SHORT COMMUNICATION

Genetic Variability in Bell Pepper (*Capsicum annum* L.) Under High Altitude Temperate Environment

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For genetic restructuring of bell pepper aimed for increasing the productivity, the genetic variability, heritability and genetic advance was assessed. The present research study conducted at Central Institute of Temperate Horticulture during summer season 2009 and 2010 involving thirty four genotypes of bell pepper for nine quantitative characters. The results revealed that PCV was greater than corresponding GCV for all the traits. High GCV and heritability accompanied by moderate to high genetic gain was observed for number of fruits and fruit weight which could be improved by selection in early generations. Fruit length and fruit diameter exhibited high heritability coupled with moderate GCV and low genetic gain which needs selection over several successive generations following hybridization for their edification. Pimento, SH-SP-52-1, SH-SP-610-1, SH-SP-610, CITH-SP-2, SH-SP-603 and SH-SP-52 were found potential and can be exploited for their potential in the temperate region.

Key Words: *Capsicum annum*, Genetic advance, Genetic variability, Heritability

Sweet pepper [*Capsicum annuum* (L)] is a potential high value vegetable and one of the most remunerative off-season crop of mid and high hilly regions of India in particular Jammu & Kashmir. At present, productivity of bell pepper in Jammu & Kashmir is very low due to non-availability of quality seeds of high yielding varieties suitable to temperate regions. A few old varieties are still being recommended for commercial cultivation, which indicate that very limited improvement work has been carried out because of narrow genetic base of the crop (Singh *et al*., 1993). There is a need for genetic restructuring of the bell pepper germplasm for increasing the productivity considering the preference of the consumers for typical bell shaped fruits with moderate size. The genetic improvement of any crop depends on magnitude of genetic variability and the extent of heritability of economically important characters. Therefore, a field investigation was carried out with an objective to study the genetic variability, heritability and genetic advance in bell pepper genotypes.

The present investigation was carried out at experimental farm of the Central Institute of Temperate Horticulture, Srinagar, Jammu &Kashmir during 2009 and 2010. Thirty four genetically diverse genotypes of bell pepper collected from various parts of the country. Row-to-row and plant-to plant spacing was maintained at 60 and 45 cm, respectively. All the recommended cultural practices were followed to raise the normal crop. Data were recorded on nine important quantitative traits viz**.,** plant height (cm), plant spread (cm), no. of primary branches**,** , fruit length (cm), fruit diameter (cm), number of fruits per plant, average fruit weight (g), fruit yield per plant (kg), and pericarp thickness (mm). The experiment was conducted under randomized block design replicated three times and average data of two years were analyzed as per the method suggested by Gomez and Gomez (1983). Genotypic and phenotypic coefficient of variation (Burton and Devane, 1953), heritability in broad sense, and genetic advance were computed according to Johnson *et al.* (1955).

Analysis of variance revealed that mean square estimates were significant for all the characters indicating sufficient diversity among the genotypes. The mean performance of the accessions (Table 1) revealed a wide range of variability for all the traits. The variation was the highest for average fruit weight followed by number of fruits per plant, plant height, plant spread, fruit length, peel, number of primary branches/plant and lowest in fruit yield. Maximum plant height recorded in Pimento genotype and minimum in SH-SP-1. The maximum plant spread measured in BSS-398 and minimum CITH-SP-4 genotype. More number of primary branches/plant was recorded in the genotype SH-SP-610-1, whereas highest number of fruits/plant was borne by variety SH-SP-610;

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Table 1. Mean performance of bell pepper genotypes in relation to different quantitative traits

Genotype	Plant height (cm)	Plant spread (cm)	Primary branches	No. of fruits	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit peel thickness (mm)	Yield (kg/plant)
SH-SP-5	44.33	42.66	4.67	20.00	108.00	6.66	6.96	0.38	1.38
SH-SP-52	54.00	39.33	5.33	32.66	51.50	4.43	5.36	0.34	1.76
SH-SP-3-1	58.33	43.66	4.33	34.00	38.46	6.70	4.46	0.32	1.31
SH-SP-706	53.00	35.66	5.67	32.66	52.50	5.53	5.66	0.45	1.20
BSS-398	60.00	54.33	4.67	20.66	100.23	9.90	6.40	0.44	1.97
SH-SP-32	49.66	38.33	5.00	28.33	48.10	5.30	5.16	0.37	1.34
SH-SP-4	40.33	44.00	4.33	22.00	58.40	4.20	6.23	0.44	1.28
SH-SP-624	62.00	41.66	4.33	30.66	66.90	6.40	5.90	0.36	2.05
SH_SP-32-1	49.66	34.66	3.66	13.66	95.53	8.00	5.90	0.42	1.32
SH-SP-603	46.33	38.33	4.00	25.00	95.90	6.13	7.23	0.49	2.37
SH-SP-1	34.66	32.66	3.66	22.33	105.90	9.40	5.43	0.42	2.36
Sh-Sp-32-2	49.66	36.66	5.00	27.33	39.46	5.00	4.83	0.30	1.07
Sh-sp-624	62.00	41.33	4.33	30.67	41.90	6.06	5.33	0.43	1.28
SH-Sp-4-1	44.66	35.66	4.66	23.67	38.66	3.60	5.43	0.72	0.90
SH_-SP_610	57.66	39.33	4.33	35.00	39.50	5.06	4.93	0.43	1.36
Sh-SP-461	56.00	42.33	3.67	28.67	67.30	11.73	3.40	0.48	1.88
SH-_SP_321	48.66	34.33	3.68	13.67	63.23	7.20	4.73	0.49	0.86
Green Bell	55.00	41.66	3.66	36.66	34.30	6.20	4.46	0.43	1.25
CITH-SP-2	48.00	46.00	3.66	8.00	134.66	6.60	6.86	0.74	1.07
SH-SP-603-1	44.00	34.33	4.66	23.67	69.33	4.86	5.63	0.32	1.63
Piemento -1	60.66	29.33	5.00	21.33	76.86	12.00	5.06	0.61	1.62
SH-SP-610	51.66	41.33	5.00	47.66	57.86	7.53	4.76	0.41	2.76
CITH-SP-1	40.33	31.33	5.00	18.00	84.26	6.93	6.03	0.39	1.48
Nishat-1	37.66	44.33	5.00	9.66	89.56	7.73	6.66	0.74	0.876
Piemento	70.66	35.66	5.33	33.66	90.23	13.80	4.90	0.49	3.16
SH-SP-52-1	54.00	40.66	5.33	37.66	82.63	5.33	6.40	0.43	3.13
SH-SP-610-1	43.66	33.66	7.33	24.33	54.16	5.63	5.63	0.43	1.32
Bhowali Local	63.66	46.33	6.66	22.00	71.80	7.06	5.63	0.48	1.58
Venidale	36.66	30.33	4.66	11.33	69.43	7.20	5.40	0.48	0.78
CITH-SP-3	48.00	39.00	5.33	23.33	66.60	6.50	5.53	0.41	1.55
SH-SP-2 -1	44.00	40.33	5.33	11.33	85.63	6.46	5.90	0.42	0.97
SH-SP-706-1	47.33	39.33	7.33	32.33	63.40	9.96	4.36	0.62	2.05
SH-SP-5-3	43.00	30.00	5.00	19.66	88.23	13.83	4.03	0.32	1.73
Orobelle	44.00	36.33	5.33	16.67	70.40	6.36	6.36	0.41	1.16
CD at 5%	**6.34**	**5.35**	**1.23**	**5.90**	**23.03**	**1.39**	**0.789**	**0.06**	**0.81**
CV%	**7.74**	**8.46**	**15.60**	**14.65**	**24.80**	**11.80**	**8.78**	**10.73**	**54.90**

however CITH-SP-1 recorded the highest fruit weight. On the other hand maximum fruit length recorded in Pimento and minimum in SH-SP-4-1. Fruit diameter was highest in SH-SP-603 followed by SH-SP-5 whereas, fruit pericarp thickness was found maximum in CITH-SP-1 and Nishat -1 followed by SH-SP-4 -1. The highest fruit yield per plant was recorded in pimento, followed by SH-SP-52-1 (3.13 kg), SH-SP-610 and least in Venidale. Among the genotypes tested. Pimento, SH-SP-52-1, SH-SP-610-1, SH-SP-610, CITH-SP-1,, SH-SP-603 and SH-SP-52 appeared to possess greater potentiality for exploitation to circumvent fruit numbers, fruit weight, fruit length, diameter, yield and its components in bell pepper.

The genetic parameters estimated Table 2. showed that high PCV and GCV were observed for fruit yield/plant whereas they were moderate for number of fruit per plant, average fruit weight, fruit length, fruit pericarp thickness and number of primary branches/plant

Table 2. Estimates of variance and other genetic parameters in bell pepper

Character	Range	Mean ± SE (m)	PCV (%)	GCV (%)	Heritability (broad sense) as %	Genetic advance %	Genetic advance % of mean
Plant height (cm)	34.66-70.66	50.09 ± 2.24	18.12	16.38	81.72	15.28	30.38
Plant spread (cm)	29.33-54.33	38.67 ± 1.89	15.50	12.98	70.15	8.66	22.39
Primary branches	3.66-7.33	4.85 ± 0.43	22.99	16.89	53.94	1.23	25.36
No. of fruits	8.00-47.66	24.65 ± 2.08	38.70	35.82	85.6	16.82	68.31
Fruit weight (g)	34.3-134.66	70.61 ± 8.13	38.52	29.48	58.55	32.55	46.09
Fruit length (mm)	3.6-13.83	7.21 ± 0.49	36.96	34.74	89.65	4.88	67.68
Fruit diameter (cm)	3.4-7.23	5.49 ± 0.27	17.26	14.86	74.14	1.45	26.41
Fruit peel thickness (mm)	0.30-0.74	0.45 ± 0.02	26.30	24.01	83.35	20.31	45.14
Yield (kg/plant)	0.78-3.16	1.58± 0.28	64.79	30.38	22.00	0.49	31.01

which suggested greater phenotypic as well as genotypic variability among the accessions and responsiveness of these traits for making further improvement by selection. These results further confirmed by (Vani *et al*., 2007; Ukkund *et al*., 2007). A high degree of disparity between PCV and GCV was observed for fruit yield per and average fruit weight depicting their susceptibility to environmental fluctuation. Heritability in broad sense ranged from 22% fruit yield to 89.65% for fruit length. Such moderate to high values of heritability for all the characters illustrated that they were least influenced by environmental modification and their substantial improvement can be made using standard selection procedures.

High estimates of genetic advance percentage of mean were noticed for number of fruits per plant and fruit length which explained that they could be improved to a large extent. High estimates of heritability coupled with low genetic gain were observed for fruit length, number of fruits, plant height and fruit diameter which may be attributed to the non-additive gene effects and these traits can be improved through hybridization and use of hybrid vigour (Panse and Sukhatme, 1956). Fruit yield and number of primary branches showed low heritability associated with low genetic advance indicating the role of non additive genes for these traits suggesting thereby that their improvement could be achieved through heterosis breeding.

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