Original Research Article

"Evaluation of strawberry (*Fragaria* x *ananassa* Duch.) cultivars for growth, flowering and fruiting behavior under farmer's field condition (Baadi) in Chhattisgarh plain region"

ABSTRACT

In a research trial for varietal evaluation under farmer's field condition, strawberry cv. Nabila recorded maximum vegetative growth *i.e.*, plant height, number of leaves, plant spread, number of runners per plant and length of runners, while the minimum was recorded under the cultivar Camarosa. Earliest flowering, fruit setting and fruit ripening was exhibited under the cultivar Nabila, whereas the cultivar Camarosa had too late in flowering, fruit setting and ripening of the fruits under farmer's field condition (Baadi).

***Key words*:** Strawberry, Nabila, Camarosa, growth parameters, flowering, fruiting behavior etc.

INTRODUCTION

Strawberry (*Fragaria* x *ananassa* Duch.) is a temperate fruit belongs to the family Rosaceae. Due to availability of thermo sensitive varieties now it can be grown in tropical and sub-tropical climate too. Nutritionally, strawberry contains low calorie carbohydrate and a potential source of vitamin C and fibers. It contains ascorbic acid (64.0mg), water (91.75g), protein (0.61g), fat (0.37g), carbohydrate (7.02g), fiber (2.3g), calcium (14.0mg), potassium (166.0 mg/160g) and vitamin-A (27 IU). Also known as wholesome fruit having 98 % edible portion with maximum fruit weight and size. Strawberries have traditionally been a popular delicious fruit for its flavour, taste, fresh use, freezing and processing. It is in high demand for table purpose as well as for Jam making, canning, ice-cream preparation, beverages, wine, soft drinks and other quality products.

Fourteen cultivars of strawberry have been evaluated at College of Horticulture and Research Station, Pendri Farm, Rajnandgaon in the year 2017-18. Among which two cultivars *i.e.*, Nabila and Camarosa were found most suitable cultivars for this region. The work on varietal

evaluation was not done earlier in Chhattisgarh plain region under farmer's field condition (Baadi), therefore, the present study was conducted to evaluate best performing strawberry cultivars under farmer's field condition for growth parameters and fruit quality attributes.

MATERIAL AND METHODS

The field trial was carried out during the winter spring season of the year 2017-18 in three farmer's field condition (Baadi) at village-Bharregaon (dist.-Rajnandgaon, Chhattisgarh) and the research farm of College of Horticulture and Research Station, Rajnandgaon (C.G.). The soil of experimental field was sandy-loam having pH 7.7. In the experiment student's t-test was used with 4 replications. The experiment was conducted with 2 cultivars *viz.* Nabila and Camarosa. Healthy Tissue cultured plants were procured from Mahabaleshwar (Maharashtra). The vigorous, healthy, diseases & pest free and well rooted saplings of all 2 varieties of Strawberry were planted in field at 45 cm x 30 cm distance with application of recommended dose of fertilizers. All the experimental plants were uniformly maintained and same cultural practices were provided *i.e.*, fertilization, irrigation and plant protection measures during whole period of investigation. Under growth parameters the observations *i.e.*, plant height, number of leaves, plant spread, number of runners per plant and length of runners were recorded and data were analyzed statistically. plant height, plant spread and length of runners were recorded with the help of measuring tape.

RESULT AND DISCUSSION

Plant height (cm)

The data on plant height during plant growth stages were recorded at 30, 60, 90, 120 and 150 days after planting are presented in Table 1 and graphically depicted in Fig. 1. At 30 days after planting, no significant differences were observed between both the varieties in respect to plant height. The maximum plant height (9.25 cm) was recorded under Nabila (V_1) and the minimum plant height (8.88 cm) was observed under Camarosa (V_2). At 60, 90, 120 and 150 days after planting, the maximum plant heights (18.99, 24.97, 29.09 and 33.12 cm) respectively were recorded under Nabila (V_1). However, the minimum plant heights (15.79, 19.99,23.96 and 27.49 cm respectively) were observed under Camarosa (V_2) in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. It is evident from the result obtained that the

in the climatic conditions prevalent at subtropical conditions at Chhattisgarh, the plants of all the cultivars were observed tall in comparison to plants raised in other states. The reason for the variation in these cultivars could be that the genes responsible for the plant height did not express them fully with the same degree as it does at other places because of different agro-climatic conditions. Varietal differences in plant height were also noted by Singh *et al.* (2008), Sharma *et al.* (2014), Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020), which supports the present observation.

Plant spread (cm) (E-W & N-S)

Observations on plant spread were recorded at 30, 60, 90, 120 and 150 days after planting in both directions *i.e.,* E-W and N-S are presented in Table 1 and illustrated in Fig. 1. At 30 days after planting, no significant differences were observed between both the varieties in respect to plant spread in E-W direction. The maximum plant spread (10.10 cm) was recorded under Nabila (V_1) and the minimum plant spread (10.01 cm) was observed under Camarosa (V_2). The data pertaining to plant spread in E-W direction observed at 60, 90, 120 and 150 days after planting revealed that the maximum plant spread (23.45, 28.52, 33.75 and 36.95 cm respectively) was recorded under Nabila (V_1). The minimum plant spread (17.65, 21.71, 25.72 and 29.15 cm) was noted under Camarosa (V_2) at different growth stages *i.e.,* 60, 90, 120 and 150 days after planting respectively in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station.

As per data observed on plant spread in N-S direction at 30 days after planting, no significant differences were observed. The Nabila (V_1) obtained maximum plant spread (11.13 cm) and the minimum plant spread (11.03 cm) was noticed under Camarosa (V_2). The data recorded at 60, 90, 120 and 150 days after planting in N-S direction the superiority of treatment Nabila (V_1), registered maximum plant spread (24.47, 29.42, 34.77, 37.97 cm respectively). However, the minimum plant spread (18.67, 22.69, 26.76 and 30.18 cm) was recorded under the treatment Camarosa (V_2) at different growth stages i.e., 60, 90, 120 and 150 days after planting respectively in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station.

It is evident from the data that plant spread was more in North-South direction in comparison to East-West. This may be due to the moisture fluctuations which was continuous in North-South directions. The above finding comes in accordance with the findings of Sharma *et al.* (2014) who proposed that that the genes responsible for the plant spread did not express them fully with the same degree as it does at other places because of different agro-climatic conditions. These results are in close agreement with the findings of Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Number of leaves per plant

The data on number of leaves per plant were recorded at 30, 60, 90, 120 and 150 days after planting are presented in Table 1 and graphically depicted in Fig. 1. At 30 days after planting, no significant differences were observed between both the varieties in respect to number of leaves per plant. The maximum number of leaves per plant (7.10) was recorded under Nabila (V_1) and the minimum number of leaves per plant (6.52) was observed under Camarosa (V_2). The data pertaining to number of leaves per plant observed at different growth stages *i.e.,* 60, 90, 120 and 150 days after planting revealed that the maximum number of leaves per plant (21.87, 32.01, 41.09 and 49.07, respectively) were recorded under the superiority of Nabila (V_1). However, the minimum number of leaves per plant (17.82, 28.31, 34.46 and 40.08) was recorded under Camarosa (V_2) at 60, 90, 120 and 150 days after planting, respectively in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. It is evident from the result obtained that the variation with respect to number of leaves could be attributed to the fact that different cultivars may react differently to photoperiod, light, temperature, nutrient status of soil, available metabolites and their allocation to the above ground plant parts. Increased number of leaves was exhibited by the plants in the experiment. The number of leaves per plant recorded in the present studies was on higher side as reported earlier by Sharma *et al.* (2014) Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Number of runners per plant

The data gathered on number of runners per plant was very much influenced by both the strawberry cultivars been presented in Table 1 and illustrated in Fig. 2. It is obvious from the data

that significantly maximum number of runners per plant (9.10) was noticed under Nabila (V_1), which was followed by Camarosa (V_2) recording minimum number of runners per plant (6.15 in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. Because of confined and short favorable agro-climatic conditions, reduced number of runners was produced by the plants. These results are in close agreement with the findings of Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Length of runners (cm)

The data pertaining to length of runners (cm) is presented in a Table 1 and graphically depicted in Fig. 2. Length of runners was significantly influenced by different strawberry cultivars. Between both the cultivars the longest runners (91.20 cm) were noticed under Nabila (V_1) and the shortest runners (74.33 cm) were observed under Camarosa (V_2) in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. There were significant differences between both the cultivars with respect to length of runners. Length of the runners was longer might be due to irrigation by flood or channel system, which confined the moisture to root zone and nearby surface areas had resulted in the longer runners, because the emerged runners were feasible to grow in length (Kumar, 2002). The present findings are in close agreement with the finding of Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Days to first flowering

The data pertaining to days to first flowering is presented in a Table 1 and illustrated in Fig. 2. Days to first flowering was significantly influenced by different strawberry cultivars. Between both the cultivars the minimum days to first flowering (42.07 days) was noticed under Nabila (V_1) and the maximum days to first flowering (49.98 days) was observed under Camarosa (V_2) in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. There were significant differences between both the cultivars with respect to days to first flowering. Early inflorescence emergence was significantly altered by the different strawberry cultivars. This might be attributed to its short crop period as observations made by Montero *et al.* (1996). Variability in flowering period in different varieties might also be due to differences in

their chilling requirement as suggested by Joolka and Badiyala (1983). Similar findings are also reported by Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Number of flowers produced per plant

The data gathered on number of flowers produced per plant was very much influenced by various strawberry cultivars are presented in Table 1 and graphically depicted in Fig. 2. The number of flowers per plant varied between 31.73 and 43.61. The maximum number of flowers per plant (43.61) was noticed under Nabila (V_1) which was followed by Camarosa (V_2) recording minimum number of flowers produced per plant (31.73) in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. This comes in accordance with the findings of Islam *et al.* (2012). The increment in the number of flowers may be due to more light intensity in the region. Increased number of flowers per plant was observed in all treatments over the reports of many researchers *viz.*, Jamul Uddin *et al.* 2016, Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Days to fruit setting

The observation recorded for days to first fruiting from planting showed significant variations between strawberry cultivars tested in the present investigation are presented in Table 1 and illustrated in Fig. 2. It is evident from the data, days to first fruiting from planting was significantly influenced by different strawberry cultivars under the present investigation. The minimum days to first fruiting (53.03 days) from planting was noted under Nabila (V_1) and the maximum days to first fruiting (62.99 days) from planting was observed under Camarosa (V_2) in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. The observation recorded for days to first fruiting from planting showed significant variations between both the strawberry cultivars. This might be attributed to its short crop period as observations made by Montero *et al.* (1996). Variability in fruit setting period in different varieties might also be due to differences in their chilling requirement as suggested by Joolka and Badiyala (1983). Similar opinion was also put forwarded by Das *et al.* (2016), Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Berry set (%)

The data with respect to percent berry set (%) in different strawberry cultivars under the present investigation are presented in Table 1 and graphically depicted in Fig. 2. Significant difference was observed between both the strawberry cultivars regarding the percent berry set. The percentage of fruit set ranged from 81.60 to 88.82 %. The maximum percent berry set (88.82 %) was noticed under Nabila (V_1), which was followed by Camarosa (V_2) recording minimum percent berry set (81.60 %) in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. This variation may be due to genetic makeup of the cultivars and adaptation to climatic condition (Jami *et al.* 2015). The above finding comes in accordance with the findings of Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in Strawberry.

Days to start fruit ripening

The data pertaining to days to start fruit ripening from planting influenced significantly by strawberry cultivars. These results are presented in Table 1 and illustrated in Fig. 2. As per the data, the minimum days to start fruit ripening (66.11 days) from planting was observed under Nabila (V_1), which was followed by Camarosa (V_2) recording maximum days (76.37 days) to start fruit ripening from planting in both the farmer's field condition (Baadi) and Research farm of Horticulture Research Station. This earliness in the ripening may be due to the varied agro-climatic conditions (temperature and light intensity differences). In the climatic conditions prevalent at subtropical conditions of Chhattisgarh, the plants of all the cultivars were observed earlier to fruit ripening in comparison to plants raised in other parts of different states reported by many researchers. These results are in close agreement with the findings of Das *et al.* (2016), Jamal Uddin *et al.* (2016), Negi and Upadhyay (2016), Gaikwad *et al.* (2018), Neetu and Sharma (2018) and Panigrahi *et al.* (2020) in strawberry.

REFFERENCES

Das, A. K., Singh, K. P., Prasad, B. and Kumar, Ravindra, 2016. 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. The Asian J. of Hort., 10 (2): 278-281

Gaikwad, S. P., Sali, V. M. and Chalak, S. U. 2018. Performance of strawberry cultivars under Mahabaleshwar conditions. Journal of Pharmacognosy and Phytochemistry; 7(4): 1850-1852

Islam, M.S., Hossan, M.J., Ahsan, M.K., Mehraj, H. and Jamal Uddin, A.F.M. 2012. Evaluation of Growth and Yield of Four Strawberry (*Fragaria ananassa*) Genotypes. A Scientific Journal of Krishi Foundation, 11(2):104-108

Jamal Uddin, A.F.M., Ahsan M.K., Hussain M.S., Mahmud M.F. and Mehraj, H. 2016. Evaluation of Strawberry Germplasm at Sher-E-Bangla Agricultural University, Bangladesh World Applied Sciences Journal 34 (1): 78-83

Jami, Y.Y., Sarkar A. and Maiti, C.S. 2015. Evaluation of strawberry cultivars in the foothills of Nagaland. Journal of Crop and Weed, 11(1):198-200

Joolka, N.K. and Badiyala, S.D. 1983. Studies on the comparative performance of strawberry cultivars. Haryana J. of Hort. Sci. 12(3-4): 173-177

Kumar, R. 2002. Studies on the performance of some strawberry (*Fragaria* x *ananassa* L.) cultivars. M.Sc. (Ag) Thesis submitted to Indira Gandhi Krishi Vishwavidyalaya, Raipur.pp.27- 64

Montero, M.T., Molla, M., Esteban, R.M. and Lopez, F.J. 1996. Andreu during ripening. Scientia Hort., 65(1): 239-250

Neetu and Sharma, S. P. 2018. Evaluation of Strawberry Cultivars for Growth and Yield Characteristics in Plain Region of Chattisgarh, India. Int. J. Curr. Microbiol. and App. Sci. 7(02): 2835-2840

Negi, N. D. and Upadhyay, S. K. 2016. Evaluation of strawberry (*Fragaria* x *ananassa* Duchesne.) cultivars under polyhouse condition in mid hills of Himachal Pradesh. Himachal Journal of Agricultural Research, 42(1): 41-46

Panigrahi, H. K., Parihar, Pushpa and Sangeeta, 2020. Evaluation of different strawberry (*Fragaria* x *ananassa* Duch.) cultivars for growth, flowering, fruiting and fruit maturity

parameters under protected condition. Journal of Pharmacognosy and Phytochemistry; 9(5): 2948-2952

Sharma, G., Yadav, A. and Thakur, M. 2014. Studies on Growth and Flowering Attributes of Different Strawberry Cultivars (*Fragaria* x *ananassa* Duch.) in Himachal Pradesh. Asian J. of Adv. Basic Sci., 3(1):1-4.

Singh, A., Patel, R.K., De, L.C. and Pereira, L.S. 2008. Performance of strawberry cultivars under sub-tropics of Meghalaya. Indian J. Agric. Sci., 78 (7): 1-4.

Table 1. Evaluation of strawberry cultivars for growth parameters under farmer's field condition (Baadi) in the Chhattisgarh plain region

S.N.	Parameters	Nabila (V_1)	Camarosa (V_2)	P(T<=t) two-tail
1.	Plant height (cm)			
	30 DAP (cm)	9.25	8.88	**0.199 (NS)**
	60 DAP (cm)	18.99	15.79	**0.035***
	90 DAP (cm)	24.97	19.99	**0.040***
	120 DAP (cm)	29.09	23.96	**0.037***
	150 DAP (cm)	33.12	27.49	**0.027***
2.	N-S Plant spread (cm)			
	30 DAP (cm)	11.13	11.03	**0.689 (NS)**
	60 DAP (cm)	24.47	18.67	**0.029***
	90 DAP (cm)	29.42	22.69	**0.018***
	120 DAP (cm)	34.77	26.76	**0.010***
	150 DAP (cm)	37.97	30.18	**0.013***
3.	E-W Plant spread (cm)			
	30 DAP (cm)	10.10	10.01	**0.686 (NS)**
	60 DAP (cm)	23.45	17.65	**0.028***
	90 DAP (cm)	28.52	21.71	**0.017***
	120 DAP (cm)	33.75	25.72	**0.009***
	150 DAP (cm)	36.95	29.15	**0.011***
4.	Number of leaves per plant			
	30 DAP	7.10	6.52	**0.205 (NS)**
	60 DAP	21.87	17.82	**0.001***
	90 DAP	32.01	28.31	**0.009***
	120 DAP	41.09	34.46	**0.001***
	150 DAP	49.07	40.08	**0.002***
5.	Number of runners per plant	9.10	6.12	**0.0001***
6.	Length of runners (cm)	91.20	74.33	**0.0235***
7.	Days to first flowering	42.07	49.98	**0.0031***
8.	Number of flowers per plant	43.61	31.73	**0.0015***
9.	Days to fruit setting	53.03	62.99	**0.0078***
10.	Berry set (%)	88.82	81.60	**0.0453***
11.	Days to start fruit ripening	66.11	76.37	**0.0451***

*Significant at 5% level of significance

DAP = Days after planting

N-S = North-South

E-W = East-West

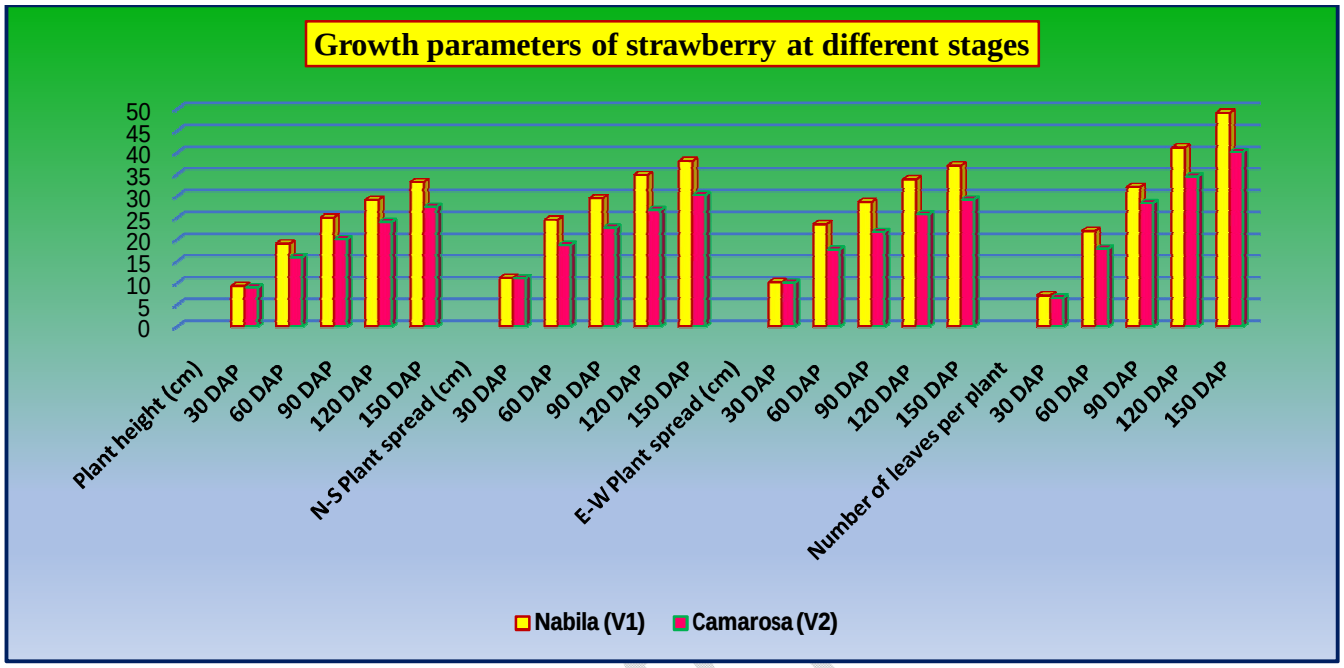

Fig. 1 – Plant height (cm), plant spread (cm) and number of leaves per plant of strawberry cultivars at different growth stages under farmer's field condition (Baadi) in the Chhattisgarh plain region

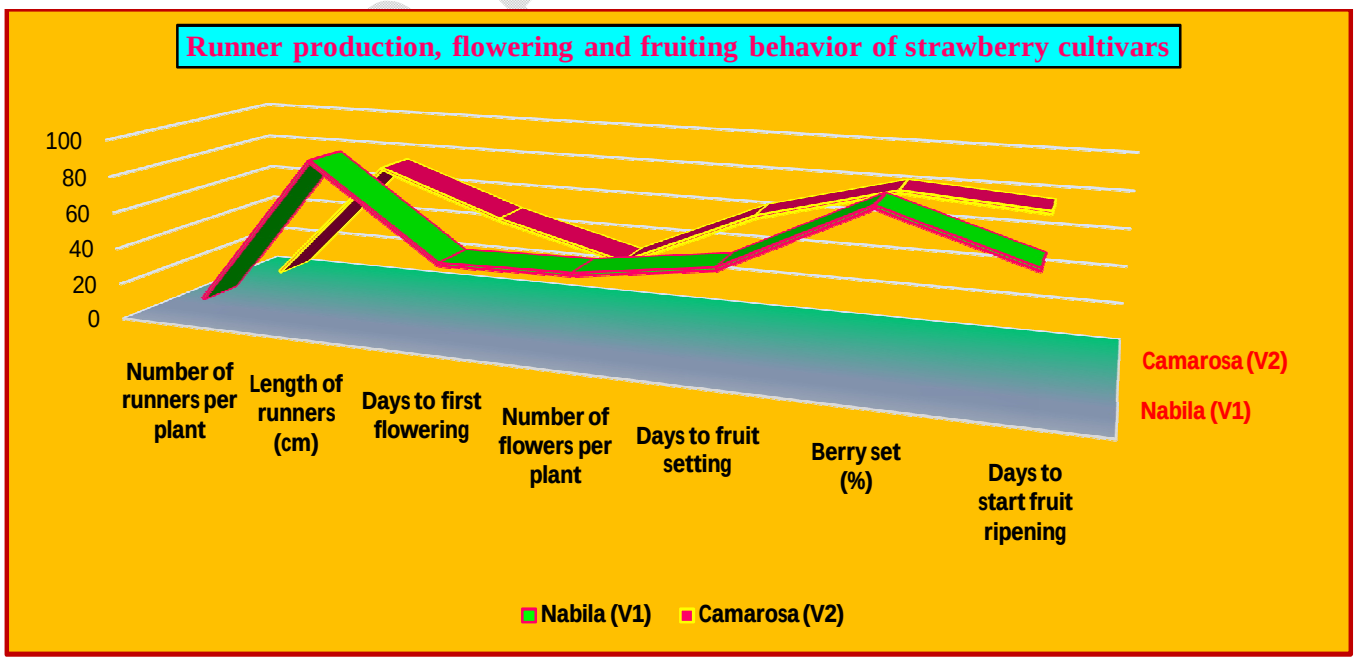

Fig. 2 – Runner production, flowering and fruiting behavior of strawberry cultivars under farmer's field condition (Baadi) in the Chhattisgarh plain region