Variability, Heritability and Genetic Advance Studies in Sweet Pepper (*Capsicum annuum* L.)

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The present investigation was conducted during *kharif*, 2003 at Hill Campus, Ranichauri, Tehri Garhwal, Uttarakhand with 45 sweet pepper genotypes. The experiment was laid out in randomized block design with three replications. Genetic variability was studied for characters viz., days to first picking, plant height, leaf area, fruit length, fruit diameter, flesh thickness, fruit weight, number of pickings, number of fruits per plant, yield per plant, TSS and ascorbic acid content. Data were analyzed statistically for phenotypic, genotypic and environmental coefficient of variation and heritability genetic advance/genetic gain. Analysis of variance revealed significant differences among the genotypes for ail the traits. Genotypes EC519610 and EC519611 were promising for further utilization in plant improvement programme as they possessed more than one desirable trails. Moderate to high PCV, GCV, heritability and genetic gain were observed for ascorbic acid content, number of fruits per plant, fruit yield per plant and fruit length.

Key words: Sweet pepper, Improvement, Variability, Heritability, Genetic advance

Sweet pepper or Shimla mirch (*Capsicum annuum* L.) is considered as one of the most important remunerative crops in Uttarakhand where it is mainly grown as off-season vegetable. The fruits are either sold in local markets or supplied to distant places as green vegetable. However, its popularity among the common mass is increasing. The farmers, thereby, fetch a good lucrative return through cultivating this crop. The net return from this crop was calculated to be as high as Rs. 1,58,607.45 per hectare. The commercially cultivated varieties in Uttarakhand are old introductions such as California Wonder and Yolo Wonder. In absence of suitable genotypes, expected growth in cultivation of this crop has not been accomplished till today. Identification of superior genotypes, therefore, becomes imperative for promoting its production, productivity and quality of the produce. Plant introduction has long been used to enrich our varietal stock. However, for their efficient use in breeding programme the introduced genotypes need to be classified into different groups based on the variability available for the best exploitation of heterosis as well as to ease in selection. Knowledge in terms of heritability, expected genetic advance, inter character relationship and relative contribution of individual characters to economic yield is needed for improvement of genotypes. In India, studies on sweet pepper have been very few because of the limited adaptability of crop. So to bridge the gap a study was undertaken under mid hill conditions of Ranichauri, Uttarakhand with 39 introduced and 6 locally adapted materials.

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Materials and Methods

The experimental material consisted of 39 sweet pepper genotypes obtained from AVRDC, Taiwan, five from Division of Vegetable Science, Ranichauri, Uttarakhand and one from DARL. Pithoragarh, Uttarakhand. The experiment was laid out in RBD with 3 replications each. The spacing followed was 45 x 45 cm. The net plot area was 2.025 m^2. Observation on different characters like days to first picking, leaf area, fruit length, fruit diameter, flesh thickness, fruit weight, number of pickings, number of fruits per plant, plant height, and yield per plant were taken. Parameters on variability were estimated as per formula given by Burton and Devane (1953).

Heritability in broad sense was calculated as per formula given by Burton and Devane (1953) and Allard (1960). The expected genetic advance resulting from selection of five percent superior individuals were worked out as suggested by Lush (1940) and further used by Burton and Devane (1953) and Johnson *et al.* (1955). Genetic gain expressed as percent of population mean was calculated by the method given by Johnson *et al.* (1955).

Results and Discussion

In the present investigation, the ANOVA revealed significant differences among the genotypes for all the traits (Table 1). These differences indicated the presence of considerable variability and good scope for further improvement. The variability in the fruit yield ranged from 153.66-464.33g per plant. The high variability in fruit yield of capsicum was also reported by Mishra *et al.*

(2001) and Dipendra *et al.* (2002). Maximum eight fruits per plant had been recorded in four genotypes which indicated that they posses greater potentiality to bear maximum number of fruits per plant and thus offer opportunity to breed variety having profuse bearing The range of fruit weight at edible maturity was 34.85-66.38 cm fruit length 4.66-8.53 cm, fruit diameter 3.86-6.06 cm. The highest flesh thickness 0.613 cm was also obtained, which indicated greater scope for long distance transport and long shelf life. Four genotypes recorded to be earliest producing marketable fruits in 56-58 days after transplanting which provide considerable for selection of early genotypes to catch the early market. The range of plant height was 29.66-49.03cm. Significant varietal differences were also observed by Sreelathkumary and Rajanomy (2002) for fruit yield and fruit length, Arya and Saini (1976 and 1977); for pericarp thickness, Choudhary *et al.* (2001) for plant height and days to 50 percent flowering. In this investigation maximum variability (55.2-318.55mg/100g) was recorded in ascorbic acid content. This indicated identification of suitable genotypes and its utilization as parent in a crossing programme may improve ascorbic acid content in sweet pepper. Simon (1966) obtained ascorbic acid content as high as 321 mg/100 g whereas Joshi and Singh, (1975) reported 175mg/100g vitamin C in *Capsicum.*

The magnitude of genetic and environmental effect involved in the expression of characters were determined by genotypic and phenotypic coefficient of variation which can precisely be used for making comparisons between populations for different matric traits. Maximum magnitude of PCV and GCV were recorded for ascorbic acid content. High PCV (31.43) was exhibited by yield per plant, number of fruits (29.4), and it has moderate value for leaf area (24.05), number of pickings (21.4). flesh thickness (20.73) and plant height (17.37), GCV estimate was high for yield per plant (29.66), lumber of fruits (28.64), and moderate for leaf area (16), number of pickings (15.48). Fruit length and fruit diameter exhibited low PCV and GCV. PCV and GCV estimates for various traits in sweet pepper have been compiled by several authors. Sreelathakumary and Rajanomy (2002) reported high PCV and GCV for fruits per plant, fruit weight, fruit length and fruit girth.

Study of genotypic coefficient of variation help to measure the range of genetic variation existed in a specific environmental site for a particular character and to compare the magnitude of variability existing in various characters. However, it cannot measure the heritable variation. GCV together with heritability estimates would give reliable indication of the expected amount of improvement through selection (Burton and Devane, 1953).

In the present investigation high heritability was found for ascorbic acid content, yield per plant, number of fruits, fruit length and days to 1st picking and moderate for TSS content, number of pickings, fruit weight, fruit diameter and plant height. High heritability for different traits indicated that large proportion of phenotypic variance has been attributed to genotypic variance and therefore, reliable selection could be made for these traits on the basis of phenotypic expression. Earlier work in this aspect revealed high heritability estimate for fruit yield per plant Kumar *et al.* (1993); number of fruits and fruit length Gogoi *et al.* (2002); Sreelathakumary and Rajanomy (2002) which are in conformity with the present study. Johnson *et al.* (1955) suggested that the estimates of heritability coupled with genetic advance provide better information rather than heritability alone.

High heritability along with high GCV and genetic gain was observed for ascorbic acid content, number of

Table 1. ANOVA for different trails in sweet pepper (*Capsicum annuum* L) genotypes

Traits	Range	General SE	Mean+/–	PCV	GCV	ECV	h^2	GA
Days to 1st harvest	56.33-77.33	65.22	1.34	9.59	8.89	3.58	86.06	11.09
Plant height (cm)	29.66-49.03	38.31	2.42	47.37	13.49	10.94	60.31	8.26
Leaf area (cm^2)	29.03-54.56	38.60	4.00	24.05	16.00	17.95	44.29	8.47
Fruit length (cm)	4.6-8.53	6.82	0.25	14.76	13.30	6.38	81.27	1.68
Fruit diameter (cm)	3.8-6.06	5.25	0.15	11.18	9.99	5.03	79.73	0.96
Flesh thick ness (cm)	0.33-0.613	0.41	0.04	20.73	12.24	16.73	34.88	0.06
Fruit weight (g)	34.85-66.38	55.87	2.65	14.36	11.74	8.23	67.17	11.11
No. of pickings	2.6-5.53	4.30	0.37	21.40	15.48	14.78	52.29	0.99
No. of fruits/plant	2.0-7.73	5.10	0.20	29.40	28.64	6.62	94.92	2.93
Yield/plant(g)	153.0-464.53	284.94	17.10	31.43	29.66	10.39	89.06	164.31
T.S.S. (Brix)	4.6-5.73	5.29	0.09	5.07	4.19	2.85	68.44	0.38
Ascorbic acid (mg/100g)	55.20-316.11	150.79	0.24	59.97	59.97	0.33	99.99	186.28

fruits per plant, fruit yield per plant, and fruit length, indicating that the traits were controlled by additive gene effect (Panse, 1957) and would respond very well to continuous selection so that considerable improvement of these traits, might be possible.

Moderate to high heritability, GCV and genetic gain for plant height and fruit weight at edible maturity and pericarp thickness suggested that these traits were controlled by non-additive gene effect. An improvement of these characters, therefore, can be achieved through exploiting the dominance effect.

High heritability and high genetic gain for fruit weight at edible maturity was reported by Vijaylakshmi *et al.* (1989) and Bhatt *et al.* (1996). These results were not in agreement with the present findings where high heritability but moderate genetic gain was observed. However, an identical result on high heritability and high genetic gain had reported in number of fruits per plant (Gupta and Yadav, 1984, Shah *et al.*, 1986), fruit length (Shah *et al.*, 1986, Meshram, 1987).

From the above study on mean performances and other genetic parameters of different plant characters, it was revealed that four characters *viz.* ascorbic acid content, number of fruits per plant and fruit yield per plant, fruit and fruit length were the most important traits for improving the genotypes while plant height, fruit weight at edible maturity and flesh thickness were considered as second most important characters for applying selection in sweet pepper genotypes.

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