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Correlation and path-coefficient analysis for yield and its contributing traits in capsicum, *Capsicum annuum* L

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ABSTRACT

The present investigations were carried out to assess the nature and magnitude of association among yield and its contributing traits in capsicum. The correlation coefficients among different characters showed that yield per plant had positive and significant association with plant height, number of branches per plant, number of fruits per plant, fruit length, fruit breadth and average fruit weight while significant and negative correlations were observed with days to 50 per cent flowering and number of seeds per fruit both at phenotypic and genotypic levels. The data pertaining to phenotypic path revealed that number of fruits per plant had maximum positive direct effect on yield per plant followed by average fruit weight, fruit breadth and fruit length. The genotypic path depicted that average fruit weight had maximum positive direct effect on yield per plant followed by number of fruits and branches per plant. Hence direct selection for number of fruits and branches per plant, fruit length, breadth and weight is reliable for yield improvement in capsicum.

Keywords: *Capsicum annuum*; correlation; path-coefficient; yield; traits

INTRODUCTION

Capsicum commonly known as bell pepper is one of the most important solanaceous vegetable crops grown extensively worldwide (Singh et al 1993). It is an excellent source of pro-vitamin A and vitamin C. Capsicum has assumed a special significance in the mid-hills of Himachal Pradesh as its production during summer and rainy seasons makes it off-season vegetable in the markets of north Indian plains which brings lucrative returns to the growers. The capsicum varieties released by public sector have become obsolete, poor yielders and vulnerable to insect-pests and diseases. So there is a need to screen out the available capsicum

germplasm so that specific genotypes may be identified and promoted for commercial cultivation in Himachal Pradesh as well as elsewhere in India.

The knowledge of degree of association of yield to its components is of great importance in selecting suitable plant type because yield being a polygenic character is the resultant of the interactions of a number of component characters among themselves as well as with the different environments. Therefore it becomes difficult to evaluate this complex character directly. By the use of variance and covariance analysis each character can be assigned appropriate weight to bring out rational improvement in yield. Although correlation studies are helpful in determining the components of yield but these do not provide a clear picture of nature and extent of contributions made by number of independent traits. Path coefficient analysis is helpful in partitioning the correlation into components due to direct and indirect effects and also permits critical examination of specific factors that provide a given correlation. Path coefficient analysis devised by Dewey and Lu (1959) however provides a realistic basis for allocation of appropriate weightage to various attributes while designing a pragmatic programme for yield improvement. Therefore the present study was undertaken to assess the nature and magnitude of association among yield and its contributing traits for yield improvement in capsicum.

MATERIAL and METHODS

The present investigations were carried out at vegetable research farm of the Department of Vegetable Science, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, HP during Kharif 2011. The experimental site is located at Nauni about 13 km from Solan at an altitude of 1270 m amsl lying between latitude 30°52' North and longitude 77°11' East under the mid-hill zone of Himachal Pradesh.

Twenty four genotypes of *Capsicum annuum* L comprising of eighteen local collections, one hybrid (Arka Mohini) and five commercially cultivated varieties used in the present studies have been listed in Table 1. Seeds of 24 genotypes of capsicum were directly sown in the field during the month of April 2011 in road row fashion. Morphological characterization of genotypes with respect to their plant and fruit characters was done with 3 replications using homozygous plants in each accession. The observations were recorded from five randomly selected plants in each replication for days to 50 per cent flowering, plant height (cm), number of branches per plant, number of fruits per plant and fruit yield per plant (g) while observations on fruit characters viz fruit length (cm), fruit breadth (cm), average fruit weight (g) and number of seeds per fruit were recorded on ten randomly selected fruits per replication.

The genotypic and phenotypic correlations were calculated as per Al-Jibouri et al (1958) by using analysis of variance and covariance matrix in which total variability was split into replications, genotypes and errors. The genotypic and phenotypic correlation coefficients were used to find out their direct and indirect contributions towards yield per plot. The direct and indirect paths were obtained according to the method given by Dewey and Lu (1959).

RESULTS and DISCUSSION

Correlation studies

Knowledge of degree of association of yield with its components is of great importance since yield is not an independent character but it is the resultant of the interactions of a number of component characters among themselves as well as with the environment in which the plant grows. In addition each character is likely to be modified by action of genes present in the genotypes of plant and also by the environment and it becomes difficult to evaluate this complex character directly. Therefore correlation study of yield with its component traits has been executed to find out the yield contributing traits.

The correlation coefficients among the different characters were worked out at phenotypic and genotypic levels (Table 2). In general the genotypic correlation coefficients were higher in magnitude than phenotypic correlation coefficients. The correlation coefficients among different characters showed that yield per plant had positive and significant association with plant height (0.68 and 0.73), number of branches

Table 1. *Capsicum annuum* L genotypes used in the present study

Genotype	Genotype
ACC-2	Kannauel
ACC-16	Local Bilaspur
EC-579997	Local Solan
HC-201	Mahog
LC-1	Nauni Collection
PC-1	R Local Collection
PC-2	Yolo Wonder
UHF-14	Arka Mohini
Dilman	Bambi Red
Feroz	California Wonder
Gajio	Orobelle
Kandaghat Selection-9	Solan Bharpur

Table 2. Phenotypic and genotypic coefficients of correlation among different traits in *Capsicum annuum* L

Trait		Days to 50% flowering	Plant height (cm)	# branches /plant	# fruits /plant	Fruit length (cm)	Fruit breadth (cm)	Average fruit weight (g)	# seeds /fruit	Fruit yield /plant (g)
		1	2	3	4	5	6	7	8	9
1	P	1.00	-0.78**	-0.68**	-0.82**	-0.37**	-0.12	-0.28*	0.28*	-0.67**
	G	1.00	-0.77**	-0.80**	-0.80**	-0.48**	-0.17	-0.37**	0.40**	-0.72**
2	P		1.00	0.91**	0.82**	0.42**	0.15	0.32**	-0.37**	0.68**
	G		1.00	0.99**	0.82**	0.52**	0.21	0.42**	-0.49**	0.73**
3	P			1.00	0.71**	0.35**	0.09	0.25*	-0.28*	0.57**
	G			1.00	0.85**	0.54**	0.24*	0.45**	-0.57**	0.77**
4	P				1.00	0.39**	0.09	0.27*	-0.32**	0.77**
	G				1.00	0.48**	0.13	0.34**	-0.42**	0.81**
5	P					1.00	0.55**	0.84**	-0.63**	0.77**
	G					1.00	0.55**	0.84**	-0.69**	0.79**
6	P						1.00	0.91**	-0.74**	0.65**
	G						1.00	0.91**	-0.82**	0.64**
7	P							1.00	-0.80**	0.80**
	G							1.00	-0.90**	0.81**
8	P								1.00	-0.70**
	G								1.00	-0.80**
9	P									1.00
	G									1.00

*Significant at 5% level of significance, **Significant at 1% level of significance, P= Phenotypic coefficient, G= Genotypic coefficient

per plant (0.57 and 0.77), number of fruits per plant (0.77 and 0.81), fruit length (0.77 and 0.79), fruit breadth (0.65 and 0.64) and average fruit weight (0.80 and 0.81) while significant and negative correlations were observed with days to 50 per cent flowering (-0.67 and -0.72) and number of seeds per fruit (-0.70 and -0.80) both at phenotypic and genotypic levels respectively. Beside this average fruit weight revealed positive and significant association with plant height (0.32 and 0.42), number of branches per plant (0.25 and 0.45), number of fruits per plant (0.27 and 0.34), fruit length (0.84 and 0.84), fruit breadth (0.91 and 0.91) and average fruit weight (0.80 and 0.81) whereas significant and negative correlations were observed with days to 50 per cent flowering (-0.28 and -0.37) and number of seeds per fruit (-0.80 and -0.90) both at phenotypic and genotypic levels respectively. Similar correlations of yield with various other horticultural traits in capsicum have also been reported earlier by Rani (2003), Bindal et al (2005), Mishra et al (2005), Gupta et al (2009) Sood et al (2009) and Sharma et al (2010).

Path coefficient analysis

Although correlation studies are helpful in determining the components of yield but these do not provide a clear picture of nature and extent of contributions made by number of independent traits. Path coefficient analysis devised by Dewey and Lu (1959) however provides a realistic basis for allocation of appropriate weightage to various attributes while designing a pragmatic programme for the improvement of yield.

The phenotypic path analysis as presented in the Table 2 reveals that number of fruits per plant (0.62) had maximum positive direct effect on yield per plant followed by average fruit weight (0.31), fruit breadth (0.22) and fruit length (0.12), while negative direct effect of days to 50 per cent flowering (-0.03), number of branches per plant (-0.03), plant height (-0.02) and number of seeds per fruit (-0.01) was observed on yield per plant. Maximum positive indirect effects of plant height (0.51), number of branches per plant (0.44) and fruit length (0.29) via number of fruits per plant and fruit breadth (0.31) and fruit length (0.29) via average fruit weight was observed on yield per plant. The maximum negative indirect effects of days to 50 per cent flowering (-0.51) via number of fruits per plant and average fruit weight (-0.27), number of fruits per plant (-0.20) and fruit breadth (-0.16) via number of seeds per fruit were noticed on yield per plot. At phenotypic level residual effect was found 0.01. Data regarding genotypic path revealed that average fruit weight (0.99) had maximum positive direct effect on yield per plant followed by number of fruits per plant (0.66), number of seeds per fruit (0.06), number of branches per plant (0.03) while negative direct effect of fruit length (-0.24), fruit breadth (-0.21), plant height (-0.10), days to 50 per cent flowering (-0.03) was

Table 3. Estimates of direct and indirect effects of different traits on yield of *Capsicum annuum* L

Trait		Days to 50% flowering	Plant height (cm)	# branches /plant	# fruits /plant	Fruit length (cm)	Fruit breadth (cm)	Average fruit weight (g)	# seeds /fruit	Correlation coefficient with fruit yield/plant (g)
		1	2	3	4	5	6	7	8	9
1	P	**-0.03**	0.01	0.02	-0.51	-0.05	-0.03	-0.10	0.00	-0.67**
	G	**-0.03**	0.08	-0.02	-0.53	0.12	0.04	-0.39	0.02	-0.72**
2	P	0.02	**-0.02**	-0.03	0.51	0.05	0.03	0.11	0.00	0.68**
	G	0.02	**-0.10**	0.03	0.54	-0.13	-0.04	0.44	-0.03	0.73**
3	P	0.02	-0.02	**-0.03**	0.44	0.04	0.02	0.08	0.00	0.57**
	G	0.02	-0.10	**0.03**	0.57	-0.13	-0.05	0.48	-0.03	0.77**
4	P	0.02	-0.01	-0.02	**0.62**	0.05	0.02	0.09	0.00	0.77**
	G	0.02	-0.08	0.02	**0.66**	-0.12	-0.03	0.35	-0.02	0.81**
5	P	0.01	-0.01	-0.01	0.24	**0.12**	0.12	0.29	0.01	0.77**
	G	0.01	-0.05	0.02	0.32	**-0.24**	-0.11	0.89	-0.04	0.79**
6	P	0.01	-0.01	-0.01	0.06	0.07	**0.22**	0.31	0.01	0.65**
	G	0.01	-0.02	0.01	0.09	-0.13	**-0.21**	0.95	-0.05	0.64**
7	P	0.01	-0.01	-0.01	0.16	0.10	0.20	**0.34**	0.01	0.80**
	G	0.01	-0.04	0.07	0.22	-0.20	-0.19	**0.99**	-0.05	0.81**
8	P	-0.01	0.01	0.01	-0.20	-0.08	-0.16	-0.27	**-0.01**	-0.70**
	G	-0.01	0.05	-0.01	-0.28	0.17	0.17	-0.94	**0.06**	-0.80**

**Significant at 1% level of significance, P= Phenotypic coefficient, G= Genotypic coefficient,
Residual effect: Phenotypic path= 0.01, Genotypic path= 0.02

Diagonal bold figures represent the direct effect

observed on yield per plant. Maximum positive indirect effects of fruit breadth (0.95), fruit length (0.89), number of branches per plant (0.48) and plant height (0.45) via average fruit weight and number of branches per plant (0.57) and plant height (0.54) via number of fruits per plant was observed on yield per plant. Whereas maximum negative indirect effects of number of seeds per fruit (-0.94) and days to 50 per cent flowering (-0.39) via average fruit weight and days to 50 per cent flowering (-0.53) and number of seeds per fruit (-0.28) via number of fruits per plant were noticed on yield per plot. At genotypic level residual effect was found 0.02. Earlier workers like Nazir et al (2005), Khader and Mini (2006), Gupta et al (2009), Sood et al (2009) and Sharma et al (2010) have also reported the same effects of component traits on yield.

CONCLUSION

The present studies conclude that yield per plant had positive and significant association with plant height, number of branches per plant, number of fruits per plant, fruit length, fruit breadth and average fruit weight. Path coefficient analysis depicted that number of fruits and branches per plant, fruit length, breadth and average weight had maximum direct effect on number of fruits per plant. Hence direct selection on the basis of these traits is reliable for yield improvement in capsicum.

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