



Genetic Variability, Character Association and Path Aoefficient Analysis of Sweet Pepper (*Capsicum Annuum L.*) Germplasms

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Abstract

The present investigation was carried out to investigate the genetic variability, character association, correlation and path coefficient analysis among thirty accessions of sweet pepper. Significant variations were observed for different morphological traits, yield and yield attributes among the accessions studied. For all the characters, genotypic coefficient of variation (GCV) was smaller than phenotypic coefficient of variation (PCV). The highest genotypic and phenotypic coefficients of variations were recorded in case of number of fruit per plant (46.37 and 47.66%) followed by fruit yield per plant (39.39 and 41.44%), fruit length (31.92 and 32.48%) and dry weight (31.50 and 32.00%). Correlation coefficient study indicated that fruit yield had highly significant and positive correlation with individual fruit weight ($r = 0.619$) and number of fruit per plant ($r = 0.605$). In respect of path analysis, number of fruit per plant was contributed by maximum direct effect on sweet pepper (0.603) indicating its importance as a selection parameter.

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Introduction

Sweet pepper (*Capsicum annuum L.*) belongs to the family Solanaceae having chromosome number 24 and is consider to have originated from Mexico (Bahurupe *et al.*, 2013). It is an important spicy vegetable and an active ingredient in cookery. Sweet pepper has diverse uses as spice, condiment, culinary supplement, medicine vegetable and ornamental plant. Sweet pepper has gained popularity due to its additional importance as it contains a large amount of phytochemicals that have exceptional antioxidant and the production and consumption increased worldwide (Hasan *et al.* 2015). A large number of local lines are cultivated in the country having diverse characters of different vegetables including sweet pepper (Nahar *et al.* 2016). The productivity of this vegetable can be increased to a great extent through varietal improvement. Although sweet pepper is the minor vegetable crop in Bangladesh (Hasan *et al.* 2014), limited attempts have been made for its genetic improvement. Therefore, intensive research efforts are needed in several areas particularly, selection of superior genotypes. The basic key to bring about the genetic upgrading of a crop is to utilize the available or created genetic variability.

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Furthermore, magnitude of interrelationship between yield attributes together with their detailed direct and indirect effects towards yield provides better knowledge in formulating selection criteria. Correlations in combination with the path coefficient analysis quantify the direct and indirect contribution of one character upon another (Dewey and Lu 1959; Basar *et al.* 2015). Therefore, the present study was undertaken to find out the genetic divergence, genetic variability for the yield and yield contributing characters and to assess the interrelationship between yield and yield contributing characters of sweet pepper germplasms.

Materials and methods

The present investigation was conducted at the Horticulture Farm and Laboratory of Horticulture Department, Bangladesh Agricultural University, Mymensingh during the period from October 2018 to April 2019. The experiment plot was medium high land. The soil texture was loam with pH 6.7. It germinates best at the temperature range from 20 to 30 °C and grows best around 25 °C. The experiment was laid out in randomized complete block design with three replications. There are 30 sweet pepper accessions collected from different region of the country and these accessions were used as experimental materials. Each sweet pepper accession was considered as an individual treatment in this experiment. The sources of accessions are presented in Table 1.

Table 1. Number and sources of 30 sweet pepper germplasms

Treatment	Accession number	Place of collection	Treatment	Accession number	Place of collection
T ₁	CA01	Bogura	T ₁₆	CA16	Sylhet
T ₂	CA02	Bogura	T ₁₇	CA17	Jashore
T ₃	CA03	Mymensingh	T ₁₈	CA18	Jashore
T ₄	CA04	Bogura	T ₁₉	CA19	Jashore
T ₅	CA05	Dinajpur	T ₂₀	CA20	Jashore
T ₆	CA06	Sylhet	T ₂₁	CA21	Mymensingh
T ₇	CA07	Sylhet	T ₂₂	CA22	Mymensingh
T ₈	CA08	Mymensingh	T ₂₃	CA23	Sylhet
T ₉	CA09	Jashore	T ₂₄	CA24	Japan
T ₁₀	CA10	Bogura	T ₂₅	CA25	Sylhet
T ₁₁	CA11	Bogura	T ₂₆	CA26	Mymensingh
T ₁₂	CA12	Bogura	T ₂₇	CA27	Japan
T ₁₃	CA13	Japan	T ₂₈	CA28	Japan
T ₁₄	CA14	Rajshahi	T ₂₉	CA29	Sulhet
T ₁₅	CA15	Bogura	T ₃₀	CA30	Bogura

The genotypic and phenotypic variances were calculated according to Johson *et al.* (1955) and genotypic and phenotypic coefficients of variations were calculated according to Burton (1952). Simple correlation coefficient (*r*) among the important characters of sweet pepper accessions were estimated by the formula

of Singh and Chaudhury (1985). Path coefficient analysis was carried out according to the procedure employed by Dewey and Lu (1959) using simple correlation values. In path analysis, correlation coefficient was divided into direct and indirect effects of the variables.

Table 2. Estimates of genetic parameters for different characters of sweet pepper germplasms

Characters	Range	Mean \pm SE	Genotypic coefficient of variation (%)	Phenotypic coefficient of variation (%)
Plant height(cm)	11.57 - 25.10	17.47 \pm 0.618	18.80	20.46
No. of primary branches	2.07 – 3.03	2.31 \pm 0.043	9.63	11.58
Width of plant (cm)	11.00 – 17.03	14.31 \pm 0.340	11.62	15.42
Length of leaf (cm)	4.63-6.30	5.57 \pm 0.084	7.70	9.26
Breadth of leaf (cm)	2.17-3.67	2.96 \pm 0.089	16.33	16.91
Petiole length (cm)	2.07-2.97	2.45 \pm 0.046	9.94	10.97
Flowering time	48.33-59.00	54.60 \pm 0.619	5.43	7.53
Number of flowers/plant	3.00-16.00	7.70 \pm 0.610	15.20	17.97
Fruit length (cm)	4.30-15.45	8.57 \pm 0.502	31.92	32.48
Fruit breadth (cm)	6.18-22.50	16.53 \pm 0.889	29.00	30.38
Pedicle length (cm)	2.00-3.00	2.17 \pm 0.069	16.76	18.61
Pedicle thickness (mm)	12.29-30.63	22.67 \pm 1.05	25.10	26.01
Individual fruit wt. (g)	35.75-113.75	70.44 \pm 3.91	30.32	30.66
No. of fruits/plant	3.10-15.74	7.63 \pm 0.652	46.37	47.66
Fruit yield/ plant (g)	192.29-941.34	506.75 \pm 37.09	39.39	41.44
Dry weight (%)	2.00-5.10	3.52 \pm 0.203	31.50	32.00
No. of seeds/ plant	61.23-151.60	107.98 \pm 4.10	20.68	20.98
Weight of 100 seeds	7.10-14.00	11.01 \pm 0.400	19.66	20.31

Results and discussion

Genetic variability

The analyses of variance indicated that the existence of sufficient genetic variability among the germplasms for all the characters studied. Range, mean, genotypic coefficient of variation (GCV %) and phenotypic coefficient of variation (PCV %) are presented in Table 2. Wide range of variability was noticed in individual fruit weight (35.75-113.75 gm). The fruit length (4.30-15.45 cm), fruit breadth (6.18-22.50 cm), number of fruits per plant (3.10-15.74), fruit yield per plant (192.29-941.34

gm) and number seeds per fruit (61.23-151.60). From the present study it was found that the phenotypic coefficient of variation was higher than the genotypic coefficient of variation (Table 2). The highest GCV and PCV were observed in case of number of fruit per plant (46.37 and 47.66%)

Table 3. Correlation between yield and yield contributing characters of 30 sweet pepper germplasms

Character	No. of primary branches	Flowering time	No. of flowers/plant	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight (g)	No. of fruits/plant	Fruit yield/plant (g)
Plant height (cm)	-0.103	-0.613**	0.339	0.390*	-0.252	0.161	0.415*	0.585**
No. of primary branches		0.131	0.099	0.106	-0.033	-0.192	0.044	-0.150
Flowering time			-0.146	-0.532**	0.302	-0.438*	-0.600	-0.976**
No. of flowers/plant				0.509	0.350	-0.323	0.433*	0.133
Fruit length (cm)					-0.396*	-0.098	0.605**	0.505**
Fruit diameter (cm)						0.619	-0.859**	-0.275
Individual Fruit weight (g)							-0.418*	0.461*
No. of fruits/plant								0.592**

** Significance at 1% level of probability; * Significance at 5% level probability

followed by fruit yield per plant (39.39 and 41.44%), fruit length (31.92 and 32.48%) and dry weight percentage (31.50 and 32%). The high genetic variability can be exploited by selection. The above results are in confirmation with the results reported Saha *et al.* (1992), Murray *et al.* (2005) and Nahar *et al.* (2016). The character like fruit breadth, pedicel thickness, plant height and pedicel length showed medium coefficient of variation at both genotypic and phenotypic levels. Low genotypic as well as phenotypic coefficients of variations were recorded in case of Width of plant, breadth of leaf, number of flower per plant and length of leaf.

Correlation studies

Correlation coefficient is a statistical measure which is used to find out the size and direction of relationship between two or more variables. Correlation coefficient measures the degree of association either in positive or negative direction. A simple correlation coefficient was used among eight important yield contributing characters of 30 sweet pepper accessions. The values of "r" and the characters correlated are

Table 4. Path coefficient of fruit producing characters on fruit yield per plant in sweet pepper germplasms

Characters	Plant height (cm)	No. of primary branches	Flowering time	No. of flower Per plant	Fruit length (cm)	Fruit breadth (cm)	Individual fruit wt. (g)	No. of fruit/plant	Fruit yield Per plant (g)
Plant height (cm)	<u>0.027</u>	0.003	0.259	-0.005	-0.0028	-0.021	0.074	0.250	0.585**
No. of primary branches	-0.003	<u>-0.025</u>	-0.055	-0.001	-0.0008	-	-0.089	0.027	-0.150
Flowering time	-0.017	-0.003	<u>-0.422</u>	0.0022	0.0039	0.025	-0.202	-	-
No. of flower/plant	0.009	-0.0024	0.062	<u>-0.015</u>	-0.004	-0.029	-0.149	0.362	0.976**
Fruit length (cm)	0.011	-0.0026	0.225	-0.0075	<u>-0.007</u>	-	-0.045	0.261	0.133
Fruit breadth (cm)	-	0.0008	-0.1277	0.0052	0.003	<u>0.082</u>	0.2860	0.364	0.505**
Individual fruit wt.	0.0044	0.0047	0.1852	0.0048	0.00071	0.0511	<u>0.462</u>	0.518	-0.275
No. of fruit/plant	0.011	-0.0011	0.2537	-0.0064	-0.0044	-0.071	-0.1931	0.252	0.461*
								<u>0.603</u>	0.592**

Residual effect: 0.0260; Underlined figures indicate the direct effect

Table 5. Average intra and inter cluster distances (D2) for 30 sweet pepper germplasms

	I	II	III	IV	V	VI
I	<u>45.22</u> (6.72)	58.24 (7.63)	541.43 (23.27)	80.32 (8.96)	342.01 (18.49)	164.43 (12.82)
II		<u>57.52</u> (7.58)	590.07 (24.29)	73.52 (8.57)	377.93 (19.44)	207.10 (14.39)
III			<u>220.29</u> (14.84)	503.99 (22.45)	488.21 (22.10)	694.61 (26.36)
IV				<u>14.91</u> (3.86)	253.66 (15.93)	303.22 (17.41)
V					<u>246.24</u> (15.69)	641.85 (25.33)
VI						<u>51.31</u> (7.16)

Bold and underline figure indicates intra cluster distance.

presented in Table 3. Various component characters which are directly and positively correlated with yield often act as useful indicator in selection. Thus, sound knowledge of such associations among the various character particularly in relation to total yield is of prime importance in planning successful and effective breeding programmes. According to Robinson (1966), correlation studies are helpful in choosing superior genotypes from phenotypic expression. Fruit yield per plant exhibited positive correlation with plant height, fruit length and number of fruit per plant but showed negative correlation with other characters. Individual fruit weight was positively correlated with fruit breadth and plant height but negatively associated with number of primary branches, flowering time and fruit length (High phenotypic co-efficient of variation (PCV) and genotypic coefficient of variation (GCV) were found for plant height (Mini and Khader 2004, Sreelathakumary and Rajamony 2004, Singh *et al.* 2009). Highly significant positive correlations were found for fruit yield with number of fruit per plant ($r = 0.592$), plant height ($r = 0.585$) and fruit length ($r = 0.505$) but showed negative association with number of primary branches and fruit breadth. Number of fruit per plant showed highly significant positive correlation with fruit length ($r = 0.605$) but had negative correlation with fruit breadth. The results of the present study are in agreement with the findings of Pandit *et al.* and Robinson *et al.* 1949; 2014).

Path analysis

The path coefficient of analysis was performed with simple correlations to assess the direct and indirect influences of yield attributes characters on fruit yield. Yield is the final outcome of different characters, considered as the resultant variable while plant height, number of primary branches, flowering time, flower per plant, fruit length, fruit breadth, individual fruit weight and number of fruit per plant are the causal variables. The path analysis revealed that direct effect of plant height on fruit yield per plant was moderate and positive (0.027) where as positive indirect effect of plant height on fruit yield per plant was contributed via number of primary branches, flowering time, individual fruit weight and number of fruit per plant. Estimation of direct and indirect effects of the causal variables have been presented in Table 4.

Clustering of germplasms

On the basis of D^2 analysis, 30 genotypes of capsicum were grouped into six clusters (Table 5). Cluster VI contained the highest number of accession having 7 accessions followed by cluster I having 6 accessions while II, III, IV and V having 5, 4, 3 and 5 accession respectively. The clustering pattern of the accessions under this study revealed that the accessions collected from the same area or region were grouped into different clusters.

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