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Rani Shiranal
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

SN Patil
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

Kulapati Hipparagi
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

YK Kotikal
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

RK Mesta
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

IB Biradar
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

Correspondence
Rani Shiranal
Deparment of Fruit Science, College of Horticulture, Bagalkot, U.H.S., Bagalkot, Udyangiri, Karnataka, India

Effect of pruning intensities on growth and quality parameters of guava CV. Sardar under different planting densities

Rani Shiranal, SN Patil, Kulapati Hipparagi, YK Kotikal, RK Mesta and IB Biradar

Abstract
An experiment was carried out during *kharif* and *rabi* seasons of 2014 -15 at College of Horticulture, Udyangiri, Bagalkot to study the effect of pruning intensities on growth and yield parameters of guava cv. Sardar under different planting densities. The data revealed that the maximum trunk girth (31.18cm), number of primary branches (3.68), girth of the secondary branches (27.49 mm), E-W canopy spread (2.68 m) and N-S canopy spread (2.63 m) was recorded in wider spacing M6. Similarly, TSS (10.45m ºB)and vitamin C (94.68 mg/100g) but maximum acidity (0.3%) was recorded from closer spacing in M1.In pruning intensities the maximum girth of the plant (28.04 cm) and secondary branches (24.30mm) was recorded on very light pruned shoots in S3 but E-W and N-S canopy spread was maximum (2.43m and 2.64m) in unprunned shoots in S4 and in quality parameters the maximum TSS (10.27ºB)and (11.24ºB)was recorded in S3 during rainy and winter season respectively, similar observations was recorded in acidity also in both the season. The maximu Vit. C in peel and pulp was observed in S1 in both the season. While pruning intensities and its interaction with spacing did not vary significantly with respect to quality parametres.

Keywords: Growth, guava, planting density, pruning intensities, quality

Introduction
Guava (*Psidium guajava* L.) the "apple of tropics" is a popular fruit tree of tropical and sub-tropical climate and is native to the Tropical America stretching from Mexico to Peru. It belongs to the family Myrtaceae. Generally, guava is cultivated through traditional planting system, in which it is very difficult to achieve desirable level of production. Moreover, in this system guava tree takes five to six years to come to commercial bearing. Therefore high density planting provides efficient use of natural resources like land, water and light. Hence, there is overriding need to improve the existing planting system (Singh *et al*. 2000) [7]. There is currently a worldwide trend to plant fruit trees on permanent high density planting orchard and to manipulate tree growth by using canopy management practice to control tree growth patterns and tree shape and maintaining high fruit production of desired size and quality. Pruning has become an essential operation to maintain vigour of trees, fruit productivity and yield in guava. In guava tree, pruning is essential practice to maintain its vigour and productivity as well as to improve the fruit size and fruit yield, ultimately produce more number of fruits with high quality marketable fruits at a low cost. Pruning in guava is pre-requisite for the better growth and yield of fruits because it bears on current season growth and flowers appear in the axils of new leaves. The present study was taken up with the objective to study the effect of pruning intensities on growth and yield of guava under different planting densities.

Material and Methods
The experiment was conducted at College of Horticulture, Udyangiri, Bagalkot, which is situated in northern dry zone of Karnataka (Zone-3) located at 16^0 10^0 North latitude, 74^0 42^0 East longitude and at an altitude of 542.0 meters above the mean sea level. The annual rainfall of 543 mm, mean temperature of 23.04 ºC to 28.80 ºC and the relative humidity of 64.16%. The soil of the experimental location was calcareous and Ph 7.60, EC 0.48 ds/m.

The experiment was laid out in split plot design with 6 planting densities *viz.* M1 (2x2 m), M2 (3x2 m), M3 (3x3 m), M4 (6x2 m), M5 (6x3 m) and M6 (6x6 m) as a main plot and 4 pruning intensities, *viz.* S1- leaving 15cm (severely pruning), S2- leaving 30cm (light pruning), S3- leaving 45cm (very light pruning), S4- control (unprunned shoot) as sub plot treatment with two replications. The planting was done during 2011-12 in the experimental field. Observation on growth and yield parameters were recorded. Trunk girth was measured in Centimeters by wrapping the tape around the trunk 5cm above the ground level. The number of primary branches arising from main stem was counted and recorded in whole number. Girth of the secondary branches was recorded by using verniar calipers and it was expressed in mili meter (mm). The horizontal distance from one end of the canopy to the other end was recorded in two directions *viz.* North – South and East – West with the help of meter tape and it was expressed in meter. The data on number of days taken for fruit set to maturity was recorded by counting the days from fruit set to maturity stage. Fruit was harvested at maturity stage and recorded fruit weight, fruit diameter and yield per tree and yield per hectare. Obtained by multiplying yield (kg/plant) with total number of tree per hectare.

Results and Discussion

All the growth parameters were significantly influenced due to the different spacings treatment (Table 1& 2), plants planted at 6x6m (M1) recorded higher trunk girth (31.18 cm), number of primary branches (3.68) and girth of the secondary branches (27.49mm). The trunk girth and girth of the secondary branches was decreased might be due to competition for light because of insufficient space. The competition between plants for light, water and nutrition under closer spacing resulted lower values of girth. These results are in agreement with the findings of Pandey *et al*. (1997) [4], Prakash *et al*. (2012) [5] and Mahajan. (2004) [2] in guava. The maximum East – West (2.68 m) and North – South canopy spread (2.63m) was also high in wider spacing in 6x6m and the lowest in closer planting 2x2m during rainy season and similar observations were recorded in winter season. Closer planting tended to decrease the canopy spread because at closer planting very little space is left for spread of plant. Similar results were also reported by Singh and Bal (2002) [6] & Kumawat *et al*. (2014) [1] in guava.

Growth parameters also significantly influenced due to the different pruning levels at all the stages of crop growth. The maximum trunk girth (28.04 cm) and girth of the secondary branches (24.30mm) was recorded in very light pruned shoots (S3) and minimum in unprunned shoot S4. Further, E-W & N-S canopy spread (2.43m and 2.64m) was maximum in unprunned shoots (S4) during rainy season and similar trend was recorded in winter season. It is well established fact that severely pruned trees reduce the canopy spread compared to unprunned trees.

Interactions also had significant influence on trunk girth and canopy spread of plant. However, the maximum trunk girth (33 cm) was recorded in very light pruned shoots under wider spacing (M6S3) however, minimum in unprunned shoots under closer spacing (M1S4) and maximum E-W& N-S canopy spread (2.90 m & 2.85m) was observed in unprunned shoots under wider spacing (M6S4) during rainy season and similar trend was recorded during winter season. It is well established fact that unpruned trees with wider spacing produce maximum canopy growth compared to pruned trees.

Spacing treatments differed significantly with concerned to TSS, acidity and vitamin C. The maximum TSS (9.91 ^{0}B and 12.31 ºB), was recorded in wider spacing in M6 followed by M5. However, the minimum TSS (8.9 ^{0}B and 11.00 ºB) was recorded in closer spacing in M1 during rainy season and winter season respectively.

Spacing treatments differed significantly. The maximum acidity (0.41%) was recorded in closer spacing in M1 which was on parwith treatment M2 (0.38 %). However, the minimum Acidity (0.27%) was recorded in wider spacing in M6. Similar trend was recorded in winter season also.

Highest TSS were recorded at wider spacing. Whereas, acidity was maximum at closer spacing. The higher photosynthesis and availability of metabolites due to higher interception of photosynthetically active radiation by individual tree might have improved fruit quality at wider spacing. Similar results were reported by Mehta *et al.* (2006) [3] and Verma *et al*. (2009) [9].

Spacing treatments differed significantly with respect to Vitamin C, The maximum Vitamin C in pulp (100.58mg/100g) and in peel (170.58mg/100g) was recorded in wider spacing in M6 followed by M5 (95.24mg/100g & 160.84 mg/100g respectively). However, the minimum Vitamin C in pulp (68.34 mg/100g) and in peel (130.49mg/100g) was recorded in closer spacing in M1 followed by M2 (75.30 mg/100g & 137.34 mg/100g respectively). Similar trend was recorded in winter season also. The higher photosynthesis and availability of metabolites due to higher interception of photosyntheticaly active radiation by individual tree might have improved fruit quality at wider spacing.

Pruning treatments also had significant influence on TSS. The maximum TSS (10.27 ºB) was recorded from S3 followed by S2 (9.8 ºB). However, minimum (9.19 ºB) was recorded from S4 followed by S1 (9.49 ºB) during rainy season. Similar trend was recorded from winter season also.

Pruned trees produced significantly higher TSS over the fruits produced by control trees. This may ascribed to the fact that pruned trees have higher leaves: fruit ratio relative to the control trees, there by increasing the TSS due to more metabolites synthesis. Similar results were also reported by Singh and Dhaliwal (2004) [8].

Pruning intensities also differed significantly with respect to acidity of the fruit, the higher per cent of acidity (0.3%) was recorded in S3 followed by S2 (0.26 %). However, the lowest per cent of acidity (0.20%) was recorded in S4 which was on parwith S1 (0.22 %) during rainy season. Similar trend was recorded from winter season also. Severely pruned trees have lesser leaves fruit ratio relative to the light pruned trees, there by decrease the TSS and increase the acidity content in the fruit.

Pruning treatments also had significant influence on Vitamin C. The maximum Vitamin C in pulp (89.50mg/100g) and in peel (163.30mg/100g) was recorded from S1 followed by S2 (84.16 mg/100g & 160.22 mg/100g respectively). However, the minimum vitamin C in pulp (71.83mg/100g) and in peel (151.68mg/100g) was recorded from S4 followed by S3 (80.30 mg/100 g & 156.81mg/100g respectively).Similar trend was recorded from winter season also. Similar results were also reported by Singh and Dhaliwal (2004) [8].

Influence of time of pruning and its interaction with spacing were found to be non-significant with respect to quality parameters.

Table 1: Effect of pruning intensities on trunk girth, number of primary branches and girth of secondary branches of guava cv. Sardar under different planting densities during rainy season.

Treatments	Trunk girth (cm)					No. of primary branch					Girth of the secondary branches (mm)				
	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean
M1	17.00	17.00	17.00	16.75	16.93	3.00	3.00	3.00	3.00	3.00	16.00	16.25	18.92	11.31	15.62
M2	22.75	22.90	24.00	22.00	22.91	3.00	3.25	3.00	3.00	3.06	21.38	20.68	20.93	13.50	19.12
M3	26.50	29.00	30.50	27.00	28.25	3.00	3.00	3.50	3.25	3.18	22.90	23.01	25.14	19.18	22.56
M4	28.00	31.00	31.75	27.75	29.62	3.25	3.00	3.00	3.25	3.12	23.57	25.20	25.89	18.56	23.30
M5	28.50	31.75	32.00	28.50	30.18	3.75	3.25	3.50	3.25	3.43	25.76	25.24	26.34	22.12	24.86
M6	30.00	32.25	33.00	29.50	31.18	3.75	3.75	3.75	3.50	3.68	27.62	27.69	28.61	26.06	27.49
Mean	25.45	27.31	28.04	25.25	26.51	3.29	3.20	3.29	3.21	3.24	22.87	23.01	24.30	18.45	22.15
	S.Em±		CD 5%			S.Em±		CD 5%			S.Em±		CD 5%		
M	0.95		3.45			0.11		0.40			1.72		6.27		
S	0.21		0.62			0.06		NS			1.05		3.11		
MXS	1.05		3.68			0.17		NS			2.81		NS		

Table 2: Effect of pruning intensity on canopy spread of guava cv. Sardar under different planting densities during rainy and winter season

	Canopy spread(m)																			
	E-W(m)										N-S (m)									
	Rainy season (June-Oct)					Winter Season (Nov - Feb)					Rainy Season (June- Oct)					Winter Season (Nov - Feb)				
Treatments	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean
M1	1.72	1.93	2.23	2.38	2.07	1.85	2.08	2.42	2.44	2.20	1.68	1.85	2.18	2.36	2.02	1.80	2.09	2.37	2.44	2.17
M2	2.19	2.31	2.40	2.38	2.32	2.35	2.45	2.53	2.64	2.49	2.15	2.26	2.35	2.36	2.28	2.31	2.40	2.47	2.61	2.45
M3	2.24	2.37	2.46	2.71	2.44	2.36	2.49	2.6	2.81	2.56	2.19	2.33	2.43	2.67	2.40	2.31	2.45	2.55	2.76	2.52
M4	2.3	2.44	2.50	2.80	2.51	2.43	2.57	2.63	2.92	2.64	2.26	2.38	2.45	2.76	2.46	2.37	2.50	2.59	2.85	2.58
M5	2.41	2.51	2.61	2.85	2.60	2.50	2.60	2.74	2.94	2.69	2.37	2.47	2.56	2.8	2.56	2.46	2.54	2.66	2.92	2.64
M6	2.51	2.63	2.68	2.90	2.68	2.63	2.77	2.82	3.09	2.83	2.46	2.57	2.64	2.85	2.63	2.59	2.71	2.77	3.02	2.77
Mean	2.23	2.36	2.48	2.67	2.43	2.35	2.49	2.62	2.81	2.56	2.18	2.31	2.43	2.64	2.38	2.31	2.45	2.57	2.77	2.52
	SE.m±		CD 5%			SE.m±		CD 5%			SE.m±		CD 5%			SE.m±		CD 5%		
M	0.02		0.08			0.05		0.19			0.02		0.07			0.05		0.19		
S	0.02		0.06			0.01		0.03			0.02		0.05			0.01		0.04		
MXS	0.05		0.15			0.06		0.20			0.04		0.13			0.06		0.20		

											S.Em±		CD 5%		S.Em±		CD 5%			
M											0.04		0.16		0.06		0.21			
S											0.02		0.05		0.02		0.06			
MXS											0.06		0.20		0.07		0.25			

Table 3: Effect of pruning levels on fruit quality of guava cv. Sardar under different planting densities during rainy and winter season

	TSS(ºB)										Acidity (%)									
Treatments	Rainy season (June- Oct)					Winter season(Nov - Feb)					Rainy season (June- Oct)					Winter season(Nov - Feb)				
	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean
M1	8.87	9.27	9.56	8.48	9.04	9.78	10.11	10.52	9.46	9.97	0.28	0.33	0.37	0.24	0.30	0.26	0.30	0.35	0.12	0.29
M2	8.97	9.48	9.78	8.67	9.22	9.92	10.43	10.73	9.68	10.19	0.24	0.3	0.34	0.23	0.27	0.23	0.29	0.33	0.10	0.27
M3	9.39	9.74	10.13	9.12	9.59	10.38	10.75	11.06	10.17	10.59	0.22	0.27	0.31	0.21	0.25	0.21	0.26	0.29	0.09	0.24
M4	9.60	9.77	10.43	9.36	9.79	10.63	10.81	11.32	10.3	10.76	0.20	0.25	0.28	0.19	0.23	0.19	0.24	0.27	0.08	0.22
M5	9.83	10.08	10.63	9.54	10.02	10.89	11.08	11.51	10.47	10.98	0.2	0.23	0.26	0.18	0.21	0.17	0.22	0.25	0.08	0.20
M6	10.26	10.48	11.07	10.01	10.45	11.37	11.62	12.33	11.06	11.59	0.18	0.21	0.24	0.16	0.19	0.15	0.2	0.23	0.07	0.18
Mean	9.49	9.80	10.27	9.19	9.68	10.49	10.80	11.24	10.19	10.68	0.22	0.26	0.30	0.20	0.25	0.20	0.25	0.28	0.18	0.24
	S.Em±		CD 5%			S.Em±		CD 5%			S.Em±		CD 5%			S.Em±		CD 5%		
M	0.02		0.08			0.02		0.06			0.01		0.04			0.01		0.03		
S	0.02		0.07			0.03		0.08			0.01		0.03			0.02		0.06		
MXS	0.05		NS			0.06		NS			0.02		NS			0.04		NS		

Table 4: Effect of pruning levels on Vitamin C of guava cv. Sardar under different planting densities during rainy and winter season

	Vitamin C mg/100g																			
	Pulp										Peel									
	Rainy season (June- Oct)					Winter season(Nov - Feb)					Rainy season (June- Oct)					Winter season(Nov - Feb)				
Treatments	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean	S1	S2	S3	S4	Mean
M1	75.81	72.17	68.68	62.66	69.83	95.63	92.68	88.72	77.69	88.68	145.71	142.72	140.19	122.63	137.81	177.74	172.91	163.13	152.85	166.65
M2	79.81	75.28	72.74	66.71	73.63	99.72	96.25	92.24	81.09	92.32	150.96	148.24	143.73	127.76	142.67	181.14	175.72	169.6	159.82	171.57
M3	85.81	81.27	77.26	69.63	78.49	108.7	103.78	99.82	84.83	99.28	157.66	155.27	152.285	132.71	149.48	190.25	183.98	174.04	167.13	178.85
M4	91.68	86.33	82.73	72.73	83.36	112.77	109.42	103.82	87.85	103.46	167.04	163.72	160.765	139.63	157.79	197.73	191.17	181.00	173.65	185.89
M5	97.24	92.25	87.63	77.63	88.69	119.73	115.74	110.27	92.59	109.58	175.76	172.22	168.225	146.73	165.73	205.24	198.23	187.07	180.62	192.79
M6	106.66	97.69	92.74	81.62	94.68	125.57	121.27	117.42	95.64	114.9	182.66	179.17	175.695	151.68	172.30	214.02	207.56	198.94	186.81	201.83
Mean	89.50	84.16	80.30	71.83	81.44	110.35	106.52	102.05	86.61	101.38	163.30	160.22	156.81	136.85	154.29	194.35	188.26	178.96	170.14	182.29
	S.Em±		CD at 5%			S.Em±		CD at 5%			S.Em±		CD at 5%			S.Em±		CD at 5%		
M	0.36		1.31			0.65		2.38			0.35		1.26			0.49		1.78		
S	0.72		2.13			1.03		3.06			0.82		2.43			0.43		1.28		
MXS	1.56		NS			2.28		NS			1.77		NS			1.03		NS		

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