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Genetic Parameters for Yield and Yield Components in F_1 Hybrids and Parents of Bell Pepper

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ABSTRACT

Twenty-eight F_1 bell pepper hybrids along with eight parents and standard check (Bharat) were evaluated for variability, heritability and genetic gain in different yield and yield contributing traits. The data was recorded on five randomly selected plants for twelve quantitative characters. The treatment, i.e. mean sum of squares due to genotypes showed significant differences for twelve characters studied, indicating the presence of high genetic variability among the genotypes. The estimates of GCV were lower than the respective PCV, indicating the influence of environmental factors on the expression of the traits studied. Characters like number of fruits per plant, fruit shape index, number of lobes per fruit, pericarp thickness and fruit yield per plant showed high heritability coupled with moderate genetic advance as percent of mean, suggesting that selection for the improvement of these characters may be rewarding. This also indicates greater role of non-additive gene action in their inheritance suggesting heterosis breeding could be used to improve these traits.

Introduction

Bell pepper occupies a pride of place among vegetables in Indian cuisine, because of its delicate taste, colour and pleasant flavour coupled with rich ascorbic acid, vitamin-A and other vitamins and minerals. Fresh peppers have exceptionally high quantities of ascorbic acid and their attractive red color is due to several carotenoid pigments that include β-carotene with pro-vitamin A activity and oxygenated carotenoids such as capsantine, capsorubin, and cryptocapsin, which are exclusive to these fruits and have proven to be effective at scavenging free radicals (Deepa *et al.*, 2006). Peppers also contain large quantities of neutral phenolic compounds or flavonoids called quercetin, luteolin, and capsaicinoids (Hasler, 1998). Continuous selection towards the preferred fruit shape leads to narrow down in bell pepper gentic base (Aditika *et al.*, 2018), therefore sound use of genetic variability available with us at indigenous and exotic level leads to the development of superior bell pepper lines. Conventional as well as non-conventional approaches are the mean of genetic improvement (Aditika *et al.*, 2017). Success of every crop improvement programme is dependent on germplasm used by the breeder. Knowledge on the genetic architecture of genotypes is necessary to formulate efficient breeding methodology. Increase fruit yield per plant is the prime objective to achieve higher productivity in bell pepper. Creation of genetic variability, selection and evaluation of selected lines are the basic steps of systematic crop improvement. Bell pepper is known to have narrow genetic base so hybridization poses one of the best method to create variability among the germplasm available with us. Level of genetic diversity among genotypes affect the extent of genetic variability in segregating populations which offers better scope for selection. Relative magnitude of additive and non-additive genetic variances, heritability and genetic gain are desirable to determine with regard to the specific yield and yield contributing characters. Heritability and genetic advance are other important selection parameters. The estimates of heritability help the plant breeder in determining the character for which selection would be rewarding. The breeders are interested in selection of superior genotypes based on their phenotypic expression. The major function of heritability estimates is to provide information on transmission of characters from the parents to the progeny. Heritability estimates can anticipate improvement by selection of useful characters. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. Therefore, estimates of GCV, PCV, heritability and genetic advance will play an important role in exploiting future research projections of bell pepper improvement.

Materials and Methods

The experiment was carried out under net house conditions at research farm, Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan HP in a Randomized Block Design with three replications. The experimental material consists of eight diverse genotypes of bell pepper *viz.,* California Wonder, Solan Bharpur, Yolo Wonder, Nishath-1, UHFBP-3, KC-10, KC-11 and KC-12 which were crossed in half diallel fashion to get twenty-eight cross combinations. The twenty-eight hybrids along with parents and a standard check (Bharat) were evaluated during summer, 2017.

The observation were recorded on twelve yield and yield related traits *viz.,* plant height (cm), number of primary branches, days to 50 per cent flowering, days to marketable maturity, number of fruits per plant, average fruit weight (g), fruit yield per plant (kg), fruit shape index, number of lobes per fruit, pericarp thickness (mm), harvest duration (days) and ascorbic acid (mg/100g) was recorded. The data recorded on the above characters were subjected to the following statistical analysis: Analysis of variance (Gomez and Gomez, 1983) coefficients of variability were calculated as per Burton and De Vane (1953), heritability (Allard, 1960) and genetic gain by Johanson *et al.,* (1955).

Results and Discussion

The mean sum of squares due to genotypes showed significant differences for twelve characters studied among thirty-seven genotypes, including parents, hybrids and check variety (Table 1), indicating the presence of high genetic variability among the genotypes. The significant differences among the genotypes studied suggest that variability can be further utilized in bell pepper improvement programme. The estimates of genetic parameters including co-efficient of variation, heritability and genetic gain deserve attention in deciding selection criteria for improvement in the concerned characters and are presented in table 2.

Table.1 ANOVA for parents and their hybrids for yield and quality traits in bell pepper

Sum of Squares	df	Source											
		PH	NPB	DF 50 %	DTMM	NFPP	AFW (g)	FSI	NLPF	PT (mm)	HD (days)	AA (mg/100g)	FYPP (kg)
Replications	2	0.11	0.01	0.06	4.57	0.29	1.36	0.01	0.02	0.06	1.32	8.98	0.00
Genotypes	36	367.11*	0.42*	19.99*	49.97*	23.97*	1346.96*	0.11*	0.55*	1.20*	29.33*	256.98*	0.10*
Error	72	0.29	0.02	0.5	1.2	0.08	0.95	0	0.02	0.04	0.82	0.49	0.00
Total	110	367.51	0.45	20.55	55.74	24.34	1349.27	0.12	0.59	2.1	31.47	266.45	0.10

Table.2 Estimates of genetic parameters for twelve characters for parents and their hybrids in bell pepper

Traits	Range	Mean ± SE(d)	Coefficients of variability (%)		Heritability (%)	Genetic advance (%)
			Phenotypic	**Genotypic**		
PH (cm)	73.79-120.83	103.077 ± 0.44	10.74	10.73	99.77	22.07
NPB	2.37-3.70	2.97 ± 0.10	13.11	12.41	89.66	24.21
DF 50 %	46.00-55.00	49.36 ± 0.58	5.36	5.16	92.88	10.25
DTMM	66.33-84.33	77.68 ± 0.89	5.38	5.19	93.14	10.32
NFPP	7.15-18.93	11.76 ± 0.23	24.11	23.99	99.00	49.18
AFW (g)	36.33-104.66	69.45 ± 0.80	29.55	29.52	99.78	60.74
FSI	0.89-1.72	1.29 ± 0.05	15.00	14.22	89.79	27.75
NLPF	2.40- 4.00	3.25 ± 0.11	13.64	12.95	90.02	25.30
PT (mm)	2.94-7.34	4.98 ± 0.17	15.37	14.76	92.16	29.19
HD	50.67- 66.00	59.35 ± 0.74	5.41	5.20	92.10	10.27
AA (mg/100g)	118.33-156.00	140.67 ± 0.57	6.59	6.57	99.43	13.50
FYPP (kg)	0.54-1.16	0.78 ± 0.02	21.72	21.57	98.69	44.15

PH (Plant height), NPB (Number of primary branches), DF 50% (Days to 50% flowering), DTMM (days to marketable maturity), NFPP (Number of fruits per plant), AFW (Average fruit weight), FSI (fruit shape index), NLPF (number of lobes per fruit), PT (Pericarp thickness), HD (harvest duration), AA (ascorbic acid), FYPP (fruit yield per plant)

The phenotypic coefficient of variation was higher than that of genotypic coefficient of variation for all the traits under study indicating the influence of environment on the expression of characters, these were found in accordance with the findings of Santosh, 2013. Both phenotypic (5.36-29.55) and genotypic (5.16-29.52) coefficients were ranged from low to moderate for all the character under study. Moderate phenotypic and genotypic coefficients were found for the characters *viz.,* number of fruits per plant (24.11, 23.99), average fruit weight (29.55, 29.52) and fruit yield per plant (21.72, 21.57). PCV was found to be moderate for fruit shape index (15.00) and pericarp thickness (15.37) whereas, GCV was found to be low for these two characters. Phenotypic and genotypic coefficients of variability were low for the remaining characters. Less difference between phenotypic and genotypic coefficient of variation in all traits indicated less influence of environment on these traits. Estimates of heritability found higher for all the characters under study. Heritability ranged from 89.66 per cent to 99.78 per cent. The estimates of heritability are more advantageous when expressed in terms of genetic advance. Johnson *et al.,* (1955) suggested that heritability and genetic advance when calculated together would prove more useful in predicting the resultant effect of selection on phenotypic expression, without genetic advance the estimates of heritability will not be of practical value and emphasized the concurrent use of genetic advance along with heritability. Genetic advance as percent of mean was higher for average fruit weight (60.74) whereas, moderate genetic gain was observed for the characters *viz*., number of fruits per plant (49.18), fruit shape index (27.75), number of lobes per fruit (25.30), pericarp thickness (29.19) and fruit yield per plant (44.15). Low gentic gain was found for plant height (22.07), number of primary branches (24.21), days to 50 per cent flowering (10.25), days to marketable maturity (10.32), harvest duration (10.27) and ascorbic acid content (13.50). High heritability along with high genetic gain was found for average fruit weight indicating role of additive gene action for its inheritance and could be improved through selection. The results are in consonance with Sree and Rajamony (2002), Chatterjee and Kohli (2004), Mishra *et al.,* (2005), Bhardwaj *et al.,* (2007) and Sharma *et al.,* (2010). Low heritability and low genetic advance shows non-additive gene action. However, characters showing high values of heritability coupled with moderate genetic advance were number of fruits per plant, fruit shape index, number of lobes per fruit, pericarp thickness and fruit yield per plant suggest that selection for the improvement of these characters may be rewarding. It also indicates greater role of non-additive gene action in their inheritance suggesting heterosis breeding could be useful for improving these traits.

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