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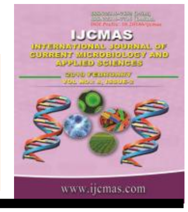

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Effect of Shoot Pruning on Growth and Yield of Guava (*Psidium guajava* L.) cv. L-49 under Foothills of Arunachal Pradesh

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A B S T R A C T

The effects of pruning months (mid-April, mid-May and mid-June) and pruning severity (pruning of 25%, 50% and 75% of shoot length from tip) on growth and yield of guava cv. L- 49 planted at a spacing of 6 m x 6 m at Fruit Research Farm, Department of Fruit Science, College of Horticulture, Pasighat, Arunachal Pradesh during April 2017 to December 2017, with an aim to optimize the time of pruning and intensity of pruning for harvesting of winter guava crop. Among different months of shoot pruning, pruning in mid-April (M_1) was found to be the best for promoting plant growth parameters like plant height, collar girth, E-W and N-S canopy spread, length of shoot, fruit set and number of fruits/plant, whereas the maximum fruit yield (kg/tree) was recorded highest in mid-May pruning. The intensity of pruning in respect of length of shoot pruning also had different responses. On the basis of overall performance the study clearly revealed that pruning of 25% of the shoot length in mid-April (P_1M_1) was found to be the best treatment among all plant growth parameters, whereas pruning of 50% of the shoot length in mid-May recorded best for obtaining maximum fruit yield in guava cv. L-49 for winter crop in sub-tropical climatic conditions under the foot hills of Arunachal Pradesh.

Introduction

Guava (*Psidium guajava* L.) the "apple of the tropics" or "poor man's apple" is one of the most popular fruit crop of tropical and sub-tropical climate belonging to Myrtaceae family [13]Radha and Mathew, (2007). It is the third richest source of Vitamin C (299 mg/100g) after Barbados cherry (1000-4000 mg/100 g pulp) and aonla (600 mg/100g of pulp) [5]Gupta (2014), contains 2 to 5 times more vitamin C than oranges and 10 times more than tomato. Guava bears fruit on current season's shoot and flowers appear in solitary or in cymes of two or three in the axil of leaves. Pruning of guava is one of the most important practices that influence the vigour, productivity and quality of the fruits. Pruning at an early stage is done to develop a strong framework and capable for bearing a heavy crop load.

The main advantages of pruning on bearing trees include the formation of new shoots, avoid overcrowding of branches, removal of criss-cross branches, diseased branches as well as water sprouts and root suckers. In a humid and high rainfall area like Arunachal Pradesh, crop regulation of guava by using chemicals and growth regulators such as Urea, NAA, etc. are not much effective because the plant do not go into dormancy due to abundant rainfall received in this area which starts from the month of March. Therefore, pruning could prove to be the most effective method for eliminating rainy season crop and production of winter season guava. If the guava tree is left unpruned, they tend to prolong the vegetative growth, reduce the bearing area, thus leading to decrease in fruit size, yield and quality. Hence, to get a good balance between the vegetative and reproductive growth, pruning becomes essential. Therefore, the present investigation aims to optimize the extent to which guava trees should be pruned and to standardize the most appropriate time for pruning of guava for winter production under the foothills of Arunachal Pradesh.

Materials and Methods

The study was carried out in the experimental field of Fruit Research Farm, Department of Fruit Science, College of Horticulture, Pasighat, Arunachal Pradesh, Central Agricultural University, during 1st April 2017 to December 2017. Seven years old guava orchard of cv. L- 49 (Sardar) planted at a spacing of 6 m x 6 m were selected for the research work. The treatment consists of three different time of pruning (mid-April, mid-May and mid-June) and three different levels of pruning intensities (pruning of 25%, 50% and 75% of shoot length from the tip). The experiment comprising 9 treatment combinations was laid out in 2-factor Factorial Randomized Block Design (f-RBD) having three replications. For each treatment combination two uniform plants were selected. The treatment details are as follows:

Factor -1 (pruning time)

M_1 = mid – April pruning
M_2 = mid – May pruning
M_3 = mid – June pruning

Factor – 2 (pruning severity)

P_1 = Pruning of 25% of the shoot length from tip
P_2 = Pruning of 50% of the shoot length from tip
P_3 = Pruning of 75% of the shoot length from tip

Treatment combinations

$T_1 = P_1 M_1$ −Pruning of 25% of the shoot length in mid- April
$T_2 = P_2 M_1$ −Pruning of 50% of the shoot length in mid- April
$T_3 = P_3 M_1$ −Pruning of 75% of the shoot length in mid- April
$T_4 = P_1 M_2$ −Pruning of 25% of the shoot length in mid- May
$T_5 = P_2 M_2$ −Pruning of 50% of the shoot length in mid- May
$T_6 = P_3 M_2$ −Pruning of 75% of the shoot length in mid- May
$T_7 = P_1 M_3$ −Pruning of 25% of the shoot length in mid- June
$T_8 = P_1 M_3$ −Pruning of 50% of the shoot length in mid- June
$T_9 = P_3 M_3$ −Pruning of 75% of the shoot length in mid- June

The guava trees were pruned according to the treatment details. Pruning was done with the help of secateurs and pruning saw and all the leaves were completely defoliated at the time of pruning. The cut ends were smeared with a paste of Copper oxychloride in vegetable oil (crude palm oil). A common dose of fertilizers (N-500 g + P_20_5 - 200 g + K_20-500 g) and 40 Kg FYM per plant per year was applied. A full dose of FYM and P_20_5 was applied at the time of imposition of treatment. Nitrogen and K_20 were applied in 2 split doses. The first dose of N and K_20 was applied along with FYM + P_20_5 and the second was applied during the second week of September. The plant protection and other cultural operations were uniformly given as and when required. The observations were recorded for its change in vegetative growth parameters like increase in plant height, collar girth, canopy spread (both E-W and N-S directions), first vegetative bud burst, number of fruit per plant and fruit yield (kg/plant). The means of all the treatments of the observations were analysed statistically by ANOVA using [15]OPSTAT software and the significance of the results are verified.

Results and Discussion

Plant height (cm)

The effect of different level of pruning time had a significant influence on the increase in plant height. The maximum plant height (50.22 cm) was recorded in M_1 (mid-April pruning) while the minimum (45.72 cm) was recorded in M_3 (mid-June pruning). With respect to the intensity of pruning, the maximum increase in height (56.56 cm) of the plant was recorded in P_1 (pruning of 25% of the shoot length) and minimum (40.11 cm) in P_3 (pruning of 75% of the shoot length). As regards to interactions, the maximum increase in height of the plant (59.00 cm) was recorded in the treatment P_1M_2 (pruning of 25% of the shoot length in mid-May) which was at par (57.00 cm) with P_1M_1 (pruning of 25% of the shoot length in mid-April) and the minimum (39.00 cm) was in P_3M_3 (pruning of 75% of the shoot length in mid-May).

In the present investigation, it was observed that early pruning result in more plant growth vice versa late pruning decrease the shoot growth. Similar findings were reported by [2]Basu *et al.*, (2007) and [16]Singh *et al.*, (2001). [16]Singh *et al.*, (2001) further concluded that pruning might shift the allocation of metabolites from rainy season crop in favour of increased vegetative growth due to flower and fruitlet removal as a result of pruning. Thus, the vegetative growth of guava seems to respond to variation in month of pruning operation. With an increase in severity of pruning the increase in plant height was less. [7]Kumar and Rattanpal (2010) stated that this may be due to the fact that pruned trees were unable to make up the loss of growth caused by severe pruning in this short period. Similar views were reported by [11]Mahesh *et al.*, (2016) and [6]Kohli *et al.*, (2017) in guava.

Collar girth (cm)

The data presented in table 1 indicate that the collar girth was influenced by the effect of time of pruning. The maximum increase in collar girth (2.60 cm) was recorded in M_1 (mid-April pruning) which was significantly higher than M_3 (mid June pruning) and at par with M_2. As regards to different levels of pruning intensity of pruning, there was statistically no significant difference in increase in collar girth.

From the data it is clear that early pruning increases the stem girth than late pruning. The results are parallel with the findings of [12]Meena *et al.*, (2016) where they reported that the maximum increase in basal circumference of the stem was recorded when plants were pruned in the month of April.

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. Similar kind of observation was also reported by [10]Lotter (1990) in relation to pruning experiment on Fan Retief Guava cultivar.

Canopy spread

East-West direction

The maximum increase (109.22 cm) in canopy spread (E-W direction) under the influence of different time of pruning was recorded in M_1 (mid-April pruning) which was at par with M_2 (mid May pruning) and lowest (99.67 cm) in M_3 (mid-June pruning). With respect to different pruning intensity, the maximum increase (114.78 cm) was recorded in P_1 (pruning of 25% of the shoot length) and lowest (92.44 cm) in P_3 (pruning of 75% of the shoot length). The interaction between time of pruning and intensity of pruning did not have significant influence on the canopy spread in E-W direction. However, the maximum increase (119.33 cm) was recorded in M_1P_1 (pruning of 25% of the shoot length in mid-April).

The results of the present investigation depict that early and lower level of pruning enhanced the canopy spread in E-W direction. However, the interaction effect between time and intensity of pruning showed non-significant effect on the canopy spread in East-West direction. Increase in the canopy spread may be due to the increase in shoot length leading to increase in canopy spreading [12]Meena *et al.,* (2016).

North-South direction

Canopy spread (N-S direction) recorded a significant increase under the influence of different time of pruning and pruning intensity. The maximum increase (109.33 cm) in canopy spread was recorded with the treatment M_1 (mid-April pruning) and lowest (95.28 cm) in M_3 (mid-June pruning). With respect to different pruning intensity, the maximum increase in the canopy spread (117.11 cm) was recorded in P_1 (pruning of 25% of the shoot length) and lowest (93.44 cm) in P_3 (pruning of 75% of the shoot length). The interaction effect between time and intensity of pruning depicted a significant influence on the canopy spread in N-S direction. The maximum increase (123.33 cm) was recorded in P_1M_2 (pruning of 25% of the shoot length in mid-May). The results of the present findings are in line with the findings of [11]Mahesh *et al.,* (2016) who stated that mild pruning (25% of the length shoot) initiated towards the end of summer with plants getting sufficient period of rest followed by pruning and irrigation resulted in profuse growth. These findings corroborate with views of [17]Sundarajan and Muthuswamy (1966) who opined that mild pruning by tipping had increased numbers of functionary laterals in guava. Similar results were also reported by [1]Ansari *et al.*, (2011) in citrus species and [8]Lal *et al.,* (2000) in mango.

Time of first vegetative bud burst (days from imposition of treatment)

The data on differences in pruning time revealed, earliest emergence (5.44 days) vegetative bud burst in P_1 (mid-April pruning) and maximum (6.79 days) in M_3 (mid-June pruning). With respect to the intensity of pruning, the minimum time (5.43 days) taken for vegetative bud burst was in P_3 (pruning 75% of the shoot length) and maximum (6.55 days) in P_1 (pruning of 25% of the shoot length). As regards to the interactions, the minimum days (4.90 days) for bud burst were in P_3M_1 (pruning 75% of the shoot length in mid-April) and maximum (7.50 days) in P_1M_3 (pruning 25% of the shoot length in mid-June).

New shoots emerged early by early pruning. This may be due to removal of apical dominance. Similar finding were reported by [2]Basu *et al.,* (2007) who stated that the increase in severity of pruning encouraged early vegetative bud emergences. The result of the present finding is similar to the findings of [3]Bhagawati *et al.,* (2015) where they stated that in severe pruning, more nutrients available to vegetative bud and also may be due to more light interception that induces early sprouting of vegetative buds.

Length of shoots (cm)

In the present investigation, it was observed that the difference in time of pruning had a significant influence on shoot length. The maximum length of shoot (23.67 cm) was recorded in M_2 (mid-May pruning) which was at par (23.11 cm) with M_1 (mid-April pruning) and lowest (20.89 cm) in M_3 (mid-June pruning). With regard to the intensity of pruning the maximum length of shoots (24.62 cm) was recorded in P_3 (pruning of 75% of the shoot length) which was at par with P_2 (pruning of 50% of the shoot length) whereas the minimum (20.98 cm) was recorded in P_1 (pruning of 25% of the shoot length). The interaction between time and level of pruning showed non-significant result. However, the maximum mean shoot length (25.67 cm) was recorded in P_3M_2 (pruning of 50% of the shoot length in mid-May).

The results revealed that the shoot length increased up to May pruning and later decrease with delay in pruning time. However, with the increase in severity of pruning the shoot length increased. This may be attributed due to relatively less number of shoots and availability of more nutrients per shoots [3]Bhagawati *et al.,* (2015).

Fruit set (%)

The fruit set was not influenced due to difference in time of pruning. However, the highest percentage of fruit set (79.22 %) was obtained in treatment M_2 (mid-May pruning) and lowest (75.28%) was observed in M_3 (mid-June pruning). Under the influence of pruning intensity maximum fruit set (79.63%) was recorded in P_1 (pruning of 25% of the shoot length) which was at par with P_2 (pruning of 50% of the shoot length) and least in P_3 (pruning of 75% of the shoot length). The interaction of pruning time and pruning intensity showed significant influenced on fruit set. The maximum fruit set (83.33%) was recorded in P_2M_2 (pruning of 50% of the shoot length in mid-May) and 83.00% in P_1M_2 (pruning of 25% of the shoot length in mid-May) and lowest (68.67 %) in P_3M_3 (pruning of 75% of the shoot length in mid-June).

The fruit set percentage decreased with increase in intensity of pruning. This may be due to the fact that light pruning increased the reproductive growth as compared to severe pruning and severely pruned trees gave rise to more vegetative growth. Similar findings were reported by [14]Sah *et al.,* (2017) and [11]Mahesh *et al.,* (2016).

Number of fruit per plant

The highest number of fruit per plant (172.78) was recorded in M_1 (mid-April Pruning) which was at par (163.11) with M_2 (mid-May pruning) due to the effect of time of pruning. Under the influence of pruning intensity, the maximum number of fruit per plant (154.56) was recorded in P_2 (pruning of 50% of the shoot length) which was at par (151.00) with P_1 (pruning of 25% of the shoot length) and least (130.78 fruits) in P_3 (pruning of 75% of the shoot length).

The interaction between the two factors also showed significant influence over the number of fruit. The maximum number of fruit (192.00) was obtained in P_2M_1 (pruning of 50% of the shoot pruning in mid-April) and least (90.00) in P_3M_3 (pruning of 75% of the shoot length in mid-June).

Table.1 Effect of pruning time and pruning severity on growth and yield of winter guava under foothills of Arunachal Pradesh

Treatment	Increase in plant height (cm)	Increase in collar girth (cm)	Increase in canopy spread (cm)		Time taken for first vegetative bud burst (days)	Length of shoots (cm)	Fruit set (%)	Number of fruit/plant	Fruit yield (kg/plant)
			E-W	N-S					
Month of pruning									
M_1	50.22	2.60	109.33	109.33	5.44	23.11	76.59	172.78	22.28
M_2	48.61	2.28	106.33	105.17	5.73	23.67	79.22	163.11	23.86
M_3	45.72	2.11	99.67	95.28	6.79	20.89	75.28	100.44	14.39
SE(m)±	0.813	1.21	2.56	1.88	0.201	0.749	1.339	3.66	0.783
CD(0.05)	2.457	0.367	7.741	5.71	0.608	2.264	NS	11.066	2.367
Intensity of pruning									
P_1	56.55	2.43	114.78	117.11	6.55	20.98	79.63	151.00	19.37
P_2	47.88	2.27	108.00	99.22	6.06	22.07	78.79	154.56	22.68
P_3	40.11	2.26	92.44	93.44	5.43	24.62	72.49	130.78	18.48
SE(m)±	0.813	1.21	2.56	1.88	0.201	0.749	1.339	3.66	0.783
CD(0.05)	2.457	NS	7.741	5.71	0.608	1.297	4.048	11.066	2.367
Interaction (P x M)									
P_1M_1	57.00	2.73	119.33	123.00	5.70	21.93	75.73	180.67	18.79
P_2M_1	49.67	2.53	118.67	109.67	5.73	21.87	76.57	192.00	27.15
P_3M_1	44.00	2.53	89.67	95.33	4.90	25.53	77.47	145.67	20.88
P_1M_2	59.00	2.42	114.67	123.33	6.23	21.67	83.00	160.33	24.06
P_2M_2	49.50	2.10	105.33	100.67	5.63	23.67	83.33	172.33	26.34
P_3M_2	37.33	2.20	99.00	92.50	5.33	25.67	71.33	156.67	21.18
P_1M_3	53.67	2.13	110.33	106.00	7.50	19.33	80.17	112.00	15.23
P_2M_3	44.50	2.17	100.00	87.33	6.80	20.67	77.00	99.33	14.56
P_3M_3	39.00	2.03	88.67	92.50	6.07	22.67	68.67	90.00	13.39
SE(m)±	1.408	0.182	4.434	3.27	0.348	1.297	2.319	6.338	1.356
CD(0.05)	4.256	NS	NS	9.89	NS	NS	7.011	19.166	4.10

M_1 = mid-April pruning, M_2 = mid-May pruning, M_3 = mid-June pruning; P_1 = pruning of 25% of shoot length, P_2 = pruning of 50% of shoot length and P_3 = pruning of 75% of shoot length; NS = Non-significant at 5 % level of significance.

The number of fruit was more in early pruning as compared to late pruning. This may be due to higher number of fruit set in early pruning. Parallel results were stated by [2]Basu *et al.,* (2007). With increasing the pruning severity decrease in fruit yield is observed. The decrease in number of fruit per plant is the consequence of pruning which reduced the fruiting area and on the other hand promoted the vegetative growth at the expense of reproductive growth ([7]Kumar and Rattanpal, 2010).

Fruit yield (kg/tree)

The effect of time of pruning on fruit yield per tree was found to be significant. The maximum fruit yield (23.86 kg/tree) was recorded in M_2 (mid-May pruning) which was at par with M_1 (mid-April pruning) and yield was least (14.39 kg/tree) in M_3 (mid-June pruning). With different level of pruning intensity the maximum fruit yield (22.68 kg/tree) was recorded in P_2 (pruning of 50% of the shoot length) and the yield due to P_1 (pruning of 25% of the shoot length) and P_3 (pruning of 75% of the shoot length) was found to be at par. The interaction between the two factors also showed significant influence with respect to fruit yield/tree with the maximum fruit yield (27.15 kg/tree) recorded in P_2M_1 (pruning of 50% of the shoot length in mid-April) which was par with P_2M_2 (pruning of 50% of the shoot length in mid-May).

The increase in yield during winter season was due to elimination of rainy season crop by shoot pruning. The present finding finds support from the report of [4]Boora *et al.,* (2016) who reported that to regulate guava crop it is essential to reduce the fruit set during the rainy season and subsequently increase the fruit set during the winter season by use of different crop regulation practices such as pruning of shoots, defoliation or deblossoming. The results of the present findings are in line with the recommendation of [12]Meena *et al.*, (2016) who opined that 45 cm shoot pruning in May would be the best for good off season production of guava.

From the present investigation, it is concluded that shoot pruning in mid-April will be the best treatment for eliminating rainy season crop and enhancing the plant growth parameters (plant height, collar girth, E-W and N-S canopy spread, early vegetative bud burst and length of shoots) whereas pruning of 50% of shoot length in mid April will be the best treatment for eliminating the rainy season crop for better yield of guava in winter season in the foothills of Arunachal Pradesh.

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