Research Article

Propagation Studies in Strawberry (*Fragaria X Ananassa* Duch.) Under Protected Conditions

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Abstract

The experiment was conducted for propagation of strawberry mother plant and runner production under protected conditions *viz.*, Greenhouse, Naturally ventilated polyhouse, Shadenet house (50%) and Open field conditions. The initiation of runner was early (29.5 days) and the number of strawberry runners per plant was maximum (10.19) under Shadenet house. Diameter and height of runner crown increased significantly with time and was maximum under Naturally ventilated polyhouse. Other growth parameters like plant height, spread of the runner plant and number of leaves per runner were better under Naturally ventilated polyhouse.

Keywords: Strawberry, Propagation, Ofra, Greenhouse, Naturally ventilated polyhouse, Shadenet house

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Introduction

The cultivated strawberry is a hybrid between *F. virginiana* Duch. and *F. chiloensis* Duch. Today, strawberry is cultivated in regions that are characteristically temperate to sub-tropical plains to high altitudes in tropical regions and even in the desert-like areas of Israel. Being a shallow rooted crop, both crop damage and plant mortality can occur during dry seasons. Strawberry cultivation recently received some impetus in India with large business houses setting up a number of agro-based establishments primarily aimed at large scale production of strawberry fruits. Being an herbaceous annual fruit crop, it can also be grown easily in kitchen gardens, roof-top gardens, pots, etc. Mulching and herbicides increased the root and shoot growth by improving the hydrothermal regime, increasing the availability of nutrients and keeping the plots free from weeds, thus resulting into higher crop load. Many workers have recommended the use of black polyethene mulch for increasing yields in strawberry [1]. [2] also recommended higher growth of strawberry under black plastic mulch. Greenhouse soilless systems can be used to grow 'chandler' mother plants for generating plantlets for annual plasticulture and plants plugged in July produce more plants than August plugged plants [3]. The cultivation of strawberry is increasing due to its genotype diversity and wide range of environmental adaptations. The demand for its plants is increasing. The technological developments particularly the plasticulture applications have made its cultivation even more profitable. The use of protected structure for its cultivation has not only increased its yield and quality but also reduce the risk factors involved in its cultivation. The environmental conditions can be suitable amended by various structures such as greenhouses, polyhouses, shadenet and nethouses etc. The objective of the present study was to study the effect on growth of mother plants and runner production of strawberry (*Fragaria* × *ananassa* Duch.) under different protected conditions.

Materials and Methods

The experiment was conducted at Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana in completely randomized design (CRD) comprising four treatments i.e.S_0: Greenhouse ; S_1: Naturally ventilated polyhouse; S_2: Shadenet house (50%) and S_3: Open field conditions with five replications. strawberry plants of cultivar Ofra were planted in July at 1m x 1m spacing under different protected conditions. The greenhouse constructed with steel pipes covered with 200 micron ultraviolet sterilized polyethylene sheet. For providing requisite sunlight, movable shade nets were also fitted in the greenhouse. Fan-pad cooling system is also fitted for maintaining temperature. The greenhouse has the micro irrigation system (drip and micro-jet) for automated fertigation and climate control. Greenhouse is also equipped with foggers to control relative humidity. The naturally ventilated polyhouse constructed with steel pipes covered with 200 micron ultraviolet sterilized polyethylene sheet with ultraviolet stabilized insect proof net on the sides along the length without any fan pad cooling system. The shade net house constructed with steel pipes covered with 50% green shade net. The observations were recorded at fortnightly

interval up to October. The numbers of plants survived after 35 days of planting on the basis of total plants planted were counted in order to work out the survival (%). Initiation of runners is calculated from the date of planting to the average of different days of start of runner formation. The spread of the mother plant and runner based on the distance covered by the plant in East-West and North-South directions and mean of sum per plant is calculated. Five runners in each replication are randomly selected for measuring the spread of the runner. Height of crown is recorded from the base of the plant to the maximum height attained by the plant. Five runners in each replication are randomly selected for measuring the number of leaves per runners. Diameter is calculated in mm by measuring the width of crown.

Results and Discussion

The percentage survival (**Table 1**) was maximum (100%) in S_2 after 35 days of planting. Minimum numbers of days (29.5) were taken for the initiation of runner in S_2 followed by S_0. Maximum numbers of days (35.4) were taken for the initiation of runner in S_1. Initiation of runner is early under S_2 perhaps due to early establishment and growth due to comfortable environment.

Table 1 Effect of different protected conditions on survival (%) and number of days taken for initiation of runner of strawberry

Structures	Survival (%)	Numbers of days taken for initiation of runner after planting
S_0	98.2	31.1
S_1	90.4	35.4
S_2	100	29.5
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.		

The data (**Table 2**) on the effect of different protected conditions on spread of the mother plant along with runners and no significant difference in the spread was observed when compared under different structures, however the spread of the mother plant increase significantly as the time interval increases after planting and after 110 days it was the maximum (86.95 cm), which is obviously due to the vegetative growth and runner production under long day and high temperature conditions

The mother plants planted under different protected conditions did not show any significant variation in the spread because there was only one cultivar i.e. Ofra and perhaps this spread is influenced by the genetic character and was not influenced by the different structures. The different spread has also been reported in different varieties and under different mulching materials by [4].

Table 2 Effect of different protected conditions on spread of the mother plant (cm) along with runners at different days after planting

Structures	Days after Planting						
	35	50	65	80	95	110	Mean
S_0	18.83	36.09	53.11	65.22	74.40	86.57	55.70
S_1	18.73	31.18	52.69	69.38	80.45	87.05	56.57
S_2	19.82	37.20	53.06	65.70	76.76	87.23	56.63
Mean	19.12	34.82	52.95	66.76	77.20	86.95	
CD at 5%	Intervals 3.08		Structures NS		Interaction NS		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

The height of crown (**Table 3**) was significantly different under different protected conditions. The maximum was under S_1, probably due to better environmental conditions like temperature, humidity and light intensity. [5] studied and found that the maximum crown height was observed under black polyethylene mulched 'Chandler' strawberry plants. The height of crown increased significantly when recorded after 15 days interval and the maximum being after 110 days after planting. This increase was due to photosynthetic activities taking place and favourable environmental conditions through the period under observation.

The height of plant (**Table 4**) was significantly more (10.65 cm) in S_1 as compared to S_0. The height of plant increased significantly with the increase in time period after planting and the maximum (15.79 cm) was recorded after 110 days after planting.

Table 3 Effect of different protected conditions on height of crown (mm) at different days after planting

Structures	Days after Planting						
	35	**50**	**65**	**80**	**95**	**110**	**Mean**
S_0	2.32	4.02	6.08	8.38	9.79	11.22	6.97
S_1	2.48	4.66	7.18	9.63	11.43	12.67	8.01
S_2	2.70	4.79	7.14	9.22	10.64	12.21	7.78
Mean	2.50	4.49	6.80	9.08	10.62	12.03	
CD at 5%	Intervals 0.32		Structures 0.22		Interaction 0.55		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

Table 4 Effect of different protected conditions on height of plant (cm) at different days after planting

Structures	Days after Planting						
	35	**50**	**65**	**80**	**95**	**110**	**Mean**
S_0	5.88	7.60	9.31	11.31	13.43	15.47	10.50
S_1	5.67	7.49	9.66	11.53	13.64	15.94	10.65
S_2	5.37	7.71	9.30	11.36	13.47	15.97	10.53
Mean	5.64	7.60	9.42	11.40	13.51	15.79	
CD at 5%	Intervals 0.18		Structures 0.13		Interaction 0.32		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

The number of leaves per runner (**Table 5**) increased significantly on S_1 as compared to S_0 and S_2. The number of leaves did not differ significantly under S_0 and S_2 but were significantly more (3.51) under S_1 when seen irrespective of time of interval. The significant difference in number of leaves per runner has been reported by [6]. The different number of leaves has also been reported in different varieties and under different mulching materials by [4].

The maximum and significantly more spread of strawberry runners (**Table 6**) were observed under S_1 (10.23 cm). It was observed that the maximum (17.81 cm) spread was 110 days after planting and the minimum (0.89 cm) was found 35 days after planting. The spread was increased due to increase in the number of leaves and the leaf size. The mother plants planted under different protected conditions and did not show any significant variation in spread of the runner plant because the spread was influenced by the genetic character and was not influenced by the different structures. The different spread has been reported under plastic tunnel and mulching by [7]. The different spread has also been reported under sodic soil conditions by [8].

Table 5 Effect of different protected conditions on number of leaves per runner at different days after planting

Structures	Days after Planting						
	35	**50**	**65**	**80**	**95**	**110**	**Mean**
S_0	1.67	1.60	2.15	3.04	4.09	4.40	2.85
S_1	1.64	2.77	2.90	3.60	4.11	6.03	3.51
S_2	1.40	1.22	2.43	2.63	3.70	5.24	2.77
Mean	1.57	1.86	2.49	3.09	3.97	5.21	
CD at 5%	Intervals 0.20		Structures 0.14		Interaction 0.36		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

Table 6 Effect of different protected conditions on spread of the runner plant (cm) at different days after planting

Structures	Days after Planting						
	35	**50**	**65**	**80**	**95**	**110**	**Mean**
S_0	0.56	2.64	6.04	10.50	13.47	16.88	8.34
S_1	1.57	4.28	8.30	11.97	15.67	19.61	10.23
S_2	0.56	2.64	6.04	10.50	13.47	16.95	8.36
Mean	0.89	3.18	6.79	10.99	14.20	17.81	
CD at 5%	Intervals 1.53		Structures 1.08		Interaction NS		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

The diameter of runner crown (**Table 7**) was observed maximum (4.20 mm) under S_1, whereas no significant difference was observed between S_0 and S_2. The significant increase in the diameter was observed 50^{th} day after planting till the 110^{th} day, when maximum (7.23 mm) was recorded. The crown diameter increase significantly under

S_1 compared to the other two structures perhaps due to better photosynthetic activity and accumulation of metabolites. Regardless of cultivar or propagation method, runners produced at high elevation has significantly greater crown diameter due to high carbohydrate accumulation as compared to low-elevation areas [9]. The significant variation in crown diameter has been recorded by [10].

The data (**Table 8**) shows that as the time period increase the number of strawberry runners produced increases significantly. Number of strawberry runners does not differ significantly under these protected structures. The number of strawberry runners produced under S_0 and S_2 are statistically same i.e. 9.67 and 10.19 respectively as compared to S_1 (6.32), both these structures produces significantly more number of strawberry runners. Number of runners produced was influenced by the genetic character and was not influenced by the different structures. The significant difference in the number of runners produced has been reported by [6]. Different number of runners produced under different mulching material by [11].

Table 7 Effect of different protected conditions on diameter of crown of runners (mm) at different days after planting

Structures	Days after Planting						
	35	**50**	**65**	**80**	**95**	**110**	**Mean**
S_0	1.66	1.59	2.14	3.03	4.09	4.39	2.82
S_1	1.64	2.77	2.90	4.60	6.11	7.23	4.20
S_2	1.42	1.23	2.44	2.65	3.73	5.22	2.78
Mean	1.57	1.86	2.49	3.43	4.64	5.61	
CD at 5%	Intervals 0.22		Structures 0.15		Interaction 0.38		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

Table 8 Effect of different protected conditions on number of strawberry runners at different days after planting

Structures	Days after Planting						
	35	**50**	**65**	**80**	**95**	**110**	**Mean**
S_0	1.17	3.87	6.98	11.28	15.74	19.01	9.67
S_1	0.80	2.30	4.68	7.16	10.14	12.88	6.32
S_2	1.57	4.28	8.30	11.97	15.61	19.40	10.19
Mean	1.18	3.48	6.65	10.13	13.83	17.09	
CD at 5%	Intervals 1.60		Structures 1.13		Interaction NS		
S_3: Under open field conditions the plants were not survived due to adverse climatic conditions.							

Conclusion

The maximum number of runners produced under shadenet and naturally ventilated polyhouse. The maximum survivals of strawberry were observed under shadenet conditions and the runners were initiated in minimum number of days under shadenet house followed by greenhouse conditions. The growth of plant with respect to the height of crown, number of leaves, spread of the runner plant and plant height was maximum under naturally ventilated polyhouse.

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