

Original Research Article

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Evaluation of Different Strawberry Cultivars for Growth, Yield and Quality Characters under Temperate Conditions of North Western Himalayas

Sehrish Jan^{1*}, Jahangeer A. Baba², M. K. Sharma¹, Sheikh Qurat¹, Tajamul Farooq Wani¹, Shemoo Nisar¹, Tashi Angmo¹, Shaila Din¹, Shahzad¹ and Safina Kossar¹

¹Division of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, J&K, India.

²Krishi Vigyan Kendra/ Extension Training Centre, Malangpora, Pulwama, J & K, India

*Corresponding author

ABSTRACT

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Investigations were carried out on fifteen cultivars of strawberry for growth, yield and quality characters. The results recorded reveal that maximum plant height (35.30cm) and number of runners (8.82) were in cultivar Catskill, however the average plant spread was found to be highest in Curaltar (34.16 cm) while cultivar Camarosa recorded maximum leaf area (42.86 cm²). Longest cultivar duration of bloom (85.30 days) was observed in cultivar Everly and minimum (55.38 days) in cultivar Winter Dawn. The number of flowers per plant ranged between 10.92 (Oso Grande) to 26.55 (Camarosa). The average fruit length ranged from 2.55 cm (Brighton) to 4.28 cm (Curaltar) while the average fruit diameter ranged from 2.09 cm (Catskill) to 3.39 cm (Camarosa). Highest fruit weight (16.30 g) was observed in cultivar Kimberly followed by cultivar Honeoye (14.12 g). Cultivar Brighton recorded highest TSS (12.63 °Brix), total sugars content (8.58) and reducing sugars (7.70) however highest titrable acidity (1.22 %) was found in Honeoye. Highest fruit yield (290.35 q/ha) was recorded in Camarosa and lowest fruit yield (59.81 q/ha) was recorded in cultivar Missionary.

Introduction

Strawberry (*Fragaria × ananassa* Duch.) is the most important soft fruits worldwide owing to its high nutritive value (rich source of vitamins and minerals), tantalizing aroma, aesthetic appeal and refreshing taste (Kher *et al.*, 2010). It is a herbaceous, perennial plant and the fruit is an aggregate fruit (etario of achenes) and is highly perishable and non-

climactic in nature. Cultivation of strawberry is gaining popularity as among all the fruits strawberry gives maximum economic returns in the shortest possible time (Das *et al.*, 2015). Fruits are used both as table fruits and frozen for later use. They are preserved as jam, jelly, crush and wine. Fruit is anti-carcinogenic due to the presence of ellagic acid (Rao and Swamy, 2017) and anti-diabetic, besides, strawberry is reported to be

a rich source of natural anti-oxidants, carotenoids, vitamins, phenols, flavonoids, dietary glutathione and metabolites (Larson, 1988).

The performance of different cultivars depends upon the agro-climatic conditions of the particular area and the best cultivars can only be selected by evaluating for growth, flowering, yield and other quality characteristics under different agro-climatic conditions. Proper and systematic evaluation of germplasm would provide very useful information with respect to their suitability and performance for commercial cultivation which in turn helps build a database regarding various important factors under a set of agro-climatic conditions. The best strawberry is one that produces large, firm fruits of good quality with attractive color and good processing and dessert quality. Temperate climatic conditions prevailing in North West Himalayas (Kashmir valley) offer immense potential for quality strawberry production. The objective of this work was to evaluate fifteen strawberry varieties for growth, yield and quality characters under temperate climatic conditions of North West Himalayas.

Materials and Methods

The experiment was conducted during the year 2017-2018 at the Experimental Farm, Division of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar (Jammu and Kashmir). The experimental site was situated at an elevation of 1685 m above MSL with an average annual rainfall of 600 mm and the temperature often goes below freezing point from December to March. The experiment was laid in randomized complete block design with three replications. The experimental area after proper ploughing, harrowing and levelling was divided into three blocks each of which was further

divided into 15 beds (2×1 m) and the strawberry runners were planted randomly across each block at spacing of 30×30 cm thus accommodating 20 plants in each bed. The study included fifteen strawberry cultivars namely Everly, Kimberly, Honeoye, Winter Dawn, Oso Grande, Curaltar, Sea Scape, Catskill, Missionary, Jutogh Special, Katrain Sweet, Chandler, Selva, Brighton and Camarosa. Transplants of some of the cultivars were obtained from CITH while the rest were obtained from SKUAST-K nursery. Intercultural operations like weeding, irrigation, mulching was carried out regularly. Harvesting was carried out manually (hand picking) at commercial maturity when 80% of the fruit turned dark red during the early morning hours.

The height and spread of plants (cm) was measured with a measuring scale. The number of leaves per plant and number of runners per plant were recorded at harvesting. Pertaining to the leaf area estimation, a portable leaf area meter was used. Date of first flowering was recorded when atleast five plants in each replication exhibited flowers while the date of last flowering was recorded when about 80 per cent of total flowers opened. Number of flowers and number of berries per plant were recorded for five randomly selected plants. The length and diameter of fruit (cm) was measured using vernier caliper while the fruit shape of each cultivar (cm) was categorized into different classes based on visual observation. Fruit weight (gm) was recorded on top pan electronic balance and this value was used to calculate yield per hectare. Fruit volume (cm^3) was calculated by water displacement method and specific gravity was obtained by dividing the weight of the fruit by the volume of water displaced. The soluble solid concentration (SSC) of ripe fruit juice was determined with the help of a hand refractometer ($0-32$ °B). Titrable acidity was estimated by titrating pure fruit juice against

0.1 N NaOH using phenolphthalein as indicator A.O.A.C. (1990). Total sugar and reducing sugar content of the berry was determined by volumetric method based on the principle that sucrose content of berry is quantitatively hydrolyzed to glucose and fructose in the presence of HCl here also as per the method of A.O.A.C (1990). The total sugar as well as reducing sugar was expressed in per cent of fresh weight of the berry pulp. The data obtained was subjected to analysis of variance as described by Gomez and Gomez (1984).

Results and Discussion

Plant growth characters

Among the different plant growth characteristics recorded cultivar Catskill showed maximum plant height (35.30 cm) while maximum plant spread of 34.16 cm was reported in Curaltar (Table1). The results obtained are in close conformity with the findings of Das *et al.*, (2015). Also, the observations on plant spread are quite similar to the findings of Dolgun (2006) (Table 1). Number of leaves in different cultivars showed significant variation ranging from 23.17 in Winter Dawn to 53.87 in Everly followed by Kimberly and Catskill (43.88 each) and Chandler (37.72). The Leaf area among different cultivars ranged from 20.73 cm² in the cultivar Catskill to 42.86 cm² in the cultivar Camarosa. Results obtained are also in line with the findings of Ahmad (2016) reported that cultivar Camarosa had the higher leaf area than other cultivars under study. Cultivar Catskill produced maximum number of runners (8.82) while minimum runners were obtained in cultivar Winter Dawn (3.96). Similar results were obtained by Mohamed *et al.*, (2016) as per which cultivar Sweet Charlie produced 4.3 runners which is in line with the results of our present study. Higher or lower number of runners may be

due to the differences in the inherent potential of cultivars for runner production and prevailing agro climatic conditions (Table 1).

Floral characters

The opening of first flower among different cultivars varied from first week of April to last week of April whereas the mean value for bloom duration of cultivars under study was extended from 55.38 to 85.30 days (Table 2). The duration of flowering was significantly longer in 'Everly' (85.30 days), and was shortest in 'Winter Dawn' (55.38 days). Similar results were recorded by Demisroy *et al.*, (2012). There were significant differences in the number of flowers per plant in the different cultivars of strawberry ranging from 10.17 (Missionary) to 26.55 (Camarosa) followed by Chandler (24.43) and Camarosa (22.94) (Table 3). The results are in agreement with those of Neetu and Sharma (2018). Number of berries per plant varied from 7.13 to 23.46, highest being in 'Camarosa' (23.46), followed by 'Chandler' (22.09) and least number of berries were recorded in 'Missionary' (7.13). The minimum days from flowering to harvest were taken by Chandler (33.20 days) whereas cultivar Brighton took more days (53.90 days) to harvest. Similar results were obtained by Kumar *et al.*, (2011) in different strawberry cultivars

Fruit physical characters

Fruit length and diameter varied significantly among all the strawberry cultivars studied with highest in 'Curaltar' (4.28 cm) and 'Camarosa' (3.39 cm) (Table 4). Cultivar 'Brighton' recorded minimum berry length (2.55 cm) and the cultivar Chandler recorded a length of 2.62 cm and diameter of 2.65 cm. The results are in line with the findings of Sharma and Thakur (2008), who recorded longer, as well as broader berries in

‘Chandler’. Average berry weight ranged from 4.94 g (Catskill) to 16.30 g (Kimberly) followed by Honeoye. The results are in line with that of Masny and Zurawicz (2009). Maximum fruit volume was obtained in cultivar Camarosa (13.90 cm³) while minimum fruit volume was recorded cultivar ‘Catskill’ (6.17 cm³) (Table 4).

Fruit chemical characters

Soluble solid concentration (SSC) of different strawberry cultivars under study varied from 7.21 °B in Everly to 12.63 °B in Brighton (Table 4). However, the highest acidity percentage was observed in ‘Honeoye’ (1.22 %), followed by ‘Curaltar’ (1.21 %) and minimum was in ‘Everly’ (0.68 %) (Table 4). The SSC/acid ratio of different strawberry cultivars varied significantly from 7.28 in Honeoye to 13.04 in Brighton. The data

obtained by Lal and Rao (2010) was in favor of the present study and the fruit total sugars also showed marked variation among the studied cultivars, highest value was in ‘Brighton’ (8.58 %) while the cultivar Oso Grande (4.84%) had the least values recorded. The highest amount of reducing sugars was also in ‘Brighton’ (7.70 %), whereas ‘Oso Grande’ (4.13 %) had minimum content. The findings are in close conformity with work of Sharma and Thakur (2008). Highest yield per hectare was observed in cultivar Camarosa (290.35 quintals) whereas ‘Missionary’ had lowest yield (59.81 quintals). The variation among all these traits may be attributed to the genetic makeup of the cultivars and climatic conditions. The results are in conformity with the results obtained by Singh *et al.*, (2012) and Das *et al.*, (2015) who reported higher yield in cultivar Camarosa in comparison to other cultivars under study.

Table.1 Plant growth characteristics of different strawberry cultivars

Parameters	Plant height (cm)	Plant spread (cm)	No. of leaves/plant	Leaf area (cm ²)	No. of runners
Cultivar					
Everly	24.13	26.83	53.87	28.50	5.49
Kimberly	21.83	22.83	43.88	38.10	6.31
Honeoye	24.30	26.00	35.83	41.46	5.11
Winter Dawn	25.76	33.83	23.17	34.80	3.96
Oso Grande	31.93	29.33	24.66	33.13	5.28
Curaltar	23.53	34.16	23.51	31.00	6.29
Sea Scape	25.93	26.66	28.09	33.93	5.03
Catskill	35.30	20.83	25.16	20.73	8.82
Missionary	27.53	27.00	43.88	28.76	5.29
Jutogh Special	27.13	25.66	35.83	29.56	5.96
Katrain Sweet	24.90	27.16	26.33	34.06	4.04
Chandler	20.13	24.33	37.72	27.60	4.77
Selva	19.70	24.16	35.15	27.20	6.69
Brighton	18.33	20.00	30.49	22.80	4.98
Camarosa	21.93	19.16	32.29	42.86	7.69
C.D_{0.05}	2.08	2.30	0.97	1.18	0.60

Table.2 Date of flowering and fruit shape of different strawberry cultivars

Parameters Cultivar	Date of first flowering	Date of last flowering	Fruit shape
Everly	03/04/2018	28/06/2018	Conical
Kimberly	13/04/2018	10/06/2018	Conical
Honeoye	02/04/2018	15/06/2018	Conical
Winter Dawn	10/04/2018	05/06/2018	Conical
Oso Grande	12/04/2018	17/06/2018	Oblate
Curaltar	14/04/2018	12/06/2018	Round
Sea Scape	06/04/2018	16/06/2018	Almost cylindrical
Catskill	05/04/2018	13/06/2018	Long conical
Missionary	16/04/2018	23/06/2018	Cylindrical/wedged
Jutogh Special	22/04/2018	21/06/2018	Conical
Katrain Sweet	12/04/2018	20/06/2018	Conical
Chandler	02/04/2018	21/06/2018	Biconical
Selva	09/04/2018	18/06/2018	Globose conical
Brighton	02/04/2018	18/06/2018	Long conical
Camarosa	08/04/2018	25/06/2018	Almost cylindrical

Table.3 Flowering characteristics of different strawberry cultivars

Parameters Cultivar	Bloom duration	No. of flowers/ plant	No. of berries/ plant	Per cent berry set	No. of days from flowering to harvesting
Everly	85.3	17.45	15.54	89.13	33.56
Kimberly	57.12	13.47	12.06	89.45	39.99
Honeoye	73.72	17.64	15.65	88.79	42.08
Winter Dawn	55.38	14.27	12.55	87.92	35.81
Oso Grande	65.47	10.92	8.55	78.42	41.50
Curaltar	58.17	12.61	10.53	83.54	47.66
Sea Scape	70.12	13.33	11.54	86.41	39.50
Catskill	68.94	13.12	11.45	87.26	46.72
Missionary	67.11	10.17	7.13	70.14	48.06
Jutogh Special	59.74	22.43	19.93	88.84	50.77
Katrain Sweet	68.69	14.38	12.80	88.84	39.40
Chandler	78.41	24.12	22.09	95.95	33.20
Selva	69.37	18.19	16.97	93.28	36.82
Brighton	78.16	22.94	20.74	90.40	53.90
Camarosa	77.85	26.55	23.46	88.34	40.41
C.D _{0.05}	1.23	1.72	1.73	5.19	1.29

Table.4 Fruit characteristics and physico-chemical characteristics of different strawberry cultivars

Parameters	Fruit length (cm)	Fruit diameter (cm)	L : D	Fruit weight (g)	Fruit volume (cm ³)	Specific gravity (g/cm ³)	SSC (⁰ Brix)	Titration acidity (%)	SSC/ Titration acidity ratio	Total sugars (%)	Reducing sugars (%)	Yield (q/ha)
Cultivar												
Everly	3.51	2.72	1.25	9.71	11.00	0.88	7.21	0.68	10.55	5.82	5.16	167.64
Kimberly	2.91	3.25	0.90	16.30	13.00	1.25	9.20	0.71	12.89	6.50	6.14	218.39
Honeoye	3.25	2.89	1.11	14.12	12.56	1.12	8.94	1.22	7.28	6.29	5.90	245.50
Winter Dawn	3.09	2.79	1.10	10.82	10.06	1.07	7.86	0.81	9.60	6.21	5.61	150.86
Oso Grande	3.63	2.60	1.39	8.20	7.26	1.12	9.51	0.75	12.57	4.84	4.13	77.70
Curaltar	4.28	2.40	1.77	9.29	8.50	1.08	11.23	1.21	9.41	5.31	5.00	108.68
Sea Scape	3.72	2.22	1.64	9.05	11.03	0.81	11.16	0.81	11.62	5.33	4.57	116.02
Catskill	3.16	2.09	1.50	4.94	6.17	0.79	10.10	0.96	12.42	5.82	5.24	62.84
Missionary	3.48	2.42	1.43	7.55	11.56	0.64	11.30	0.91	11.44	7.66	6.57	59.81
Jutogh Special	3.55	2.13	1.67	12.36	11.05	1.11	12.23	1.07	8.80	6.24	5.85	273.67
Katrain Sweet	4.28	2.58	1.66	10.45	12.46	0.83	8.37	0.95	11.68	6.38	5.77	148.61
Chandler	2.62	2.65	0.99	9.69	9.96	0.96	10.20	0.87	11.68	6.12	5.85	237.81
Selva	3.71	2.33	1.59	10.70	9.54	1.11	10.04	1.14	8.76	6.48	6.12	201.72
Brighton	2.55	3.08	0.82	11.72	12.25	0.95	12.63	0.96	13.04	8.58	7.70	269.92
Camarosa	3.87	3.39	1.13	11.14	13.90	0.79	8.30	0.94	8.76	6.78	6.23	290.35
C.D_{0.05}	0.20	0.17	0.14	0.27	0.44	0.03	0.27	0.03	0.88	0.08	0.08	1.00

From the forgoing discussion it is concluded that among all the studied cultivars, Catskill stood out for plant height and runner production. Honeoye, Chandler and Brighton were good for early flowering while Jutogh Special was the last to flower. Selva showed maximum bloom duration. Brighton was found to be better in terms of SSC, total sugars and reducing sugars content. Highest mean fruit weight was recorded in Kimberly while Camarosa recorded highest fruit yield among all the cultivars. Hence, based on these observations we can select a cultivar for a particular character.

References

- A. O. A. C. 1990. Official methods of analysis. *Association of Official Analytical Chemist*. Washington, D. C. USA.
- Ahmad, M. 2016. Studies on morphological, floral, fruit and yield attributes of exotic strawberry cultivars. M.Sc. Thesis Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar pp. 20-22.
- Das, A. K., Singh, K. P., Prasad, B. and Kumar, R. 2015. Evaluation of cultivars of strawberry, a temperate fruit for its adaptability as well as productivity in sub-tropical agro-climatic condition of Supaul district in Bihar. *Asian J. Hort.* 10: 278-81.
- Demirsoy, L., Demirsoy, H. and Balci, G. 2012. Different growing conditions affect nutrient content, fruit yield and growth in strawberry. *Pakistan J. Bot.* 44: 125-29.
- Dolgun, O. 2006. Yield performance of strawberry plug plants in Eastern Mediterranean climatic conditions. *International J. Agric. Res.* 1: 280-85.
- Kher, R., Baba, J. A. and Bakshi, P. 2010. Influence of planting time and mulching material on growth and fruit yield of strawberry cv. Chandler. *Indian J Hortic* 67: 441-444.
- Kumar, R., Saravanan, S., Bakshi, P. and Srivastava, J. N. 2011. Influence of plant growth regulators on growth, yield and quality of strawberry (*Fragaria × ananassa* Duch.) cv. Sweet Charlie. *Prog. Horti.* 43: 264-67.
- Lal, B. and Rao, B. K. 2010. Physico-chemical characteristics of some strawberry (*Fragaria × ananassa*) genotypes under Garhwal region of Uttarakhand. *Indian J. Agri. Sci.* 80: 342-44.
- Larson, R. A. 1988. The antioxidants of higher plants. *Phytochem.* 27: 969-78.
- Masny, A. and Zurawicz, E. 2009. Yielding of new dessert strawberry cultivars and their susceptibility to fungal diseases in Poland. *J. Fruit Ornament. Pl. Res.* 17: 191-202.
- Mohamed, A. K. A., Haridy, A. G., Soliman, M. S. E. and Abd El-Hafez, M. H. A. 2016. Performance of some strawberry cultivars grown under Assiut climatic conditions. *Assiut J. Agric. Sci.* 47: 518-32.
- Neetu and Sharma, S. P. 2018. Evaluation of strawberry cultivars for growth and yield characteristics in plain region of Chattisgarh. *Int. J. Curr. Microb. Appl. Sci.* 7: 2835-840.
- Rao, V. and Swamy, G. S. K. 2017. Performance of strawberry (*Fragaria x ananassa* Duch.) genotypes for yield and quality parameters. *Int. J. Curr. Microb. App. Sci.*: 1904-08.
- Sharma, S. and Thakur, M. S. 2008. Evaluation of different strawberry cultivars for yield and quality characters in Himachal Pradesh. *Agric. Sci. Dig.* 28: 213-15.
- Singh, S. R., Srivastava, K. K., Sharma, M. K., Singh, L. and Sharma V. K. 2012. Screening of strawberry (*Fragaria x ananassa*) varieties under organic

production system for Kashmir valley.
Indian J. Agric. Sci. 82: 538-42.
Gomez, K. A. and Gomez, A. A. 1984.
Statistical Procedures for Agricultural

Research (2nd edition). Hohn Willey
and Sons, New York, USA pp. 28-92.

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