Original Research Article

Growth and yield performance of strawberry cultivars under different growing conditions

Abstract

A trial was conducted at Nursery of Horticulture Section at College of Agriculture Dhule, during 2023-24 to evaluate the performance of strawberry cultivars mainly Florida Beauty, Winter Dawn and Sweet Sensation under three growing conditions *viz.*, open field, shade net and poly house condition. The experiment was laid out in factorial randomized block design with three treatments and three replications. Observations were recorded on different growth and yield characters such as plant height (cm), plant spread (cm), leaf area (cm^2), days taken for first flower initiation, number of fruits per plant, average fruit weight (g), yield per plant (kg) and yield per hectare (MT). Open field condition (C_1) with Sweet Sensation variety (V_3) recorded significantly maximum plant height (25.63 cm), plant spread (41.82 cm EW and 42.03 cm NS), maximum leaf area (134.33 cm^2) and least number of days were taken for first flower initiation (26.67 days). Whereas, as regards to fruit and yield characters i.e. greater number of fruits per plant (21.00), maximum weight of fruit (21.01 g), yield per plant (0.44 kg/plant) and yield per hectare (11 MT/ha) the results were significantly higher in open field condition with Sweet Sensation variety.

Keywords: Growing conditions, Varieties, Strawberry

Introduction

Strawberry (*Fragaria x ananassa* Duch.) is the most refreshing and delicious fruit crop which belongs to the family Rosaceae. Strawberries are native to North America. Worldwide it is the most widely distributed fruit crop due to its genetic diversity, highly heterozygous nature and broad range of environmental adaptations (Kurian, A. (2015)). All cultivated varieties are octoploid (2n=56) in nature and belongs to the Rosaceae family. Botanically, it is an aggregate fruit which is highly perishable. It is a short-day herbaceous plant, behaves as perennial in temperate condition and as annual in sub-tropical climate. It has shallow root system with a short stem known as crown. The edible portion is modified receptacle and achenes (true seeds) which is a non-climacteric and propagated through runners (Bai *et al.*, (2023)). As of 2020-2021, the total strawberry cultivation area in India was 3,031 ha, yielding approximately 19,840 MT. Productivity of strawberry in India is very low (7.8 MT/ha). Maharashtra contributes about 56 % of the strawberry production in India. The productivity of Haryana is (17.63 MT/ha) more than Maharashtra (6.82 MT/ha).

It is native of temperate regions, however, varieties which can be cultivated in subtropical climate are available. In India it is cultivated in the hills. Its main centres of cultivation are Nainital and Dehradun districts in Uttaranchal, Mahabaleshwar in

Maharashtra, Kashmir Valley, Bengaluru and Kalimpong in West Bengal. In recent years, strawberry is being cultivated successfully in plains of Maharashtra around Pune, Nashik and Sangli towns. (Gaikwad *et al.,* 2018).

The fresh ripe fruits of strawberry are rich source of vitamins mainly vitamin A (60 IU/100g of fruit) and vitamin C (30-120 mg/100g of fruit). It has abundance of minerals like potassium, calcium and phosphorus and has high pectin (0.55 per cent). Basically, growers are interested in having cultivars with high yields, acceptable yield earliness and disease resistance under different weather conditions, which allow them to supply the market when premium prices are available. Cultivation of strawberry is greatly influenced by specific regional adaption due to critical photoperiod and temperature requirement by the crop. (Khound *et al.,* 2021).

Climatologically, Dhule district falls in the sub-tropical region at the North of Maharashtra state. Generally, monsoon commences in the first week of June and retreats at the end of September with the average annual rainfall of 487.3 mm at College of Agriculture, Dhule. This is realized entirely from South-West monsoon. The rainfall is mostly received in 32 rainy days in a year. The mean annual maximum and minimum temperature ranges from 40.20^0 C and 13^0 C, respectively. The maximum sunshine hours are 08.50 hrs.

Considering the above facts, the present study work was undertaken with a view to evaluate the growth and yield characters of strawberry cultivars under different growing conditions of Dhule district.

Material and Methods

The experiment was conducted over a period of one season from November, 2023 to April, 2024 in three growing systems *viz*., open field condition, shade net condition and polyhouse condition in the Nursery of Horticulture section, College of Agriculture, Dhule, Maharashtra. The planting was done on the first week of November 2023. Design of the experiment was factorial randomized block design with three replications in each location. Treatments are arranged randomly in each growing condition. Double row hill system of planting was done on raised beds of size 1.5 x 0.5 x 0.5 m^3. Between the beds, half meter spacing was given. In each growing system, there were about 18 raised beds or plots. Spacing given was 30 x 30 cm^2. Five random competitive plants were selected from each replication and observations were recorded. The observations were taken on various parameters such as growth and yield characters on monthly intervals. Height of the plant at 90 Days after planting was measured from the ground level up to the tip of the mature leaf and expressed in centimetre (cm). Spread of the plant at 90 Days after planting in East-West and North-South directions were measured and the average is recorded in centimeter (cm). Leaf area at 90 Days after planting was measured manually with a grid sheet (millimeter paper) and expressed in cm^2. Number of days required for the emergence of first flower bud after planting was recorded and expressed in days. The total number of fruits produced per plant was counted and recorded. Weight of each fruit was recorded separately and average weight was calculated and expressed in gram (g). The yield of fruits from each plant were harvested separately and expressed in kg. Yield per hectare was calculated from the yield per plot by using suitable conversion factor. These data were subjected to statistical analysis following standard procedures (Panse and Sukhatme, 1985).

Results and Discussions

Plant height (cm)

The data pertaining to plant height of different varieties under various growing conditions is presented from Table 1. The highest plant height was recorded in open field condition (23.07cm) which was at par with shade net condition (22.25cm) and lowest plant height was recorded in poly house condition (18.92cm). This might be due to the congenial micro-climatic conditions under open field. Also, good amount of photosynthesis led to the good vegetative characters. (Singh and Kaur (2020)). In regards to varieties, Sweet Sensation recorded highest plant height of 23.33 cm which was at par with the Winter Dawn variety and recorded plant height of 22.48 cm. The lowest plant height was recorded in variety Florida Beauty which was 18.43 cm. The reason for variation in the cultivars could be that the genes responsible for plant height did not express themselves fully with same degree as it does at other places because of different agro-climatic conditions. (Singh and Kaur (2020)). The interaction of Sweet Sensation variety under open field condition was found superior with respect to plant height (25.63 cm). The results were at par with interaction of Florida Beauty under shade net condition (24.60 cm), Sweet Sensation variety under shade net condition (23.57 cm) and open field condition with Winter Dawn variety (24.33 cm). Significantly, lowest plant height was recorded in Florida Beauty grown under polyhouse condition (18.43 cm).

Plant Spread (cm)

The data pertaining to plant spread at East West and North South direction of different varieties under different growing conditions is presented in Table 1. The maximum plant spread was recorded in open field condition (37.57 cm EW and 38.24 cm NS) which was at par with shade net condition (35.59 cm EW and 36.02 cm NS) and minimum plant spread recorded in poly house condition (31.24 cm EW and 28.65 cm NS). This might be due to the congenial micro-climatic conditions under open field. Also, good amount of photosynthesis led to the good vegetative characters. (Sahu and Chandel (2014)). Amongst the three varieties grown, the variety Sweet Sensation recorded maximum plant spread of 37.64 cm EW and 38.03 cm NS which was at par with the variety Winter Dawn which recorded plant spread of 33.44 cm EW and 34.34 cm NS. The minimum plant spread was recorded in variety Florida Beauty which was 33.32 cm EW and 30.54 cm NS. The reason for variation in the cultivars could be that the genes responsible for plant spread did not express themselves fully with same degree as it does at other places because of different agroclimatic conditions. (Singh and Kaur (2020)). The interaction of open field condition with Sweet Sensation variety was found superior with respect to plant spread (41.82 cm EW and 42.03 cm NS) which was at par with shade net condition with Winter Dawn variety (36.13 cm EW and 38.33 cm NS), Florida Beauty under open field condition (37.81 cm EW) and Sweet Sensation variety under shade net condition (38.33 cm EW). The minimum plant spread was recorded in interaction of Florida Beauty under poly house condition (29.83 cm EW and 23.67 cm NS) which was at par with Winter Dawn variety under poly house condition (24.33 cm NS).

Leaf Area (cm^2)

The data pertaining to leaf area of different varieties under different growing conditions is presented in Table 1. The maximum leaf area was recorded in open field condition (111.36 cm^2) which was at par with shade net condition (103.77 cm^2) and the minimum leaf area recorded in poly house condition (95.00 cm^2). Amongst the three varieties grown, the variety Sweet Sensation recorded significantly maximum leaf area of 113.57 cm^2. Whereas, the minimum leaf area was recorded in variety Florida Beauty which was 94.27 cm^2. The findings of Singh and Kaur (2020) are in line with the present research study.

Significantly, the maximum leaf area was recorded in interaction of Sweet Sensation under open field condition (134.33 cm^2). Minimum leaf area was recorded in interaction of Florida Beauty under poly house condition with 90.03 cm^2.

Days taken for first flower initiation

Analysis of the data corresponding to days taken for first flowering in strawberry varieties grown under different growing conditions is presented in Table 1. Open field condition took significantly the minimum duration of 29.37 days for flowering. Whereas, poly house condition (34.89 days) recorded the maximum days for first flower initiation and found at par with shade net condition (34.85 days). Variety Sweet Sensation took minimum duration of 30.60 days for flowering which was at par with Winter Dawn variety (33.22 days). Maximum duration taken for first flower initiation was in variety Florida Beauty (35.29 days). The interaction of Sweet Sensation variety under poly house condition recorded minimum days for first flower initiation (26.67 days) which was at par with Winter Dawn variety under open field condition (29.13 days), Sweet Sensation variety under poly house condition (31.67 days) and Florida Beauty variety under open field condition (32.33 days). The maximum duration recorded for first flower initiation was in Florida Beauty variety under poly house condition (37.33 days). The results are in line with findings obtained by Neetu and Sharma (2018).

Number of fruits per plant

Perusal of the data are presented in the Table 1. The significantly maximum number of fruits per plant (18.91) were recorded in open field condition. Whereas, the minimum number of fruits per plant were harvested from poly house condition (12.34). Significantly the maximum number of fruits per plant were found in Sweet Sensation variety (18.02). Variety Florida Beauty (13.80) recorded the minimum number of fruits per plant which was at par with Winter Dawn (15.97). The treatment combination of Sweet Sensation variety under open field condition produced higher number of fruits per plant (21.00) which was at par with Sweet Sensation variety under shade net condition (18.80). The combination of Florida Beauty variety under poly house condition (9.53) recorded significantly minimum number of fruits per plant. The present findings are in line with the findings of Singh and Kaur (2020).

Average Fruit Weight (g)

Perusal of the data are presented in the Table 1. The maximum fruit weight was recorded in open field condition (19.48 g) which was at par with shade net condition (18.76 g). Whereas, the minimum fruit weight was recorded in poly house condition (11.55 g). Significantly, the maximum weight of fruit was recorded in variety Sweet Sensation (18.32 g). The minimum weight of fruit was recorded in Florida Beauty variety (14.87 g) which was at par with variety Winter Dawn (16.60 g). Whereas, Sweet Sensation variety grown under open field condition (C_1V_3) recorded maximum weight of fruit (21.01 g) which was at par with Winter Dawn grown under open field condition (19.21 g) and Sweet Sensation grown under shade net condition (20.90 g). Whereas, Florida Beauty variety grown in polyhouse condition recorded significantly the minimum average weight of fruit (9.10 g). Similar results were obtained by Neetu and Sharma (2018) in strawberry.

Table 1. Growth and yield characters of strawberry cultivars under different growing conditions

Treatments	Plant height (cm)	Plant spread (EW) (cm)	Plant spread (NS) (cm)	Leaf Area (cm^2)	Days taken for first flower initiation	Number of fruits per plant	Average fruit weight (g)	Yield per plant (kg)	Yield per hectare (MT)
Open field (C_1)	23.07	37.57	38.24	111.36	29.37	18.91	19.48	0.36	9.16
Shade net (C_2)	22.25	35.59	36.02	103.77	34.85	16.54	18.76	0.31	7.73
Poly house (C_3)	18.92	31.24	28.65	95.00	34.89	12.34	11.55	0.14	3.50
S.E.	0.65	1.24	1.28	2.74	1.18	0.48	0.42	0.008	0.15
C.D	1.94	3.71	3.84	8.21	3.55	1.44	1.26	0.024	0.45
Florida Beauty (V_1)	18.43	33.32	30.54	94.27	35.29	13.80	14.87	0.21	5.33
Winter Dawn (V_2)	22.48	33.44	34.34	102.30	33.22	15.97	16.60	0.26	6.66
Sweet Sensation (V_3)	23.33	37.64	38.03	113.57	30.60	18.02	18.32	0.33	8.40
S.E.	0.65	1.24	1.28	2.74	1.18	0.48	0.42	0.008	0.15
C.D	1.94	3.71	3.84	8.21	3.55	1.44	1.26	0.024	0.45
C_1V_1	19.23	37.81	32.33	97.37	32.33	17.67	18.23	0.32	8.00
C_1V_2	24.33	33.11	40.37	102.40	29.13	18.07	19.21	0.34	8.50
C_1V_3	25.63	41.82	42.03	134.33	26.67	21.00	21.01	0.44	11.00
C_2V_1	18.60	32.33	35.63	95.40	36.23	14.20	17.29	0.24	6.00
C_2V_2	24.60	36.13	38.33	107.73	34.87	16.63	18.10	0.30	7.50
C_2V_3	23.57	38.33	34.10	108.17	33.47	18.80	20.90	0.39	9.70
C_3V_1	17.47	29.83	23.67	90.03	37.33	9.53	9.10	0.08	2.00
C_3V_2	18.50	31.13	24.33	96.77	35.67	13.23	12.50	0.16	4.00
C_3V_3	20.80	32.77	37.97	98.20	31.67	14.27	13.07	0.18	4.50
S.E.	1.12	2.15	2.22	4.75	2.05	0.82	0.81	0.009	0.41
C.D	3.37	6.43	6.64	14.23	6.15	2.46	2.43	0.027	1.23

Yield per plant (kg)

Among the three growing conditions open field condition had significantly highest yield per plant (0.36 kg) which was followed by shade net condition and the lowest yield was harvested from poly house condition (0.14 kg). The variety Sweet Sensation recorded significantly highest yield of 0.33 kg which was followed by Winter Dawn and the lowest yield was recorded in variety Florida Beauty (0.21 kg). The interaction of Sweet Sensation variety under open field condition recorded highest yield of 0.44 kg whereas, the lowest yield was recorded in the interaction of Florida Beauty variety under poly house condition (0.08 kg). The present findings are in line with the results of Bai *et.al.* (2023).

Yield per hectare (MT)

Among the three growing conditions open field condition had significantly highest yield per hectare (9.16 MT) which was followed by shade net condition and the lowest yield was harvested from poly house condition (3.50 MT). The variety Sweet Sensation recorded significantly highest yield of 8.40 MT which was followed by Winter Dawn and the lowest yield was recorded in variety Florida Beauty (5.33 MT). The interaction of Sweet Sensation variety under open field condition recorded highest yield of 11 MT whereas, the lowest yield was recorded in the interaction of Florida Beauty variety under poly house condition (2 MT). The present findings are in line with the results of Bai *et.al.* (2023).

Conclusion

From the present investigation it can be concluded that, the open field condition was found beneficial in improving the vegetative growth, flower characters and fruit quality of strawberry and maximizing the net income returns through highest fruit yield. Sweet Sensation variety was found to be superior among the three varieties in respect of vegetative growth, fruit characters and yield.

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