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Short Communication

Variation studies for bell pepper [*Capsicum annuum* (L.) Sendt. var. *grossum*] improvement under cold desert conditions of North-Western Himalayas

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Bell pepper [*Capsicum annuum* (L.) Sendt. var. *grossum*] holds a very coveted position as a leading off-season vegetable in Himachal Pradesh, a state in North-Western Himalayas generating cash revenues to the farmers by selling the produce in the neighbouring states and metropolitan cities. In recent years, its demand has increased tremendously with the emergence of pizza culture. In order to maximize such benefits, there is a need for the genetic restructuring of the bell pepper germplasm for increasing the productivity considering the preference of the consumers for the typical bell shaped fruits. Hence, an attempt was made with specific objectives to examine the genetic parameters of variability in order to identify major characters for achieving higher yields.

The experimental material for the present investigation comprised of fourteen bell pepper genotypes *viz.*, California Wonder (CW), Yolo Wonder (YW), Royal Wonder (RW), Russian Yellow (RY), EC-119058, PCWR-16, PCWR-8, EC-464115, EC-464112, EC-464113, Bastidon, Arka Gaurav, Arka Mohini and IHR-546. These were evaluated in randomized block design with three replications for two consecutive years 2002 and 2003 at Experimental Farm of Highland Agricultural Research and Extension Centre, Kukumseri (Lahaul & Spiti, situated at 2672m above mean sea level under dry temperate high hill conditions) in Himachal Pradesh in North-Western Himalayas. The seedlings were transplanted with inter and intra row spacing of 45 cm each, during the last week of May each year. The observations were recorded on five randomly taken competitive plants for fourteen quantitative characters *viz.*, days to 50% flowering, days to first picking, fruits per plant, average fruit weight (g), fruit length (cm), fruit width at stem end (cm), fruit width at middle (cm), fruit width at blossom end (cm), pericarp thickness (cm), lobes per fruit, harvest duration (days), seeds per fruit, plant height (cm) and fruit yield per plant (g). In addition, observations on 13 morphological characters were also recorded. The pooled data over the years were statistically analyzed as per the standard procedure for variability [1].

The fourteen genotypes involved in the study varied significantly among themselves for all the horticultural traits studied, as revealed by analysis of variance over the years. These results support the selection programme for the better quality of bell pepper. The genotypes Arka Mohini (41.33 days) was the earliest in flowering took minimum number of days (63.50 days) to first picking (Table 1). Similarly, the maximum number of fruits per plant was harvested from PCWR-8 (12.48) though had small sized fruits with low average fruit weight. The highest average fruit weight was obtained from California Wonder (49.68 g) with maximum fruit width and pericarp thickness. Royal wonder (63 days) had longer harvest duration which is desirable to have staggered and more number of pickings.

Fruit yield per plant is the most important horticultural trait of a crop. The highest fruit yield per plant was recorded in Yolo Wonder (440.33 g). Similar pattern of variability in germplasm evaluation of different sizes for various horticultural traits in capsicum have earlier been reported by Sreelathakumary and Rajamony [2, 3]. In addition, these genotypes had compact plant growth habit alongwith intermediate to dense tillering and branching habit. California wonder and Yolo Wonder had lanceolate leaf shape while Royal Wonder and EC-119058 had the ovate. Stigma exsertion was at the same level and was having dentate calyx margin. California wonder, Yolo Wonder and Royal Wonder had blocky fruit shape with sunken blossom end while EC-119058 had triangular fruit shape with pointed blossom end. They were green in colour with smooth fruit surface. Similarly, fruit shape at pedicel attachment was cordate for California wonder and EC-119058 and lobate for Yolo Wonder and Royal Wonder.

A close proximity in the phenotypic and genotypic coefficients of variability (Table 2) was observed

Table 1. Mean performance of various genotypes for different traits in capsicum

Variety (s)/ character	Days to 50% flowering	Days to first picking	Fruits per plant	Average fruit wt (g)	Fruit length (cm)	Fruit width (cm) at			Pericarp thick-ness (mm)	Lobes per fruit	Harvest duration	Seeds/ fruit	Plant height (cm)	Yield/ plant (g)
						Stem end	Middle end	Blossom end						
CW	47.33	72.00	8.71	49.68	7.52	4.88	4.51	2.96	3.20	3.81	61.83	300.07	39.21	421.00
YW	51.83	80.83	10.15	43.22	7.02	4.93	4.96	3.36	3.48	3.67	52.00	245.89	32.11	440.33
RW	47.67	67.33	8.50	46.25	6.36	4.75	4.73	3.34	3.30	3.46	63.00	246.08	27.44	395.67
RY	49.50	78.33	10.35	27.80	9.94	3.50	3.19	1.54	2.88	1.00	56.50	172.77	48.15	287.17
EC-119058	41.83	71.83	9.86	35.71	7.43	4.29	3.66	2.19	3.29	3.58	61.33	127.59	33.49	352.33
PCWR-16	55.00	86.83	12.19	20.43	8.16	3.55	2.93	1.71	2.60	3.15	44.67	181.69	47.30	248.17
PCWR-8	53.67	83.50	12.48	26.47	7.74	3.80	3.50	2.06	2.82	3.19	46.83	249.50	42.06	330.17
EC 464115	57.17	88.33	7.24	38.62	7.72	4.42	4.08	2.56	3.62	3.48	44.00	219.46	35.43	279.79
EC 464112	63.33	94.33	8.27	25.92	7.08	3.82	3.50	2.38	3.04	3.19	37.83	99.02	30.06	214.39
EC 464113	60.00	90.17	7.81	26.93	9.01	3.26	2.78	1.72	2.49	2.73	42.50	169.23	29.67	211.36
Bastidon	62.67	89.67	5.95	23.26	8.11	3.14	2.90	2.20	3.05	3.29	46.17	151.05	20.16	138.36
Arka Gaurav	53.00	78.83	4.82	39.20	6.34	3.66	3.13	2.57	3.07	3.02	46.67	147.85	28.30	188.08
Arka Mohini	41.33	63.50	5.08	40.93	6.57	3.91	2.99	2.44	2.92	2.94	42.33	140.88	24.07	208.07
IHR 546	51.67	76.00	7.51	26.72	8.23	3.32	2.64	1.66	2.68	3.28	40.00	157.71	28.50	199.82
CD (P = 0.05)	3.30	3.24	0.80	2.35	0.54	0.40	0.32	0.38	0.28	0.28	4.36	21.54	4.34	31.82

Where, CW: California Wonder, YW: Yolo Wonder, RW: Royal Wonder and RY: Russian Yellow

Table 2. Coefficient of variability, heritability and genetic advance for various traits in capsicum over the years (pooled data)

Character	Range	Mean	Coefficient of variability (%)		Heritability (%)	Genetic advance (% of mean)
			Phenotypic	Genotypic		
Days to 50% flowering	41.33-63.33	52.71	14.00	12.92	85.20	24.57
Days to first picking	63.50-94.33	80.11	11.88	11.36	91.40	22.37
Fruits per plant	4.82-12.48	8.47	27.76	26.51	91.20	52.18
Average fruit weight (g)	20.43-49.68	33.65	28.28	27.33	95.50	55.60
Fruit length (cm)	6.34-9.34	7.66	14.10	12.70	81.10	23.50
Fruit width at stem end (cm)	3.14-4.93	3.94	17.70	15.42	75.90	27.66
Fruit width at middle end (cm)	2.78-4.96	3.54	22.86	21.39	87.60	41.24
Fruit width at blossom end (cm)	1.66-3.36	2.34	28.77	25.23	76.90	45.73
Pericarp thickness (mm)	2.49-3.62	3.03	13.41	10.58	62.20	17.16
Lobes per fruit	1.0-3.81	3.13	21.41	19.86	86.00	38.02
Harvest duration	37.83-63.00	49.98	18.84	17.20	83.30	32.34
Seeds per fruit	99.02-300.07	186.34	32.19	30.61	90.40	59.95
Plant height (cm)	20.16-48.15	33.28	27.32	24.91	83.10	46.78
Yield per plant (g)	138.36-440.33	299.62	33.31	31.83	91.30	62.67

indicating a little influence of environment in the expression of various horticultural traits studied. Seeds per fruit and fruit yield per plant had the highest magnitude of phenotypic and genotypic coefficients of variability. Similarly, fruits per plant, average fruit weight, fruit width at blossom end and plant height also exhibited fairly high estimates of these components. This indicated better scope of phenotypic selection through these traits for improvement in capsicum. High heritability alongwith high estimates of genetic advance were noticed for fruit yield/plant, seeds/fruit, average fruit weight and fruits/plant. This inferred that simple selection among different accessions for these traits can bring about significant improvement in the fruit yield of capsicum. The findings are in consonance for some of the traits with those of earlier workers [2-4].

Thus, fruit width at stem end, at middle and at blossom end, harvest duration, pericarp thickness and average fruit weight need to be well considered as selection criterion including fruit yield *per se* with the future cultivar improvement programme besides plant height and fruits per plant. The genotypes California wonder and Yolo Wonder alongwith Royal Wonder and EC-119058 can be recommended for cultivation in the high hill dry temperate conditions of Himachal Pradesh and should be utilized in future breeding programme for developing superior varieties.

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