

## Effect of pruning and growth regulators on physico-chemical characters of guava during rainy season planted at different spacing

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### ABSTRACT

The present investigation were conducted in the Department of Horticulture, Punjab Agricultural University, Ludhiana during 2004-05 to ascertain the effect of pruning (10 and 20 cm) and growth regulators (paclobutrazol and ethephon @ 500 and 1000 ppm) on physico-chemical characters of guava cv. Allahabad Sufeda during rainy season planted with four different spacings (6 x 2 m, 6 x 3 m, 6 x 4 m and 6 x 5 m). Maximum fruit size, palatability rating, TSS and vitamin C were noted in wider spacing (6 x 5 m). Maximum fruit weight and minimum seed number per fruit was recorded in 6 x 3 m and 6 x 5 m, respectively. Minimum seed number per fruit and maximum palatability rating, TSS were observed with ethephon 1000 ppm. Paclobutrazol @ 1000 ppm resulted maximum fruit size and fruit weight. Whereas maximum Vitamin C was found in control in guava fruits. Physical characters like fruit weight was improved at 20 cm level of pruning. Whereas, fruit quality (chemical characters) were noted better at 10 cm level of pruning.

**Key words:** Guava, Spacing, Pruning, Growth regulators, Physico-chemical characters

### INTRODUCTION

Guava is highly prolific and remunerative fruit which grows well under wide range of soil and agroclimatic conditions. In India, it is the fourth major fruit crop and occupies an area of 2.2 lakh ha with an annual production of 17.80 lakh mt (Anon 2005). The fruit is nutritious being rich in vitamin C (200-300 mg/100g of pulp). It also contains a fair source of vitamin A, riboflavin, thiamine and minerals like calcium, phosphorus and iron. Furthermore, guavas are processed commercially into jam, jellies and other products. Under Punjab conditions, guava flowers twice in a year i.e., April-May and July-August and produce about 90 per cent crop in rainy season. In spite of being a popular fruit, meager information is available on suitable planting density for guava. Now, pruning has emerged as a commercial and alternative method for regulating the crop in guava (Lal 1983, Tiwari *et al* 1992). Thus, the pruning may be helpful in reducing the tree size and improving the fruit quality as well. Also, the growth regulators like paclobutrazol helps in controlling the tree size and improves the fruit quality as it restricts the vegetative growth by inhibiting the GA synthesis and shift more carbohydrates from source (vegetative growth) to sink (fruits). Whereas, ethephon acts as a ripening hormone and enhances the ripening process and thus helps in improving the fruit quality.

Keeping in view, the studies were thus planned to see the effect of pruning and growth regulators on physico-chemical characters of guava planted during rainy season at different spacing.

### MATERIALS AND METHODS

Present investigations were carried out in the New Orchard, Department of Horticulture, Punjab Agricultural University, Ludhiana during 2004-05 on one year old plants of guava cv. Allahabad Sufeda raised on 'Sardar' guava rootstock. The plantation was made with four different spacings viz., 6 x 2 m, 6 x 3 m, 6 x 4 m and 6 x 5 m having three replications. The plants were pruned in March, 2004 by removing the terminal part of branch up to 10 and 20 cm. Then, the growth regulators viz., paclobutrazol and ethephon @ 500 and 1000 ppm were sprayed on the whole trees after pruning. The data on physical and chemical characters of rainy season fruits were recorded in July-August. The observation of Fruit size (length and breadth), fruit weight and number of seeds per fruit were recorded. Palatability rating in terms of general appearance, taste and flavour were recorded by panel of five judges and evaluation was made out of 20 points. Total soluble solids were determined with the help of Bausch and Lomb hand refractometer in terms of degree Brix. The values of TSS were corrected at 20°C. The acidity was estimated by titrating a known volume of pulp against 0.1 N NaOH using

phenolphthalein as an indicator. The results were expressed in percentage of citric acid. Vitamin C was recorded according to the method of AOAC (1990).

### RESULTS AND DISCUSSION

#### Physical Characters

##### Fruit size :

Spacing had significant effect on fruit length as well as on fruit breadth (Table 1,2). The mean maximum fruit size was recorded in wider spacing of 6 x 5 m i.e. (6.7 cm and 6.3 cm length and 6.8 cm and 6.2 cm breadth) at 10 cm and 20 cm pruning levels, respectively. The average minimum fruit size was observed in closer spacing of 6 x 2 m. The results obtained by Mitra and Bose (1990), Sidhu *et al* (1992), Lal *et al* (2000), Singh and Bal (2002) and Bal and Dhaliwal (2003) in guava are in agreement with the present investigation. The maximum mean fruit length was observed with paclobutrazol 1000 ppm (5.8 cm) and minimum with ethephon 1000 ppm (5.1 cm) at 10 cm pruning level. The maximum average fruit length at 20 cm pruning was noted with paclobutrazol 1000 and ethephon 500 ppm (5.7 cm) and minimum with paclobutrazol 500 ppm and control (5.4 cm). The mean maximum fruit breadth was obtained with paclobutrazol 1000 ppm i.e. 5.7 cm and 5.6 cm at 10 cm and 20 cm level of pruning, respectively. The average least fruit breadth at 10 cm pruning level was noted with paclobutrazol 500 and ethephon 1000 ppm (5.3 cm). Control at 20 cm pruning level produced the least average fruit breadth of 5.2 cm. Pruning level had no significant effect on fruit size of guava. The interactions between pruning x spacing x PGR treatments with regard to fruit length and fruit breadth was found significant. The wider spacing of 6 x 5 m gave maximum fruit length (7.2 cm) and fruit breadth (7.4 cm) with paclobutrazol 1000 ppm. The minimum fruit length was noted with paclobutrazol 500 ppm in 6 x 4 m (4.6 cm) spacing at 10 cm level of pruning and minimum with ethephon 1000 ppm in 6 x 2 m (4.8 cm) at 10 cm and 20 cm level of pruning, respectively.

##### Fruit weight :

The fruit weight was obtained maximum in 6 x 3 m spacing i.e. 110.9 g at 10 cm and 115.3 g at 20 cm pruning level (Table 3). The minimum fruit weight was observed in 6 x 4 m (88.3 g at 10 cm) spacing and in 6 x 2 m (94.9g at 20 cm) spacing. The similar results were obtained by Sidhu *et al* (1992) in Allahabad Sufeda, Singh and Bal (2002) and Bal and Dhaliwal (2003) in Sardar guava, who reported maximum fruit weight in widely spaced trees. An average maximum fruit weight of 124.8 g and 119.2 g was obtained, when the plants were sprayed with paclobutrazol 1000 ppm at both the levels of

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Table 1: Effect of growth regulators and pruning levels on fruit length (cm) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
	6x2m	6x3m	10 cm					20 cm		
			6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	4.7	5.1	4.6	6.7	5.2	5.2	5.6	5.2	5.8	5.4
Paclobutrazol 1000 ppm	5.5	5.1	5.5	7.2	5.8	6.0	5.5	5.3	6.1	5.7
Ethephon 500 ppm	5.1	5.1	4.7	7.1	5.5	5.3	5.3	5.3	6.9	5.7
Ethephon 1000 ppm	4.6	5.2	4.7	6.1	5.1	4.6	5.2	5.5	6.8	5.5
Control	5.3	5.5	4.9	6.3	5.5	5.3	5.5	4.9	6.0	5.4
Mean	5.0	5.2	4.8	6.7	5.4	5.2	5.4	5.2	6.3	5.5

CD at 5%      Pruning level (A) : NS,      Spacing (B) : 0.16,      Treatments (C) : 0.18,      Interactions: A x B x C : 0.53

Table 2 : Effect of growth regulators and pruning levels on fruit breadth (cm) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
	6x2m	6x3m	10 cm					20 cm		
			6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	4.9	5.0	4.8	6.7	5.3	5.3	5.5	5.6	5.8	5.5
Paclobutrazol 1000 ppm	5.2	4.8	5.5	7.4	5.7	5.6	5.3	5.7	6.1	5.6
Ethephon 500 ppm	5.0	5.4	5.1	7.2	5.6	4.9	5.3	5.4	7.1	5.6
Ethephon 1000 ppm	5.0	5.2	4.9	6.2	5.3	4.8	5.2	5.5	6.6	5.5
Control	4.9	5.2	5.0	6.6	5.4	4.9	5.2	5.0	5.9	5.2
Mean	5.0	5.1	5.0	6.8	5.5	5.1	5.3	5.4	6.2	5.6

CD at 5%      Pruning level (A) : NS,      Spacing (B) : 0.07,      Treatments (C) : 0.08,      Interactions : A x B x C : 0.23

Table 3 : Effect of growth regulators and pruning levels on fruit weight (g) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
	6x2m	6x3m	10 cm					20 cm		
			6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	93.2	122.2	79.0	51.8	86.5	101.5	130.2	100.4	79.0	102.8
Paclobutrazol 1000 ppm	102.7	113.9	125.1	157.5	124.8	100.7	121.3	132.0	112.8	119.2
Ethephon 500 ppm	102.9	101.5	98.5	96.3	99.8	101.9	101.7	98.0	154.7	114.1
Ethephon 1000 ppm	74.3	117.8	57.7	113.6	90.8	76.0	124.2	121.9	113.9	109.0
Control	84.1	99.3	81.2	52.3	79.2	84.1	99.3	81.2	52.3	79.2
Mean	91.4	110.9	88.3	94.3	96.2	94.9	115.3	106.7	102.5	104.9

CD at 5%      Pruning level (A) : 1.53,      Spacing (B) : 2.17,      Treatments (C) : 2.42,      Interactions : A x B x C : 6.87

Table 4 : Effect of growth regulators and pruning levels on seed no. per fruit in rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
			10 cm				20 cm			
	6x2m	6x3m	6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	213.3	226.0	223.0	152.3	203.3	233.3	246.0	357.0	117.3	238.4
Paclobutrazol 1000 ppm	232.3	128.0	145.0	122.7	157.0	244.3	129.0	150.3	131.3	163.7
Ethephon 500 ppm	202.0	167.0	231.0	134.0	183.5	191.0	165.0	125.3	168.3	162.4
Ethephon 1000 ppm	138.0	184.3	121.3	195.0	159.7	133.3	181.0	167.3	117.7	149.8
Control	120.3	124.3	128.3	191.3	141.1	137.3	127.0	128.3	162.3	138.7
Mean	181.2	165.3	169.7	159.0	169.0	187.9	169.6	185.6	139.5	170.7
CD at 5%	Pruning level (A) : NS,		Spacing (B) : 6.36,		Treatments (C) : 7.11,			Interactions : A x B x C : 20.12		

Table 5 Effect of growth regulators and pruning levels on palatability rating (out of 20) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
			10 cm				20 cm			
	6x2m	6x3m	6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	14.40	13.33	14.33	15.33	14.34	14.41	13.50	14.41	14.00	14.08
Paclobutrazol 1000 ppm	13.91	13.91	14.63	15.23	14.42	13.91	13.67	14.58	14.81	14.24
Ethephon 500 ppm	14.56	14.08	14.66	15.00	14.57	14.50	14.08	14.50	15.33	14.60
Ethephon 1000 ppm	15.23	14.68	14.50	15.33	14.93	14.90	14.51	15.00	14.73	14.78
Control	14.90	14.70	13.75	15.16	14.62	14.91	14.67	13.75	15.16	14.62
Mean	14.60	14.14	14.37	15.21	14.58	14.52	14.08	14.44	14.80	14.46
CD at 5%	Pruning level (A) : NS,		Spacing (B) : 0.19,		Treatments (C) : 0.21,			Interactions : A x B x C : NS		

Table 6 : Effect of growth regulators and pruning levels on TSS (%) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
			10 cm				20 cm			
	6x2m	6x3m	6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	8.43	7.83	8.23	9.23	8.43	8.63	7.83	8.43	8.03	8.23
Paclobutrazol 1000 ppm	8.03	7.83	8.43	9.43	8.43	8.03	7.83	8.23	8.83	8.23
Ethephon 500 ppm	8.23	8.03	9.03	8.23	8.35	8.23	8.23	9.03	8.63	8.53
Ethephon 1000 ppm	8.83	8.43	8.43	8.43	8.53	8.43	8.03	7.23	7.63	8.05
Control	8.63	8.63	7.83	9.03	8.53	8.63	8.63	8.03	9.03	8.55
Mean	8.43	8.15	8.36	8.84	8.42	8.36	8.08	8.20	8.60	8.29
CD at 5%	Pruning level (A) : 0.13,		Spacing (B) : 0.15,		Treatments (C) : 0.17,			Interactions A x B x C : 0.48		

Table 7: Effect of growth regulators and pruning levels on acidity (%) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
			10 cm				20 cm			
	6x2m	6x3m	6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	0.268	0.249	0.249	0.249	0.253	0.288	0.249	0.249	0.211	0.249
Paclobutrazol 1000 ppm	0.268	0.249	0.268	0.249	0.258	0.249	0.249	0.211	0.230	0.234
Ethephon 500 ppm	0.288	0.268	0.211	0.268	0.258	0.268	0.268	0.249	0.249	0.258
Ethephon 1000 ppm	0.249	0.249	0.249	0.249	0.249	0.268	0.230	0.268	0.288	0.263
Control	0.288	0.249	0.211	0.211	0.239	0.288	0.249	0.230	0.230	0.249
Mean	0.272	0.252	0.237	0.245	0.252	0.272	0.249	0.241	0.241	0.251
CD at 5%	Pruning level (A) : NS,		Spacing (B) : 0.016,		Treatments (C) : NS,			Interactions : A x B x C : NS		

Table 8 : Effect of growth regulators and pruning levels on vitamin C (mg/100g pulp) of rainy season guava cv. Allahabad Sufeda, planted in different spacings.

Treatments	Spacings		Pruning levels							
			10 cm				20 cm			
	6x2m	6x3m	6x4m	6x5m	Mean	6x2m	6x3m	6x4m	6x5m	Mean
Paclobutrazol 500 ppm	72.96	72.73	106.70	91.68	86.01	72.16	73.75	91.47	106.92	86.07
Paclobutrazol 1000 ppm	70.78	77.63	75.92	109.42	83.43	70.71	78.63	103.27	112.61	91.30
Ethephon 500 ppm	79.63	83.34	99.93	116.61	94.87	82.15	84.25	88.72	106.22	90.33
Ethephon 1000 ppm	87.41	79.86	101.54	97.49	91.57	89.27	84.01	73.57	97.98	86.20
Control	80.50	107.75	74.40	119.92	95.64	80.50	107.77	74.34	121.27	95.97
Mean	78.25	84.26	91.69	107.02	90.31	78.95	85.68	86.27	109.00	89.98
CD at 5%	Pruning level (A) : NS,		Spacing (B) : 2.99,		Treatments (C) : 3.34,			Interactions : A x B x C : 9.46		

pruning. The average minimum fruit weight was observed in control (79.2 g) at both the levels of pruning. The average fruit weight was found maximum at 20 cm level of pruning (104.9 g). The results obtained are in accordance with Sheikh and Hulmani (1993), who also reported maximum fruit weight in guava in severely pruned branches. Dhaliwal *et al* (2000) obtained maximum fruit weight at 100% pruning level, when pruning was done on 20<sup>th</sup> February and 30<sup>th</sup> May, respectively. Dhaliwal and Kaur (2003) recorded maximum fruit weight at 30 cm pruning level, when the trees were pruned on 30<sup>th</sup> April. The interactions between pruning level x spacing x PGR treatments with respect to fruit weight of guava was found significant. Paclobutrazol 1000 ppm produced maximum fruit weight of 157.5 g and paclobutrazol 500 ppm produced minimum fruit weight of 51.8 g in wider spacing of 6 x 5 m at 10 cm level of pruning.

#### Seed number :

As the spacing between plants was increased, the seed number per fruit was reduced significantly (Table 4). The minimum average seed number was recorded in wider spacing of 6 x 5 m i.e. 159.0 at 10 cm and 139.5 at 20 cm level of pruning. This may be due to poor pollen germination on the stigma due to high temperature etc. Similar results were obtained by Singh and Bal (2002) that the number of seeds per fruit were the least from 6 x 6 m spacing when compared with other spacings i.e. 6 x 4 m and 6 x 5 m in Sardar guava. Minimum

seed number per fruit at both the pruning levels was observed in control during rainy season. Almost the same number of seeds per fruit were counted from both the pruning levels. The interactions between spacing x pruning level x PGR treatments was found significant. Paclobutrazol 500 ppm produced the guava fruits with maximum seed number in 6 x 4 m (357.0) spacing and minimum in 6 x 5 m (117.3) at 20 cm level of pruning.

#### Chemical Characters

##### Palatability rating :

Palatability rating of fruits was recorded maximum from wider spacing of 6 x 5 m i.e. 15.21 and 14.80 (out of 20) at 10 cm and 20 cm level of pruning (Table 5). Similar results were obtained by Singh and Bal (2002), who reported maximum palatability rating of fruits in wider spacing of 6 x 6 m, followed by medium (6 x 5 m) spaced plants. Ethephon 1000 ppm resulted highly palatable fruits i.e. 14.93 and 14.78 at 10 cm and 20 cm level of pruning, respectively. Palatability rating of fruits was recorded more from the trees pruned at 10 cm level.

##### Total soluble solids :

The wider spacing of 6 x 5 m resulted higher average TSS i.e. 8.84 per cent at 10 cm and 8.60 per cent at 20 cm level of pruning

(Table 6). The average least TSS were found in closer spacing of 6 x 3 m i.e. 8.15 per cent and 8.08 per cent at 10 cm and 20 cm pruning level, respectively. These results are in the same line with the results recorded by Gaikwad *et al* (1981) in guava, who obtained significantly lower TSS with higher plant density. Lal *et al* (2000), Singh and Bal (2002) and Bal and Dhaliwal (2003) also reported higher TSS of fruits of guava in wider spacing than closer spacing. Ethephon 1000 ppm and control resulted in maximum TSS in fruits (8.53%) at 10 cm pruning level and with control (8.55%) at 20 cm pruning level. TSS were recorded more in the trees pruned at 10 cm level.

#### Acidity :

The acidity in guava fruits was noted minimum in 6 x 4 m spacing i.e. 0.237% at 10 cm and 0.241% at 20 cm level of pruning (Table 7). The mean maximum acidity was noted in closer spacing of 6 x 2 m (0.272%) at both the levels of pruning. These findings are in agreement with that of Gaikwad *et al* (1981), who reported that the acidity was increased with the increase in planting density in guava. Different treatments and pruning levels had no significant effect on the acidity of fruits.

#### Vitamin C :

Vitamin C content increased with the increase in spacing and was found maximum in wider spacing (6 x 5 m) i.e. 107.2 mg/100 g at 10 cm and 109 mg/100g at 20 cm level of pruning, respectively (Table 8). The mean vitamin C was found minimum in closer spacing of 6 x 2 m i.e. 78.25 mg/100 g at 10 cm and 78.95 mg/100 g at 20 cm level of pruning. Similar results were obtained by Gaikwad *et al* (1981), who found that vitamin C was significantly reduced with the higher plant density in guava. Maximum vitamin C was estimated in guava fruits in control (95.64 and 95.97 mg/100 g at 10 cm and 20 cm level of pruning). The interactions between spacing x pruning level x PGR treatments with regard to vitamin C was found significant. The wider spacing of 6 x 5 m in control produced maximum content of vitamin C (121.27 mg/100 g pulp) in fruits at 20 cm pruning level.

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