 50 percent flowering is not reliable. Number of fruits per plant exhibited significant and positive correlation with dry chilli yield per plot suggesting that selection for yield based on number of fruits per plant is beneficial. The fruit number had significant and positive association with total colour value. Number of fruits per plant showed significant and negative correlation with capsaicin value at phenotypic level indicating that the where increase in selection for this trait cause decrease in apparent association with capsaicin value.

Average seed count per fruit showed significant and positive correlation with dry chilli yield per plot (0.28) and capsaicin value (0.66) and also thousand seed weight (0.12), showed positive and non-significant correlation with average seed count per fruit. Total colour value showed negative and significant correlation with average seed count per fruit.

Average seed count per fruit showed significant and positive correlation with dry chilli yield per plot and capsaicin values, suggesting that selection for yield based on average seed count per fruit is beneficial. Average seed count per fruit showed significant and negative correlation with total colour value (ASTA) at phenotypic level indicating that the increase in selection for this trait cause decrease in selection for total colour value (ASTA), so simultaneous selection for these traits is not possible.

Dry chilli yield per plot showed positive and significant correlation with plant height (0.29), number of fruits per plant (0.49), average seed count per fruit (0.28) and leaf curl virus incidence (0.17) and total colour value (0.56). Positive and non-significant relation with days to 50 percent flowering (0.05), Plant canopy width (0.16), fruit

Table 3: Genotypic correlation coefficient (GCV) and phenotypic correlation coefficients (PCV) for yield and its component characters in 48 chilli genotypes .

Correl-ation	Chara-cter	DFF	PH	PW	FL	FW	NFPP	ASC	TSW	DCY	LCV	SHU	ASTA
GCV	DFF	1.00	0.05	-0.16	-0.34	-0.15	-0.10	0.08	-0.20	0.05	0.27	0.61	-0.40
PCV		1.00	0.04	-0.14	-0.32**	-0.13	-0.09	0.07	-0.17*	0.04	0.20*	0.53**	-0.39
GCV	PH		1.00	-0.01	0.04	-0.33	0.44	0.25	-0.21	0.31	0.11	-0.11	0.48
PCV			1.00	-0.01	0.04	-0.32**	0.43**	0.24**	-0.20*	0.29**	0.08	-0.10	0.39**
GCV	PCW			1.00	0.27	0.25	0.44	0.20	0.03	0.16	0.04	0.58	-0.02
PCV				1.00	0.26**	0.24**	0.43**	0.19*	0.04	0.15	0.03	0.50	-0.02
GCV	FL				1.00	0.36	0.36	0.13	0.40	0.12	-0.39	-0.21	0.59
PCV					1.00	0.34**	0.36**	0.13	0.37**	0.12	-0.31**	-0.24	0.41**
GCV	FW					1.00	-0.11	0.08	0.10	-0.18	-0.15	0.68	-0.30
PCV						1.00	-0.10	0.08	0.10	-0.17*	-0.12	0.58**	-0.29
GCV	NFPP						1.00	0.14	0.01	0.51	0.03	-0.60	0.61
PCV							1.00	0.14	0.01	0.49**	0.02	-0.56*	0.49**
GCV	ASC							1.00	0.13	0.30	-0.02	0.74	-0.63
PCV								1.00	0.12	0.28**	-0.01	0.66**	-0.60**
GCV	TSW								1.00	0.16	-0.09	-0.43	0.48
PCV									1.00	0.15	-0.03	-0.40	0.56
GCV	DCY									1.00	0.20	-0.43	0.07
PCV										1.00	0.17*	-0.40	0.56**
GCV	LCV										1.00	-0.60	0.37
PCV											1.00	-0.56	0.44
GCV	SHU											1.00	-0.93
PCV												1.00	0.56
GCV	ASTA												1.00
PCV													1.00

*: Significant at 5% level; **: significant at 1% level.

DFF-days to 50 percent flowering, PH-plant height, PW- plant canopy width, FL-fruit length, FW-fruit width, NFPP-number of fruits per plant, ASC-average seed count, TSW-thousand seed weight, DCY-dry chilli yield per plant, LCV-leaf curl virus incidence, SHU-capsaicin value, ASTA-total colour value.

length (0.12), thousand seed weight (0.16). Showed negative and significant correlation with fruit width (0.17) and negative and non-significant correlation with capsaicin value (000' SHU).

Dry chilli yield per plot showed significant and positive correlation with plant height, number of fruits per plant, average seed count per fruit, leaf curl virus incidence and total colour value at phenotypic level. Since most of the characters are showing strong significant positive association with dry chilli yield per plot, rational improvement in yield is possible through simultaneous selection for these component characters. The dry chilli yield per plot had non-significant and negative association with capsaicin value, clearly indicating the independent nature of these two characters and selection of dry chilli yield per plot based on the capsaicin value is not reliable.

Capsaicin value showed significant and positive correlation with days to 50 percent flowering, fruit width and average seed count per fruit, clearly indicating that selection for capsaicin value based on the other characters is possible. Capsaicin value showed non-significant and negative association with dry chilli yield per plot, thousand seed weight, fruit length and plan height, this clearly indicated the independent nature of these characters and selection for each of these characters is based on capsaicin value is not reliable.

Capsaicin value showed positive and significant correlation with days to 50 percent flowering (0.53), fruit width (0.58), average seed count per fruit (0.66) and dry chilli yield per plot (0.28). Showed positive and non-significant correlation with Plant canopy width (0.58). Showed negative and significant correlation with number of fruits per plant. Showed negative and non-significant correlation with plant height (0.11), fruit length (0.58), thousand seed weight (0.43) and leaf curl virus incidence (0.60). And total colour value (0.93).

A significant positive correlation of economic traits like, plant height, number of fruits per plant, average seed count per fruit, leaf curl virus incidence and total colour value was recorded suggesting that selection for these characters would lead to improvement in yield (Table 2). Hasanuzzaman and Faroq (2011); Kumar *et al.,* (2012); Priyanka and Mishra (2016); Rokib *et al.,* (2016); Shimless Akula *et al.,* (2016) also made similar reports.

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