



EVALUATION OF PERFORMANCE OF STRAWBERRY CULTIVARS FOR VEGETATIVE ATTRIBUTES AND RUNNER PRODUCTION

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Abstract

Strawberry cultivation is influenced by suitability of cultivars in the growing regions due to critical photoperiod and temperature requirement. It is necessary to evaluate the performance of available genotypes for vegetative growth and yield affecting traits like runner production. The cultivars 'Chandler' (V₁) followed 'Camarosa' (V₃) and 'Winter dawn' (V₂) were reported with higher vegetative growth and lower mortality while 'Sweet Charlie' (V₆) and Hadar (V₇) were identified with high mortality and poor vegetative growth due to poor adaptability of these genotypes in the sub-mountainous region of Punjab.

Key words : Chandler, Camarosa, Winter dawn, Strawberry, Runners, Mortality.

Introduction

Strawberry (*Fragaria × ananassa* Duch.) is herbaceous fruit plant belongs to the family Rosaceae and is octaploid in nature having chromosome number $2n=8x=56$. Strawberry fruit is one of the refreshing, delicious and attractive aggregate fruit. Strawberry fruit crop gives high returns per unit area and quick growing crop which is ready to harvest within five months after planting as compared to other fruit crops (Sharma and Sharma, 2004). It is also growing in kitchen garden. Maharashtra is a leading state in production of strawberry fruits. It is also cultivated in Utrakhand, hills of Darjeeling (West Bengal) and Jammu and Kashmir. In recent years, its cultivation has also been extended from the temperate to the sub-tropical regions (Haryana & Punjab) where this grows as an annual crop.

The cultivation of strawberry is highly affected by the climatic adaptability of the region which is being used for cultivation because of critical photoperiod and temperature requirement of a cultivar; and is being further depends on the cultural practices (Sharma and Sharma, 2003). There are cultivars/varieties available with us but merely tested for their adaptability and performance in Punjab condition before recommending for commercial cultivation. There are many germplasm that have been grown but their adaptability and acclimatization to

subtropical climatic condition of Punjab is yet to be confirmed for better performance and exploitation towards quantitative and qualitative yield. Currently strawberry cultivation is limited due to lack of proper package of practices in the plains of Punjab. This will not only help the farmers to grow suitable varieties but it also helps them to understand their superiority over presently grown varieties.

Considering the significance of varietal evaluation in different climatic conditions 12 genotypes were evaluated at experimental area of the Baba Farid College, Bathinda during 2017-19 to compare the performance of these genotypes for vegetative parameters and runner production.

Materials and Methods

The runners were planted on (15cm) raised bed in October, 2017. Twenty-one plants of each twelve germplasm with thrice replication were planted on the thirty-six raised beds at 30 cm space between row to row and plant to plant under randomized complete block design. Twenty-one plants of each of the twelve strawberry cultivars were planted in 2 × 1.0 m raised beds for detailed investigations.

The dead plants/runners were counted after seven days of transplanting of each treatment. Mortality percentage of plants was calculated with help of following formula:

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$$\text{Mortality (\%)} = \frac{\text{Total number of plant died}}{\text{Total number of transplanted plant}} \times 100$$

The other vegetative parameters *viz.* plant height, plant spread, number of leaves (Count), leaf area and petiole length were also recorded on randomly selected plants and average was subjected to statistical analysis. The qualitative traits of leaves were also evaluated on the basis of visual observations. The shapes of leaves are generally obovate, elliptical and ovate. So, leaf shape was observed by visual evaluation. Leaf base was recorded by visually observation which were classified as Acute and Obtuse. Leaf apex was recorded by visually observation which were classified as Obtuse and Acute. The leaf colour of upper and lower surface was recorded with help of (Royal Horticultural Society, U.K.) colour charts. The nature of leaf is generally thin, smooth, thick and rough in nature on the basis of observation. Leaf margin was recorded by visual observation of boundary area along with leaf edge which was represented as serrated or entire type of margin. The runners were counted from all plants per replication at the end of season. The mean value of the number of runners was calculated. The date of planting and formation of first runner were noted and the days taken for formation of first runner after planting were calculated in days. All the quantitative traits based on vegetative parameters and runner production were subjected to statistical analyzed for randomized block design.

Results and Discussion

Performance of strawberry genotypes for growth parameters

The observations recorded on various vegetative parameters were reported to be statistically significant for all traits (Table 1). The mortality of plant ranged from 11.11 percent to 52.38 percent. The lowest mortality rate of plant (11.11 percent) was observed in ‘Camarosa’ (V₃) which was statistical at par with ‘Chandler’ (V₁) whereas highest mortality rate (52.38 percent) was found in ‘Sweet Charlie’ (V₆) as compared to other germplasms like V₂, V₄, V₅, V₇, V₈, V₉, V₁₀, V₁₁ and V₁₂. According to Beniwal *et al.*, (1989), the results variation in these germplasms may be the genes responsible for these results did not express themselves fully with same degree as it does at others

places because of different agro-climatic conditions.

The maximum plant height (12.07 cm) was recorded in Chandler (V₁) followed by 11.90 cm in ‘Camarosa’ (V₃) and 11.37 cm in ‘Winter dawn’ (V₂) whereas, minimum height (8.83 cm) of plant was obtained in Hadar (V₇) followed by 9.30 cm in E1-13#31 (V₉), 9.37 cm in E1-13#32 (V₅) and 9.47 cm in ‘Sweet Charlie’ (V₆). These results are in similarity with the findings of Rao and Lal, (2010) who tested different varieties of strawberry and recorded that highest plant height in Chandler. The lower plant height in these genotypes may be related to genetic structure (Garg, 2013; Sahu and Chandel, 2014). Further the plant size is a quantitative trait which is greatly influenced by different environmental factors which might be the reason of critical differences among plant heights of different genotypes.

The average plant spreads and varied from 10.67 cm to 13.83 cm. The results of plant spread was critically observed that ‘Winterdawn’ (V₂) showed the highest plant spread followed by ‘Camarosa’ (V₃), ‘Chandler’ (V₁) and Yamni (V₁₀) among all germplasms while, the least plant spread (10.67 cm) was found in ‘Hadar’ which was closely followed by 10.75 cm in ‘Sweet Charlie’ (V₆) and 10.83 cm in E1-13#31 (V₉). Like plant height, the plant spread was also greatly influenced by different environmental factors which might be the reason behind variable response of genotypes under the existing agro-climatic conditions. The result was closely related with findings of Gaikwad *et al.*, (2018) and Garg, (2013).

Table 1: Performance of different strawberry genotypes for plant growth parameters.

Germplasms		Mortality rate (%)	Plant height (cm)	Plant spread (cm)	Number of leaves	Leaf Area (cm ²)
V ₁	Chandler	14.29	12.07	12.70	13.58	73.29
V ₂	Winter Dawn	17.46	11.37	13.83	14.17	72.08
V ₃	Camarosa	11.11	11.90	13.43	13.33	74.03
V ₄	FL-09-127	25.40	9.67	12.60	12.50	60.48
V ₅	E1-13#32	34.92	9.37	11.42	13.10	67.71
V ₆	Sweet Charlie	52.38	9.47	10.75	10.83	61.23
V ₇	Hadar	36.51	8.83	10.67	11.67	66.03
V ₈	E1-13#33	41.27	10.13	12.50	12.90	68.38
V ₉	E1-13#31	31.75	9.30	10.83	9.67	54.87
V ₁₀	Yamini	33.33	10.70	12.73	10.00	59.93
V ₁₁	E-22	42.86	10.70	11.83	9.50	54.47
V ₁₂	Shani	30.16	10.23	12.45	12.00	69.80
Mean	30.95	10.31	12.15	11.94	65.19	
C.D.	5.093	0.735	1.164	0.963	6.462	
SE(m)	1.725	0.249	0.394	0.326	2.189	
SE(d)	2.44	0.352	0.558	0.461	3.096	
C.V.	9.656	4.18	5.626	4.733	5.816	

Table 2: Variation in qualitative traits of leaf under different strawberry genotypes.

Germplasms	Leaf shape	Leaf base	Leaf tip	Leaf surface upper surface	Leaf margins
V ₁ Chandler	Obovate	Obtuse	Obtuse	Dark green apubescent	Medium serrated
V ₂ Winter Dawn	Obovate	Obtuse	Acute-Obtuse	Dark green apubescent	Medium serrated
V ₃ Camarosa	Obovate	Obtuse	Obtuse	Dark green slightly pubescent	Shallowly serrated
V ₄ FL-09-127	Ovate-Obovate	Obtuse	Obtuse	Dark green apubescent	Shallowly serrated
V ₅ E1-13#32	Ovate-Obovate	Obtuse	Obtuse	Green, slightly pubescent	Medium serrated
V ₆ Sweet Charlie	Obovate	Obtuse	Acute-obtuse	Green, slightly pubescent	Shallowly serrated
V ₇ Hadar	Obovate	Obtuse	Obtuse	Green, slightly pubescent	Shallowly serrated
V ₈ E1-13#33	Ovate-obovate	Obtuse	Obtuse	Green apubescent	Medium serrated
V ₉ E1-13#31	Obovate	Acute-Obtuse	Obtuse	Dark green apubescent	Medium serrated
V ₁₀ Yamini	Obovate	Obtuse	Obtuse	Green, slightly pubescent	Shallowly serrated
V ₁₁ E-22	Obovate	Obtuse	Obtuse	Green, slightly pubescent	Medium serrated
V ₁₂ Shani	Ovate-obovate	Obtuse	Obtuse	Dark green apubescent	Medium serrated

The number of leaves per plant was maximum (14.17) in the 'Chandler' (V₁) followed by 13.58 in 'Winterdawn' (V₂) and 13.33 in 'Camarosa' (V₃) while, minimum (9.50) was obtained in E-22, 9.67 in E1-13#31 (V₉) and 10.00 in Yamini (V₁₀). This variation in leaves number per plant could be genetic variation in the germplasms, cultivation site, cultural practices and climatic conditions (Li *et al.*, 1993). The present results are agreements with findings of Garg, (2013) and Singh *et al.*, (2008).

The data of leaf area was significantly shown the variation between all germplasms and varied from 54.47 cm² to 74.03 cm² percent. The highest leaf area (74.03 cm²) was observed in 'Camarosa' (V₃) which was

statistical similar with 'Chandler' (V₁) and Winterdawn (V₂) whereas lowest (54.47 cm²) was found in 'E-22' which was statistically at par with (54.87 cm²), 'E1-13#31' (V₉), (59.93 cm²), 'Yamini' (V₁₀) and (60.48 cm²) in 'FL-09-127' (V₄). The variation in leaf area might be result of response of these genotypes to light, photoperiod, temperature, soil nutrition, free metabolites and their allocation to the above ground plant parts. Further, the altitude of experiment sites also affected the leaf areas per plant and fruit yield (Crespo *et al.*, 2010). The results were according to findings of Rao and Lal, (2010), who observed maximum leaf numbers in 'Chandler' and 'Camarosa'.

Table 3: Performance of different strawberry genotypes for runner formation and petiole length.

Germplasms	Number of runners	Days to runner formation after planting	Petiole Length (cm)
V ₁ Chandler	10.33	162.77	9.43
V ₂ Winter Dawn	8.33	169.60	8.53
V ₃ Camarosa	9.67	165.83	9.63
V ₄ FL-09-127	7.00	176.10	6.80
V ₅ E1-13#32	5.00	175.47	7.87
V ₆ Sweet Charlie	5.33	177.90	6.17
V ₇ Hadar	3.67	185.93	7.80
V ₈ E1-13#33	7.67	171.93	7.73
V ₉ E1-13#31	4.33	180.00	8.43
V ₁₀ Yamini	8.33	169.17	9.17
V ₁₁ E-22	5.33	187.70	9.13
V ₁₂ Shani	6.00	167.83	8.10
Mean	6.75	174.19	8.23
C.D.	1.658	3.338	0.524
SE(m)	0.562	1.131	0.177
SE(d)	0.795	1.599	0.251
C.V.	14.417	1.124	3.733

Performance of strawberry genotypes for leaf related traits

The leaf related qualitative and quantitative traits have given variable response (Table 2). The different shape of leaf was observed in different germplasms of strawberry. The germplasms 'Chandler', 'Camarosa', 'Winterdawn', 'Sweet Charlie', 'E-22', 'Hadar', 'E1-13#31', 'Yamini' were having obovate shape of leaf while 'FL-09-127', 'E1-13#32', 'E1-13#33' and 'Shani' were bearing ovate-obovate leaves. All different germplasms were having obtuse leaf base except 'E1-13#31' which showed acute-obtuse leaf shape. The leaf apex was obtuse in all germplasms but acute-obtuse leaf apex was obtained in 'Winter Dawn' and 'Sweet Charlie' germplasms. The upper surface of leaf colour was dark green to green color and a pubescent to slightly pubescent. The dark green colour of upper surface was found in Chandler, Winter Dawn, Camarosa, FL-09-127, E1-13#31 and Shani while the green colour was recorded in the E1-13#33, Hadar, Sweet Charlie, Yamini, E1-13#32 and E-22. The germplasms Chandler, Winter Dawn, FL-09-127, E1-13#31, E1-13#33 and Shani showed apubescent surface while rest of the genotypes like Hadar, Sweet Charlie, Yamini, E1-13#32, E-22 and Camarosa showed

slightly pubescent. The medium serrated leaf margin was found in Chandler, Winter Dawn, E-22, Shani, E1-13#31, E1-13#32 and E1-13#33 while shallow serrated leaf margin was recorded in Sweet Charlie, Yamni, Camarosa, FL-09-127 and Hadar.

The data related length of petiole in different germplasms under Punjab condition was recorded and significantly different from each other (Table 3). The length of petiole was highest (9.63cm) in Chandler (V_1) which was closely followed by 9.43 cm in ‘Camarosa’ (V_3), 9.17 cm in ‘Yamini’ (V_{10}) and 9.13 cm in ‘E-22’ (V_{11}) whereas, lowest length of petiole was obtained in 6.17 cm in ‘Sweet Charlie’ (V_6). The results were in agreement with Singh, (2016) who recorded that maximum length of petiole in cultivar Camarosa and Chandler. The variation in length of petiole among different genotypes was due to variation in gene structure and their response to photoperiod and light intensity (Darrow, 1966).

Performance of strawberry genotypes for runner production

The maximum runners per plant (10.33) was counted in ‘Chandler’ (V_1) which was at par with ‘Camarosa’ (V_3). ‘Hadar’ (V_7) showed the minimum (3.67) number of runners which was lower than rest of the germplasm followed by 4.33 in ‘E1-13#31’ (V_9), 5.00 in ‘E1-13#32’ (V_5) and (5.33) ‘E-22’ (V_{11}). The results of present investigation were closely related to findings of Das *et al.*, (2007) and Garg, (2013). This variation in number of runners per plant may be due to potential of cultivars to produce runners.

The germplasm minimum (162.77) days taken for runner formation was observed in ‘Chandler’ (V_1) closely followed by 165.83 in ‘Camarosa’ (V_3). The maximum days taken to runner formation after planting (187.7) was counted in germplasm ‘E-22’ (V_{11}) followed by 185.93 in Hadar (V_7). Gupta, (1998) and Garg, (2013) have also observed earlier runner formation in Chandler than other cultivars. Some of the germplasms like E-22, Hadar were showing poor runners which may be due to prevalence of relatively shorter day length in Northern Indian sub-mountainous regions during summer as some germplasms formed runners early in 16 hours day length (Rao and Lal, 2010).

Conclusions

Among the 12 strawberry genotypes, the varieties which were found to be suitable for sub-mountainous and subtropical climatic condition of Punjab are Camarosa, Chandler and Winter Dawn. These varieties have performed well in terms of survival, vegetative growth

with substantial amount of runner production.

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