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RESEARCH PAPER

Evaluation of genotypes of bell pepper *(Capsicum annuum* L.) in cold desert zone of Tabo valley of Spiti district of Himachal Pradesh

SEEMA THAKUR*, RAJESH THAKUR[1] AND DEVINDER KUMAR MEHTA[2]
Directorate of Extension Education, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, SOLAN (H.P.) INDIA (Email : thakurseema76@gmail.com)

Abstract : Identification and development of new varieties of bell pepper adapted to Spiti valley of Himachal Pradesh is very important because farmers are cultivating off-season pea on commercial scale but are ignorant about the production technology of bell pepper or Shimla Mirch (*Capsicum annuum* L.) cultivation under low polytunnels. The present investigations were undertaken at Regional Horticultural Research Sub- station, Tabo, Spiti, Himachal Pradesh which is located at an elevation of 3280 m (10760 ft.) above mean sea level. Highest fruit yield per plant was observed in SP-701 (1350 g) which showed statistical superiority among all the genotypes understudy. Hence, SP-701 can be recommended to the farmers for getting high yield in Tabo valley. High heritability coupled with high genetic gain were observed for average fruit weight, fruit yield /plant and fruit length which indicated the presence of additive gene action and thus, offers more scope for reliable and effective selection. It can be concluded from the study of the correlation that fruit yield per plant can be improved by improving the number of fruits per plant, average fruit weight, plant height and fruit breadth in bell pepper.

Key Words : Genetic variability, Correlation, Fruit yield, Mean performance, Bell pepper

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INTRODUCTION

Spiti district of Himachal Pradesh is known as the cold desert zone of Himachal. This zone experiences low precipitation, long, harsh winters along with short summers. UV radiations intensity is very high in the region which positively influences the quality of the vegetables being grown. The cropping season is very short (*i.e.* April to September) and generally the temperature drops down severely to -30^{0}C in winters. Pea is the only commercial vegetable crop cultivated in Spiti valley and farmers are ignorant about the production technology of bell pepper or Shimla Mirch (*Capsicum annuum* L.), although it can be profitably grown in the low cost polytunnels and can be very remunerative as these vegetables are not available for sale in the local market.

Identification and development of new varieties of bell pepper adapted to this region is very important to explore and boost the production and productivity of the

*** Author for correspondence:**
[1]Krishi Vigyan Kendra, Kandaghat, SOLAN (H.P.) INDIA
[2]Department of Vegetable Science, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, SOLAN (H.P.) INDIA

crop in the valley. Evaluation of the germplasm is the first step in this direction, since the improvement in any crop is proportional to the magnitude of genetic variability (Sureja and Sharma, 2000)

Estimates of parameters of variability, importantly heritability and genetic gain are reliable indicators for the improvement of characters in particular genetic material through selection. Since the selection for highly heritable characters is more effective, therefore, heritability along with other parameters can be used in predicting the gain for a given selection intensity and expected genetic gain gives the idea of extent of improvement in a character through simple selection. Moreover, selection for yield and quality traits can be better achieved if the information with respect to correlation between such traits is also available. The present study was planned to evaluate different varieties of Shimla Mirch under cold desert conditions of Spiti valley along with the study of the genetic variability and correlation studies among different traits.

MATERIAL AND METHODS

The present investigations were undertaken at Regional Horticultural Research Sub- station, Tabo, Spiti, Himachal Pradesh during the year 2010-11. Ten genotypes of bell pepper were evaluated for yield and different horticultural traits. The site is located at an elevation of 3280 m (10760 ft.) above mean sea level. The valley has short summers growing season (April-September) and the region experiences extreme climatic conditions with temperatures dropping upto -30 degree during winter months.

The experiment was planted in Randomized Complete Block Design with three replications. The observations were recorded on five randomly selected plant for number of fruits per plant, average fruit weight (g), fruit yield per plant (g), fruit length (cm), fruit breadth (cm), pericarp thickness (mm) and plant height (cm). The data were analyzed as per the standard procedure for the analysis of variance (Panse and Sukhatme,1984) and correlation co-efficients (Dewey and Luk, 1959).

RESULTS AND DISCUSSION

Significant differences were observed for all the traits except fruit breadth in the present study which indicates the existence of sufficient possibility for selecting horticulturally superior genotypes. Mean performance of various genotypes with respect to horticultural traits have been presented in Table 1. Number of fruits per plant is an important parameter which directly influences the yield. Maximum number of fruits per plant (22.00) was observed in HC-201 which showed statistical proximity with SP-633 (18.57). The genotype California Wonder recorded maximum average fruit weight (75.00 g) and was statistically at par with the genotypes *viz.*, SP-701 (74.00 g), SP-633 (70.00 g) and UHF-14 (70.00 g). High fruit yield /plant is the prime objective of any breeding programme. Highest fruit yield per plant was observed in SP-701 (1350.00 g) which showed statistical superiority among all the genotypes understudy. Hence, SP-701 can be recommended to the farmers to be grown under dry temperate conditions of Tabo district. Plant height is an important factor determining the harvest duration of any crop. Longer harvest duration is generally preferred in the present marketing system under Indian conditions because it not only avoids the glut in the market

Table 1: Mean performance of various genotypes with respect to different horticultural traits in bell pepper

Genotype	Number of fruits/plant	Average fruit weight (g)	Fruit yield/plant (g)	Fruit length (cm)	Fruit breadth (cm)	Pericarp thickness (mm)	Plant height (cm)
California wonder	12.66	75.00	950.00	8.41	4.35	4.21	60.00
Feroz	17.66	48.00	820.00	8.65	4.39	4.06	54.00
HC-201	22.00	55.00	1,000.00	7.00	4.56	4.16	56.00
Kandaghat Selection -9	11.00	40.33	450.00	6.26	4.21	4.11	48.33
SP-633	18.57	70.00	1,000.00	8.21	4.91	4.80	52.33
SP-701	17.72	74.00	1,350.00	8.10	4.91	4.58	59.00
Sel.-9	9.50	65.66	650.00	6.41	4.53	4.32	49.00
Sel.64-1-1-4	12.50	44.00	450.00	8.30	4.29	4.50	50.00
Solan Bharpur	14.58	58.00	800.00	6.50	4.56	4.43	50.333
UHF-14	13.51	70.00	1,041.66	4.49	4.36	4.50	40.667
C.D. (P=0.05)	3.44	5.30	163.56	0.81	0.62	0.30	4.46

but off-season value of the crop is also maintained. Maximum plant height (60.00 cm) was observed in California Wonder which was found in statistical proximity with the genotypes *viz.,* SP-701 (59.00 cm) and HC-201 (56.00 cm).

The difference between PCV and GCV of various characters was very little indicating the greater role of genetic factors in the expression of characters with less influence of environment thus, offering the ample scope for the improvement. The phenotypic co-efficient of variation (PCV) and genotypic co-efficient of variation (GCV) were found moderate for most of the traits understudy (Table 2). This reflects genetic variability among all the genotypes for these characters. The estimates of heritability (broad sense) were found high for the traits *viz.,* average fruit weight, fruit yield /plant, fruit length and plant height. The results further confirmed the findings of high heritability estimates for average fruit weight (Sharma *et al.,* 2010), fruit yield per plant (Sree and Rajamony, 2002), fruit length (Bharadwaj *et al.*,2007) and fruit breadth (Kumari, 2013). Burton (1952) suggested that GCV together with the heritability estimates would give the clear picture of extent of advance to be expected by selection. High heritability coupled with high genetic gain were observed for average fruit weight, fruit yield /plant and fruit length which indicated the presence of additive gene action and thus offers more scope for reliable and effective selection. The results are in consonance with the findings of Chatterjee and Kohli (2004); Mishra *et al*. (2002) and Kumari (2013). High heritability along with low genetic gain was observed for plant height indicating non-additive gene action and these traits could be improved through hybridization (Kumari, 2013). The study of the correlations between different characters is more important in improving the selection. Characters of economic characters like yield are complex in inheritance and a product of action and interaction among several traits. The correlation co-efficients among different characters were worked out at phenotypic and genotypic

Table 2 : Co-efficients of variability, heritability and genetic advance for various traits understudy in bell pepper

Traits	Genotypic co-efficient of variation	Phenotypic co-efficient of variation	Heritability (%)	Genetic advance	Genetic gain (%)
Number of fruits/plant	24.65	28.13	76.80	6.65	44.51
Average fruit weight (g)	21.13	21.76	94.27	25.32	42.27
Fruit yield/plant (g)	32.23	34.14	89.12	533.59	62.69
Fruit length (cm)	17.99	19.22	87.68	2.51	34.72
Fruit breadth (cm)	2.36	8.67	7.42	0.06	1.32
Pericarp thickness (mm)	4.81	6.27	58.71	0.33	7.59
Plant height (cm)	10.52	11.66	81.39	10.16	19.56

Table 3 : Phenotypic (P) and genotypic correlations (G) for different horticultural traits in bell pepper

Traits		Number of fruits/plant	Average fruit weight (g)	Fruit yield/plant (g)	Fruit length (cm)	Fruit breadth (cm)	Pericarp thickness (mm)
Average fruit weight (g)	P	0.089					
	G	0.130					
Fruit yield/plant (g)	P	0.661**	0.805**				
	G	0.549**	0.720**				
Fruit length (cm)	P	0.324	-0.037	0.067			
	G	0.327	-0.004	0.095			
Fruit breadth (cm)	P	0.676**	0.966**	0.664**	0.505**		
	G	0.333	0.442*	0.403*	0.219		
Pericarp thickness (mm)	P	0.061	0.573**	0.447*	0.033	0.963**	
	G	0.153	0.411*	0.249	0.007	0.358	
Plant height (cm)	P	0.514**	0.247	0.424*	0.842**	0.864**	-0.158
	G	0.339	0.215	0.334	0.717**	0.231	-0.134

* and ** indicates significance of value at P=0.01 and 0.05, respectively

level and are presented in Table 3.Number of fruits/plant showed significant correlation with fruit yield/plant. The results are in consonance with the findings of Mishra *et al.* (2002) and Sharma *et al*.(2010). Average fruit weight had positive and significant correlation with fruit yield / plant, fruit breadth and pericarp thickness. The results are in agreement with those of Shreshtha (2003); Sweta Rani (2003) and Kumari (2013). Similar work related to the present investigation was also carried out by Shivakumar *et al*. (2012); Ganiger *et al*. (2012a and b) and Kumari (2013).

Fruit breadth also had positive significant correlation with pericarp thickness and plant height. Hence, it can be concluded from the study of the correlation that fruit yield per plant can be improved by improving the number of fruits per plant, average fruit weight, plant height and fruit breadth.

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