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Effect of plant geometry and nutrients on growth and yield of guava (*Psidium guajava* L.) cv. Sardar

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Abstract
Experiment conducted to find out the effect of plant spacing and nutrients on growth and yield of eight years old guava (*Psidium guajava* L.) cv. Sardar in hasth bahar revealed that the plant height, stem girth, plant spread for North-South, plant spread for East-West, canopy volume, number of secondary branches and number of tertiary branches, number of flowers, fruit set and yield per plant were found significantly higher with the wider spacing of 6 m x 6 m. Whereas yield per hectare was significantly highest in the closer spacing (2 m x 1 m). Nutrition also had great influence on growth and yield of guava where application of 200:80:150 g NPK/ plant increased plant height, stem girth, plant spread north-south, plant spread east-west, canopy volume, number of secondary branches and number of tertiary branches, number of flowers, per cent fruit set, yield per plant and yield per hectare.

Keywords: Guava, plant geometry, nutrition, growth and yield

Introduction
Guava (*Psidium guajava* L.) is one of the most important fruit crops of tropical and sub-tropical regions of India. It can be grown satisfactorily on marginal soils with minimum care. In India, it has become an important fruit crop owing to its wider edapho-climatic adaptability, hardy to various biotic and abiotic stresses, precocious and prolific bearing habit and highly remunerative even without much care. Guava has gained considerable prominence on account of its high nutritive and medicinal values, as a rich source of vitamin C, pectin, moderately good source of iron, calcium and phosphorus. Guava is one of the richest sources of dietary fiber.

Tree spacing is one of the prominent factors in cultivation oh land for its efficient and profitable usage. Its basic function is to confine the exploitation zone of the plant with regard to optimal availability of light, water and nutrients to obtain the highest total yield potential from the smallest possible area (Boswell *et al.*, 1982; Singh, 2005) [2, 28]. Hence, through adoption of high density planting system, it is possible to manipulate tree growth by following canopy management which eventually resulted in controlled plant growth for the highest fruit production of desired quality.

Nutrient management in fruit crops is the important aspect to get higher returns. Each of the nutrients have specific role in growth and development of plant. The stagnation and decline in the productivity of guava is due to decline in the soil organic matter, over mining of nutrients reserve, loss of nutrients and non availability of cost effective fertilizers. So, it is essential to supply the nutrients in required concentration at proper time to get good yield and quality fruits. A study was conducted to study the "Effect of plant geometry and nutrients on growth and yield of guava (*Psidium guajava* L.) cv. Sardar." with an objective to assess the effect of plant spacing and nutrients on growth and yield of guava.

Material and Methods
The experiment was carried out at Kittur Rani Channamma College of Horticulture, Arabhavi (University of Horticultural Sciences, Bagalkot), Gokak taluk of Belagavi district, Karnataka, India during 2016-2018 on eight year old guava plants during hasth bahar. Site is located in zone-3 of region-2 of agro-climatic zones of Karnataka with an average rainfall of 530 mm and mean temperature of 33 °C.

The experiment consisted of fifteen treatments executed in three replications having factorial randomized block design. The treatments included five spacing *viz.*, S_1, S_2, S_3, S_4 and S_5 (2 m x 1 m, 3 m x 1.5 m, 3 m x 3 m, 6 m x 3 m and 6 m x 6 m respectively) and three fertilizer combinations *viz.*, F_1, F_2 and F_3 (200:80:150 g NPK/plant (100% RDF), 150:60:110 g NPK/plant (75% RDF) and 100:40:75 g NPK/plant (50% RDF) respectively). Recommended doses of fertilizer were applied on per plant basis according to the treatment details in two split doses. The first as a basal dose, where only 50 per cent urea was applied in the month of July and the remaining second dose consisting of 50 per cent urea and full dose of single super phosphate and muriate of potash was applied during October. The observations for growth parameters were recorded in three months intervals till harvesting of fruits.

Results and Discussion

Growth Parameters

The data regarding the plant height (Table 1) was found statistically significant among the different spacing before and after the application of treatment. The plants with wider spacing recorded highest plant height compared to closer spacing. The highest plant height (1.52 m) was recorded in S_5 spacing (6 m x 6 m). The lowest plant height (1.24 m) was recorded in S_1 (2 m x 1 m). This may be due to vigorous plant growth, less competition for space and nutrients and sufficient availability of space and light. Similar findings were reported by Bal and Dhaliwal (2003) [1] who got the higher plant height in 6 m x 6 m spacing than 6 m x 5m and 6 m x 4 m spacings in guava cv. Sardar. Contrary to this Kundu (2007) [16] reported increased plant density will increase the plant height.

Among different nutrition, the plant height was found statistically non-significant before treatment. But it differed significantly and was in increasing order after every successive month of observations. The highest plant height (1.51 m) was recorded in the F_1 consisting of 200:80:150 g NPK/ plant, whereas the lowest height (1.29 m) was noticed in F_3. The increased height in the present investigation might be due to application of nitrogen which resulted in vigorous vegetative growth of the plant and gave the darker green color of the foliage. This favored the photosynthetic activity of the plants and greater synthesis of carbohydrates, which led to the formation of amino acids, nucleo-proteins, chlorophyll, alkaloids and amides. The increase in growth as a result of nitrogen application is obvious. Similarly, increase in vegetative growth of fruit plants by the application of nitrogen has also been reported earlier by Dhomane *et al.* (2011) [6] in guava.

With relation to interaction effect, data revealed that there were non-significant results of plant height initially and in three months after treatment imposition. Further, it significantly differed in every month till end. The highest plant height (1.71 m) was recorded on S_5F_1 (6 m x 6 m spacing with 200:80:150 g NPK/ plant) followed by (1.58 m) in S_4F_1 (6 m x 3 m spacing with 200:80:150 g NPK/ plant) and the lowest (1.16 m) was observed in S_1F_3 (2 m x 1 m spacing with 100:40:75 g NPK/plant).

Stem girth, plant spread (N-S and E-W) and canopy volume (Table 1 and 2) was found statistically significant among the different spacing before and after the application of treatment. The plants with wider spacing recorded maximum values compared to closer spacing. The maximum stem girth (8.27 cm), plant spread (N-S and E-W) (2.31 m and 2.12 m) and canopy volume (3.20 m^3) was recorded in S_5 spacing (6 m x 6 m). The lowest (6.67 cm, 1.44 m, 1.53 m and 1.09 m^3 respectively) was recorded in S_1 (2 m x 1 m). Increase in stem girth with wider spacing is attributed due to reduced competition in plants for water, nutrients, sunlight and other requirements. Enhanced stem girth at wider spacing is also justified by greater availability of photosynthates in reserve tissues. The results are in tune with the findings of Sidhu *et al*. (1992) [27], Singh and Bal (2002) [29], Bal and Dhaliwal (2003) [1] and Singh *et al.* (2007) [30]. Higher canopy spread in wider spacing is due to availability of sufficient space for canopy spread. The results of Mitra and Bose (1990) [21] and Singh *et al.* (2007) [30] are found in line with the present investigation verifying that increased planting density reduced the interplant spread.

Among different nutrition, the stem girth, plant spread (N-S and E-W) and canopy volume were found statistically non-significant before treatment and three months after treatment. But differed significantly and were in increasing order after every successive month of observations. The maximum stem girth (7.65 cm), plant spread (N-S and E-W) (1.91 m and 1.83 m) and canopy volume (2.40 m^3) was recorded in the F_1 level consisting of 200:80:150 g NPK/ plant. Whereas the lowest stem girth (6.98 cm), plant spread (N-S and E-W) (1.73 m and 1.72 m) and canopy volume (1.61 m^3) was noticed in F_3. This was due greater availability of nutrients which in turn increased vegetative growth. These findings were in line with Dhomane *et al.* (2011) [6], Reddy *et al.* (2000) [25] in pomegranate and Sureshkumar *et al.* (2011) [31] in custard apple.

The data from the interaction effect revealed that there was statistically insignificant among the different spacing before and after the application of treatment. The maximum stem girth (8.68 cm), plant spread (N-S and E-W) (2.54 m and 2.19 m) and canopy volume (4.13 m^3) were recorded on S_5F_1 (6 m x 6 m spacing with 200:80:150 g NPK/ plant) and the lowest stem girth (6.43cm), plant spread (E-W) (1.49 m) and canopy volume (0.95 m^3) was observed in S_1F_3, whereas lowest plant spread (N-S) (1.41) was observed in S_1F_1

The interpreted data (Table 2 and 3) showed the significant difference in number of secondary and tertiary branches per plant among different spacings. The maximum number of secondary (17.75) and tertiary (35.11) branches per plant was recorded in the plants of S_5 spacing, (6 m x 6 m). The minimum number of secondary and tertiary branches per plant (14.08 and 29.08 respectively) was recorded in the plants of S_1 spacing, (2 m x 1 m) after nine months of treatment. The increasing trend observed in the number of secondary and tertiary branches with the low plant population might be due to more space available for proper spread. These results were in line with Chundawat *et al*., 1992 [4] and Leigh Issell, 1999 [20].

Significant difference in the number of secondary and tertiary branches per plant was also noticed among the different levels of nutrition except before application of nutrients. The maximum number of secondary (17.14) and tertiary (33.36) branches per plant was recorded in the plants of F_1 treatment (200:80:150 NPK g/plant) after nine months of treatment. Application of nutrients resulted in vigorous vegetative growth of the plant. The complex compounds produced by the photosynthetic activity are responsible for building up of new tissues and are associated with a number of metabolic processes, which in turn favour better developments of plants. Similar findings were reported by Kumar *et al*. (2009) [13], Kotur *et al*. (1997) [11] and Mitra and Bose (1990) [21].

The interaction effect revealed non-significant difference in number of secondary and tertiary branches per plant among all the spacings and nutrition levels. The maximum number of secondary and tertiary branches per plant (19.22 and 36.17) was recorded in the nutrition of S_5F_1 and lowest number of secondary branches per plant (13.08) was observed in S_1F_2 of 2 m x 1 m spacing with 150:60:110 g NPK/ plant, whereas lowest number of tertiary branches per plant (28) was recorded in S_1F_3.

Flowering Parameters

The analyzed data (Table 3) on initiation of flowering showed non-significant difference among different spacings. But significant results were obtained by nutrients. The minimum days (39.47) taken for initiation of flowering was recorded in F_3 (100:40:75 g NPK/ plant). The maximum days (47.12) was recorded in F_1. The optimum dose of nutrient combinations (NPK) accelerates the metabolic activities of the plant by increasing the meristematic activities which in turn increases the vegetative growth and ultimately lead to initiation of flowering and maximum fruit setting per cent. Similar results have also been reported by Sharma and Sharma (1992) [26], Zang and Tao (2000) [34] and Umashankar *et al.* (2002) [33] in guava.

The interaction effect had shown non-significant results for initiation of flowering in guava. The minimum days (35.67) was recorded in S_2F_3 and the maximum days (48.62) in S_2F_1 of 3 m x 1.5 m spacing with 200:80:150 g NPK/ plant.

Analyzed data showed significant difference among different spacings with respect to total number of flowers and fruits per plant and fruit set per cent. The maximum total number of flowers (43.56) and fruits (37.01) per plant and higher fruit set per cent (85.36%) was recorded in S_5 (6 m x 6 m) spacing and the least (30.31, 24.13 and 78.84%) was recorded in S_1 (2 m x 1 m) spacing. These findings are similar to Kundu (2007) [16] who reported maximum number of flowers obtained from 6 m x 6 m spacing.

Significant difference with respect to total number of flowers and fruits per plant and fruit set per cent was also observed at different levels of NPK application. The maximum number of flowers (48.20) and fruits (40.47) per plant and fruit set per cent (83.79%) was recorded in F_1 (200:80:150 g NPK/ plant) nutrition followed (38.72) by F_2 (150:60:110 g NPK/ plant) level). This may be due to better photosynthesis recording good growth and formation of more number of flowers. The promotive effect of N and K in rapid production of leaves with better photosynthetic activity resulting in higher C: N ratio for flowering and fruit set. The present findings were in line with Turner and Barkus (1982) [32].

The interaction effect had shown a non-significant difference with respect to total number of flowers and fruits per plant and fruit set per cent. The highest total number of flowers (56.08) and fruits (49.33) per plant and fruit set per cent (88.11%) was recorded in S_5F_1 and the least in S_1F_3.

Yield Parameters

The analyzed data (Table 3) pertaining to the fruit weight was found significantly different among the different spacings. The maximum fruit weight (218.78 g) was noticed in the S_5 (6 m x 6 m). The minimum fruit weight (183.22 g) was recorded in plants spaced at 2 m x 1 m. Low fruit weight at closer spacing in guava may be ascribed to the reduced availability of photosynthates to the developing fruits as smaller canopies resulting from high plant density led to poor light penetration in plants. Earlier, Sidhu *et al.* (1992) [27], Lal *et al.* (2000) and Kundu (2007) [16] also reported the similar findings in guava.

Nutritional treatments also expressed statistically significant differences to fruit weight. The maximum fruit weight (215.49 g) was recorded in F_1 (200:80:150 g NPK/ plant), whereas minimum fruit weight (192.56 g) recorded in F_3 (100:40:75 g NPK/ plant). This is due to the fact that nitrogen increases the efficiency of metabolic processes of the plant and consequently increases the size and weight of the fruit, another probable cause could be greater mobility of nutrients to the developing fruits which act as strong metabolic sink. Similar results were also reported by Prasad and Mali, (2000) [23] in pomegranate, Dudi *et al.*, (2004) [7] in kinnow and Kashyap *et al.,* (2012) [9] in guava.

There was non-significant difference among the different treatment combinations with respect to interaction effect on fruit weight. Fruit weight varied between 174.22 g to 233.11 g. The maximum fruit weight (233.11 g) was recorded in S_5F_1 and minimum fruit weight (174.22 g) was in S_1F_3. This might be due to wider canopy which lead to more amount of sink and source relationship.

Yield per plant was found significantly different among the different spacings. The highest yield (8.22 kg/ plant) was recorded in S_5 (6 m x 6 m) spacing, which was significant with S_4 (6.97 kg/ plant). The lowest yield (4.49 kg/ plant) was recorded in S_1 (2 m x 1 m) spacing. As the plant population per unit area increased, yield per plant decreased. Lower number of flower bud and fruits per plant in closely spaced plants seems to be due to lesser photosynthetic activity, while higher yield per hectare with close spaced plants may be due to more plants accommodated per unit area in guava (Kumawat *et al.*, 2014) [15]. These results are also in agreement with the findings of Lal *et al.* (1996) [19], Lal *et al.* (2007) [18] and Kundu (2007) [16] in guava and Kumar *et al.* (2013) [12] in apricot.

The effect of nutrients also showed the significant difference in yield. The maximum yield (8.79 kg/ plant) was recorded in F_1 (200:80:150 g NPK/ plant) nutrition, whereas lowest yield (3.67 kg/ plant) was recorded in F_3. This may be due to increased photosynthesis, better plant growth and dry matter accumulation in addition to increase in number of flowers and fruit volume and fruit weight. Khattak *et al.* (2005) [10], Kundu (2007) [16], Kumar *et al.* (2009) [13] and Cardoso *et. al.* (2011) [3] also reported similar results in guava.

Non-significant difference in yield was observed in the interaction effects of different spacings as well as nutrition. However, it was ranging from 2.39 to 11.50 kg/ plant. The highest yield (11.50 kg/ plant) was recorded in S_5F_1, followed by S_4F_1 (9.48 kg/ plant) and the lowest yield (2.39 kg/ plant) was recorded in S_1F_3.

It was found that there was significant difference in yield among the different spacings of guava. The highest yield (22.46 t/ha) was recorded in plants spaced at S_1 (2 m x 1 m) and the lowest yield (2.28 t/ha) was obtained in plants spaced at S_5 (6 m x 6 m). These findings are supported by Kundu (2007) [16] who reported yield per unit area and yield per hectare significantly increased with the increase in plant density. This may be due to accommodation of more number of plants per unit area in closer spacing compared to wider spacing. The similar trend was also found by Chunadawat *et al.* (1992), Gorakh Singh (2011) [8], Sharma and Sharma (1992) [26], Sharma and Patel (1997) in guava and Kumar *et al.* (1989) [14].

Significant difference was also found with regard to yield in nutrition. The highest yield per hectare (13.64 t/ha) was recorded in the plants applied with F_1 (200:80:150 g NPK/ plant) nutrition. The lowest yield (5.26 t/ha) was recorded in plants applied with F_3 nutrition. This was due to optimum vegetative growth and increased chlorophyll content, which together accelerated the photosynthetic rate and thereby increased the supply of carbohydrates to plants. The similar findings were also reported by Ramniwas *et al* (2012) [24] for guava, Patel *et al.* (2007) [22] and Deshmukh *et al.*, 2013 [5] in guava.

There was significant difference with regard to yield in interaction effects. The highest yield (33.45 t/ha) was recorded in S_1F_1 treatment of 2 m x 1 m spacing with 200:80:150 g NPK/ plant, which was on par with S_1F_2 (21.95 t/ha). The lowest yield (1.43 t/ha) was recorded in S_5F_3 of 6 m x 6 m spacing with 100:40:75 g NPK/ plant.

Table 1: Effect of plant geometry and nutrients on plant height, stem girth and plant spread (N-S) of guava cv. Sardar

Treatments	**Plant height (m)**				**Stem girth (cm)**				**Plant spread (North-South) (m)**			
	Months after treatment				**Months after treatment**				**Months after treatment**			
	Initial	**3**	**6**	**9**	**Initial**	**3**	**6**	**9**	**Initial**	**3**	**6**	**9**
Spacing (S)												
S_1	0.97	1.08	1.17	1.24	6.16	6.31	6.50	6.67	1.01	1.20	1.33	1.44
S_2	1.11	1.16	1.24	1.33	6.28	6.44	6.59	6.76	1.18	1.27	1.38	1.46
S_3	1.16	1.21	1.30	1.39	6.38	6.55	6.74	6.94	1.33	1.49	1.57	1.75
S_4	1.22	1.28	1.36	1.45	7.19	7.39	7.59	7.83	1.59	1.77	1.93	2.12
S_5	1.25	1.34	1.44	1.52	7.92	8.03	8.07	8.27	1.65	1.83	2.14	2.31
SEm ±	0.03	0.03	0.04	0.01	0.23	0.20	0.12	0.14	0.05	0.04	0.04	0.05
CD @ 5%	0.08	0.09	0.13	0.04	0.66	0.58	0.35	0.42	0.13	0.10	0.12	0.16
Nutrition (F)												
F_1	1.18	1.26	1.44	1.51	6.95	7.11	7.32	7.65	1.34	1.51	1.74	1.91
F_2	1.13	1.21	1.24	1.35	6.89	7.00	7.10	7.26	1.35	1.53	1.65	1.80
F_3	1.11	1.17	1.22	1.29	6.53	6.72	6.88	6.98	1.36	1.49	1.62	1.73
SEm ±	0.02	0.02	0.03	0.01	0.18	0.16	0.09	0.11	0.03	0.03	0.03	0.04
CD @ 5%	NS	0.07	0.10	0.03	NS	NS	0.27	0.32	NS	NS	0.09	0.13
Interactions (S x F)												
S_1F_1	1.06	1.13	1.26	1.34	6.31	6.49	6.88	7.12	1.01	1.15	1.35	1.41
S_1F_2	0.92	1.06	1.13	1.21	6.03	6.14	6.20	6.47	0.94	1.22	1.34	1.46
S_1F_3	0.92	1.05	1.12	1.16	6.13	6.32	6.41	6.43	1.09	1.22	1.30	1.44
S_2F_1	1.15	1.20	1.36	1.41	6.65	6.80	6.96	7.14	1.11	1.27	1.39	1.50
S_2F_2	1.10	1.16	1.21	1.32	6.13	6.33	6.50	6.65	1.14	1.25	1.35	1.45
S_2F_3	1.09	1.12	1.16	1.26	6.06	6.18	6.31	6.50	1.30	1.30	1.38	1.44
S_3F_1	1.18	1.24	1.44	1.52	6.26	6.58	6.81	7.20	1.40	1.53	1.61	1.83
S_3F_2	1.16	1.20	1.24	1.35	6.49	6.56	6.71	6.91	1.29	1.44	1.58	1.73
S_3F_3	1.14	1.18	1.21	1.30	6.41	6.51	6.69	6.71	1.30	1.49	1.52	1.68
S_4F_1	1.25	1.36	1.50	1.58	7.08	7.20	7.64	8.11	1.50	1.76	1.98	2.27
S_4F_2	1.23	1.27	1.31	1.41	7.46	7.49	7.54	7.66	1.63	1.78	1.86	2.05
S_4F_3	1.17	1.22	1.28	1.37	7.03	7.49	7.60	7.73	1.63	1.77	1.93	2.04
S_5F_1	1.28	1.38	1.65	1.71	8.43	8.47	8.31	8.68	1.67	1.82	2.37	2.54
S_5F_2	1.25	1.37	1.35	1.46	8.33	8.50	8.53	8.60	1.78	1.99	2.12	2.33
S_5F_3	1.23	1.28	1.31	1.40	7.01	7.12	7.37	7.53	1.51	1.68	1.94	2.05
SEm ±	0.05	0.05	0.07	0.03	0.39	0.34	0.21	0.25	0.08	0.06	0.07	0.10
CD @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

S1 – 2 m x 1 m
S2 – 3m x 1.5 m
S3 – 3 m x 3 m
S4 – 6 m x 3 m
S5 – 6 m x 6 m

F1– 200:80:150 g NPK/plant (100% RDF)
F2– 150:60:110 g NPK/plant (75% RDF)
F3– 100:40:75 g NPK/plant (50% RDF)

Table 2: Effect of plant geometry and nutrients on plant spread (E-W), canopy volume and number of secondary branches of guava cv. Sardar**.**

Treatments	**Plant spread (East-West) (m)**				**Canopy volume (m^3)**				**Number of secondary branches**			
	Months after treatment				**Months after treatment**				**Months after treatment**			
	Initial	**3**	**6**	**9**	**Initial**	**3**	**6**	**9**	**Initial**	**3**	**6**	**9**
Spacing (S)												
S_1	1.09	1.29	1.34	1.53	0.40	0.63	0.83	1.09	10.40	11.15	12.08	14.08
S_2	1.20	1.33	1.49	1.60	0.60	0.76	0.99	1.27	11.49	12.48	13.50	15.42
S_3	1.35	1.50	1.66	1.79	0.84	1.07	1.36	1.82	12.48	13.14	14.10	16.14
S_4	1.35	1.50	1.68	1.83	0.98	1.40	1.77	2.40	12.82	14.16	15.54	17.13
S_5	1.53	1.74	1.93	2.12	1.11	1.74	2.44	3.20	13.44	15.07	15.46	17.75
SEm ±	0.04	0.04	0.03	0.04	0.08	0.07	0.07	0.11	0.46	0.42	0.35	0.35
CD @ 5%	0.10	0.11	0.09	0.12	0.23	0.20	0.21	0.32	1.32	1.20	1.00	1.01
Nutrition (F)												
F_1	1.30	1.51	1.67	1.83	0.75	1.20	1.71	2.40	12.66	14.12	15.33	17.14
F_2	1.28	1.43	1.61	1.78	0.80	1.11	1.43	1.86	11.97	12.90	13.57	15.72
F_3	1.33	1.47	1.58	1.72	0.81	1.05	1.29	1.61	11.75	12.58	13.51	15.45
SEm ±	0.03	0.03	0.02	0.03	0.06	0.05	0.06	0.08	0.35	0.32	0.27	0.27
CD @ 5%	NS	NS	0.07	0.09	NS	NS	0.16	0.25	NS	0.93	0.78	0.78
Interactions (S x F)												

S_1F_1	1.01	1.32	1.37	1.60	0.41	0.65	0.96	1.27	11.03	12.05	13.04	15.04
S_1F_2	1.12	1.24	1.35	1.49	0.35	0.61	0.79	1.06	10.05	10.15	11.12	13.08
S_1F_3	1.16	1.30	1.31	1.50	0.42	0.63	0.75	0.95	10.12	11.25	12.09	14.10
S_2F_1	1.19	1.35	1.53	1.64	0.59	0.81	1.20	1.42	12.05	13.22	14.19	16.15
S_2F_2	1.25	1.38	1.53	1.63	0.59	0.77	0.92	1.25	11.17	12.09	13.17	15.04
S_2F_3	1.16	1.27	1.42	1.54	0.61	0.71	0.86	1.13	11.27	12.12	13.15	15.07
S_3F_1	1.39	1.54	1.72	1.81	0.89	1.16	1.62	2.18	13.09	14.18	15.15	17.22
S_3F_2	1.31	1.47	1.61	1.76	0.78	1.00	1.25	1.68	12.30	13.04	14.09	16.15
S_3F_3	1.34	1.49	1.64	1.79	0.85	1.04	1.20	1.58	12.06	12.20	13.06	15.06
S_4F_1	1.37	1.54	1.76	1.92	0.90	1.55	1.66	2.98	13.08	15.15	17.12	18.09
S_4F_2	1.30	1.46	1.67	1.90	0.99	1.35	2.00	2.27	13.23	14.13	15.27	17.28
S_4F_3	1.37	1.49	1.61	1.68	1.04	1.31	1.64	1.95	12.15	13.20	14.22	16.00
S_5F_1	1.57	1.78	1.97	2.19	0.95	1.83	3.10	4.13	14.03	16.00	17.15	19.22
S_5F_2	1.40	1.61	1.89	2.11	1.27	1.84	2.21	3.02	13.12	15.07	14.22	17.03
S_5F_3	1.62	1.82	1.93	2.06	1.10	1.55	2.00	2.45	13.16	14.13	15.01	17.01
SEm ±	0.06	0.07	0.05	0.07	0.14	0.12	0.13	0.19	0.79	0.72	0.60	0.60
CD @ 5%	NS	NS	NS	NS	NS	NS	0.45	0.67	NS	NS	NS	NS

S1 – 2 m x 1 m — F1– 200:80:150 g NPK/plant (100% RDF)
S2 – 3m x 1.5 m — F2– 150:60:110 g NPK/plant (75% RDF)
S3 – 3 m x 3 m — F3– 100:40:75 g NPK/plant (50% RDF)
S4 – 6 m x 3 m
S5 – 6 m x 6 m

Table 3: Effect of plant geometry and nutrients on number of tertiary branches, flowering and yield parameters a of guava cv. Sardar

Treatments	Number of tertiary branches				Flowering parameters				Yield parameters		
	Months after treatment										
	Initial	3	6	9	Initiation of flowering (days)	Number of flowers/plant	Number of fruits/plant	Fruit set (%)	Fruit weight (g)	Yield per plant (kg)	Yield per hectare (t)
Spacing (S)											
S_1	22.57	23.20	26.15	29.08	43.17	30.31	24.13	78.84	183.22	4.49	22.46
S_2	23.61	25.78	29.17	33.08	43.21	34.32	27.34	78.88	196.00	5.42	12.04
S_3	24.32	26.49	29.14	32.22	43.29	37.67	30.08	78.73	205.19	6.25	6.94
S_4	25.35	23.83	29.17	32.15	43.65	39.56	32.12	80.85	214.48	6.97	3.87
S_5	26.24	23.19	33.05	35.11	43.78	43.56	37.01	85.36	218.78	8.22	2.28
SEm ±	0.30	0.35	0.35	0.35	1.48	0.51	0.43	1.40	1.84	0.10	0.28
CD @ 5%	0.88	1.01	1.01	1.01	NS	1.48	1.25	4.06	5.32	0.29	0.80
Nutrition (F)											
F_1	24.90	25.03	30.34	33.36	47.12	48.20	40.47	83.79	215.49	8.79	13.64
F_2	24.22	24.31	29.35	32.31	43.67	38.72	31.07	80.47	202.56	6.35	9.65
F_3	24.13	24.16	28.33	31.32	39.47	24.33	18.87	77.34	192.56	3.67	5.26
SEm ±	0.23	0.27	0.27	0.27	1.14	0.40	0.33	1.08	1.42	0.08	0.21
CD @ 5%	NS	NS	0.78	0.78	3.31	1.15	0.97	3.14	4.13	0.23	0.62
Interactions (S x F)											
S_1F_1	22.94	24.19	27.14	30.10	44.18	41.59	34.30	82.42	195.00	6.69	33.45
S_1F_2	22.28	23.16	26.06	29.14	42.33	31.33	24.34	77.12	180.44	4.39	21.95
S_1F_3	22.50	22.24	25.24	28.00	43.00	18.00	13.76	76.99	174.22	2.39	11.97
S_2F_1	24.26	26.27	30.26	34.01	48.62	43.66	36.00	82.47	206.00	7.41	16.47
S_2F_2	23.44	26.07	29.21	33.06	45.33	37.66	30.02	79.80	195.00	5.85	13.01
S_2F_3	23.14	25.00	28.05	32.17	35.67	21.67	16.00	74.38	187.00	2.99	6.65
S_3F_1	25.08	26.33	30.04	33.22	46.88	49.00	40.67	82.96	218.00	8.87	9.85
S_3F_2	24.17	26.03	29.16	32.16	44.33	40.00	32.02	80.04	200.00	6.40	7.11
S_3F_3	23.72	27.11	28.23	31.29	38.67	24.00	17.56	73.19	197.56	3.47	3.85
S_4F_1	25.50	24.19	30.26	33.29	47.91	50.67	42.06	83.01	225.33	9.48	5.26
S_4F_2	25.08	23.11	29.21	32.12	43.00	41.00	33.00	80.48	215.11	7.10	3.94
S_4F_3	25.46	24.19	28.05	31.04	40.04	27.00	21.30	79.05	203.00	4.33	2.40
S_5F_1	26.75	24.16	34.00	36.17	48.00	56.08	49.33	88.11	233.11	11.50	3.19
S_5F_2	26.12	23.16	33.11	35.09	43.33	43.59	36.00	84.91	222.22	8.00	2.22
S_5F_3	25.85	22.24	32.05	34.08	40.00	31.00	25.71	83.06	201.00	5.17	1.43
SEm ±	0.52	0.60	0.60	0.60	2.56	0.89	0.75	2.43	3.19	0.17	0.48
CD @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.62	1.70

S1 – 2 m x 1 m (5000 plants/ha)
F1–200:80:150 g NPK/plant (100% RDF)
S2 – 3m x 1.5 m (2222 plants/ha) — F2–150:60:110 g NPK/plant (75% RDF)
S3 – 3 m x 3 m (1111 plants/ha) — F3–100:40:75 g NPK/plant (50% RDF)
S4 – 6 m x 3 m (555 plants/ha)
S5 – 6 m x 6 m (277 plants/ha)

References

1. Bal JS, Dhaliwal GS. High density planting studies in guava. Haryana J. Hort. Sci. 2003; 32(1, 2):19-20.
2. Boswell SB, Naue, EM, Atkin DR. Effect of tree density on fruit quality, temperature, light penetration, growth, and production of old-line "Atwood" Novel Orange trees. J. Amer. Soc. Hort. Sci. 1982; 107(1):60-65.
3. Cardoso E deA, Costa Soares JTA, Silva IS, Da RM, Maracaja PB. Productivity of guava 'Paluma' for each of mineral fertilization. Revista Verde de Agroecologia e Desenvolvimento Sustentavel. 2011; 6(2):149-153.
4. Chundawat BS, Kikani KP, Verma LR, Jadav RG. Studies on hedge row plantation in 'Allahabad Safeda' guava. Indian J Hort. 1992; 49(2):134-137.
5. Deshmukh NA, Lyngdoh P, Jha AK, Patel RK, Deka BC. Comparative study on newly developed guava hybrids with commercial cultivars under mid-hills of NE India. The Bioscan. 2013; 8(4):1467-1470.
6. Dhomane PA, Kadam AS, Lakade SK, Gharge VR. Effect of different sources of nitrogen on growth and yield of guava cv. sardar. Asian J Hort. 2011; 6(1):92-95.
7. Dudi OP, Kumar S, Singh S, Singh D. Effect of urea and FYM on fruit size and yield of Kinnow mandarin. Haryana J Hort. Sci. 2004; 22(3, 4):179-180.
8. Gorakh singh. Application of canopy architecture in high density planting in guava, Indian J Hort. 2011; 43(1):36-43.
9. Kashyap P, Pramanick KK, Meena V. Effect of N and P application on yield and quality of Pomeganate cv. Ganesh under rainfed conditions. Indian J Hort. 2012; 69(3):322-327.
10. Khattak MR, Abdul Latif, Bashir Ahmad, Muhammad Wazir. Effect of different levels of nitrogen, phosphorus and potassium on the growth and yield of guava. Sarhad J of Agri. 2005; 21(2):185-187.
11. Kotur SC, Ramkumar, Singh PH. Influence of nitrogen, phosphorus and potassium on composition of leaf and its relationship with fruit yield in 'Allahabad Safeda' guava (*Psidium guajava*) on an Alfisol. Ind. J of Agril. Sci. 1997; 67(12):568-570.
12. Kumar D, Ahmed N, Verma MK, Dar TA. Growth, yield, quality and leaf nutrient status as influenced by planting densities and varieties of apricot. Indian J Hort. 2013; 70(2):126-130.
13. Kumar Dinesh, Pandey V, Anjaneyulu K, Vishal Nath. Optimization of major nutrients for guava yield and quality under east coastal conditions. Indian J Hort. 2009; 66(1):18-21.
14. Kumar TK, Sen SK, Bhattacharya SP, Battacharjee O. Effect of spacing and variety on plant growth and yield of papaya. Indian Agriculturist. 1989; 33:239-245.
15. Kumawat KL, Sarolia DK, Kaushik RA, Jodha AS. Effect of different spacing on newly planted guava cv. L-49 under ultra high density planting system. Afr. J Agr. Res. 2014; 9(51):3729-3735.
16. Kundu S. Effect of high density planting on growth, flowering and fruiting of guava (*Psidium guajava* L.). Acta Hortic. 2007; 735:26770.
17. Lal G, Sen LN. Effect of N Zn and Mn fertilization on fruit quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda. Haryana J. of Hort. Sci. 2001; 30(3, 4):209-210.
18. Lal S, Tiwari JP, Mahajan AR. Studies on planting systems in guava (*Psidium guajava* L.) cv. Sardar. Acta Hort. 2007; 735:263-266.
19. Lal S, Tiwari JP, Misra KK. Effect of plant spacing and pruning intensity on flowering and fruiting of guava. Ann. Agril. Res. 1996; 17(1):83-89.
20. Leigh Issell. Closer planting of peach trees in Goulburn Valley orchards, Tatura. NY Fruit Quarterly. 1999; 7:26-30.
21. Mitra SK, Bose TK. In: The Fruits of India–Tropical and Sub-tropical, TK Bose and SK Mitra (eds.). Naya Prakash, Calcutta. 1990, 286-301.
22. Patel RK, Yadav DS, Babu KD, Singh A, Yadav RM. Growth, yield and quality of various guava (*Psidium guajava* L.) hybrids/cultivars under mid hills of Meghalaya. Acta Hort. 2007; 735:57-59.
23. Prasad RN, Mali PC. Effect of different levels of nitrogen on quality characters of Pomegranate fruit cv. Jalore seedless., Haryana J. Hort. Sci. 2000; 29(3, 4):186-187.
24. Ramniwas RA, Kaushik DK, Sarolia SP, Sin V. Effect of irrigation and fertigation scheduling on growthand yield of guava (*Psidium guajava* L.) under meadow orcharding. Afr.J. Agric. Res. 2012; **7**(47):6350-6356.
25. Reddy YTN, Kurian RM, Kohli RR, Gorakh Singh. Effect of nitrogen, phosphorous and potassium on growth, yield and quality of 'Totapuri' mango (*Mangifera indica*). Indian Journal of Agricultural Sciences. 2000; 70(7):475-478.
26. Sharma DP, Sharma GR. Effect of foliar application of NPK on growth and yield of guava (*Psidium guajava* L.). Adv. in Plant Sci. 1992; 5:313-315.
27. Sidhu PJS, Kalra SK, Dhaliwal GS, Singh R. Effect of different spacings on vegetative growth and nutrient level in the leaves of guava cv. Allahabad Safeda. Punjab Hort. J. 1992; 32:55-59.
28. Singh G. Meadow-orchard system in guava production. Indian Hort. 2005; 50(1):17-18
29. Singh J, Bal JS. Effect of planting density on tree growth, fruit yield and quality of 'Sardar' guava (*Psidium guajava* L.). J Res. Punjab Agric. Univ. 2002; 39:56-62.
30. Singh G, Singh AK, Mishra D. High density planting in guava. Acta Hortic. 2007; 735:235-41.
31. Sureshkumar T, Girwani A, Satyanarayana Reddy G, Bhagwan A. Studies on Nutrient Management in Custard Apple cv. Balanagar. Acta Hort. 2011, 890.
32. Turner DW, Barkus. The uptake and distribution of mineral nutrients in banana in response of K, Mg and Mn. International Banana News letter. 1982; 5:25.
33. Umashankar, Pathak RA, Pathak RK, Ojha MC. Effects of NPK on the yield and fruit quality of guava cv. Sardar. Prog. Hort. 2002; 34(1):49-55.
34. Zang XP, Tao LX. The application of fertilizer for guava trees. South China Fruits, 2000; 29(6):29-31.