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Studies on growth and yield of shoot pruning in guava (*Psidium Guajava* L.) Cvs. Lalit and Shweta

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Abstract

The present investigation entitled “Studies on growth and yield of shoot pruning in guava (*Psidium guajava* L.) cvs. Lalit and Shweta” was carried out at experimental orchard of Central Research Farm, GSM Division, ICAR-Indian Grassland and Fodder Research Institute, Jhansi during the year 2021-22. The experiment was laid out in Factorial Randomized Block Design with eight treatments replicated thrice with two cultivars Shweta and Lalit, and four levels of pruning (15 cm pruning intensity, 30 cm pruning intensity, 45 cm pruning intensity and no pruning). Shoot pruning of last season twig growth was done during April-May, 2021. The present investigation clearly revealed that 30 cm shoot pruning of last season growth under Bundelkhand region was effective practice to manage the plant canopy area, increased yield per unit area and better the fruit quality. Findings revealed that growth and yield had significant variation among cultivars, pruning levels and interaction between both. The maximum tree height (5.93 m) and number of emerged shoot lets per twig (5.66) was recorded in cv. Shweta with control (unpruned). Maximum tree stem diameter (20.56 cm) and shoot length (25.91 cm) was observed in cv. Lalit with 45 cm pruning level (P₃). The maximum canopy spread (5.93 m), canopy area (7.5 m²) and number of leaves in new shoot (19.12) were recorded in cv. Lalit with control (unpruned). Maximum shoot diameter of new shoot (0.35 cm) was found in cv. Lalit with 15 cm pruning level (P₁) while, the maximum leaf area (57.29 cm²) was recorded in cv. Lalit with 30 cm pruning level (P₂). Maximum number of fruits per shoot (4.16), fruits per plant (443.50), yield per tree (65.10 kg) and yield per hectare (18.03 t/ha) were recorded in cv. Lalit and 30 cm pruning level (P₂). The Maximum fruit size (length 9.34 cm and width 10.70 cm) and fruit weight (198.92g) was recorded in cv. Shweta with 15 cm pruning level (P₁). Here, all the mentioned growth and yield attributes had significant variation. Pruning treatment gave better yield than the control (unpruned). Thus 30 cm shoot pruning of last season growth during April-May was found most effective practice to manage the plant growth, improved the productivity of guava cvs. Lalit and Shweta and fruit quality of guava during winter season under Bundelkhand region.

Keywords: Fruit yield, guava, pruning intensity, tree growth, winter season

Introduction

Guava (*Psidium guajava* L.), a Myrtaceae family member, is a prolific and profitable fruit crop that thrives in a variety of soil and agro-climatic conditions. It has been widely embraced and is widely farmed in India. It has become a significant fruit crop in India, it is produced 4304000 MT of guava from a 287000-ha area with an average productivity of 14.99 t/ha. Out of 99.07 million tonnes of total fruit production, it contributes 4.07% in national fruit basket production (DAFW, 2021). Although, it is grown throughout the India's in tropical and subtropical regions, the major guava growing states are Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Maharashtra, and West Bengal. The Allahabad region of Uttar Pradesh is regarded as one of the world's greatest guava growing regions (Mitra and Sanyal, 2004) [6]. Allahabad is known for producing the highest quality fruits in India and the world (Mitra and Bose, 1985) [5]. In Uttar Pradesh, guava is cultivated in area around 49.53 (000 ha) and it produced 928.44 (000 MT) according to the data (Horticultural statistic at a glance 2018). Guava is one of the important fruit crop of the Bundelkhand region of UP and MP. It is also known as "apple of the plain" and "poor man's apple" due to its low cost of production under varied soil and climatic conditions without much care. Spring (Ambe Bahar), rainy (Mrig Bahar), and autumn (Hasta Bahar) are the three separate flowering

seasons in guava, with the corresponding harvesting times in the rainy, winter, and spring seasons (Rathore and Singh, 1974) ^[11]. The guava crop in the rainy season is rough, insipid, low in quality, and nutrition, and it is affected by a variety of insect pests and illnesses (Radha and Mathew, 2007). Therefore, Mrig bahar guava fruit matures during winter season is commercially taken. Since, guava could produce fruits throughout the year. Fruit matures during summer and rainy season are remains poor in quality and taste. Winter fruits are of higher quality, free of illnesses and pests, and command higher market prices. Winter crops have a longer storage life and can thus be transferred to destinations that pay well (Nautiyal *et al.*, 2016) ^[8].

Guava tree bears flowers and fruits on the current season growth and flowers appear in the axils of new leaves, therefore it responds well to pruning. Unpruned guava trees tend to extend vegetative development, reduced bearing area, and eventually branch become unproductive. As a result, in order to control growth and to get fresh vegetative growth, pruning is beneficial practice in fruit crops (Jawadagi *et al.*, 1996) ^[12]. Increase in the number of current season's shoots by pruning significantly influences productivity of the plant. Guava, being a current season bearing plant, responds favorably to different pruning practices. Shoot pruning increases the number of shoots in a newly pruned plant, which results in early blossoming and more blooms on current emergent branches, resulting in great amounts of flowers. Increasing the number of fruits improves the quality and output of guava, resulting in higher profits (Reddy, 2010) ^[12]. Pruning is the art and science of removing a section of a plant's development to improve its shape, vegetative growth, flowering, fruitfulness, and product quality. Shoot trimming is beneficial for reducing tree size and enhancing fruit quality, as well as increasing the number of trees per unit space.

Materials and Methods

The present study was carried out at the research farm was done at the experimental orchard of the Central Research Farm in the ICAR-Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh. During winter seasons of 2021-2022. Fourteen years old plants of guava *cv.* Lalit and Shweta planted at 6x6 m spacing were selected for the research work. The experiment was laid out in Factorial Randomized Block Design with eight treatments replicated thrice. Pruning of guava shoot was performed during April-May, 2021 (summer season) after harvesting of fruits. As per the technical programme and plants of uniform growth and in good physical condition were selected two varieties viz., Lalit (CISHG-3) and Shweta (CISHG-4) with four pruning intensity; 15 cm above portion of one/more year-old shoot (P₁), 30cm above portion of one/more year-old shoot (P₂), 45cm above portion of one/more year-old shoot (P₃), Control-No pruning (P₄). Different treatment combination is V₁P₁: Lalit-15cm above portion of one/more year-old shoot, V₁P₂: Lalit-30cm above portion of one/more year-old shoot, V₁P₃: Lalit-45cm above portion of one/more year-old shoot,, V₁P₄: Lalit-No pruning (Control), V₂P₁: Shweta-15cm above portion of one/more year-old shoot, V₂P₂: Shweta-30cm above portion of one/more year-old shoot, V₂P₃: Shweta-45cm above portion of one/more year-old shoot and V₂P₄ Shweta-No pruning (Control).

Results and Discussion

Vegetative parameters: The interaction between cultivars and pruning treatments was statistically found non-significant. However, the unpruned tree of both *cvs.* Shweta and Lalit (V₂P₄ and V₁P₄) expressed the highest tree height (5.93 m and 5.80 m, respectively) followed by pruned trees. The highest stem diameter outlined (20.56 cm) in V₁P₃ *i.e.*, *cv.* Lalit with 45 cm pruning level and minimum outlined (17.29 cm) under 15 cm pruning level. Canopy spread root in highest (5.93 m) under V₁P₄ *i.e.*, *cv.* Lalit with unpruned tree and lowest (5.07 m) found in V₂P₃ *i.e.*, *cv.* Shweta and 45 cm pruning intensity. The interaction effect between cultivars and pruning intensity on canopy area also found to be statistically significant. Significantly highest canopy area (7.54 m²) estimated in V₁P₄ *i.e.* *cv.* Lalit with unpruned trees followed by V₁P₂ *i.e.* *cv.* Lalit with 30 cm pruning intensity, V₂P₄ *i.e.* *cv.* Shweta with unpruned trees, V₂P₁ *i.e.* *cv.* Shweta with 15 cm pruning intensity, V₁P₁ *i.e.* *cv.* Lalit with 15 cm pruning intensity, V₂P₂ *i.e.* *cv.* Shweta with 30 cm pruning intensity V₁P₃ *i.e.* *cv.* Lalit with 45cm pruning intensity and V₂P₃ *i.e.* *cv.* Shweta with 45 cm pruning intensity and recorded canopy were 6.53 m², 5.97 m², 5.86 m², 5.44 m², 5.31 m², 5.23 m² and 5.03 m² respectively. As a result, the interlinkage between the cultivars and pruning intensity were found statistically non-significant, the highest number of newly emerged shoot lets were found V₂P₄, *i.e.*, interaction between the *cv.* Shweta and unpruned tree, recorded value was (5.66) and the lowest were found in V₂P₁ *i.e.*, interconnection between the *cv.* Shweta and 15 cm pruned shoot length. In *cv.* Shweta with 15 cm pruning level (V₂P₁) shoot length was insignificantly larger (26.62 cm) than other interaction the lowest was outlined in V₁P₄ *i.e.*, unpruned trees of *cv.* Lalit (22.70 cm). The major shoot length was found in between the *cv.* Lalit and 15 cm pruned shoot length *i.e.*, V₁P₁ (0.35 cm) and lowest is found in interaction between *cv.* Lalit and 45 cm pruned shoot length *i.e.*, V₁P₃ (0.28 cm). The interaction between cultivars and pruning treatments was statistically found non-significant. Whereas the unpruned tree of *cv.* Lalit (V₁P₄) expressed the highest number of leaves (19.12) followed by 15cm pruned shoot length of *cv.* Shweta (V₂P₁) and lowest was found in *cv.* Shweta and 30cm shoot length *i.e.*, V₂P₂ (17.18). Observations of leaf area revealed that there is an insignificant difference in leaf area between the interaction of cultivar and pruning treatments. The major leaf area was found in the interlinkage between the *cv.* Lalit and 30 cm shoot length pruning *i.e.*, V₁P₂ (57.29 cm²) and lowest was recorded in *cv.* Shweta and unpruned tree *i.e.*, V₂P₄ (41.24 cm²).

Tree height showed non-significant among cultivars. However, *cv.* Lalit recorded the highest tree height than *cv.* Shweta. The highest tree height recorded in Lalit might be due to the genetic makeup of the variety which has vigorous growth habit. The tree height was significantly decreased with increasing the pruning intensity. Unpruned tree recorded significantly highest tree height than the pruned tree. Lesser height of pruned trees might be due to the fact that trees were unable to make up the loss of growth due to pruning in short period of time. Kumar and Rattan pal (2010) ^[3] also observed in guava that tree height reduced by removal of half of vegetative growth. Similar results obtained by Singh *et al.* (2012) ^[15] and Pratibha *et al.* (2013) ^[9] in guava

The stem diameter of tree trunks differed significantly due to treatments. The maximum stem diameter of tree trunk was noticed under *cv. Lalit* than *cv. Shweta* might be due the genetic makeup of the cultivar and climatic condition. Among the pruning effect, the major stem diameter in guava tree was observed under the highest pruning intensity (45 cm pruning level) and lowest in (15 cm pruning intensity). This may be due to the shift of metabolites from flowering sites to new vegetative growth sites influencing the increase in the stem circumference of the tree. This might be due to quick response to supplied food material absorbed by the roots and it transmitted to the main trunk of such trees. Moreover, in such trees most of the carbohydrates and nitrogen were utilized for the vegetative growth. These results are in concord with that Dhaliwal and Singh (2004)^[14] in guava.

The cultivars and pruning treatments had an inconsiderable impact on canopy spread and canopy area. The data demonstrates that when the pruning acuteness increases it inversely affect the canopy spread. The maximum increase in canopy spread and canopy area found in *cv. Lalit* followed by *cv. Shweta* and canopy spread determined to be insignificant but canopy area found to be significant in the midst of cultivars. Canopy spread and canopy area was found to be significantly higher in unpruned trees than in all other pruned trees. The lowest value was found in pruning of 45cm shoot length. Lesser tree spread and canopy area in pruned trees might be due to the facts that trees were unable to make up the loss of growth due to pruning in short period of time. Analogous results have been reported by Kumar and Rattan pal (2010)^[3], Singh *et al.* (2012)^[15] in guava.

The cultivars are counted non-significant difference, *Shweta* had more shoot lets (3.5) and *Lalit* had less (3.4) number of shoot lets. The fruit production is bound to increase with the increase in the number of new shoot lets produced, since the new shoots are the potent fruit bearing organs in guava the number of newly emerged shoot lets per twig was increased significantly but the unpruned branch showed highest number of shoot lets in severe pruning and minimum shoot

lets found in light pruning.

Shoot length has an insignificant variation in guava cultivars. Cultivar *Shweta* performed better shoot length. Among pruning level, unpruned trees recorded less shoot growth than pruned trees. Shoot length was found higher in pruned trees might be due to reserve food materials in main branches helpful to increase the length of new shoots which were emerged after pruning. Similar finding was also reported by Mohammed *et al.* (2006)^[7] in guava that pruning at 60 cm resulted in maximum shoot length during rainy and winter season. Similar results have been reported by Meena *et al.* (2016)^[4] in guava.

The effect of pruning treatments on the shoot diameter of new shoot lets revealed that amid the cultivars it showed the non-significant difference and the highest shoot diameter is recorded under the *cv. Shweta* (0.32 cm) and lowest is seen in *cv. Lalit* (0.31 cm). The 15 cm pruning level found highest shoot diameter and the lowest under control (unpruned). However, statistical analysis revealed that the other pruning treatments had a insignificant difference.

The number of leaves per shoot was found to be insignificant. The maximum leaves are counted in *cv. Lalit* may be due to the varietal character or more sunlight uptake. Among the pruning treatment it showed the insignificant difference. Number of leaves found drastically decreasing whiles the pruning intensity increase. Due to longer shoot length in severe pruning, it consumes more nutrient so there is less availability of food for the leaves to emerge, hence the severe pruning had a smaller number of leaves and light pruning had a greater number of leaves.

Leaf area was insignificantly different among the cultivars and pruning treatments. The highest leaf area is recorded in *cv. Shweta* due to more interception of sunlight. Increased pruning severity resulted in a considerable reduction in leaf area. Leaf area was much larger in 15 cm shoot length pruning, while it was insignificantly lower in unpruned trees. The increased leaf area in pruning level than unpruned due to the creation of metabolites in pruned trees and as a result of increased availability of nutrients to these leaves.

Table 1: Effect of Different Pruning Level on Growth Parameters of Guava *Cv. Lalit* and *Shweta*

Treatment combination	Vegetative parameters								
	Tree height (m)	Tree stem diameter (cm)	Canopy spread (m)	Canopy area (m ²)	No. of emerged shoot lets per twig	Shoot length (cm)	Shoot diameter of new shoot (cm)	No. of leaves in new shoot	Leaf area (cm ²)
V1P1	5.43	17.29	5.57	5.44	2.00	22.94	0.35	18.37	42.81
V1P2	5.06	17.43	5.53	6.53	2.66	24.43	0.33	18.29	57.29
V1P3	5.10	20.56	5.10	5.23	4.00	25.91	0.28	18.58	47.78
V1P4	5.80	18.85	5.93	7.54	5.33	22.7	0.29	19.12	43.77
V2P1	5.00	17.78	5.33	5.86	1.66	26.62	0.33	18.89	51.16
V2P2	5.00	18.20	5.23	5.31	3.00	25.51	0.33	17.18	50.46
V2P3	4.40	18.51	5.07	5.03	3.66	26.15	0.31	16.70	55.17
V2P4	5.93	17.72	5.76	5.97	5.66	22.82	0.30	17.58	41.24
SE m ±	0.18	0.54	0.20	0.30	0.27	2.36	0.03	1.86	4.73
CD (0.05)	NS	NS	NS	0.94	NS	NS	NS	NS	NS

Yield attributes: The fruit weight interaction effect between cultivars and pruning intensity shown to be statistically insignificant. In comparison to all other interaction, the highest fruit weight (198.92 g) was reported between *cv. Shweta* with 15 cm pruning intensity (*V₂P₁*) and the smallest fruit weight (134.64g) between unpruned *Lalit* trees (*V₁P₄*). The highest fruit length outlined (9.34 cm) in *V₂P₁* i.e., *cv. Shweta* with 15cm pruning level and minimum outlined (5.07 cm) under unpruned *Lalit* trees (*V₁P₄*). The

interaction between cultivars and pruning treatments was statistically found non-significant. However, the unpruned tree of *cv. Lalit* (*V₁P₄*) expressed the lowest fruit width (7.09 cm) and the highest fruit width (10.70 cm) was observed in *cv. Shweta* with 15cm pruning intensity (*V₂P₁*). Highest number of fruit per shoot (4.16) was noticed in *cv. Lalit* with 30 cm pruning intensity (*V₁P₂*), whereas, lowest number of fruit per shoot (1.78) was recorded in *cv. Shweta* of unpruned trees (*V₂P₄*). Whereas other interaction recorded

as 2.80, 2.16, 2.10, 2.07, 2.01 and 1.83 of *cv.* Lalit with 15 cm pruning level (V_1P_1), *cv.* Lalit with 45 cm pruning level (V_1P_3), *cv.* Shweta with 45 cm pruning level (V_2P_3), *cv.* Lalit with 45 cm pruning level (V_1P_3), *cv.* Shweta with 45 cm pruning level (V_2P_3), *cv.* Lalit with unpruned (V_1P_4). The maximum number of fruits counted (443.50) was observed in between *cv.* Lalit and 30 cm pruning level (V_1P_2) and the lowest (222.30) unpruned *cv.* Shweta (V_2P_4). Among the other interaction the recorded data were (374.01, 343.33, 322.23, 316.83, 258.83 and 246.83) *cv.* Lalit with 15 cm pruning level (V_1P_1), *cv.* Shweta with 30 cm pruning level (V_2P_2), *cv.* Lalit with 45 cm pruning level (V_1P_3), *cv.* Shweta with 15 cm pruning level (V_2P_1), *cv.* Lalit with unpruned (V_1P_4) and *cv.* Shweta with 45 cm pruning level (V_2P_3) respectively. Highest fruit yield (65.10 kg) was noticed in *cv.* Lalit with 30 cm pruning intensity (V_1P_2), whereas, lowest fruit yield (38.03 kg) was recorded in *cv.* Shweta of unpruned trees (V_2P_4). Whereas other interaction recorded as 55.80 kg, 52.03 kg, 50.53 kg, 47.96 kg, 45.60 kg, and 43.53 kg of *cv.* Shweta with 30 cm pruning level (V_2P_2), *cv.* Lalit with 15 cm pruning level (V_1P_1), *cv.* Shweta with 15 cm pruning level (V_2P_1), *cv.* Lalit with 45 cm pruning level (V_1P_3), *cv.* Shweta with 45 cm pruning level (V_2P_3), *cv.* Lalit with unpruned (V_1P_4). Significantly highest yield (18.03 tonnes) estimated in V_1P_2 i.e. *cv.* Lalit with 30 cm pruning level followed by V_2P_2 i.e. *cv.* Shweta with 30 cm pruning intensity, V_1P_1 i.e. *cv.* Lalit with 15 cm pruning level, V_2P_1 i.e. *cv.* Shweta with 15 cm pruning intensity, V_1P_3 i.e. *cv.* Lalit with 45 cm pruning intensity, V_2P_3 i.e. *cv.* Shweta with 45 cm pruning intensity, V_1P_4 i.e. *cv.* Lalit with control (without pruning) and V_2P_4 i.e. *cv.* Shweta with unpruned and recorded yield per tonnes

were 15.43 tonnes, 14.40 tonnes, 14.00 tonnes, 13.27 tonnes, 12.60 tonnes, 12.06 tonnes and 10.50 tonnes respectively.

The number of fruit per shoot and number of fruit per plant was significantly affected by the cultivars, *cv.* Lalit recorded higher number of fruit per shoot might be due to genetic makeup of the variety. Maximum number of fruit was recorded from trees pruned 30 cm shoot length and lowest was recorded in unpruned trees. The number of fruits per shoot and number of fruits per plant was significantly affected by the pruning treatments. Due to a greater number of reproductive shoots were emerged in moderate pruning than the severe and light pruning, unpruned trees had more number of shoots but the reproductive shoots were very less because the guava bear fruits on the current season shoots. Akin result was found Shiva Adhikari and Tanka Prasad Kandel (2015).

Fruit yield per tree and in a hectare was significantly affected by the cultivars, Lalit recorded higher yield may be appropriate to the inherited character of the variety. Maximum yield per tree was recorded from trees pruned 30 cm shoot length and lowest was recorded in unpruned trees. The fruit yield per tree and per hectare was also significantly affected by the pruning treatments. Bagchi *et al.* (2008) [1] reported a consistent increase in concentration of tryptophan, proline, polyphenol oxidase, catalase and peroxidase levels in leaves, bark and fruit of the guava tree and decreased in phenolics concentration after pruning. Such chemical changes, especially proline biosynthesis, in plants parts after pruning may have contributed towards more in flowering and fruiting, resulted in higher yield.

Table 2: Effect of different pruning level on yield attributes of guava *cv.* Lalit and Shweta

Treatment combination	Yield attributes						
	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	No. of fruits per shoot	No. of fruits/plant	Fruit yield (kg/tree)	Yield per hectare (t/ha)
V1P1	168.77	7.48	9.88	2.80	374.01	52.03	14.40
V1P2	164.46	7.82	8.68	4.16	443.50	65.10	18.03
V1P3	139.99	6.81	7.68	2.07	322.23	47.96	13.27
V1P4	134.64	5.07	7.09	1.83	258.83	43.53	12.06
V2P1	198.92	9.34	10.70	2.10	316.83	50.53	14.00
V2P2	188.31	8.43	9.78	2.16	343.33	55.80	15.43
V2P3	161.58	7.50	8.46	2.01	246.83	45.60	12.60
V2P4	154.72	6.98	8.23	1.78	222.30	38.03	10.50
SE m ±	6.27	0.30	0.42	0.31	13.84	2.77	0.76
CD (0.05)	NS	NS	NS	1.00	41.98	8.31	2.30

NS: Non-significance

On the basis of the results summarized above, it can be concluded that pruning was found most effective practice of guava to manage the tree canopy and crop regulation based upon positive results of effective management of plant growth parameters and vegetative character like tree height, stem diameter, spread, canopy area and number of shoot let. Maximum production and better quality of fruits was recorded in pruning intensity (30 cm pruning level). Whereas among cultivars, yield was better in *cv.* Lalit recorded more yield than Shweta but fruit size and fruit weight found higher in *cv.* Shweta. Conclusively, it emerges that shoot pruning of guava during summer (April-May) by the 30 cm pruning level was found most effective to manage plant growth factors and increased the growth, production and productivity of guava cultivars Lalit and Shweta.

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