Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.3092

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (5):** 207-211 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Effect of Different Planting Time and Spacing on Growth, Yield and Quality of Strawberry (*Fragaria×ananassa*) cv. Ofra

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Received: 6.06.2017 | Revised: 18.06.2017 | Accepted: 20.06.2017

ABSTRACT

Strawberry (Fragaria×ananassa) is an important commercial fruit crop, grown almost anywhere in the world. For the purpose of commercial production, plants are propagated from runners. The present investigation was carried out to standardize the optimum time of planting and spacing of Strawberry under semiarid conditions during the year 2012-13 and 2013-14. Four different date of planting (15th Sept. 22nd Sept., 1st Oct. and 15th Oct.) and three different spacing (25x25cm, 20x30 cm. and 30x30cm) were compared. Two years' data were subjected to pooled analysis using two factorial randomized block design. The growth in terms of height of Strawberry was found maximum (12.42 cm) in the spacing of 25 x 25 cm. The effect of date of planting was not found significant. The numbers of leaves (19.40) were maximum at a spacing of 30x30cm. in 15thSept. Planting. The crown diameter was found maximum (29.18 mm) on 22ndSept. planting at a spacing of 30x30cm. Maximum no. of the fruit (22.10) were recorded on 22nd Sept. planting under the spacing 30x 30 cm. Second date of planting (22nd Sept.) and planted at a spacing of 30x30cm was found optimum under present agro climatic condition.

Key words: *cv. Ofra, Date of planting, Spacing, Strawberry, Yield*

INTRODUCTION

Strawberry (*Fragaria×ananassa*) belonging to the family Rosaceae is a lucrative fruit with high market demand in India. Its commercial cultivation has recently begun in the country.In India, Maharashtra is the leading state in the production of strawberry. Recently its area has considerably increased in Haryana and Punjab. It is desirable to enhance the yield of Strawberry not only quantitatively but also qualitatively with ever limiting resource of cultivated lands. In India, strawberry is cultivated from September to April. In this point of view, strawberry may help to increase the availability of fruits in this lean period of the country. But planting time is a limiting factor for growing strawberry in this country, because of prevailing short winter season. There are several reports available in the literature indicating that strawberry can be planted on different times of the year depending on the variety, location and climates[4,16].

Cite this article: Bhatia, S.K., Sharma, R. and Kumar, R., Effect of Different Planting Time and Spacing on Growth, Yield and Quality of Strawberry (*Fragaria×ananassa*) cv. Ofra, *Int. J. Pure App. Biosci.* **5(5):** 207-211 (2017). doi: http://dx.doi.org/10.18782/2320-7051.3092

Planting time has direct effect on day and night temperature, day light intensity and photoperiod, which affect the floral induction, fruit size, quality and production. Because 90 to 95% of a plant's dry weight is derived from photosynthesis[2] and photosynthesis efficiency directly depends on day and night temperature, day light intensity and photoperiod. So, planting time of strawberry is important for dry matter production as well as the growth and yield a crop. Rice[15] observed that late planting of strawberry significantly reduced the economically viable yield, because later planted plants did not enjoy enough time for vegetative Chercuitte *et al*[3]. Plantingdensity also greatly influence production and fruit quality of strawberry plants that are grown from cuttings[5]. Optimum plant spacing ensures proper growth and development of plant resulting in maximum yield of the crop and the best use of land. Considering the above facts, the present experiment was undertaken to find out the suitable planting time and optimum plant spacing for obtaining maximum fruit yield of Strawberry.

MATERIAL AND METHODS

2.1. Experiment site and treatments

The experiment was conducted at the PFDC farm, department of Horticulture, CCS HAU, Hisar during the year 2012-13 and 2013-14. The experiment was consisted of two factors: Factor A—Three spacing: 25 cm. X 25cm., 20 cm. X 30 cm., and 30 cm. X 30 cm. and Factor B—Four planting time: the runners of strawberry plants Cv. Ofra were planted in four different date i.e. 15th Sept., 22nd Sept., 1st Oct., and 15th Oct. under open field.

2.2. Experiment design and intercultural operation

The experiment was laid out in a two factorial Randomized Block Design with five replications having four time of planting dates and three different types of spacing. Beds were raised 30 cm above main field with 50 cm drain in between 2 beds. The plants were irrigated just after planting manually and after with the help of drip irrigation systems. Black polyethylene sheet stretched and covering the entire row of the plant after planting. The use of black polyethylene sheet created favorable conditions for the growth of the plants and minimize the weed growth. The Strawberry cultivation with drip irrigation has resulted in water saving, increase in yield and better quality. The crop was irrigated with drip irrigation system when needed depending on the moisture status of the soil and requirement of plants. Plots with plants were regularly observed to find out any damage or dead seedlings for its replacement and weeding was done as per requirement and also plant protected measure were done against insect and disease. Data were collected from five plants were randomly selected from each plot for data collection on growth and yield characteristics during the growth of plants and at harvesting time of the crop.

Observations recorded

Five plants were randomly selected from each plot for data collection on growth and yield characteristics during the growth of plants and at harvesting time of the crop. Two year's data on different morphological, vegetative and yield parameters were subjected to pooled analysis following two factorial Randomized Block Design. The data were recorded on the following parameters—plant height (cm), leaves plant−1, crown diameter (mm), no. of fruits and fruit Yield (q/ha).

RESULTS AND DISCUSSION

Effect of date of planting:-Date of planting non significantly influenced the plant height of Strawberry. Plant height ranged from 11.24 cm. to 11.94 cm. in pooled over two years. The tallest plant (11.91 cm) was found in 22nd Sept. Planting but at par to 15th Sept. Planting. Whereas the shortest plant (11.24 cm.) was found in 1st Oct. Planting. The effect of planting dates was significantly pronounced on the number of leaves per plant. The maximum no. of leaves (16.56) were produced in 22nd Sept. Planting followed by 15th Sept. The minimum no. of leaves (13.40) were produced in 1st Oct. Planting but statistically at par to 15th Oct. Planting. It was observed that 22nd Sept. planting produced the maximum crown

diameter (24.83 mm) and 1st Oct. Planting produced the minimum in pooled over two years. Regarding planting time, plant height, number of leaves per plant and crown diameter decreased with delayed planting, probably due to receiving less time for vegetative growth (table 1). Plant height, no. of leaves and crown diameter was higher in earlier planting than in later planting because earlier planting provide more time for vegetative growth and leaf production. The flower initiation of strawberry begins at the later part of November. Therefore, earlier plants enjoyed enough time for vegetative growth but later plants did not. This finding is in line with the findings of Chhercuitte *et al*[3]. Singh *et al*[19] found maximum leaf number in strawberry plants in early planting. Their finding is very close to present observation. Anna *et al*., observed better growth of strawberry plants after the second week of October under north Indian condition because the temperature in these areas usually started to decrease after first fortnight of October. September 22nd planting gave the highest no. of fruits/plant (16.56) where the minimum no. of fruits /plant (12.16) was measured in 15th Oct. planting in pooled over two years. This result corroborated the results of Lewis[8], who observed a declining effect in number of fruits plant−1 with delayed planting time. This might be due to the fact that earlier plants enjoyed more favorable condition for vegetative growth, flower and fruiting. This result is in perfect agreement with the present finding. Similar responses of strawberry to time of planting have been observed in Arkansas. Chercuitte *et al*[3]., recorded early planted strawberry plants produced more fruits than late planted plants in Cambridge. Fruit yield/ha of Strawberry differed non significantly due to planting date and it varied from 219.75 to 151.01 Q/ha.

Effect of Spacing: -Effect of plant spacing was found to be significant on plant height at final harvest. The closet spacing (25 x25 cm.) produced the tallest plant (12.11 cm) and the shortest plants were obtained from the wider spacing. The results of the present study for this character are in agreement with the findings of Maya *et al*[11]. Similar results were also obtained by Kulkarni and Reddy[7] in Chrysanthemum. Plant height decreased significantly with increasing levels of spacing. It is quite natural that when more plants per unit area are retained, mutual shading was more, which tended the plants to grow taller. The decrease in plant height with wider spacing can also be due to competition for light under inadequate spacing. These results are in agreement with the findings of Sheoran *et al*[17]., Mane *et al*[10]., and Beniwal *et al*[1]., in tuberose. Number of leaves per plant differed significantly by different spacing. (table1). The highest no. of leaves per plant (17.25) was recorded from wider spacing (30x 30 cm.) and the closet spacing (25 x 25 cm.) gave the lowest no. of leaves in data pooled over two the year. The results of the present study for this character are in agreement with the findings of Ravanappa *et al*[14]. This might be due to the plants of wider spacing could receive more light, nutrients and other resources than the plants of closer spacing. The maximum crown diameter (24.48 mm) was recorded under the spacing 30 x30 cm. It might be due to availability of more nutrients and light at wider spacing that ultimately increased the rate of net photosynthesis and translocation of assimilates. The wider spacing produced the maximum crown diameter and it was gradually decreased with decreasing plant spacing. Kim *et al*[6]. also expressed similar opinion on stem diameter of Capsicum. Among the various spacing 30x 30 cm. spacing produced the maximum no. of fruits (17.15) (table 1) which was significantly higher than those of other spacing. The lowest no. of fruits (12.20) per plant was noted under the closet spacing (25 x25 cm.). Reduced no. of plants under wider spacing undergone less inter or intra plant competition which caused an increased no. of fruits per plants. The results are in agreement with the report of Mishriky and Alphonse[12] who stated that the number of fruits per plant decreased with closer plant spacing. Plant spacing had significant effect on yield per hectare (table 1) produced the maximum yield of fruits (209.35

q/ha) and the widest (30 x30 cm.) spacing showed the minimum (167.45 q/ha). It was observed that the yield of fruits per unit area was inversely related to the plant spacing i.e. the closer plant spacing produced the higher yield of fruits per plot and per hectare. Similar kind of findings were reported by Ughade and Mahadkar[20] and Shukla *et al*[18]. The higher yield of fruits was mainly contributed by the higher plant population per unit area in closer spacing. The result of the present experiment with the findings of Manchanda *et al*[9]., and Ramachandran and Subbiah[13]. Mishriky and Alphonse[12] also obtained the highest yield from closer plant spacing.

Combined effect of planting time and spacing: - The combined effect of planting time and spacing on plant height at final harvest was statistically significant. The maximum plant height (12.42 cm) was recorded in 4th date of planting under 25 x 25 cm spacing in the data pooled over two years. Maximum No. of leaves per plant (19.40) were observed in the 1st date of planting under the spacing 30x30 cm followed by 2nd date of planting under the spacing of 30x30 cm. (Table 1). The maximum crown diameter (29.18 mm) was recorded under the spacing 30x30 cm in 2nd date of planting. Plant height, no. of leaves and crown dia was higher in earlier planting and wider spacing than in later planting and closer spacing because earlier planting provides more time for vegetative growth and leaf production and this might be due to the plants of wider spacing could receive more light, nutrients and other resources than the plants of closer spacing. Among the various planting times 2nd date of planting and 30x30 cm spacing produced the maximum no. of fruits (22.10) (Table 1) which was significantly higher than those of other spacing. The lowest no. of fruits (10.80) per plant was noted under the closet spacing (25 X 25cm) in 1stdate of planting. The maximum fruit yield (243.49 q/ha) was recorded under the spacing 20 x 30 cm in 2nd date of planting. The higher yield of fruits was mainly contributed by the higher plant population per unit area in closer spacing.

Table1: Effect of Date of planting and spacing on plant height, no. of leaves ,crown diameter , No. of fruits and fruit yield of Strawberry cv. Ofra

Time of planting	Plant height(cm.)				No. of Leaves				Crown diameter (mm.)				No. of Fruits				Fruit Yield (q/ha)			
	Spacing (cm.)				Spacing (cm.)				Spacing (cm.)				Spacing (cm.)				Spacing (cm.)			
	25 x 25	20 x 30	30 x 30	Mean	25 x 25	20 x 30	30 x 30	Mean	25 x 25	20 x 30	30 x 30	Mean	25 x 25	20 x 30	30 x 30	Mean	25 x 25	20 x 30	30 x 30	Mean
1st date of planting	12.04	11.251	11.98	11.84	14.60	14.40	19.40	16.13	19.33	22.07	24.06	21.82	10.80	13.60	15.30	13.23	140.08	189.16	129.79	153.01
2nd date of planting	11.73	11.94	12.06	11.91	18.90	11.90	18.90	16.56	26.80	18.52	29.18	24.83	13.80	13.80	22.10	16.56	197.60	243.49	218.17	219.75
3rd date of planting	12.28	10.72	10.73	11.24	12.20	12.50	15.50	13.40	17.82	18.51	21.20	19.17	13.30	13.00	17.50	14.60	194.08	227.38	179.25	200.23
4th date of planting	12.42	11.19	10.49	11.36	11.70	13.50	15.20	13.46	17.15	19.84	23.49	20.16	10.90	11.90	13.70	12.16	141.54	177.38	142.58	153.83
Mean	12.11	11.34	11.31		14.80	13.07	17.25		20.27	19.74	24.48		12.20	13.07	17.15		168.32	209.35	167.45	
	CD for A= 0.56 CD for B= N/A CD for A x B = N/A				CD for A = 2.26 CD for B= 2.61 CD for A X B = 4.52				CD for A = 1.92 CD for B = 2.22 CD for A X B = 3.84				CD for A= 2.16 CD for B= 2.50 CD for A x B = N/A				CD for A = 11.67 CD for B = 13.47 CD for A X B =N/A			

CD at 5%, A= Date of Planting, B= Spacing
1st date of planting= 15th Sept. 2nd date of planting= 22 nd Sept. 3rd date of planting= 1st October 4th date of planting=15th October

CONCLUSION

Considering growth and yield characters it can be inferred that 22nd September planting and 30 x 30 cm spacing was suitable for strawberry cultivation in Hisar conditions.

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