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Evaluation of Coloured Sweet Pepper Genotypes under Temperate Conditions of Kashmir Valley

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A B S T R A C T

In the present study fifteen coloured capsicum genotypes were evaluated for maturity, yield attributing and quality traits with the purpose of identifying genotypes with higher yielding ability and better quality. The experimental materials were evaluated at Experimental Farm of Division of Vegetable Science, SKUAST-K, Shalimar during *Kharif* 2018. The experiment was laid out in complete randomized block design with three replications. The observations were recorded on various maturity, growth, yield attributing and maturity traits. Mean performance of genotypes for maturity, yield and quality traits depicted the existence of sufficient amount of variation in the given set of genotypes thereby indicating a good scope for improvement of the population through various breeding procedures.

Introduction

Bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.), also known as Sweet pepper, green pepper and Shimla mirch is grown worldwide for its delicate taste, pleasant flavor and colour and is also the most leading crop under protected structures. Sweet pepper consists of tall and stout plants with generally large sized fruits which are smooth, thick fleshed, inflated with depression at the base, sides usually furrowed, 3-4 lobed, broadly oblong, bell or apple shaped, generally green at immature stage and yellow or orange red or red when mature and non-pungent or mild in flavor. Some cultivars of the plant produce immature fruits in different colours, including red, yellow, orange, green, chocolate/brown, vanilla/white, and purple. It holds a very coveted position as leading off-season vegetable by generating cash revenues to the farmers by selling the produce in the neighbouring states and metropolitan cities.

The climatic conditions of Kashmir valley are ideal not only for the production of fruits but also for quality seed production which offers a great scope for production and export of quality seed to rest of the country. It is necessary to identify and develop varieties showing good performance under temperate environmental conditions of Kashmir.

Materials and Methods

The present investigation was conducted during *Kharif* 2018 at Vegetable Experimental Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar. The basic materials consisted of fifteen diverse genotypes of coloured capsicum (*Capsicum annuum* L. var. *grossum* Sendt.). The experiment was laid out in a completely randomized block design with three replications. The observations were recorded on various maturity, yield attributing and quality traits. The data was analysed as per standard statistical procedures.

Results and Discussion

Mean performance of genotypes for maturity, yield and quality traits is presented in Table 1a and 1b. The perusal of table depicts the existence of sufficient amount of variation in the given set of genotypes there by indicating a good scope for improvement of the population through various breeding procedures. Table 2 reveals the best genotypes of based on *per se* performance with respect to different traits.

Data on average number of days taken for flowering revealed that SH-SP-5 was earliest taking 28.80 days for first flowering followed by SH-SP-2 (28.95 days) and SH-SP-11 (29.42 days). The average number of days to first flowering of all the genotypes was 31.31. Data on number of days taken to first fruit set revealed that SH-SP-11 (33.64 days) was earliest followed by SH-SP-5 (34.42) and SH-SP-8 (34.85 days). The average number of days to first fruit set of all the genotypes was 36.68 days. Average number of days taken for first harvest was lowest in SH-SP-5 (49.02 days) followed by SH-SP-2 (50.40 days) and SH-SP-11 (50.49 days). The average number of days to first fruit harvest of all the genotypes was 52.48 days.

Highest plant height of 52.61 cm was observed in SH-SP-2 followed by SH-SP-8 (51.28 cm) and SH-SP-14 (50.93 cm). The average plant height of all the genotypes was 46.15 cm. Maximum spread was observed in SH-SP-2 (45.28 cm) followed by SH-SP-8 (45.151 cm) and SH-SP-14 (43.942 cm). The average plant spread of all the genotypes was 41.55 cm. Maximum number of secondary branches plant^{-1} (8.09) was recorded in the genotype SH-SP-5 which was followed by SH-SP-11 (7.88) and Nishat-1 (7.66). The average number of secondary branches plant^{-1} of all the genotypes was 7.34.

SH-SP-11 (13.79) followed by SH-SP-5 (13.64) and Nishat-1 (13.15) recorded maximum number of fruits per plant. The average number of fruits plant^{-1} of all the genotypes was 11.00.The genotypes SH-SP-2 (106.05 g) followed by SH-SP-3 (102.65 g) and SH-SP-8 (102.03 g) exhibited highest fruit weight as compared to Nishat-1 (77.16 g). The average of all the genotypes was 90.93 g. Highest average fruit length of (7.47 cm) was observed in SH-SP-1 followed by SH-SP-7 (7.38 cm) and SH-SP-2 (7.35 cm). The average fruit length of all the genotypes was 6.96 cm.

Fruit diameter was found highest in the genotype SH-SP-1 (7.29 cm) followed by SH-SP-12 (7.13 cm) and SH-SP-4 (7.00 cm). The average fruit diameter of all the genotypes was 6.89 cm. Maximum flesh thickness was recorded in the genotype SH-SP-1 (5.86 mm) followed by SH-SP-7 (5.85 mm) and SH-SP-3 (5.83 mm).

The average flesh thickness of all the genotypes was 5.29 mm. The highest pedicel length was recorded in the genotype SH-SP-4 (3.55 cm) followed by SH-SP-2 (3.45 cm) and SH-SP-8 (3.427 cm). The average pedicel length of all the genotypes was 3.07 cm.

Table.1a Mean performance coloured capsicum (*Capsicum annuum* L. var.*grossum* Sendt.) genotypes

S.No.	Genotypes	Days to first flowering	Days to first fruit set	Days to first harvest	Plant height (cm)	Plant spread (cm)	Number of secondary branches	Number of fruits plant^{-1}	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (mm)	Pedicel length (cm)
1.	SH-SP-1	31.11	37.82	52.29	47.57	42.24	7.53	10.75	94.77	7.47	7.29	5.86	3.26
2.	SH-SP-2	28.95	35.73	50.40	52.601	45.28	7.42	11.73	106.05	7.35	6.92	4.99	3.45
3.	SH-SP-3	32.53	37.44	53.67	41.00	40.91	6.91	11.47	102.65	6.97	6.94	5.83	2.47
4.	SH-SP-4	30.67	36.31	51.64	45.06	41.58	7.53	11.47	83.71	6.84	7.00	4.63	3.55
5.	SH-SP-5	28.80	34.42	49.02	49.02	40.57	8.09	13.64	84.09	6.73	6.74	4.91	2.96
6.	SH-SP-7	30.80	37.27	52.87	47.30	41.11	7.33	10.18	92.32	7.38	7.21	5.85	3.24
7.	SH-SP-8	29.47	34.85	51.55	51.28	45.15	7.38	10.98	102.09	7.31	6.83	4.50	3.48
8.	SH-SP-9	33.02	37.49	53.31	40.32	41.12	7.00	9.85	101.32	6.87	6.83	5.82	2.45
9.	SH-SP-10	31.11	35.87	52.38	44.45	41.51	7.62	10.33	80.84	6.74	6.94	5.16	3.19
10.	SH-SP-11	29.42	33.64	50.49	47.86	40.70	7.89	13.78	78.27	6.63	6.66	4.85	2.95
11.	SH-SP-12	32.82	38.82	53.89	45.97	39.83	7.00	9.75	89.33	7.16	7.13	5.78	3.23
12.	SH-SP-14	31.44	37.33	53.00	50.93	43.94	6.93	10.18	98.72	7.13	6.75	4.95	3.43
13.	SH-SP-15	34.82	39.07	55.53	38.99	40.19	6.64	8.75	94.79	6.74	6.72	5.79	2.44
14.	SH-SP-16	33.47	38.02	53.98	43.05	40.24	7.18	9.44	77.86	6.57	6.86	5.19	3.17
15.	Nishat-1	31.18	36.15	52.35	46.86	38.89	7.67	13.15	77.16	6.49	6.50	4.80	2.92
	CD at 5%	**1.487**	**1.227**	**1.690**	**3.989**	**2.287**	**0.737**	**2.084**	**20.812**	**0.445**	**0.353**	**0.617**	**0.285**

Table.1b Mean performance of coloured capsicum (*Capsicum annuum* L. var.*grossum* Sendt.) genotypes

S.No.	Genotypes	Average seed weight fruit^{-1} (g)	Number of seeds fruit^{-1}	Average fruit yield plant^{-1} (kg)	Average fruit yield plot^{-1} (kg)	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (g)	SSC (°Brix)	Vitamin C (mg/100g)	Total chlorophyll (mg/100g)	Total carotenoids (mg/100g)
1.	SH-SP-1	4.17	255.51	0.99	9.97	44.49	445.22	3.67	155.33	80.50	1.02
2.	SH-SP-2	4.63	262.91	1.28	12.80	54.43	544.33	4.49	167.78	81.14	0.91
3.	SH-SP-3	4.02	235.33	1.04	10.45	41.88	418.85	3.08	126.67	59.78	0.85
4.	SH-SP-4	4.30	248.22	0.91	9.11	47.07	470.70	3.93	148.12	74.55	0.36
5.	SH-SP-5	3.96	261.27	1.15	11.50	52.67	526.71	3.95	161.11	71.52	0.37
6.	SH-SP-7	4.14	254.04	0.93	9.36	41.42	414.19	3.59	156.31	80.97	0.91
7.	SH-SP-8	4.61	261.78	1.17	11.75	50.71	507.13	4.42	168.80	80.97	0.88
8.	SH-SP-9	3.95	234.00	0.91	9.10	37.26	372.62	3.11	127.44	60.24	0.86
9.	SH-SP-10	4.29	248.58	0.82	8.27	43.48	434.80	3.92	149.91	74.93	0.36
10.	SH-SP-11	3.93	261.60	1.12	11.25	52.29	522.90	3.88	156.09	71.26	0.37
11.	SH-SP-12	4.06	248.93	0.86	8.56	39.28	392.80	3.70	155.89	80.48	0.92
12.	SH-SP-14	4.59	257.33	1.03	10.30	46.70	467.04	4.24	167.45	80.36	0.87
13.	SH-SP-15	3.89	230.87	0.79	7.86	32.74	327.37	3.23	125.90	59.69	0.85
14.	SH-SP-16	4.16	245.64	0.73	7.28	38.64	386.39	3.78	148.29	75.04	0.36
15.	Nishat-1	3.87	256.87	1.02	10.25	49.03	490.29	4.09	160.72	72.11	0.37
	CD at 5%	**0.457**	**20.966**	**0.262**	**2.633**	**7.780**	**77.820**	**0.519**	**17.491**	**10.341**	**0.264**

Table.2 Best genotypes of coloured capsicum (*Capsicum annuum* var. *grossum* Sendt.) based on *per se* performance with respect to different traits

S.No	Traits	Best Genotypes
1.	Days to flowering	SH-SP-5 (28.80), SH-SP-2 (28.95 days) and SH-SP-11 (29.42 days).
2.	Days to first fruit set	SH-SP-11 (33.64 days), SH-SP-5 (34.42) and SH-SP-8 (34.85 days)
3.	Days to first fruit harvest	SH-SP-5 (49.02 days), SH-SP-2 (50.40 days) and SH-SP-11 (50.49 days)
4.	Plant height	SH-SP-2 (52.61 cm), SH-SP-8 (51.28 cm) and SH-SP-14 (50.93 cm).
5.	Plant spread	SH-SP-2 (45.28 cm), SH-SP-8 (45.151 cm) and SH-SP-14 (43.942 cm)
6.	No. of secondary branches plant^{-1}	SH-SP-5 (8.09), SH-SP-11 (7.88) and Nishat-1 (7.66).
7.	No. of fruits plant^{-1}	SH-SP-11 (13.79), SH-SP-5 (13.64) and Nishat-1 (13.15)
8.	Fruit weight	SH-SP-2 (106.05 g), SH-SP-3 (102.65 g) and SH-SP-8 (102.03 g)
9.	Fruit length	SH-SP-1(7.47 cm), SH-SP-7 (7.38 cm) and SH-SP-2 (7.35 cm)
10.	Fruit diameter	SH-SP-1 (7.29 cm), SH-SP-12 (7.13 cm) and SH-SP-4 (7.00 cm)
11.	Flesh thickness	SH-SP-1 (5.86 mm), SH-SP-7 (5.85 mm) and SH-SP-3 (5.83 mm)
12.	Pedicel length	SH-SP-4 (3.55 cm), SH-SP-2 (3.45 cm) and SH-SP-8 (3.427 cm)
13.	Seed weight fruit^{-1}	SH-SP-2 (4.63 g), SH-SP-8 (4.61 g) and SH-SP-14 (4.586 g)
14.	Number of seeds fruit^{-1}	SH-SP-2 (262.91), SH-SP-8 (261.78) and SH-SP-5 (261.27)
15.	Fruit yield plant^{-1}	SH-SP-2 (1.28 kg), SH-SP-11 (1.12 kg) and SH-SP-5 (1.15 kg)
16.	Fruit yield plot^{-1}	SH-SP-2 (12.80 kg), SH-SP-8 (11.75 kg) and SH-SP-11 (11.25 kg)
17.	Seed yield plant^{-1}	SH-SP-2 (54.43 g), SH-SP-5 (52.67 g) and SH-SP-11 (52.290 g)
18.	Seed yield plot^{-1}	SH-SP-2 (544.33 g), SH-SP-5 (526.71 g) and SH-SP-11 (522.900 g)
19.	SSC	SH-SP-2 (4.49 °brix), SH-SP-8 (4.42 °brix) and SH-SP-14 (4.24 °brix)
20.	Vitamin C	SH-SP-8 (168.80 mg/100g), SH-SP-2 (167.78 mg/100g) and SH-SP-14 (167.455 mg/100g)
21.	Total chlorophyll	SH-SP-2 (81.14 mg/100g), SH-SP-8 (80.97 mg/100g) and SH-SP-7 (80.97 mg/100g)
22.	Total carotenoid	SH-SP-1 (1.02 mg/100g), SH-SP-12 (0.92 mg/100g) and SH-SP-7 (0.91 mg/100g)

The highest seed weight fruit^{-1} was found in SH-SP-2 (4.63 g) followed by SH-SP-8 (4.61 g) and SH-SP-14 (4.586 g). The average seed weight fruit^{-1} for all the genotypes was 4.17 g. Highest number of seeds fruit^{-1} was found in the genotype SH-SP-2 (262.91) followed by SH-SP-8 (261.78) and SH-SP-5 (261.27). The average number of seeds fruit^{-1} for all the genotypes was 250.86.

Highest fruit yield plant^{-1} was recorded for the genotype SH-SP-2 (1.28 kg) followed by SH-SP-11 (1.12 kg) and SH-SP-5 (1.15 kg). The average fruit yield plant^{-1} for all the genotypes was 0.98 kg. The genotype SH-SP-2 (12.80 kg) recorded the highest fruit yield plot^{-1} followed by SH-SP-8 (11.75 kg) and SH-SP-11 (11.25 kg). The average fruit yield plot^{-1} for all the genotypes was 9.85 kg. Highest seed yield plant^{-1} was recorded for the genotype SH-SP-2 (54.43 g) followed by SH-SP-5 (52.67 g) and SH-SP-11 (52.290 g). The average seed yield plant^{-1} of all the genotypes was44.81 g. The genotype SH-SP-2 (544.33 g) recorded the highest seed yield plot^{-1} followed by SH-SP-5 (526.71 g) and SH-SP-11 (522.900 g). The average seed yield plot^{-1} of all the genotypes was 448.09 g.

Highest SSC was recorded for the genotype SH-SP-2 (4.49 °brix) followed by SH-SP-8 (4.42 °brix), SH-SP-14 (4.24 °brix) and Nishat-1 (4.088 °brix). The average SSC of all the genotypes was 3.81 °brix. The genotype SH-SP-8 (168.80 mg/100g) recorded the highest vitamin C content followed by SH-SP-2 (167.78 mg/100g) and SH-SP-14 (167.455 mg/100g). The average

vitamin C of all the genotypes was 151.72 mg/100g.Highest total chlorophyll content was recorded for the genotype SH-SP-2 (81.14 mg/100g) followed by SH-SP-8 (80.97 mg/100g) and SH-SP-7 (80.97 mg/100g). The average total chlorophyll of all the genotypes was 73.57 mg/100g.The genotype SH-SP-1 (1.02 mg/100g) recorded the highest total carotenoid content followed by SH-SP-12 (0.92 mg/100g) and SH-SP-7 (0.91 mg/100g). The average total carotenoid content of all the genotypes was 0.69 mg/100g. Table 2 depicts the best performing genotypes with respect to different traits.

Selection of genotypes on the basis of *per se* performance may be rewarding. However the *per se* performance should be supplemented with genetic studies like variability, heritability, genetic advance, correlation and path analysis, to make the process of selection more effective. Variation in performance of genotypes have also been reported by Stoffela *et al.,* (1995) in Bell pepper for fruit size and marketable fruit yield; Srividhya and Ponnuswami (2010) in Paprika for number of fruits plant^{-1}, fruit weight and fresh fruit yield plant^{-1}; Gurung *et al.,* (2012) in Chilli for dry fruit weight plant^{-1}; Abu *et al.,* (2013) in aromatic pepper for plant height, number of branches plant^{-1}, number of fruits plant^{-1}, fruit diameter, fruit length, pericarp thickness, single fruit weight and fresh fruit yield (t/ha); Tembhurne and Rao (2013) reported in Chilli for days to 50% flowering, number of fruits plant^{-1}, fruit length, fruit diameter, number of primary branches, plant height, number of seeds fruit^{-1}, 1000 seed weight, fresh fruit weight plant^{-1}, net plot yield; Ummyiah *et al.,* (2015) reported in tomato for plant height, days to first fruit picking, fruit length, fruit diameter, number of fruits plant^{-1}, average fruit weight, fruit yield plant^{-1} and fruit yield hectare-1;Zaki*et al.,* (2015) in Sweet pepper for vitamin C, total carotenoids, total sugars and Spaldon*et al.,* (2017) in tomato for pericarp thickness, total soluble solids, ascorbic acid.

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