



## Pruning and integrated nutrient management for growth and yield of guava (*Psidium guajava*)

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### ABSTRACT

An experiment was conducted to study the effect of different combinations of pruning and plant nutrition on growth and yield of guava (*Psidium guajava* L.) during 2015–16 and 2016–17. The maximum number of new shoot emergence (6.69), number of flower bud emergence per shoot (14.10), fruits/shoot (12.01), fruit set (84.61%), fruits retained per shoot (9.28) and yield (24.13 kg/plant) was recorded with pruning at 20 cm from the shoot apex. Whereas, higher shoot length (62.26 cm) and shoot diameter (5.35 mm) was associated with pruning at 40 cm from the shoot apex. The minimum effect was recorded in unpruned shoot. Different sources of nutrition also affected growth, flowering, fruiting and yield of guava. In general, application of fertilizers through combination of organic, inorganic sources and biofertilizers exhibited the maximum number of new shoot emergence (6.23), shoot length (64.73 cm), shoot diameter (5.52 mm), number of flower bud emergence per shoot (13.33), fruits/shoot (11.76), fruit set (87.02%), fruits retained per shoot (9.76). The highest per plant yield (24.23 kg/plant) was recorded with the application of 5 kg Farm Yard Manure + 2 kg Vermi-Compost + 75% Recommended dose of fertilizer (225:150:150 g NPK) + *Azotobacter* 150g + PSB 100 g/plant. The interaction of pruning intensity and fertilizers was significant on yield and yield attributes. The maximum yield (31.03 kg/plant) was recorded in P<sub>2</sub>F<sub>6</sub> with B:C ratio of 6.52.

**Key words:** Flowering, Guava, Nutrition, Pruning, Yield

Guava (*Psidium guajava* L.) is one of the most important fruit crop of the tropics and sub-tropics of the world. It belongs to family myrtaceae and is aptly called apple of the tropics. Guava is hardy, prolific bearer and highly remunerative fruit crop grown on a variety of soil under varied agro-climatic conditions. Guava trees produce flowers thrice in a year (Feb-March, June-July and October-November) in North Indian condition. Whereas, in Madhya Pradesh, it flowers twice, once in Feb-March for the rainy season crop and again in July-August for the winter season crop. A new growth can be ensured by pruning and it is one of the cultural practices done in temperate and sub-tropical fruit crops to bring a new growth. A light pruning is considered necessary to encourage new shoots after the harvest. Pruning during May helps to induce new shoots which brings *mrig bahar* flowering (June-July) and fruits are harvested during October-November.

Guava is a hardy crop, yet responds to manuring and fertilization well. Organic amendments are an effective means for improving soil aggregation, structure and fertility, increasing microbial diversity and populations, improving the

moisture holding capacity of soil, increasing the soil cation exchange capacity (CEC) and consequently crop yield (Zink and Allen 1998). The conjunctive use of biofertilizers with nitrogenous fertilizers increases the efficiency of nitrogen, improves the soil health, soil microbes and controls the soil pollution. Similarly, use of organic manures along with biofertilizers and inorganic fertilizers as a cheap source of available nutrient to plants has beneficial effects on growth and yield of various fruit crops (Ram and Rajput 2000). Having observed benefits of integrated use, it is essentially required to standardize the optimum ratio of inorganic and organic fertilizers through other possible sources of nutrients for better growth, production and reduced production cost as well.

Keeping in view the above mentioned facts, the objectives of the study was to understand how growth and yield of guava are influenced by pruning and fertilizer application.

### MATERIALS AND METHODS

The present investigation was carried out at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur with 6-year old uniform plants of Guava cv. Allahabad Safeda during 2015–16 and 2016–17. The trees were maintained under uniform cultural practices during the entire course of investigation. The pruning was done on 24<sup>th</sup> May 2016 and 24<sup>th</sup> May 2017. Treatment consisted of three pruning levels, i.e. unpruned

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(P<sub>1</sub>) pruning at 20 cm from shoot apex (P<sub>2</sub>), pruning at 40 cm from shoot apex (P<sub>3</sub>) and six levels of nutrition i.e. F<sub>1</sub> (5 kg Farm yard manure + 2 kg Vermi-Compost/plant), F<sub>2</sub> (5 kg FYM + 2 kg VC + *Azotobacter* 150 g /plant), F<sub>3</sub> (5 kg FYM + 2 kg VC + Phosphorus solubilizing bacteria 100g/plant), F<sub>4</sub> (*Azotobacter* 150 g + PSB 100 g/plant), F<sub>5</sub> [5 kg FYM + 2 kg VC + 100% recommended dose of fertilizer {300:200:200g NPK}/plant], F<sub>6</sub> [5kg FYM + 2kg VC + 75% RDF {225:150:150 g NPK} + *Azotobacter* 150g + PSB 100 g/plant]. The balanced pruning was performed in all directions of the canopy with the help of secateur, which were dense and overcrowded. The (P<sub>1</sub>) plants were left as such without pruning. As per treatments the full dose of phosphorus, potassium and organic sources i.e. FYM, Vermicompost and bio-fertilizer were applied as a basal dose in the 1<sup>st</sup> week of July, while nitrogen was applied in two split doses, one with basal dose (1<sup>st</sup> week of July) and another after one month (1<sup>st</sup> week of August) through basin method.

Various plant growth, flowering and yield characters were measured by following set procedures. Number of new shoot emergence was counted on 4 tagged flowering shoots in each direction of each plant in the treatments and average was calculated. New emerging (four) shoots were tagged in each direction for measurement of shoot. The longest shoot length was measured in centimeter with the help of meter scale on each selected emerging shoot at maturity of the fruit after pruning and the mean length of shoot was calculated. Shoot diameter was recorded at maturity of the fruit from four tagged shoots in each direction and mean was calculated and expressed in millimeter (mm). The total number of flower buds were counted on the four randomly selected shoots in each direction and average number of flower bud emergence per shoot was calculated. Total number of flower buds which set into fruits were counted on the four randomly selected shoots in each direction and average number of fruits per shoot was calculated. The fruit set was calculated one month after anthesis from four tagged shoots in each direction. The average per cent fruit set was calculated by given below formula.

$$\text{Fruit set (\%)} = \frac{\text{Number of fruit set}}{\text{Total flowers counted}} \times 100$$

The fruits retained per shoot on four tagged shoots in each direction were counted from each tree and average number of fruits per branch was worked out. Mature fruits were harvested periodically and separately in each treatment and the weight was recorded with the help of single pan balance and the yield (kg/plant) was calculated.

The experiment was conducted in a factorial randomized block design replicated thrice. Two plants in each of the three replicates, total six plants for each treatment.

## RESULTS AND DISCUSSION

### *Effect of pruning levels on plant growth characteristics:*

It is evident from pooled data presented in Table 1 that different pruning levels, fertilizers and their combinations

Table 1 Effect of pruning levels and integrated nutrient management on growth characteristics of guava

Treatments	Number of new shoot emergence	Shoot length (cm)	Shoot diameter (mm)
P1	3.36	54.59	4.68
P2	6.69	59.53	4.97
P3	5.52	62.26	5.35
SEm ±	0.02	0.17	0.008
CD (P=0.05)	0.06	0.48	0.024
F1	4.55	55.76	4.72
F2	5.27	59.24	5.01
F3	4.97	57.87	4.88
F4	4.26	53.27	4.55
F5	5.87	61.88	5.33
F6	6.23	64.73	5.52
SEm ±	0.03	0.24	0.012
CD (P=0.05)	0.08	0.68	0.034
P1 F1	2.97	51.45	4.43
P1 F2	3.41	55.48	4.70
P1 F3	3.26	54.67	4.57
P1 F4	2.72	49.62	4.34
P1 F5	3.69	56.82	4.94
P1 F6	4.11	59.48	5.09
P2 F1	5.79	56.59	4.67
P2 F2	6.99	60.12	5.00
P2 F3	6.31	58.25	4.86
P2 F4	5.43	53.65	4.52
P2 F5	7.63	62.73	5.31
P2 F6	8.02	65.82	5.48
P3 F1	4.90	59.25	5.04
P3 F2	5.41	62.12	5.34
P3 F3	5.33	60.68	5.20
P3 F4	4.62	56.53	4.78
P3 F5	6.29	66.08	5.74
P3 F6	6.58	68.90	6.00
SEm ±	0.05	0.41	0.021
CD (P=0.05)	0.14	1.18	0.059

had significant effect on plant growth attributes like number of new shoot emergence, shoot length and shoot diameter in guava. Maximum number of new shoot emergence was (6.69) with pruning at 20 cm from the shoot apex whereas, shoot length (62.26 cm) and shoot diameter (5.35 mm) with pruning at 40 cm from the shoot apex. Number of new shoot emergence increased with pruning at 20 cm from shoot apex whereas, significantly decreased with increased severity of pruning intensity. This might be due to less number of vegetative buds left on severely pruned shoot. While the new shoots emergence was lowest in shoots without pruning (Lakhpathi *et al.* 2013). The increase in shoot length might

be attributed to the less number of shoots and more food reserves available to individual shoots. Another reason for higher shoot growth in heavily pruned trees could be the lower yield and conversion of nutrient elements for use in vegetative growth. The results are in accordance with the findings of Shaban and Haseeb (2009). Pruning intensities influenced the tree growth, shoot diameter and shoot length due to removal of apical dominance of a bud. The above results are in conformity with the findings of Kumar and Thakur (2012).

*Effect of fertilizers on plant growth characteristics:*

Application of manure and fertilizers sources from organic, inorganic and biofertilizers components, exhibited the maximum number of new shoot emergence (6.23), shoot length (64.73 cm) and shoot diameter (5.52 mm) was recorded with 5kg FYM+2kg VC + 75% RDF (225:150:150 g NPK) + *Azotobacter* 150 g + PSB 100 g/plant. The interaction of pruning levels and fertilizers registered the maximum number of new shoot emergence (8.02) with pruning at 20 cm from the shoot apex while, shoot length (68.90 cm) and shoot diameter (6.0 mm) was found with pruning at 40cm from the shoot apex in combination with 5 kg FYM + 2 kg VC + 75% RDF (225:150:150 g NPK) + *Azotobacter* 150g + PSB 100 g/plant. Results of present study are in accordance with Ram and Pathak (2007) who observed improvement in the vegetative growth parameter in guava with the application of different fertilizers, organic manure and biofertilizers. The increase in shoot length and number of shoot emergence per branch could be attributed to the stimulative activity of microflora in the rhizosphere leading to increased nutrient availability. These results are in agreement with the findings of Meena *et al.* (2014) and Goswami *et al.* (2015). The useful effect of nitrogen is the result of an increase in growth attributes. As nitrogen is the major constituent of fertilizers applied and as it is constituent of the proteins essential for formation of protoplasm, it affects the cell division and cell elongation and, thereby, leads to more vegetative growth. Inoculation with *Azotobacter*—a biological nitrogen fixer improves the nitrogen use efficiency of the plant Godage *et al.* (2013).

*Effect of pruning levels on flowering and yield attributing characters:* The result obtained from the present investigation revealed that pruning levels and fertilizers significantly improved the number of flower bud emergence per shoot and various yield attributing characters like fruits per shoot, fruit set and fruits retained per shoot (Table 2). Pruning at 20 cm from the shoot apex produced maximum number of flower bud emergence per shoot (14.10), fruits per shoot (12.01), fruit set (84.61%) and fruits retained per shoot (9.28) as compared to unpruned. Since flowering in guava occurs on current season growth, therefore pruning helps in getting new fruiting units and thus, increases the number of flower buds per shoot as explained by Pilonia *et al.* (2010). Maximum number of flower bud per shoot found in pruning at 20 cm from the shoot apex is, perhaps due to the more number of new emerging shoots. These results confirm with the finding of Pratibha *et al.* (2013)

Table 2 Effect of pruning levels and integrated nutrient management on flowering and yield attributing characteristics of guava

Treatments	Number of flower bud emergence shoot-1	Fruit-sper shoot	Fruit set (%)	Fruits retained per shoot
P1	7.51	5.53	73.11	4.23
P2	14.10	12.01	84.61	9.28
P3	11.34	9.41	82.22	7.43
SEm ±	0.04	0.06	0.76	0.04
CD (P=0.05)	0.12	0.17	2.19	0.12
F1	9.69	7.52	76.50	5.29
F2	11.25	9.19	80.42	7.20
F3	10.49	8.41	79.02	6.58
F4	8.80	6.53	73.01	4.51
F5	12.34	10.52	83.94	8.54
F6	13.33	11.76	87.02	9.76
SEm ±	0.06	0.08	1.08	0.06
CD (P=0.05)	0.17	0.23	3.10	0.18
P1 F1	6.87	4.78	69.53	3.31
P1 F2	7.59	5.59	73.58	4.59
P1 F3	7.50	5.37	71.69	4.19
P1 F4	6.09	4.02	65.99	2.83
P1 F5	8.17	6.31	77.20	4.99
P1 F6	8.84	7.14	80.70	5.46
P2 F1	12.11	9.82	81.05	6.70
P2 F2	14.86	12.56	84.55	9.41
P2 F3	13.47	11.25	83.56	8.37
P2 F4	11.47	8.98	78.40	6.03
P2 F5	15.87	14.08	88.69	11.94
P2 F6	16.83	15.39	91.41	13.23
P3 F1	10.08	7.95	78.91	5.85
P3 F2	11.31	9.41	83.12	7.61
P3 F3	10.50	8.59	81.79	7.18
P3 F4	8.86	6.59	74.64	4.66
P3 F5	12.99	11.16	85.92	8.71
P3 F6	14.33	12.75	88.95	10.60
SEm ±	0.10	0.14	1.87	0.11
CD (P=0.05)	0.29	0.40	NS*	0.30

\*NS- Non significant

and Bhagawati *et al.* (2015). Increase in number of fruits at light pruning intensity (15 cm) might be due to the optimum balance between the vegetative and reproductive growth of tree (Brar *et al.* 2007). Significantly higher fruit set percentage was recorded with pruning at 20 cm, which might be due to more vegetative growth in lower level of pruning intensities as compared to severe pruning. The above findings are in accordance with Brar *et al.* (2007). Greater photosynthetic activity due to pruning is another reason for higher fruit setting because of exposure of more

number of leaves to sunlight to the lower branches of the trees. Similar results were also reported by Dhaliwal *et al.* (2000). More number of fruit retention and lesser flower and fruit drop in winter season with light pruning may be due to reserve food material during rainy season. Besides, the winter season crop has long crop duration, favourable climatic conditions like low temperature, full sunlight, optimum dry to humid weather, optimum soil moisture level and comparatively less incidence of insect-pests and diseases during both the years. These results confirm with the findings of (Sahar and Hameed 2014). Production of large number of flowering shoots, diversion of stored food materials for healthy shoot, flowering after rainy season crop leads to better flowering and higher fruit set. With the improved light penetration in the canopy desirable level of flower production on new shoot was observed with 20 cm pruning.

**Effect of fertilizers on flowering and yield related traits:** Use of fertilizers combination had significantly affected the flowering and yield related traits. The maximum number of flower bud emergence per shoot (13.33), fruits per shoot (11.76), fruit set (87.02%) and fruits retained per shoot (9.76) was recorded with 5 kg FYM + 2 kg VC + 75% RDF (225:150:150 g NPK) + *Azotobacter* 150 g + PSB 100 g/plant, while minimum was noted with F<sub>4</sub>. The interaction of pruning levels and fertilizers significantly improved the number of flower bud emergence per shoot but not the per cent fruit set. In the present study, the maximum number of flower bud emergence per shoot (16.83), fruits per shoot (15.39), fruit set (91.41%) and fruits retained per shoot (13.23) was recorded in combination of pruning at 20 cm from the shoot apex with 5 kg FYM + 2 kg VC + 75% RDF (225:150:150 g NPK) + *Azotobacter* 150 g + PSB 100 g/plant. Nutrients availability for longer period

from Vermicompost might have enhanced the flowering and increased number of flowers per shoot (Meena *et al.* 2014). Higher flowering and fruit set with higher fruit retention might be due to increased nutrient availability from NPK, and FYM, the organic phosphorus from PSB and *Azotobacter* increased various endogenous hormonal levels in plant tissue which are responsible for flowering, pollen germination and pollen tube and ultimately increased fruit set and higher fruit retention as explained by Godage *et al.* (2013). The improvement in fruit set and fruit retention was mainly due to overall improvement of health of the trees, owing to better photosynthesis and translocation of assimilates in the fruits. Similar results were also reported by Goswami *et al.* (2015).

**Effect of pruning levels on yield:** Among various levels of pruning, the maximum yield (24.13 kg/plant) was obtained with pruning at 20 cm from the shoot apex (Fig 1). Higher yield may be due to more fruits per shoot in pruning at 20 cm (Table 2). This is quite possible with the present study due to less competition for nutrients, increased vegetative growth, proper space between branches and increased fruiting area. Increasing yield with 20 cm pruning was also because of more open tree canopy with wider leaf area allowing more light penetration that led assimilation more photosynthetic materials. These results are in accordance with the findings of Kumar and Rattanpal (2010). The decrease in the fruit yield with the increase in pruning severity may be due to more vegetative growth and lesser number of fruiting spurs. The above findings are in accordance with (Shaban and Haseeb (2009).

**Effect of fertilizers on yield:** Application of fertilizers registered the maximum yield (24.23 kg/plant) in 5 kg FYM + 2 kg VC + 75% RDF (225:150:150 g NPK) + *Azotobacter* 150 g + PSB 100 g/plant. The integration of pruning levels

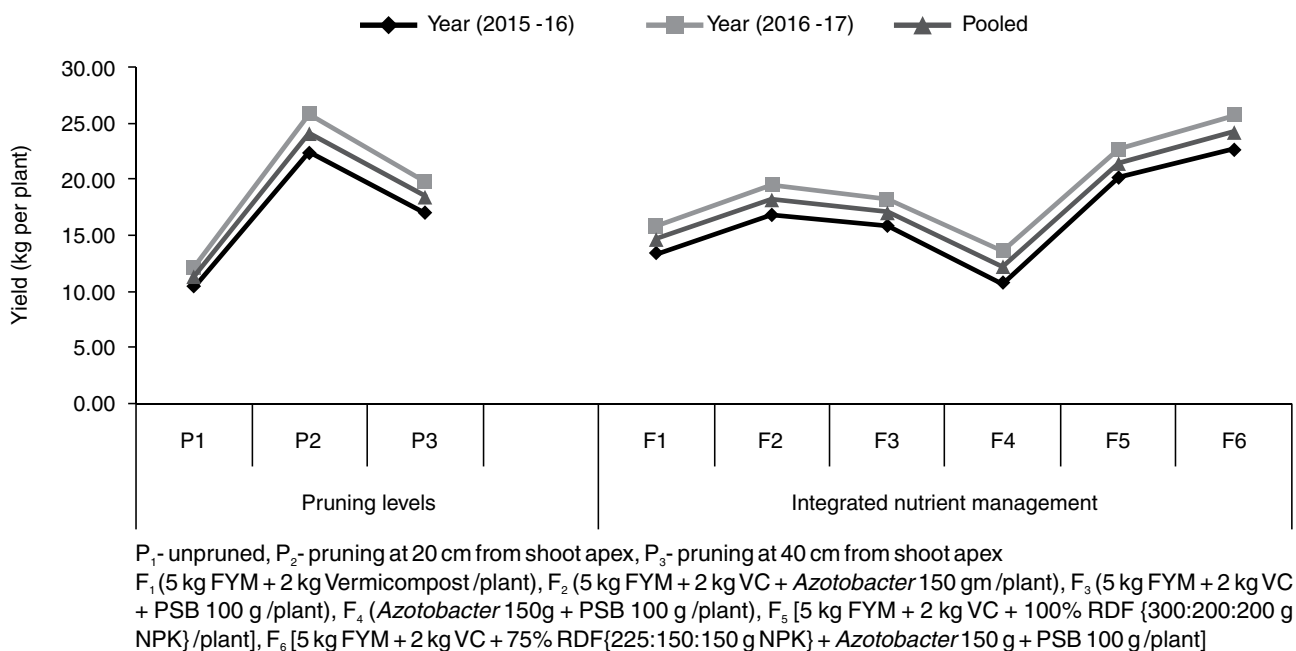


Fig 1 Effect of pruning levels and integrated nutrient management on yield (kg/plant). Line indicate significant ( $P \leq 0.05$ ) differences between treatments.

and application of fertilizers maximized the yield (31.03 kg/plant) which was recorded with pruning at 20 cm from the shoot apex in combination with 5 kg FYM + 2 kg VC + 75% RDF (225:150:150g NPK) + *Azotobacter* 150 g + PSB 100 g/plant. Rational partitioning of dry matter to economic sink improved the yield attributes (Barne *et al.* 2011). The maximum yield in the combined application of organic and inorganic fertilizers is a result of the interaction between them which helped in increasing the soil nutrient availability and their uptake by the plants that resulted in better vegetative growth which have produced the higher quantum of carbohydrates needed for the development of the fruits thereby, increasing the number, size and weight of fruits which ultimately leads towards getting higher yield in these treatments (Sahu *et al.* 2014).

**Benefit:cost ratio:** The results revealed that the highest benefit: cost ratio from the mean of two years (6.52) was recorded in the treatment of pruning at 20 cm from the shoot apex in combination with 5 kg FYM + 2 kg VC + 75% RDF 225: 150: 150 g NPK + *Azotobacter* 150 g + PSB 100 g/plant ( $P_2F_6$ ). While, the lowest benefit:cost ratio from the mean of two years (1.92) was recorded in unpruned shoot + *Azotobacter* 150g + PSB 100 g/plant ( $P_1F_4$ ). The highest benefit: cost ratio in the treatment of  $P_2F_6$  could be attributed to good gross monetary returns that resulted in high benefit: cost ratio. Whereas, lowest benefit: cost ratio in  $P_1F_4$  may be due to poor gross monetary returns.

On the basis of results obtained, it could be concluded that number of new shoot emergence, number of flower bud emergence, fruits per shoot, fruit set (%), fruits retained and yield per plant increased with pruning at 20 cm from the shoot apex. Whereas pruning at 40 cm was found the best for increase in shoot length and shoot diameter. The fertilizers application through (organic, inorganic and bio-fertilizers) 5 kg FYM+2 kgVC + 75% RDF 225:150:150 g NPK + *Azotobacter* 150g + PSB 100 g/plant proved to be the best treatment with regards to all growth, flowering and yield attributing characters. Similarly, pruning at 20 cm from the shoot apex + 5 kg FYM + 2 kg VC + 75% RDF 225:150:150 g NPK + *Azotobacter* 150 g + PSB 100 g/plant gave higher fruit yield per plant with more per cent fruit setting, fruits per shoot and fruit retention.

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