



EFFICACY OF STRAWBERRY (*FRAGARIA ANANASSA* DUCH.) GENOTYPES UNDER VALLEY CONDITION OF GARHWAL HILLS

Tanuja* and D. K. Rana

Department of Horticulture, H.N.B. Garhwal Central University, Srinagar - 246 174 (Garhwal) (Uttarakhand), India.

Abstract

An experiment was conducted at Horticultural Research Centre, Chauras, HNB Garhwal University, Srinagar Garhwal, Uttarakhand, India during summer season 2016 to find out the efficacy of strawberry (*Fragaria ananassa* Duch.) genotypes under valley conditions of Garhwal hills. This experiment was laid out in randomized block design with 03 replications and 10 treatments with 40 × 20cm planting distance. The treatment consisted of 10 genotypes of strawberry viz., Belrubi, Catskill, Chandler, Fern, Howard, Pajaro, Selva, Sweet Charlie, Tioga and Torrey. Strawberry plants were grown over flat beds prepared independently under natural growing environments. Between the two beds 1.0 m space was left for proper intercultural operations and crop management.

The experimental findings revealed that maximum plant spread (48.05 cm), maximum number of leaves/plant (33.56 cm), days taken to final harvesting (224.67), fruit length (40.33 mm), and number of fruits/plant (41.33), maximum TSS (13.27° Brix), maximum vitamin C (48.14 mg/100 g), maximum titratable acidity (0.98%), maximum TSS : Acid ratio (19.60) and maximum yield/plant (814.15 g) was recorded with cv. Chandler. Thus, from the above studies it may be concluded that strawberry cultivar Chandler was best for commercial cultivation in valley condition of Garhwal hills.

Key words : Strawberry, quality, yield.

Introduction

Fruits are not only good source as food; they are serving as medicine and treat ailments. India with diverse soil and climate comprising several agro-ecological regions provides ample opportunity to grow a genotype of fruit crops. India is the largest producer of fruit by producing 94383 thousand MT under an area of 6523 thousand hectare in the global fruit production. In strawberry, India accounts four thousand MT production from an area of one thousand hectare (NHB, 2017-18).

Strawberry (*Fragaria x ananassa* Duch.) is one of the most important temperate fruit but it can also be grown in tropical and subtropical climate. It belongs to the family Rosaceae and all cultivated varieties are octaploid (2n=56). Strawberry has gained the status of being one of the most important soft fruits of the world after grapes. Among the fruits it gives quickest return in shortest possible time. Nutritionally, strawberry is a low calorie carbohydrate fruit but a rich source of vit. A (60 IU/100g

of edible portion), vit. C (30-120mg/100g of edible portion), fiber and also has high pectin content (0.55%) available in the form of calcium pectate. Water is a major constituent (90 %) of strawberry fruit. Ellagic acid is a naturally occurring plant phenol. It has been found to inhibit the cancer disease and asthma by the regular consumption of its fruits (Wange and Kzlogoz, 1998).

The cultivated strawberry (*Fragaria x ananassa* Duch.), a hybrid of two native American species; *F. chiloensis* and *F. virginiana* was first developed in France in the 17th century. It grows well under temperate climate but can also be grown in tropical and sub-tropical climates. It is also grown widely in European countries, Israel, Japan, Turkey, Australia and New Zealand. The United States is the world's largest producer of strawberries accounting for about 30% of the world strawberry production (Morgan, 2012).

In India, it is mainly grown in Maharashtra and in hills of Himachal Pradesh, J & K and Uttarakhand. Strawberry prefers slight acidic soils with pH of 5.8-6.5.

*Author for correspondence : E-mail: dimritanuja.18@gmail.com

Mulches have their impact in making crop sphere amenable to plant. The temperature and day-length (photoperiodism) have the considerable effect on growth and yield of the strawberry probably through the control the production of plant hormones. An average growing temperature of 15°C has been reported ideal for most of the strawberry cultivars and species. However, they grow well at a temperature range between 20°C and 26°C. It has been observed that high growth rates in strawberries are maintained at day temperatures of 22-23°C (Rana and Chandel, 2003).

Strawberry displays a wide variation in adaptation to environmental conditions. Early efforts to popularize its cultivation in Uttarakhand received a setback on account of poor return per unit area. A major back through was seen with the introduction of few cultivars from America during late seventies, some of which like Tioga and Torrey displayed high yield of excellent quality berries. Recently, several new strawberry cultivars have been introduced from different parts of the world, which could be exploited for bringing about improvement in strawberry production in the state. The climatic conditions of the state are congenial for the production of fruits as well as runners. The runner production in strawberry does not take place in warm areas.

Materials and Methods

The experiment was conducted under the field conditions of Horticultural Research Centre, HNB Garhwal University, Srinagar (Garhwal), Uttarakhand during summer season of 2016.

The experiment was laid out in a Randomized block design and plots containing different genotypes were replicated thrice with 10 treatments. The treatment consisted of 10 genotypes of strawberry *viz.*, Belrubi (G₁), Catskill (G₂), Chandler (G₃), Fern (G₄), Howard (G₅), Pajaro (G₆), Selva (G₇), Sweet Charlie (G₈), Tioga (G₉) and Torrey (G₁₀). The planting of strawberry plant is done in the summer season, 2016 with spacing of 40 x 20 cm. Various growth, yield and quality parameters, *viz.*, crown height (cm), number of leaves/plant, plant spread (cm), runner production/plant, days taken to first flower initiation, days taken to 50% flowering, days taken to first fruit set, days taken to final harvest, number of pickings, fruit length (mm), fruit width (mm), length: diameter ratio, fresh weight of fruit (g), dry weight of fruit (g), number of fruits/plant, fruit yield/plant, TSS (^oBrix), titratable acidity (%), TSS/acid ratio, vitamin C (mg/100g). The significance of variation among the treatments was calculated by applying analysis of variance (ANOVA) and critical difference (C.D) test at 5% probability level (Cochran

and Cox, 1992).

Results and Discussion

The behavior of all genotypes with relation to growth, yield and quality may be attributed to the genetic makeup of the genotypes, soil and climate of the area and environmental conditions prevailing during the growth phase. The evaluation of these genotypes for their relative performance for a particular area may further require investigations and may be refined further. The table 1 showed that maximum plant height (27.75 cm) was recorded under the genotype Sweet Charlie (G₈), whereas the minimum plant height (14.40 cm) was recorded under the genotype Catskill (G₂). The maximum number of leaves/plant (31.56) was recorded under the genotype Chandler (G₃), whereas the minimum number of leaves/plant (16.44) was recorded under the genotype Fern (G₄). The maximum plant spread (46.05 cm) was recorded with Chandler (G₃), and the minimum plant spread (25.50 cm) was recorded with Brighton (G₃). The maximum runner production/plant (23.00) was observed in Howard (G₅), whereas the minimum runner production /plant (8.44) were recorded in Belrubi (G₁) genotype.

It is noted from table 2 that the minimum days (80.33) taken to 1st flower initiation was recorded under Pajaro (G₆), and the maximum days (125.33) taken to 1st flower initiation was recorded under Selva (G₇). The minimum days (113.00) taken to 50% flowering was recorded under Sweet Charlie (G₈), whereas the maximum days (164.67) taken to 50% flowering was recorded under Selva (G₇). The minimum days (86.00) taken to 1st fruit setting was recorded under genotype Pajaro (G₆) and the maximum days (130.67) taken to 1st fruit setting was recorded under Selva (G₇). The minimum days (120.00) taken to 50% fruit setting was recorded under genotype Sweet Charlie (G₈), and the maximum days (171.00) taken to 50% fruit setting was recorded under the genotype Selva (G₇). The minimum days (107.33) taken to 1st harvest was recorded under genotype Pajaro (G₆), and the maximum days (149.67) taken to 1st harvest was recorded under Selva (G₇). The minimum days (180.33) taken to final harvest was recorded under genotype Sweet Charlie (G₈), and the maximum days (224.67) taken to final harvest was recorded under Chandler (G₃). The maximum (23.33) number of pickings was recorded under the genotype Howard (G₅), whereas the minimum (13.00) number of pickings was recorded under the genotype Sweet Charlie (G₈). The maximum fruit length (43.54 mm) was recorded under the genotype Sweet Charlie (G₈), whereas minimum fruit length (22.66 mm) was recorded under the genotype Tioga (G₉). These variations may be due to

Table 1 : Performance of strawberry (*Fragaria ananassa* Duch.) genotypes for growth characters.

S. no.	Name of genotype	Crown height (cm)	Number of leaves/plant	Plant spread (cm)	Runner production/plant	Days taken to 1 st flower initiation	Days taken to 50% flowering	Days taken to 1 st fruit set	Days taken to 50% fruit set	Days taken to 1 st harvest	Days taken to final harvest
1	Belrubi	23.50	25.00	38.21	10.44	117.67	153.67	123.00	161.33	146.00	219.67
2	Catskill	16.40	21.56	32.16	22.45	88.67	136.67	95.67	143.33	120.00	208.33
3	Chandler	25.29	33.56	48.05	22.56	100.33	145.00	105.67	151.67	127.00	224.67
4	Fern	20.63	18.44	33.24	23.78	106.67	149.33	111.67	156.33	132.00	224.67
5	Howard	23.16	19.89	29.07	25.00	87.33	139.33	92.33	145.33	112.33	215.00
6	Pajaro	23.05	21.22	28.73	21.55	80.33	128.33	86.00	134.33	107.33	199.33
7	Selva	21.09	25.89	37.90	16.34	125.33	164.67	130.67	171.00	149.67	221.33
8	Sweet Charlie	29.75	32.22	36.99	22.11	83.33	113.00	90.33	120.00	112.00	180.33
9	Tioga	19.42	20.44	28.17	15.22	97.33	147.00	103.33	152.00	124.33	212.67
10	Torrey	22.72	23.78	34.65	22.45	121.67	161.00	127.33	168.67	147.00	218.67
S.Em±		0.19	0.84	0.27	0.66	0.44	0.56	0.52	0.65	0.30	1.09
CD at 5%		0.52	2.41	0.75	1.88	1.24	1.59	1.46	1.83	0.83	3.13

Table 2 : Performance of strawberry (*Fragaria ananassa* Duch.) genotypes for yield characters.

S. no.	Name of genotype	Number of pickings	Fruit length (mm)	Fruit width (mm)	Length:diameter ratio	Fresh wt. of fruit (g)	Dry wt. of fruit (g)	No. of fruits/plant	Fruit yield/plant (g)
1	Belrubi	15.67	36.77	20.62	1.89	16.90	0.79	27.67	384.24
2	Catskill	17.33	32.10	22.95	1.49	11.97	0.42	25.67	237.84
3	Chandler	21.67	40.33	32.12	1.40	30.03	1.82	41.33	814.15
4	Fern	17.33	33.70	21.45	1.65	11.54	0.39	19.67	170.44
5	Howard	23.33	37.77	23.85	1.66	22.77	1.06	25.33	486.54
6	Pajaro	19.33	29.18	24.18	1.25	23.34	1.06	21.33	414.80
7	Selva	17.33	28.64	22.64	1.31	22.00	1.00	34.33	649.00
8	Sweet Charlie	13.00	43.54	30.53	1.36	30.01	1.64	37.33	692.00
9	Tioga	14.67	22.66	17.89	1.32	11.32	0.43	27.67	241.11
10	Torrey	17.67	32.74	23.38	1.46	21.75	0.99	24.67	449.95
S.Em±		0.52	0.30	0.36	0.05	0.46	0.06	0.50	18.48
CD at 5%		1.48	0.84	1.00	1.00	1.30	0.12	1.42	49.74

Table 3 : Performance of strawberry (*Fragaria ananassa* Duch.) genotypes for quality characters.

S. no.	Name of genotype	TSS (° Brix)	Titratable acidity (%)	TSS:Acid ratio	Vitamin C (mg/100g fruit)
1	Belrubi	11.90	0.68	17.03	35.02
2	Catskill	10.80	0.93	11.67	45.05
3	Chandler	13.27	0.98	19.60	48.14
4	Fern	11.77	0.84	13.87	39.75
5	Howard	9.97	0.66	10.31	43.59
6	Pajaro	13.20	0.64	20.07	34.57
7	Selva	12.27	0.70	17.18	39.52
8	Sweet Charlie	12.23	0.61	19.25	41.78
9	Tioga	9.67	1.30	7.99	38.26
10	Torrey	11.97	0.69	16.90	38.23
S.Em±		0.14	0.04	0.38	0.24
CD at 5%		0.38	0.08	1.07	0.67

genetic makeup of these genotypes (Sharma and Sharma, 2006) and growing (Dwiwedi *et al.*, 2004). The maximum fruit width (32.12 mm) was recorded under the genotype Chandler (G₃), whereas minimum fruit length (17.89 mm) was recorded under the genotype Tioga (G₉). The maximum length:diameter ratio (1.89) was recorded under the genotype Belrubi (G₁), whereas minimum length:diameter ratio (1.25) was recorded under the genotype Pajaro (G₆). The maximum fresh weight of fruit (30.03 g) was recorded under the genotype Chandler (G₃), whereas minimum fresh weight of fruit (11.32 g) was observed under Tioga (G₉). The maximum dry weight of fruit (1.82 g) was recorded under the genotype Sweet Charlie (G₈), whereas minimum dry weight of fruit (0.39g) was observed under Fern (G₄). The maximum number of fruit/plant (41.33) was recorded under the genotype Chandler (G₃), whereas minimum number of fruit/plant (19.67) was observed under Dana (G₄). The maximum fruit yield/plant (992.00 g) was recorded under Chandler (G₃) whereas the minimum fruit yield/plant (114.15g) was recorded under the genotype Sweet Charlie (G₈). The growth and yield parameters observed in present study were in agreement with other workers (Lal and Rao, 2010; Das *et al.*, 2007 and Singh *et al.*, 2008).

It is noted from table 3 that maximum TSS (13.27° Brix) was observed under the genotype Pajaro (G₆), and the minimum (9.67° Brix) was recorded under the genotype Tioga (G₉). The maximum titratable acidity (1.30%) was observed under the genotype Tioga (G₉), whereas the minimum (0.69%) was recorded in Torrey (G₁₀). Varietal differences in respect to acidity was reported by Chandel and Badiyala (1996), which may be due to genetic and environmental effects as cooler night and warmer days promote more synthesis of acidity in fruits (Wani *et al.*, 2007). The maximum TSS/acid ratio

(20.07) was recorded under the genotype Pajaro (G₆), whereas minimum TSS/acid ratio (7.99) was found in Tioga (G₉). These variations may be due to genetic and environmental effect. These results are in almost conformity with findings of Lal and Rao (2010). The maximum vitamin C (48.14 mg/100 g) was recorded under the genotype Catskill (G₂) and the minimum (34.57 mg/100 g) was recorded under Pajaro (G₆).

Conclusion

On the basis of above findings, it may be concluded that among different genotypes, the genotype Chandler of strawberry was found superior over others under Garhwal Hills on the basis of performance *viz.*, growth, yield and quality parameters, followed by Sweet Charlie. Further study may be needed for the cultivation and recommendation of this genotype of strawberry under hill condition.

References

- Chandel, J. S. and S. D. Badiyala (1996). Performance of some strawberry cultivars in foothills of Himachal Pradesh. *Ann. Agric. Res.*, **17** : 375–378.
- Cochran, W. G. and C. M. Cox (1992). *Experimental Design*. John Wiley and Sons, Inc., New York.
- Das, B., Vishal Nath, B. R. Jana, P. Dey, K. K. Parmanik and D. K. Kisore (2007). Parformance of strawberry cultivars grown on different mulching material under sub humid sub tropical plateau conditions of eastern India. *Indian J. Hort.*, **64** : 137–43.
- Dwiwedi, S. K., Abdul Kareem and B. Raut (2004). Introduction and evaluation of strawberry cultivars for cold arid conditions of Ladakh. *Prog. Hort.*, **36** : 207–210.
- Lal, B. and B. K. Rao (2010). Physico-chemical characteristics of some strawberry (*Fragaria × ananassa*) genotypes under Garhwal region of Uttarakhand. *Indian J. Agric.*

- Sci.*, **80(4)**: 342–344.
- Morgan, K. L. (2012). Commodity strawberry profile. *Mississippi State University*. [http://www.agmrc.org/commodities/Products/fruits/strawberries/commoditystrawberry-profile/\(01.10.2015\)](http://www.agmrc.org/commodities/Products/fruits/strawberries/commoditystrawberry-profile/(01.10.2015))
- National Horticulture Board (2018) http://nhb.gov.in/statistics/State_Level/area_prod20161718.pdf. July 15, 2018.
- Rana, R. K. and J. S. Chandel (2003). Effect of bio-fertilizer and nitrogen growth, yield and fruit quality of strawberry. *Prog. Hort.*, **35 (1)**: 23-30.
- Sharma, G and O. C. Sharma (2006). Correlation and path analysis in strawberry (*Fragaria ×ananassa* Duch). *The Hort. J.*, **19**: 1–4.
- Wange, R. S. and Kzlogoz (1998). Effect of biotertilizer on growth, yield and quality of strawberry. *Ann. Agric. Sci. Mosthohor.*, **43(2)**: 247–254.
- Wani, M. S., B. A. Rather, M. K. Sharma and S. R. Singh (2007). Effect of different planting times and mulches on flowering, yield and quality of strawberry. *The Hort. J.*, **20**: 57.