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Effect of pruning techniques and fertilizer application on yield and quality of guava (*Psidium guajava* L.) cv. Sardar under Chatrapti Sambhajinagar condition of Maharashtra

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Abstract
The investigation was conducted to investigate impact of pruning techniques and fertilizer application on the quality and yield of guava (*Psidium guajava* L.) cv. Sardar under the climatic conditions of Chatrapati Sambhajinagar (Aurangabad), Maharashtra. Guava, valued for its high nutritional content, is an important tropical fruit grown globally. The experiment involved four levels of pruning (no pruning, 30 cm, 60 cm, 90 cm) and different fertilizer combinations to four-year-old guava plants, with a focus on quality attributes viz. acidity, vitamin C, pectin, and total soluble solids along with yield parameters. Results showed that, pruning at 90 cm with highest level of 1000:400:400 NPK/ g/plant) significantly improved quality and yield, yielding highest fruit quality metrics such as ascorbic acid, pectin content, and soluble solids. The highest yield per plant and hectare were recorded under this treatment, suggesting that on whoa basis the optimal combination of pruning and fertilization enhances both fruit production and quality. The study supports the use of specific pruning and fertilization practices for increasing guava yield and improving fruit quality contributing to better management practices for guava cultivation.

Keywords: Pruning, fertilizer, guava, quantity, TSS

Introduction

Guava (*Psidium guajava* L.), known as the "Apple of the Tropics," is highly valued for its nutritional content, aroma, and flavor. Rich in vitamin C, pectin, calcium, and phosphorus, it is consumed fresh or processed into products like jelly, juice, and jam. Originating from tropical America, guava was introduced to India in the 17th century by Portuguese explorers and is now cultivated globally, thriving in diverse soils and climates.

Guava grows best in tropical and subtropical regions, requiring a temperature range of 23-28 °C and annual rainfall of 1000-2000 mm. The tree, belonging to the Myrtaceae family and is hardy, drought-tolerant, and highly productive with minimal care. Its adaptability and high nutritional value make it a significant fruit crop, ranking fifth in India’s fruit production.

The fruits, borne on current season growth, are rich in vitamin C (100-260 mg/100 g pulp), sugars, and minerals like phosphorus, calcium, and iron. Pruning plays a crucial role in maintaining productivity by stimulating new shoot growth for flowering and fruiting. Proper pruning enhances light penetration, photosynthesis, and fruit quality.

Due to economic importance of guava, the present study investigates the effect of pruning techniques and fertilizer application on the quality and yield of guava (*Psidium guajava* L.) cv. Sardar under Chatrapti Sambhajinagar condition of Maharashtra.

Materials and Methods

Experimental details, materials used, and methodologies followed during the study titled “Impact of pruning and fertilizer Application on the quality and yield of guava cv. Sardar under Chatrapti Sambhajinagar (Aurangabad) condition of Maharashtra” as below.

Treatment Detail

Four-year-old guava orchard of the variety Sardar, planted at a spacing of 5 m × 5 m were utilised for experiment. Pruning was carried out in April.

The treatments consist of four pruning levels viz; at 30 cm, 60 cm, 90 cm, and a control (no pruning) with soil application of N: P_2O_5: K_2O fertilizers at varying levels.

Treatment combinations are as below

Treatment details

Sr. No.	Treatment No	Treatment Detail
1	T_0	No pruning with RDF
2	T_1	Pruning of shoot at 30 cm with Soil application of N: P_2O_5: K_2O @ 900: 300: 300 g/plant.
3	T_2	Pruning of shoot at 30 cm with Soil application of N: P_2O_5: K_2O @ 800: 200: 200 g/plant.
4	T_3	Pruning of shoot at 30 cm with Soil application of N: P_2O_5: K_2O @ 1000: 400: 400 g/plant.
5	T_4	Pruning of shoot at 60 cm with Soil application of N: P_2O_5: K_2O @ 900: 300: 300 g/plant.
6	T_5	Pruning of shoot at 60 cm with Soil application of N: P_2O_5: K_2O @ 800: 200: 200 g/plant.
7	T_6	Pruning of shoot at 60 cm with Soil application of N: P_2O_5: K_2O @ 1000: 400: 400 g/plant.
8	T_7	Pruning of shoot at 90 cm with Soil application of N: P_2O_5: K_2O @ 900: 300: 300 g/plant.
9	T_8	Pruning of shoot at 90 cm with Soil application of N: P_2O_5: K_2O @ 800: 200: 200 g/plant.
10	T_9	Pruning of shoot at 90 cm with Soil application of N: P_2O_5: K_2O @ 1000: 400: 400 g/plant.

Observations Recorded

Observations were recorded primarily on quality and yield characteristics of the fruit.

Chemical Attributes

For estimation of Titrable Acidity, Ascorbic Acid (Vitamin C), Pectin, Total Soluble Solids (TSS), Reducing Sugars, Non-reducing Sugars, Total Sugars attributes procedure developed by rangantha was followed.

Yield Characteristics

1. **Number of Fruits per Plant:** Simply counted and recorded.
2. **Yield per Plant:** Measured by weighing the total fruit harvested from each plant.
3. **Yield per Hectare:** Calculated by multiplying the yield per tree by the number of trees per hectare.

Result and Discussion

1. Titrable Acidity (%)

Data presented in Table shows that, titrable acidity of guava fruits was significantly affected by pruning and fertilizer treatments. The minimum titrable acidity (0.41%) was recorded in treatment T_9 (pruning shoots at 90 cm with soil application of N: P_2O_5: K_2O @ 1000:400:400 g/plant). This was statistically at par with treatment T_7 (0.44%) where pruning was done at 90 cm but with fertilizer applications of 900:300:300 g/plant. In contrast, the maximum titrable acidity (0.67%) was observed in the control (T_0: no pruning with RDF).

Acidity is a crucial quality parameter, especially for fruits like citrus, pomegranate, and aonla. It helps balance sweetness, as overly sugary fruits have shorter storage lives. An optimal blend of acids and sugars is essential for quality fruits. In this study, treatment T_9 demonstrated the lowest acidity, corroborating findings by Nadal and Arola (1995) [17]. The reduction in titrable acidity during ripening is attributed to decreasing malic acid concentrations, as noted by Calo *et al.* (1997) [3] in grapes.

2. Ascorbic Acid (mg/100 g Pulp)

The effect of pruning and fertilizer treatments on ascorbic acid content is presented in Table no. 1. The maximum ascorbic acid content (222.44 mg/100 g pulp) was recorded in treatment T_9 (pruning shoots at 90 cm with soil application of N: P_2O_5: K_2O @ 1000:400:400 g/plant), which was statistically similar to T_7 (216.90 mg/100 g pulp) and T_8 (212.48 mg/100 g pulp) where pruning was done at 90 cm but with fertilizer applications of 900:300:300 g/plant and 800:200:200 g/plant, respectively. The minimum ascorbic acid content (164 mg/100 g pulp) was observed in the control (T_0) which had no pruning and only the recommended dose of fertilizer (RDF) was applied.

Optimal NPK application enhances fruit quality. Phosphorus contributes to phospholipids and nucleic acids, which are integral to cellular structures, while potassium accelerates enzyme activity and the synthesis of complex substances. Nitrogen improves uptake of phosphorus and potassium, supporting chain reactions essential for fruit quality. Similar findings have been reported by Kundu *et al.* (2007) [12], Kumar *et al.* (2008) [11], and Kumar *et al.* (2009) [10] in guava.

3. Pectin (%)

Data on pectin content is presented in Table shows that the highest pectin content (1.66%) was recorded in treatment T_9 (shoots pruning at 90 cm with soil application of N: P_2O_5: K_2O @ 1000:400:400 g/plant), followed by T_7 (1.57%) and T_8 (1.46%) where pruning was done at 90 cm but with fertilizer applications of 900:300:300 g/plant and 800:200:200 g/plant, respectively. all statistically at par with each other. The lowest pectin content (0.58%) was observed in the control (T_0) which had no pruning and only the recommended dose of fertilizer (RDF) was applied.

Higher pectin content during fruit maturation is attributed to enzyme-regulated sugar accumulation and transformation, which maintain the structural framework of the fruit. Pruning improves fruit quality by enhancing sugar content, as supported by Tahir and Kamran (2002) [23].

4. Total Soluble Solids (TSS %)

Table No. 1 highlight the effect of pruning and fertilizers on TSS. The maximum TSS (11.71%) was recorded in treatment T_9 (pruning shoots at 90 cm with soil application of N: P_2O_5: K_2O @ 1000:400:400 g/plant), which was statistically at par with T_7 (11.50%) where pruning was done at 90 cm but with fertilizer applications of N: P_2O_5: K_2O @ 900:300:300 g/plant. The minimum TSS (9.99%) was observed in the control (T_0) which had no pruning and only the recommended dose of fertilizer (RDF) was applied.

Pruning at 90 cm enhances TSS by improving carbohydrate availability and reducing crop load during the rainy season. Fertilizer application also contributes to sugar accumulation and hydrolysis of proteins, as noted by Nateshbeena *et al.* (1993) [18] and Tirkey *et al.* (2003) [24] in bananas. T_9's high TSS is linked to enhanced carbohydrate metabolism and protein synthesis, as reported by Tisdale and Nelson (1966) [25].

5. Total Sugar (%), Reducing Sugar (%) and Non-Reducing Sugar (%)

The maximum total sugar content (8.59%) was recorded in T_9, followed by T_7 (8.39%) and T_8 (8.23%), all statistically at par. The minimum total sugar content (6.50%) was observed in the control (T_0).

Data on reducing sugar content is presented in Table No. 1. Treatment T_9 (pruning shoots at 90 cm with soil application of N: P_2O_5: K_2O @ 1000:400:400 g/plant) recorded the highest reducing sugar content (4.83%), statistically at par with T_7 (4.76%) and T_8 (4.72%) where pruning was done at 90 cm but with fertilizer applications of 900:300:300 g/plant and 800:200:200 g/plant, respectively. The lowest reducing sugar content (3.81%) was observed in the control (T_0) which had no pruning and only the recommended dose of fertilizer (RDF) was applied.

The highest non-reducing sugar content (3.75%) was observed in T_9, followed by T_7 (3.63%) and T_8 (3.52%), all statistically similar. The control (T_0) recorded the lowest non-reducing sugar content (2.69%).

Pruning and fertilization together (T_9) resulted in the highest sugar content in guava fruit. This must be due to a synergistic effect, where pruning improves nutrient transport and photosynthesis, while fertilization provides the necessary nutrients for optimal plant growth and fruit development.

Pruning and fertilization may increase the activity of enzymes like amylase, which breaks down complex carbohydrates into simple sugars, enhancing sugar translocation to the developing fruit.

These results is congruent with Tahir and Kamran (2002) [23], Tisdale *et al.* (1966) [25], Kundu *et al.* (2007) [12], Kumar *et al.* (2008, 2009) [11, 10], have reported similar findings in guava and other fruit crops.

6. Number of Fruits per Plant

The data presented in Table No. 1 highlights the significant differences in the number of fruits per plant, with values ranging from 82.51 to 247.03 based on the application of various pruning and fertilizer treatments. The treatment with the highest number of fruits per plant (247.03) was the pruning of the shoot at 90 cm from the tip, combined with soil application of N: P_2O_5: K_2O at 1000: 400: 400 g/plant (T_9). This treatment was at par with treatments such as T_7 (232.77), T_8 (211.75), T_6 (191.7), and T_4 (177.34). In contrast, the minimum number of fruits was recorded for treatment T_0 (82.51).

Pruning, particularly in combination with appropriate fertilizer application, seems to be enhance fruit production. This effect may be attributed to the pruning treatment stimulating the development of more flowers, possibly by reducing the number of blind flower buds on the tree. The results align with the findings of Bajpai *et al.* (1973) [2], Gopikrishna (1981) [7], and Singh (2001) [22], who observed similar results in guava.

The significant increase in fruit number under T_9 treatment might be attributed to the balanced nitrogen supply which likely promoted the translocation of phytohormones to the shoots, stimulating flower and fruit initiation. This treatment not only enhanced the number of fruits but also led to improve on the other yield parameters, such as the number of shoots, flowers, and fruit set. Consequently, the higher number of fruits per plant and increased single fruit weight contributed to higher overall yield, as also noted by Hanamanth (2002) [8] in mango production.

7. Yield per Plant (kg)

The data in Table No. 1 clearly demonstrates that, the fruit yield per tree varied between 10.94 and 56.18 kg due to different pruning and fertilizer treatments. The highest yield (56.18 kg) was observed in treatment T_9, which involved pruning the shoot at 90 cm combined with the soil application of N: P_2O_5: K_2O at 1000: 400: 400 g/plant. Where as lowest yield (10.14 kg) was recorded in treatment T_0, which had no pruning and used recommended dose of fertilizer (RDF).

Among the treatments, pruning at 90 cm consistently resulted in increased fruit yield. This could be attributed to the plants preparing food during the rainy season, which was then diverted to support fruit development during the winter season. Chandra and Govinda (1995) [4] observed similar results in guava.

The increased yield under treatment T_9 can be attributed to the synchronized supply of water and NPK in the root zone, matching the plant's water and nutrient demands. This balanced nutrient management might have promoted higher fruit yield. These findings align with the work of Singandhupe *et al.* (2003) [21] in tomatoes and Mandal *et al.* (2007) [15] in guava.

The shoot pruning at 90 cm with NPK application might have also contributed to enhanced metabolic responses, including an increase in amino acid content in the leaves. This could have stimulated higher nitrogen turnover in the guava trees. According to Mengel & Kirkby (1987) [16], during nitrogen turnover, the conversion of inorganic nitrogen to organic nitrogen compounds, such as amino acids, proteins, and chlorophyll, is influenced by plant nutrition. Additionally, potassium (K+) plays a significant role in promoting CO_2 assimilation and enhancing photosynthesis by influencing the synthesis of ribulose-bisphosphate carboxylase and reducing CO_2 resistance in the mesophyll (Peoples & Koch, 1979) [19]. Potassium also facilitates phloem loading and the translocation of newly synthesized photosynthetic material, as well as mobilized stored nutrients (Malek and Baker, 1977; Koch & Mengel, 1977) [14, 9]. The combined effect of higher levels of nitrogen and potassium likely increased photosynthesis and nutrient transport, leading to higher guava yields, as observed by Dantas *et al.* (2007) [5].

8. Yield per Hectare (t/ha)

The data presented in Table No. 1on the influence of various pruning and fertilizer treatments on fruit yield per hectare indicates that the yield ranged from 4.37 to 22.47 tons per hectare. The highest yield (22.47 tons/ha) was achieved in treatment T_9, which involved pruning the shoot at 90 cm and applying N: P_2O_5: K_2O at 1000: 400: 400 g/plant. Conversely, the lowest yield (10.94 tons/ha) was recorded in treatment T_0, where no pruning was done, and only the recommended dose of fertilizer (RDF) was applied.

Data reveals that, treatment T_9 was superior in several yield-related parameters, including the number of fruits per plant, average fruit weight, yield per plant, and yield per hectare. This could be attributed to the pruning treatment, which likely diverted the tree's energy from producing cellulose (structural growth) to producing fructose (sugars), enhancing fruit production. Pruning also improves the plant's ability to absorb water, carbon dioxide, and sunlight, which are essential for photosynthesis, leading to higher carbohydrate production. These carbohydrates contribute to the tree's increased yield.

Additionally, pruning increases photosynthetic activity and fruit set by reducing fruit drop, leading to a higher number of fruits. This ultimately results in a higher fruit yield. These findings are consistent with the results of Ghum (2011) [6] in custard apple, Prakash *et al.* (2012) [20], and Adhikari and Kandel (2015) [1] in guava, all of whom observed similar benefits of pruning in enhancing fruit yield.

Table 1: Effect of different pruning intensities and soil nutrient applications on titrable acidity, ascorbic acid, pectin, total soluble solids, sugars, fruit yield, and productivity in guava

Treatment No	Treatment Detail	Titrable acidity (%)	Ascorbic acid (mg/100 g pulp)	Pectin (%)	Total soluble solid (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Number of fruits per plant	Yield per plant (kg)	Yield per hectare (tone/ha)
T_0	No pruning with RDF	0.67	164	0.58	9.99	3.81	2.69	6.50	82.51	10.94	4.37
T_1	Pruning of shoot at 30 cm with Soil application of N: P_2O_5: K_2O @ 900: 300: 300 g/plant.	0.58	191.44	0.97	10.63	4.30	3.05	7.44	133.8	22.1	8.84
T_2	Pruning of shoot at 30 cm with Soil application of N: P_2O_5: K_2O @ 800: 200: 200 g/plant.	0.60	179.36	0.90	10.33	4.23	3.06	7.31	124.64	19.18	7.67
T_3	Pruning of shoot at 30 cm with Soil application of N: P_2O_5: K_2O @ 1000: 400: 400 g/plant.	0.57	194.68	1.06	10.68	4.37	3.19	7.59	140.94	24.72	9.88
T_4	Pruning of shoot at 60 cm with Soil application of N: P_2O_5: K_2O @ 900: 300: 300 g/plant.	0.53	204.53	1.46	10.99	4.56	3.29	7.92	177.34	32.91	13.16
T_5	Pruning of shoot at 60 cm with Soil application of N: P_2O_5: K_2O @ 800: 200: 200 g/plant.	0.546	201.03	1.186	10.89	4.49	3.25	7.74	164.18	29.52	11.80
T_6	Pruning of shoot at 60 cm with Soil application of N: P_2O_5: K_2O @ 1000: 400: 400 g/plant.	0.50	206.82	1.33	11.11	4.61	3.39	8.01	191.7	36.84	14.7
T_7	Pruning of shoot at 90 cm with Soil application of N: P_2O_5: K_2O @ 900: 300: 300 g/plant.	0.44	216.90	1.57	11.50	4.76	3.63	8.39	232.77	50.49	20.19
T_8	Pruning of shoot at 90 cm with Soil application of N: P_2O_5: K_2O @ 800: 200: 200 g/plant.	0.46	212.48	1.47	11.33	4.72	3.52	8.23	211.75	43.74	17.56
T_9	Pruning of shoot at 90 cm with Soil application of N: P_2O_5: K_2O @ 1000: 400: 400 g/plant.	0.41	222.44	1.66	11.71	4.83	3.75	8.59	247.03	56.18	22.47
	SE(m)±	0.01	3.40	0.08	0.11	0.07	0.06	0.14	24.14	1.73	0.69
	CD at 5%	0.04	10.12	0.23	0.32	0.22	0.18	0.40	71.72	5.15	2.05

Conclusion

The study highlights the significant influence of pruning and fertilizer treatments on guava fruit quality and yield. Pruning at 90 cm combined with the soil application of N: P_2O_5: K_2O at 1000:400:400 g/plant (T_9) resulted in the highest yield (22.47 t/ha), maximum ascorbic acid (222.44 mg/100 g), total sugars (8.59%), and total soluble solids (11.71%), with the lowest titrable acidity (0.41%). This suggests that higher pruning intensity and balanced nutrient application improve fruit quality, sugar accumulation, and yield. The findings confirm that strategic pruning enhances carbohydrate metabolism, nutrient uptake, and photosynthesis, ultimately boosting guava productivity. These results can guide optimal agronomic practices for improved guava cultivation.

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