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Growth response of guava (*Psidium guajava* L.) to differential spacing and nutrient management under high density planting system in Kerala

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Abstract
A study was conducted in guava to evaluate the effect of spacing and nutrient level and schedule on the vegetative parameters of guava under HDP system in Kerala. Experiment was laid out in split plot design with four levels of spacing as main plot and six fertilizer level as subplot treatments replicated thrice. The results indicated that plant height was significantly higher in closer spacing of 2.0 m × 1.5 m with 100% of fertilizer dose as per schedule -2 (S_4F_6; 1.23 m; 1.60 m) at 6 and 9 MAP. The highest plant girth (9.30 cm) and canopy spread in N-S direction (105.98 cm) were observed as a result of the interactive effect of 3.0 m × 3.0 m spacing with 100% of fertilizer dose as per schedule -2 (S_1F_6) at 6 MAP while at 9 MAP the highest values were obtained with 3.0 m × 3.0 m with 100% of fertilizer dose as per schedule -1 (S_1F_5) (13.15; 123.44 cm). Canopy spread in E-W direction was the highest in 3.0 m × 3.0 m spacing with 100% of fertilizer dose as per schedule -1 at 6 MAP (99.33 cm) and at 9 MAP 3.0 m x 3.0 m with 100% of fertilizer dose as per schedule -2 recorded the highest values (136.01 cm). Data on primary branch girth, secondary branch girth and pruned biomass showed that interactive effect has no significant effect at 6 and 9 MAP. The least number of days to shoot emergence (5.04) was observed in 3.0 m × 3.0 m with 100% of fertilizer dose as per schedule -2 at 9MAP. In conclusion, the growth parameters were observed to be better at highest spacing and nutrient dose (S_1F_6 and S_1F_5) except the plant height which was observed to be the highest with S_4F_6.

Keywords: Guava, Arka Kiran, plant height, spacing, canopy spread, plant girth, fertilizer, HDP

Introduction

Guava (*Psidium guajava* L.), popularly known as the “apple of the tropics,” ranks fourth in area and production after mango, banana, and citrus. Traditionally, guava is cultivated under conventional planting systems, which often hinder the attainment of optimal productivity. This limitation is primarily due to the large canopy size of the trees, resulting in lower yield per unit area and increased labour requirements (Singh *et al*., 2003) [20]. In addition, such trees require several years to reach the bearing stage, thereby increasing the overall production cost per unit area. Maximizing productivity necessitates the adoption of modern and efficient production practices. Key strategies include utilizing high-quality planting material, optimizing planting density, implementing scientific canopy management techniques, and enhancing support and input management systems. High density planting not only enhances yield and economic returns per unit area during the initial years but also ensures more efficient utilization of available inputs (Reddy, 2004) [18]. Effective nutrient management plays a crucial role in sustaining productivity under high density systems. The nutrient requirement of guava varies across regions depending on soil characteristics and climatic conditions, which influence plant growth and flushing patterns. Guava is highly responsive to inorganic fertilizer application, and a balanced supply of nitrogen, phosphorus, and potassium is essential for optimal growth and fruit production (Kumar *et al.*, 2009) [11]. However, standardized recommendations for major nutrient application under high density planting system are yet to be established for local agroclimatic regions. Hence, the primary objective of the study was to evaluate the effect of spacing and nutrient levels and schedules on the vegetative parameters of guava under high density planting system in Kerala.

Materials and Methods

The field experiment was conducted at the Department of Fruit Science, College of Agriculture, Vellayani during the year 2023 - 2025. The primary objective of the study was to evaluate the effect of spacing and nutrient levels and schedules on vegetative parameters of guava under high density planting system. The area is situated at 8º 43' North Latitude and 76º 54' East Longitude at an altitude of 29 m above mean sea level. Four months old layers of guava variety Arka Kiran, a pink fleshed hybrid (Kamsari × Purple Local) released by the ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru was use for the study. Experiment was laid out in split plot design with four main plot treatments and six subplot treatments replicated three times. Main plot treatments included four levels of spacing (S); S_1 - 3.0 m × 3.0 m, S_2 - 3.0 m × 1.5 m, S_3 - 2.0 m × 2.0 m and S_4 -2.0 m × 1.5 m. Subplot treatments included six levels of fertilizer dose and schedule (F); F_1 - 50% of fertilizer dose as per schedule -1, F_2 - 50% of fertilizer dose as per schedule -2, F_3 - 75% of fertilizer dose as per schedule -1, F_4 - 75% of fertilizer dose as per schedule -2, F_5 - 100% of fertilizer dose as per schedule-1 and F_6 - 100% of fertilizer dose as per schedule -2. Fertilizer doses were given based on KAU package of practices recommendations: Crops (KAU, 2016) [7]. For first year, 1/5th of RDF was given based on soil test data. In schedule 1 fertilizers were applied after each pruning in three equal splits. Table1 indicates schedule 2.

Each subplot contained six plants which were maintained under uniform condition of orchard management system during the study period. All agronomic practices were carried out as per package of practices of KAU. First pruning was done at around 3 MAP maintaining a height of 45 to 60 cm, 3-4 primary branches were retained, second pruning was done after three months to primary branches by removing 50% of their length. Three secondary branches were retained. Third pruning was given after 3 months to secondary branches by removing 50% of their length. Three tertiary branches were retained.

Observations recorded

Vegetative parameters such as plant height (m) was measured using measuring tape in centimeters from soil level to the tip of the growing point and average was calculated, stem girth (cm) of the plant was recorded as circumference in centimeters 5-10 cm above soil level using a measuring tape and average was calculated, canopy spread (North -South direction (cm), East - West direction (cm)) was determined by measuring the widest horizontal distance between the outermost branches of each plant, encompassing the entire canopy using a measuring scale, circumference of the primary and secondary branches were measured and expressed in centimeters (cm), and pruned biomass (kg) was measured using weighing balance after each pruning and days to shoot emergence after each pruning was counted.

Results and Discussion

Plant height: The tallest plants were observed under S_1 - 3.0 m × 3.0 m (0.66 m) at 3 MAP and it was on par with S_4 - 2.0 m × 1.5 m (0.65 m), S_4 spacing at 6 MAP (1.08 m) and 9 MAP (1.42 m). The least plant height was observed in S_1 (0.83m and 1.17m respectively) at 6 MAP and 9 MAP. Among different fertilizer doses, the tallest plants were observed in F_2 (0.61 m) at 3 MAP. While at 6 MAP and 9 MAP the highest plant height was observed in F_6 - 100% of fertilizer dose as per schedule -2 (1.08 m, 1.45 m). The shortest plant height was observed in F_1 (0.86 m and 1.17 m respectively) at 6 MAP and 9 MAP. Among the interaction, S_4F_6 (3.0 m × 3.0 m with 100% of fertilizer dose as per schedule -2) recorded the highest plant height (0.75 m, 1.23 m) at 3 MAP and 6 MAP. At nine months after planting also S_4F_6 (1.60) recorded the highest plant height and it was on par with S_4F_5.

The observed increase in plant height under higher planting density may be attributed not only to competition among plants, primarily for light, but also for water and soil nutrients (Johnson and Robinson, 2000; Policarpo *et al.*, 2006) [6, 16]. Under closer spacing, overlapping canopies reduce light penetration to the leaves, thereby limiting photosynthetic efficiency and carbohydrate synthesis essential for growth (Policarpo *et al*., 2006) [16]. As a result, intense competition for resources under high density leads to reduced shoot growth after pruning. The growth parameters were observed to be enhanced by the application of nutrients in the present investigation. This response may be attributed to the role of mineral fertilizers in enriching soil nutrient status, which in turn facilitated uptake by plant roots and supported various metabolic processes during growth (Baviskar *et al.*, 2018) [3]. These observations are consistent with the findings of Tripathy *et al*. (2015) [28] and Singh *et al.* (2016) [26].

Plant girth: Among the spacings S_1 - 3.0 m × 3.0 m (7.66 cm) recorded a greater plant girth and it was on par with S_2 (7.42 cm) at six months after planting. Similar trend was noted at nine months after planting also *i.e.* S_1 (12.15 cm). With respect to fertilizer application highest plant girth was recorded by F_6 - 100% of fertilizer dose as per schedule -2 (8.57 cm) and it was on par with F_5 - 100% of fertilizer dose as per schedule - 1 (8.39 cm) at six months after planting. Similar trend was noted at the 9 MAP also *i.e.* F_6 (12.18 cm). Among the interaction effect, S_1F_4 (4.44 cm) recorded the highest plant girth and it was on par with S_1F_3, S_1F_1, S_1F_2, S_3F_2 and S_1 F_6 (3.94, 3.82, 3.78, 3.78 and 3.63 cm) at 3 MAP. At 6 MAP, S_1F_6 (9.30 cm) recorded the highest plant girth, and it was on par with S_1F_5, S_2F_5 (8.87 cm and 8.67 cm respectively) (Table 2). At nine months after planting also S_1F_5 (13.15 cm) recorded the highest plant girth and it was on par with S_1F_6 (13.13 cm).

Increased plant girth in higher plant spacing may be due to less competition between plants for moisture, nutrients and sunlight. Similar observations were made by Singh and Bal (2002) [24], Bal and Dhaliwal (2003) [2]. This response may be attributed to greater photosynthetic activity and higher chlorophyll content in the leaves of trees planted at wider distances. The absorption of nitrogen and phosphorus likely facilitated the synthesis of proteins and amino acids, contributing to the development of new tissues. Furthermore, the application of balanced nutrient doses appeared to stimulate indole-3-acetic acid (IAA) production, which promoted cell division and consequently resulted in increased stem girth.

E W Direction (cm)

The highest plant spread at E-W Direction was noticed in S_1 (35.75 cm) at 3 MAP. S_1 (84.15 cm and 120.08 cm) recorded higher plant spread at 6 MAP and 9 MAP. Results obtained from the individual effect of fertilizer application level revealed that F_3 (36.91cm) recorded the highest plant spread at 3 MAP. Highest plant spread was recorded on F_5 (88.49 cm) at 6 MAP. However, at 9 MAP it was recorded on F_6 (120.23 cm). Among the interaction, S_1F_5 (99.33 cm) was superior and it was on par with S_1F_6 (94.33 cm) at 6 MAP and at 9 MAP S_1F_6 (136.01 cm) recorded higher plant spread (Table 3).

Greater plant spread under wider spacing may be attributed to enhanced inter-row distance, which facilitates improved light interception (Leigh, 1999) [13]. Conversely, reduced plant growth was observed under closer spacing, primarily due to reduced light penetration into the canopy and restricted apical growth, ultimately limiting overall plant vigour. Similar observations on the influence of plant spacing in guava have been reported by Pratibha *et al.* (2013) [17] and Pal and Lal (2015) [15].

N-S Direction (cm): Individual effect of spacing on plant spread revealed that planting in S_1 spacing resulted in the highest plant spread in N-S direction at 3 MAP (42.59 cm), 6 MAP (81.94 cm) and 9 MAP (102.72 cm) which were significantly different from other spacing treatments except at 9 MAP, where S_2 (99.63 cm) was on par. Plant spread was recorded to be the lowest for S_3 at 3 MAP (23.81 cm), and S_4 at 6 MAP (66.25 cm) and 9 MAP (76.18 cm). The different fertilizer doses showed significant variation where F_3 (35.66 cm) recorded higher plant spread in N-S direction at 3 MAP, F_6 (96.16 cm) recorded the highest plant spread in N-S direction at 6 MAP and F_5 (104.16 cm) recorded the highest plant spread in N-S direction at 9 MAP and this was on par with F_6 (102.30 cm). Plant spread was recorded to be the least in F_1 at 3 MAP, 6 MAP and 9 MAP (21.94 cm, 53.13 cm, and 73.25 cm). The interaction effect revealed that significant difference was observed among the treatments at 6 MAP and 9 MAP. Plant spread was the highest for S_1F_6 (105.98 cm) which was on par with S_1F_5 (100.55 cm) and S_2F_6 (99.22 cm) at 6 MAP. However, S_1F_5 (123.44 cm) recorded the highest plant spread at 9 MAP and it was on par with S_2F_5 (117.22 cm) and S_1F_6 (110.66 cm). Baviskar *et al*. (2018) [3] observed that application of nitrogen, phosphorus, and potassium has been reported to significantly enhance the vegetative growth of guava plants.

Primary branch girth (cm): Primary branch girth of the plant did not show any significant difference at different spacings at 3 MAP, 6 MAP and 9 MAP. Fertilizer dose significantly influenced primary branch girth in guava at 6 MAP and 9 MAP. 100% of fertilizer dose as per schedule-1 (F_5) registered the highest primary branch girth at 6 MAP (4.50 cm), and 9 MAP (7.21 cm), which was significantly different from other spacing treatments except at 6 MAP where F_6 (4.39 cm) is found to be on par. The interaction level of spacing and fertilizer dose did not show any significant variation among the treatments at any observational stage (Table 5).

Secondary branch girth (cm): Spacing did not show any significant variation in the secondary branch girth at 3 MAP. S_1 (3.46 cm) spacing showed the highest secondary branch girth and it was on par with S_2 (3.45 cm) at 9 MAP. Different doses of fertilizer and interaction effect of spacing and fertilizer dose did not show any significant variation among the treatments at 3 and 9 MAP.

Pruned biomass (kg): Different levels of spacing did not express any significant difference among the treatments. Application of 100% of fertilizer dose as per schedule-2 (F_6) recorded higher pruned biomass at 6 MAP (0.16 kg) and 9 MAP (0.26 kg) and it was on par with 100% of fertilizer dose as per schedule-1 (F_5, 0.15 kg and 0.22 kg). The interaction level of spacing and fertilizer application level did not show any significant variation among the treatments at all observation stages (Table 5). In guava and other perennial fruit crops, the application of higher fertilizer doses has been shown to increase pruned biomass, primarily through the stimulation of vegetative growth. Adequate nutrient supply, particularly of nitrogen, phosphorus, and potassium, enhances cell division, shoot elongation, and lateral branching, thereby contributing to the development of a denser canopy (Sharma *et al*., 2013) [19]. Improved nutrient availability also increases leaf area and chlorophyll content, resulting in greater photosynthetic efficiency and assimilate production, which ultimately leads to higher biomass accumulation (Kumar *et al*., 2017) [9].

Days to shoot emergence: Spacing did not show any significant variation in the days to shoot emergence at 3 MAP and 6 MAP. S_1 (6.16) treatment resulted in the least number of days to shoot emergence at 9 MAP followed by S_2 (6.49). Fertilizer dose significantly influenced days to shoot emergence in guava i.e. emergence of primaries after first pruning and secondaries after second pruning). F_6 showed the least number of days to shoot emergence after first (6.32) and second (5.86) pruning and after second pruning F_6 was on par with F_5 (6.57). The interaction effects of spacings and fertilizer doses showed significant variation among the treatments during 9 MAP. S_1F_6 (5.04) recorded the least number of days to shoot emergence followed by S_2F_6 (5.67).

Table 1: Schedule 2

Time of application	N%)	P (%)	K (%)
After first pruning	40	100	20
After second pruning	30	_	30
After third pruning	30	_	50
Total	100	100	100

Table 2: Effect of spacing and fertilizer dose on plant height and plant girth at 3 MAP, 6 MAP and 9 MAP

Treatments	Plant height (m)			Plant girth (cm)		
	3 MAP	6MAP	9MAP	3 MAP	6MAP	9MAP
Spacing level (S)						
S_1	0.66	0.83	1.17	3.86	7.66	12.15
S_2	0.38	0.93	1.27	2.67	7.42	11.47
S_3	0.52	1.01	1.33	2.86	7.04	10.63
S_4	0.65	1.08	1.42	3.40	7.03	9.77
S.Em (+)	0.034	0.004	0.008	0.32	0.114	0.085

CD (0.05)	0.119	0.015	0.027	NS	0.395	0.296
Fertilizer dose (F)						
F_1	0.54	0.86	1.17	3.24	6.14	9.71
F_2	0.61	0.90	1.19	3.52	5.95	10.19
F_3	0.57	0.94	1.23	3.22	7.18	10.88
F_4	0.55	0.98	1.33	3.18	7.49	11.27
F_5	0.47	1.01	1.41	2.97	8.39	11.80
F_6	0.57	1.08	1.45	3.05	8.57	12.18
S.Em (+)	0.021	0.003	0.009	0.14	0.127	0.059
CD (0.05)	0.062	0.010	0.028	NS	0.364	0.169
Interaction (S x F)						
S_1F_1	0.75	0.76	1.14	3.82	6.49	10.51
S_1F_2	0.67	0.78	1.07	3.78	6.63	11.29
S_1F_3	0.59	0.80	1.04	3.94	7.32	12.2
S_1F_4	0.70	0.84	1.21	4.44	7.37	12.63
S_1F_5	0.65	0.86	1.26	3.55	8.87	13.15
S_1F_6	0.62	0.96	1.32	3.63	9.30	13.13
S_2F_1	0.30	0.86	1.16	3.45	6.67	10.16
S_2F_2	0.41	0.87	1.22	3.04	6.26	10.46
S_2F_3	0.46	0.89	1.23	2.7	7.09	11.60
S_2F_4	0.30	0.93	1.31	1.88	7.33	11.63
S_2F_5	0.29	0.98	1.33	1.97	8.67	12.61
S_2F_6	0.49	1.03	1.35	2.99	8.53	12.38
S_3F_1	0.49	0.90	1.16	2.68	6.23	9.50
S_3F_2	0.60	0.97	1.21	3.78	5.67	9.90
S_3F_3	0.66	1.01	1.27	2.89	6.83	10.49
S_3F_4	0.62	1.02	1.34	3.01	7.29	10.84
S_3F_5	0.32	1.03	1.46	2.69	8.03	11.16
S_3F_6	0.75	1.12	1.52	2.09	8.21	11.92
S_4F_1	0.60	0.92	1.22	3.01	5.20	8.70
S_4F_2	0.75	1.00	1.28	3.50	5.27	9.11
S_4F_3	0.57	1.05	1.38	3.35	7.50	9.24
S_4F_4	0.59	1.12	1.47	3.40	7.98	10.00
S_4F_5	0.63	1.18	1.58	3.68	8.01	10.27
S_4F_6	0.75	1.23	1.60	3.49	8.24	11.31
S.Em (+)	0.043	0.007	0.019	0.29	0.255	0.118
CD (0.05)	0.124	0.020	0.058	0.84	0.729	0.338

Table 3: Effect of spacing and fertilizer dose on E-W direction and N-S direction at 3 MAP, 6 MAP and 9 MAP

Treatments	E W Direction (cm)			N S Direction (cm)		
	3 MAP	6MAP	9MAP	3 MAP	6MAP	9MAP
Spacing level (S)						
S_1	35.75	84.15	120.08	42.59	81.94	102.72
S_2	22.57	78.79	112.51	26.32	73.92	99.63
S_3	27.16	75.37	98.90	23.81	69.74	79.27
S_4	30.23	69.66	85.10	25.92	66.25	76.18
S.Em (+)	2.420	0.956	0.178	2.910	0.768	1.941
CD (0.05)	8.40	3.309	0.617	10.07	2.657	6.718
Fertilizer dose (F)						
F_1	17.49	63.10	87.88	21.94	53.13	73.25
F_2	34.58	67.80	95.01	31.74	56.36	80.10
F_3	36.91	79.66	101.38	35.66	72.33	83.69
F_4	33.30	78.16	106.01	30.91	70.22	93.19
F_5	23.71	88.49	114.39	27.66	89.58	104.16
F_6	27.58	84.75	120.23	30.05	96.16	102.30
S.Em (+)	3.070	0.858	0.240	2.820	1.635	2.409
CD (0.05)	8.770	2.455	0.688	8.07	4.674	6.886
Interaction (S x F)						
S_1F_1	15.22	69	101.39	39.33	55.11	94.89
S_1F_2	43.77	73.28	107.58	43.55	63.78	98.66
S_1F_3	42.55	89	120.76	49.55	89.34	87.88
S_1F_4	39.66	80	123.54	41.55	76.89	100.78
S_1F_5	41.66	99.33	131.23	39.66	100.55	123.44
S_1F_6	31.66	94.33	136.01	41.88	105.98	110.66
S_2F_1	24.66	61.75	98.00	25.77	54.55	76.22
S_2F_2	20.21	70.33	106.22	23.88	58.22	88.44
S_2F_3	31.44	82.33	110.40	35.44	74.43	103.33
S_2F_4	22.88	82.99	114.66	29.55	71.89	105.00

S_2F_5	11.55	89.99	121.03	18.44	85.22	117.22
S_2F_6	24.66	85.37	124.77	24.88	99.22	107.56
S_3F_1	15.77	60.99	80.74	10.77	51.64	67.55
S_3F_2	43.11	71.61	90.99	35.99	56.91	70.66
S_3F_3	38.99	77.00	93.68	31.11	66.78	70.22
S_3F_4	33.77	75.33	100.41	27.44	68.77	85.77
S_3F_5	18.55	88.66	111.5	14.88	86.66	83.99
S_3F_6	12.77	78.67	116.08	22.66	87.66	97.44
S_4F_1	14.33	60.66	71.39	11.88	51.22	54.33
S_4F_2	31.22	56.00	75.27	23.55	46.55	62.66
S_4F_3	34.66	70.33	80.67	26.55	58.77	73.33
S_4F_4	36.88	74.33	85.44	25.10	63.33	81.22
S_4F_5	23.10	76.00	93.78	37.66	85.89	91.99
S_4F_6	41.21	80.66	104.06	30.79	91.77	93.55
S.Em (+)	6.140	1.717	0.481	5.650	3.271	4.818
CD (0.05)	NS	4.909	1.377	NS	9.349	13.772

Table 4: Effect of spacing and fertilizer dose on primary branch girth and secondary branch girth at 3 MAP, 6 MAP and 9 MAP.

Treatments	Primary branch girth (cm)			Secondary branch girth (cm)	
	3 MAP	6MAP	9MAP	3 MAP	9MAP
Spacing level (S)					
S_1	1.92	4.25	6.69	0.56	3.46
S_2	1.97	4.19	6.70	0.49	3.45
S_3	1.80	3.89	6.54	0.31	3.21
S_4	1.91	4.05	6.29	0.44	3.21
S.Em (+)	0.193	0.120	0.106	0.230	0.042
CD (0.05)	NS	NS	NS	NS	0.145
Fertilizer dose (F)					
F_1	1.98	3.75	6.08	0.15	3.29
F_2	2.01	3.76	6.03	0.43	3.13
F_3	1.90	4.10	6.37	0.67	3.34
F_4	1.86	4.08	6.78	0.54	3.28
F_5	1.94	4.50	7.21	0.50	3.45
F_6	1.71	4.39	6.88	0.42	3.51
S.Em (+)	0.127	0.139	0.119	0.160	0.097
CD (0.05)	NS	0.399	0.341	NS	NS
Interaction (S x F)					
S_1F_1	1.71	3.62	6.04	0.00	3.29
S_1F_2	2.21	4.21	6.01	0.45	3.18
S_1F_3	2.27	4.25	6.44	0.68	3.42
S_1F_4	1.80	4.15	7.09	0.47	3.26
S_1F_5	1.65	4.80	7.55	0.91	3.93
S_1F_6	1.88	4.51	7.05	0.83	3.70
S_2F_1	2.39	3.81	6.09	0.63	3.35
S_2F_2	1.88	3.58	5.92	0.39	3.09
S_2F_3	1.93	4.25	6.91	0.58	3.55
S_2F_4	1.93	4.57	6.6	1.13	3.47
S_2F_5	2.37	4.56	7.55	0.00	3.32
S_2F_6	1.32	4.40	7.12	0.22	3.90
S_3F_1	1.60	3.71	6.05	0.00	3.27
S_3F_2	2.11	3.47	6.08	0.68	3.05
S_3F_3	1.54	3.98	6.22	0.43	3.22
S_3F_4	1.92	3.46	6.89	0.20	3.18
S_3F_5	1.95	4.37	7.08	0.43	3.29
S_3F_6	1.69	4.35	6.94	0.16	3.26
S_4F_1	2.20	3.85	6.13	0.00	3.25
S_4F_2	1.83	3.81	6.11	0.20	3.20
S_4F_3	1.88	3.91	5.90	0.98	3.18
S_4F_4	1.82	4.16	6.53	0.36	3.23
S_4F_5	1.78	4.29	6.67	0.66	3.25
S_4F_6	1.97	4.29	6.4	0.47	3.18
S.Em (+)	0.255	0.279	0.238	0.320	0.195
CD (0.05)	NS	NS	NS	NS	NS

Table 5: Effect of spacing and fertilizer dose on pruned biomass and days to shoot emergence at 3 MAP, 6 MAP and 9 MAP.

Treatments	Pruned biomass (kg)			Days to shoot emergence		
	3 MAP	6MAP	9MAP	3 MAP	9MAP	9MAP
Spacing level (S)						
S_1	0.19	0.14	0.22	7.16	6.98	6.16
S_2	0.04	0.11	0.19	7.22	6.96	6.49
S_3	0.04	0.11	0.16	7.22	6.93	6.88
S_4	0.05	0.10	0.13	7.27	7.16	7.45
S.Em (+)	0.057	0.023	0.020	0.161	0.054	0.048
CD (0.05)	NS	NS	NS	NS	NS	0.166
Fertilizer dose (F)						
F_1	0.04	0.07	0.10	7.58	7.78	7.56
F_2	0.25	0.07	0.13	7.50	7.67	7.16
F_3	0.05	0.11	0.17	7.58	7.00	6.91
F_4	0.05	0.12	0.17	7.08	6.70	6.64
F_5	0.03	0.15	0.22	6.75	6.57	6.32
F_6	0.04	0.16	0.26	6.83	6.32	5.86
S.Em (+)	0.080	0.012	0.028	0.266	0.124	0.040
CD (0.05)	NS	0.036	0.080	NS	0.356	0.114
Interaction (S x F)						
S_1F_1	0.07	0.09	0.12	7.66	7.77	7.13
S_1F_2	0.85	0.11	0.16	7.66	7.46	6.55
S_1F_3	0.07	0.13	0.19	7.66	6.89	6.23
S_1F_4	0.07	0.14	0.19	7.00	6.72	6.21
S_1F_5	0.03	0.16	0.25	6.33	6.81	5.77
S_1F_6	0.04	0.19	0.38	6.66	6.22	5.04
S_2F_1	0.03	0.06	0.11	8.00	7.69	7.33
S_2F_2	0.06	0.06	0.14	7.33	7.67	6.92
S_2F_3	0.05	0.11	0.2	7.66	7.55	6.72
S_2F_4	0.04	0.12	0.16	6.33	6.55	6.33
S_2F_5	0.02	0.14	0.26	7.66	6.11	6.00
S_2F_6	0.04	0.16	0.27	6.33	6.19	5.67
S_3F_1	0.03	0.06	0.09	7.33	7.77	7.6
S_3F_2	0.07	0.06	0.10	7.33	7.77	7.2
S_3F_3	0.04	0.10	0.15	7.33	6.72	7.07
S_3F_4	0.05	0.12	0.17	7.66	6.88	6.69
S_3F_5	0.03	0.14	0.19	6.66	6.11	6.53
S_3F_6	0.03	0.15	0.23	7.00	6.33	6.18
S_4F_1	0.03	0.06	0.09	7.33	7.87	8.20
S_4F_2	0.04	0.06	0.12	7.66	7.78	7.97
S_4F_3	0.04	0.10	0.13	7.66	6.84	7.63
S_4F_4	0.04	0.11	0.14	7.33	6.67	7.34
S_4F_5	0.05	0.14	0.16	6.33	7.27	7.01
S_4F_6	0.07	0.15	0.17	7.33	6.55	6.57
S.Em (+)	0.161	0.025	0.056	0.532	0.249	0.080
CD (0.05)	NS	NS	NS	NS	NS	0.266

Conclusion
On the basis of experimental results, it can be concluded that the adoption of the widest plant spacing of 3.0 m × 3.0 m with application of 100% of fertilizer dose as per schedule -1(*i.e.* equal splits) and 100% of fertilizer dose as per schedule -2 resulted in better growth parameters like plant girth, canopy spread (N-S direction and E-W direction), primary branch girth, secondary branch girth and pruned biomass and least number of days to shoot emergence while closer spacing of 2.0 m × 1.5 m with 100% of fertilizer dose as per schedule -2 resulted in the highest plant height in guava under HDP in the humid tropical climatic region of Kerala.

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Conflict of Interest
All authors declared that there is no conflict of interest.

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