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Spacing trial in high-density planting in guava cv. Hisar Safeda

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ABSTRACT

A field study was carried out to study the spacing trial in high-density planting in guava cv. Hisar Safeda. There were total of seven different treatments i.e. 5 m x 3 m, 5 m x 4 m, 5 m x 5 m, 6 m x 3 m, 6 m x 4 m, 6 m x 5 m and 6 m x 6 m with four replications and the design followed was Randomized Block Design (RBD). Maximum plant height (5.23 m) was recorded in 5 m x 3 m spacing, whereas maximum stem girth (59.3 cm) was found in 6 m x 5 m spacing. At the age of ten years, maximum fruit yield (96.0 kg/plant) was recorded in 6 m x 6 m spacing. However, maximum yield per hectare (327.4 q) was found in 6 m x 4 m spacing, which was significantly higher over all other treatments except 5 m x 5 m spacing. Maximum fruit weight (79.9 g and 115.0 g) was recorded at 6 m x 6 m spacing during rainy and winter seasons. Total soluble solids (TSS) of fruits were recorded maximum (10.5 °Brix) at 6 m x 5 m spacing during the rainy season, whereas it was maximum (11.5 °Brix) at 6 x 6 m spacing during the winter season. During both seasons, the ascorbic acid content of fruits was found maximum (163.7 and 192.7 mg/100 g pulp) at 6 m x 5 m spacing.

Keywords: *Myrtaceae, high-density planting, spacing, TSS, ascorbic.*

Introduction

Guava (*Psidium guajava* L.) holds a special place as one of India's most prized fruit crops within the Myrtaceae family, often referred to as the "Apple of tropics" (Sharma *et al*., 2023). Widely cultivated in tropical and sub-tropical regions up to 1500 m above sea level, guava thrives in areas with distinct winters, resulting in increased yield and improved quality. This robust fruit crop, requiring minimal care and input, proves highly profitable, even on marginal lands. Recognized as a multipurpose tree, guava serves various roles, including fruit production, fuel, fodder and timber. Though native to Central America, guava has been cultivated and naturalized across tropical regions and is now extending into some subtropical areas due to rising demand (Baloda *et al*., 2023). Guava stands out as a rich source of sugars, ascorbic acid (Vitamin C) and pectin. The ascorbic acid content in the pulp ranges from 75-260 mg/100 g, varying based on cultivar, season, location, and maturity stage. Guava fruits not only provide a significant source of vitamin A (around 250 IU/100g) but also contain appreciable amounts of thiamine, niacin, and riboflavin (Gaur *et al*., 2014). In pursuit of intensive fruit production, High-Density Planting (HDP) emerges as a crucial technique, particularly relevant for ensuring food and nutritional security in the face of a growing population (Anonymous, 2010). Applied to various tropical, subtropical and temperate fruit crops, HDP technologies have been specifically developed to optimize both horizontal and vertical space for guava fruit cultivation (Yadav *et al*., 2023).

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Keeping in view, this experiment has been planned to study the "spacing trial in high-density planting in guava cv. Hisar Safeda" with the objective to standardizing the optimum spacing for high-density planting in guava to fetch maximum yield of quality fruits.

Materials and Methods

The present investigation was conducted at the Experimental Orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar on guava trees during the year 2018-22. Hisar Safeda variety was selected as an experimental material to study the spacing trial in high-density planting in guava. The experiment comprised of seven different treatments i.e. 5 m x 3 m, 5 m x 4 m, 5 m x 5 m, 6 m x 3 m, 6 m x 4 m, 6 m x 5 m, and 6 m x 6 m with four replications under Randomized Block Design (RBD). Different growth and yield parameters including the number of plants/ha, Plant height (m), Yield (kg/plant), and Yield (q/ha) were calculated using respective methods. The quality parameters - Fruit weight (g), TSS (°Brix), Acidity (%) and Ascorbic acid (mg/100g) were recorded using several methods.

Number of plants/ha: The number of plants/ha was calculated using the formula:

$$\text{Number of plants/ha} = \frac{\text{Area (m}^2\text{)}}{\text{Spacing (m)}}$$

Plant height (m): The initial and final heights of the trees were measured with the help of a measuring pole, upto the maximum point of height. Odd-type shoots were ignored. The increase in plant height was calculated by the following formula:

$$\text{Plant height (m)} = \frac{\text{Final height} - \text{initial height}}{\text{Initial height}} \times 100$$

Yield (kg/plant): To calculate total fruit yield, the total number of fruits per tree was multiplied by average fruit weight and the value was expressed in kilograms (kg/tree).

Fruit weight: Five randomly selected fruits from the tagged branch of the tree were picked and weighed on top pan electric balance. To calculate the average fruit weight the total fruit weight was divided by a total number of fruits taken and expressed in grams (g).

TSS (ºBrix): The total soluble solids (TSS) was measured by hand refractometer.

Acidity (%): Acidity was estimated by using the method given in A.O.A.C. (1990).
The method is as follows:

Reagents prepared.
The following reagents were prepared for further use:
1. Sodium hydroxide 0.1 N
2. Phenolphthalein indicator 1 per cent

Procedure
Five grams of fruit pulp was mashed in a pestle mortar using a small amount of distilled water. Two ml of filtrate was pipetted out into a beaker and titrated against N/10 sodium hydroxide using phenolphthalein as an indicator. The appearance of a light pink color atleast for 15 seconds was the endpoint of the titration. Acidity was expressed in terms of per cent citric acid equivalent after applying the following formula:

$$\text{Acidity (\%)} = \frac{\text{Titrate value x Normality of NaOH x Equivalent weight of citric acid.}}{\text{The volume of juice taken (ml) x 1000}} \times 100$$

Ascorbic acid (mg/100g pulp) : The ascorbic acid content was estimated by following the standard method suggested by A.O.A.C, (1990).

Reagents
a) Metaphosphoric acid solution (3%)
Metaphosphoric acid (HPO_3) 15 g
Glacial acetic acid 40 ml
Final volume adjusted 500 ml
b) 2, 6 dichlorophenol indophenol dye
2, 6-dichlorophenol indophenol dye 50 mg
Sodium bicarbonate 42 mg
Volume adjusted 200 ml
c) Standard ascorbic acid solution
50 mg of ascorbic acid ($C_6H_8O_6$) was dissolved in 50 ml metaphosphoric acid (3%).

Estimation
Grinding of 5 g of fruit pulp was done using 25 ml of 3 per cent metaphosphoric acid and filtered through muslin cloth. A 2 ml of filtrate was titrated against 2, 6-dichlorophenol dye until a distinctly rose pink color appeared. Concurrently, 1.0 ml of standard ascorbic acid was also titrated against the dye. The results were manifested as mg of ascorbic acid per 100 g of fruit pulp. It was determined by the given mathematical formula:
Titrate value x total volume

$$\text{Ascorbic acid (mg/100 g fruit pulp)} = \frac{}{\text{Standard reading x ml of sample}} \times 100$$

Results and Discussion

Table 1 depicts the growth and yield parameters of guava planted at different spacings. With the decreasing planting density, there is an increase in a number of plants/ha and maximum number of plants/ha (666) was recorded in 5 x 3 m spacing, and a minimum number of plants/ha was found in 6 x 6 m spacing. Similarly, with the increasing planting density, there was an increase in plant height (m) and maximum plant height (5.23 m) was recorded in 5 x 3 m spacing and the minimum was found in 6 x 6 m spacing. The maximum stem girth (59.3 cm) was found in 6 x 5 m spacing and minimum stem girth was recorded under 5 x 3 m spacing. On the other hand, maximum fruit yield (96.0 kg/plant) was recorded in 6 x 6 m spacing, however, maximum yield per hectare (327.4 q) was assessed in 6 x 4 m spacing which was significantly higher than all other treatments and minimum yield was noted under 5 x 3 m spacing. Similar results were seen by Baysal, F. (2023) in bananas, Ramteke *et al*. (2023) in custard apples, Kundu, S. (2005), Kumawat *et al*. (2014), Nayak *et al*. (2020), Chawla *et al*. (2023) in guava and Singh *et al*. (2023) in Litchi.

Table 1. Growth and yield parameters in guava planted at different spacing.

Sr. No.	Spacing (m)	Plants/ha	Plant height(m)	Stem girth (cm)	Yield (kg/plant)			Yield (q/ha)
					Rainy	Winter	Total	
1	**5 x 3**	666	5.23	53.7	18.7	16.3	35.0	233.1
2	**5 x 4**	500	4.55	56.3	28.0	24.7	52.7	263.5
3	**5 x 5**	400	4.42	56.7	44.3	36.0	80.3	321.2
4	**6 x 3**	555	5.16	54.3	24.0	19.3	43.3	240.3
5	**6 x 4**	416	4.48	58.0	42.0	36.7	78.7	327.4
6	**6 x 5**	333	4.65	59.3	46.7	39.0	85.7	285.4
7	**6 x 6**	277	4.35	54.3	51.3	44.7	96.0	265.9
CD at 5%			0.38	1.3	-	-	4.1	9.9

Table 2 shows the quality parameters in guava planted at different spacing. The maximum fruit weight (79.9 g and 115.0 g) was recorded from 6 x 6 m spacing during the rainy and winter seasons, respectively and the minimum fruit weight for the rainy season (70.2 g) was noted in 6 x 6 m spacing whereas for the winter season the minimum (104.2 g) was recorded in 5 x 3 m spacing. The TSS of fruits was found maximum (10.5 °Brix) at 6 x 5 m spacing and minimum TSS was recorded under 5 x 3 m spacing during the rainy season, whereas, during the winter season it was maximum (11.5 °Brix) at 6 x 6 m spacing and minimum at 5 x 3 m spacing. During both seasons, ascorbic acid content of fruits was found maximum (163.7 and 192.7 mg/100g pulp) at 6 x 5 m spacing and the minimum was recorded under 5 x 3 m spacing. However, acidity was not altered significantly with different spacing treatments

during both seasons. Similar observations were recorded by Baysal, F. (2023) in bananas, Ramteke *et al.* (2023) in custard apples, Kundu, S. (2005), Kumawat *et al*. (2014), Nayak *et al*. (2020), Chawla *et al*. (2023) in guava and Singh *et al*. (2023) in Litchi.

Table 2. Quality parameters in guava planted at different spacing.

Sr. No.	Spacing (m)	Fruit weight (g)		TSS (^{0}Brix)		Acidity (%)		Ascorbic acid (mg/100g)	
		Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
1	5 x 3	71.3	104.2	9.9	10.5	0.45	0.43	147.7	178.3
2	5 x 4	73.0	105.7	10.1	10.8	0.44	0.42	149.0	181.7
3	5 x 5	75.0	111.4	10.4	11.2	0.45	0.39	159.0	185.0
4	6 x 3	70.2	105.9	10.1	10.7	0.48	0.41	153.7	183.7
5	6 x 4	77.7	108.0	10.4	11.3	0.47	0.42	163.0	189.3
6	6 x 5	78.0	114.8	10.5	11.4	0.45	0.40	163.7	192.7
7	6 x 6	79.9	115.0	10.3	11.5	0.44	0.39	162.3	190.3
CD at 5%		1.1	2.1	0.2	0.2	NS	NS	1.3	2.1

Conclusion

With the increasing planting density, there is an increase in plant height and maximum plant height (5.23m) was recorded in 5 x 3 m spacing, whereas, maximum stem girth (59.3 cm) was found in 6 x 5 m spacing. At the age of ten years, maximum fruit yield (96.0 kg/plant) was recorded in 6 x 6 m spacing, however, maximum yield per hectare (327.4 q) was assessed in 6 x 4 m spacing which is significantly higher than all other treatments except 5 x 5 m spacing. Maximum fruit weight (79.9 g and 115.0 g) was recorded from 6 x 6 m spacing during the rainy and winter seasons, respectively. TSS of fruits was found maximum (10.5 °Brix) at 6 x 5 m spacing during the rainy season, whereas, during the winter season it was maximum (11.5 °Brix) at 6 x 6 m spacing. During both seasons ascorbic acid content of fruits was found maximum (163.7 and 192.7 mg/100g pulp) at 6 x 5 m spacing. However, acidity was not altered significantly with different spacing treatments during both seasons.

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