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Influence of pruning time, intensity and bagging on economic feasibility of guava cv. Lucknow-49 for Eastern U.P

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Abstract
A field experiment was carried out at main experiment Station, Department of fruit Science, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, (U.P) during the year 2019 and 2020. The experiment was conducted in a Randomized block design (Factorial) with three replications. The treatment combination comprise of 3 factors *viz.* 3 pruning time, 2 pruning intensity and 2 bagging levels. The minimum cost of cultivation Rs 55754 ha^{-1} was computed under control treatment, while maximum cost of cultivation Rs 114954 ha^{-1} was obtained in treatment 20th June pruning with 60 percent pruning intensity and bagging 20 days after fruit set. The highest gross return and net return Rs 317200 and 203811 was achieved in treatment 5th June pruning with 60 percent pruning intensity and bagging 20 days after fruit set, respectively and the lowest gross return and net return (Rs 109500 and Rs 55754 ha^{-1}) was recorded under control treatment. The maximum cost-benefit ratio (1:1.79) was computed with treatment combination of 5th June pruning time with 60 per control treatment. Pruning of guava trees in the first week of June with 60 percent pruning intensity of annual shoot growth and bagging 20 days after fruit set can be recommended to obtain higher yield with quality fruit and maximum return.

Keywords: C:B ratio, yield, pruning, bagging, economics, return

Introduction
Guava (*Psidium guajava* L.) is one of the most popular tropical and subtropical fruit crops grown in India owing to its several health promoting properties and value-addition avenues. It is well known fact that guava has two distinct botanical characteristics; one is the flowers are always borne on newly emerging vegetative shoots, irrespective of the time of year (Rathore & Singh, 1974; Singh, 1985) [11, 12]. This feature makes guava unique, that it can be pruned as severely as temperate fruit tree (Lotter, 1990) [17] for high density management. Several workers reported the beneficial effects of pruning on yield and fruit quality of guava. Second is that guava has more than one bearing season. These two features provide an opportunity to regulate guava crop through pruning along with high density management. In *tarai* region of India, three flowering seasons are very common, *viz.* April-May (For rainy season crop), July-August (for winter season crop) and October- November (Spring season crop). During winter season, the flowering and vegetative growth is almost negligible due to low temperature. As a result plants accumulate sufficient food reserve, which results in maximum new vegetative growth in the following spring due to optimum temperature. This vegetative flush produces floral buds which produces flower during summer season (40 days after floral initiation) for rainy season crop. The production is being maximum during the rainy season. However, the fruits produced during rainy season are severely attacked by fruit fly (Stonehouse *et al.*, 2002) [13] which leads significant loss in fruit production and it also have poor nutritive value and keeping quality. On the other hand, winter season crop is superior in quality, free from the pest and diseases, having long storage life and fetches more prices in the market as compared to the rainy season crop.
By keeping the above mentioned points in mind, it is beneficial to take winter season crop mainly. Crop regulation in guava is also used in other parts of world like in Hawaii and Kauai, where it is known as cycling. Pruning can be used for crop regulation. Pruning has its physiological effects basically due to changes in the partitioning of the reserves.

It changes sink preference for allocation of photosynthates. Depending upon the time of the year, the extent and frequency of pruning, some sites of accumulation will disappear and others will be created. As a result, changes in seasonal fluctuations of reserves can appear as well. In this way, pruning helps in both ways, firstly to regulate crop (Kindo, 2005) [14] and secondly to manage high density. Standard spacing for guava is 6 m × 6 m.

Materials and Methods

The experiment was carried out at Main Experiment Station, Department of Fruit Science, College of Horticulture and Forestry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh during year 2019- 20 and 2020- 21. The experiment was laid out in factorial randomized block design with thirteen treatments and three replications with one plant in each replication. The plants were planted at spacing of 6 m x 6 m. Thirteen treatment combinations were formed from 3 pruning time, 2 pruning intensity, 2 bagging time and control.

Number of fruit per tree

Fruits are born in the axil of leaves of the shoot and also those emerged newly on branches where fruit are available were recorded. The average number of fruits per plant was worked out.

Fruit Yield per ha. (Ton)

Yield per tree was multiplied with number of plants per ha to obtain the yield in tons/ha.

$$\text{Yield ton per ha} = \frac{\text{Yield kg per tree x No. of trees per ha}}{1000}$$

Economic studies

The economics of various treatments was calculated by converting the total fruit yield into money value.

Cost of Cultivation

Cost of cultivation of different treatment was estimated on per hectare basis by considering all the expenditures incurred for establishment guava cv. Lucknow- 49 of canopy management experiment and added with common cost for various operations.

Gross return

Gross return was worked out by multiplying fruit yield of guava per hectare separately under various treatments to their existing market prices.

Net return

Net return was obtained by deducting the total cost of cultivation from the gross return from the individual treatment (Rs/ hectare) calculated.

Net return = Gross return – Total cost of cultivation

Benefit-Cost ratio

The benefit-cost ratio was estimated on the basis of cost of cultivation, gross return and net return obtained from guava orchard. The return per hectare was estimated in terms of fruit yield per hectare at existing market rate available during the year 2019-20 and 2020-21. Benefit-cost ratio was obtained by dividing the net return by cost of cultivation

Benefit-cost ratio = Cost of cultivation/Net return

Results and Discussion

Number of fruit/ Tree

Pruning time 5th June and pruning with 60 percent intensity yielded highest number of guava fruit per tree. Highest number of fruit per tree was obtained with 05th June pruning time and pruning with 60 percent intensity during both the years. The treatments were also found effective against control in both the years. Singh and Varu (2017) [8] in winter season crop, maximum number of fruits per tree and fruit yield per plant and per hectare was recorded with 30th May pruning. Dhaliwal *et al.* (2000) [2] reported that the maximum number of fruit was recorded with 50% pruning intensity, while the minimum number of fruits was obtained with 100% pruning intensity. The study revealed that heading back at the level of 200 cm and two pinching were found most effective in increasing the growth characters of the plant, i.e. number of sprouts per shoot, flowering intensity, fruit setting, number of fruits/plant and yield as compared to control and other treatments (Saini *et al.* 2016) [6]. In case of yield and fruit attributes the highest fruit set was registered, highest numbers of fruits per tree, maximum fruit yield was obtained in 30 cm of pruning (Choudhary and Dhakare 2018) [1]. The results of the study revealed that among the various pruning treatments the pruning of 30 cm of apical shoots on 15th May proved to be the best in increasing the yield and yield attributes in terms of number of fruits per tree (Singh *et al.* 2020) [9].

Table 1: Effect of pruning time, pruning intensity and bagging on number of fruit/ Tree of guava

Treatments	Number of fruit/ Tree	
A. Pruning time	2019	2020
T_1 (Pruning on 20th May)	184.11	198.87
T_2 (Pruning on 5th June)	187.69	202.73
T_3 (Pruning on 20th June)	164.45	177.63
SE(m±)	3.085	3.753
CD (P=0.05%)	9.005	10.954
B. Pruning intensity		
P_1 (30% Pruning)	169.81	183.43
P_2 (60% Pruning)	187.69	202.73
SE(m±)	2.519	3.064
CD (P=0.05%)	7.353	8.944
C. Bagging		
D_1 (Bagging at 10 DAFS)	175.18	189.22
D_2 (Bagging at 20 DAFS)	182.33	196.94
SE(m±)	2.519	3.064
CD (P=0.05%)	NS	NS
D. Treatment vs Control		
Treatment (T)	178.75	193.08
Control (C)	111.00	138.87
SE(m±)	6.171	7.506
CD (P=0.05%)	18.010	21.907

Fruit yield (ton/ha.)

The pruning time 05th June, 60 percent pruning intensity and bagging at 20 days after fruit set gave highest fruit yield (ton/ha.) of guava. The highest yield was seen with 5th June pruning. The 60% pruning intensity gave 7.78 ton and 7.96 ton/ha yield during 2019 and 2020. The bagging was effective with 20 DAFS in both the years. However the

treatments were found effective against control during both the years. In general, the treatment effect on fruit yield (tons/ha) of guava were more pronounced in 2020 than 2019. Among the first order interactions only T × P interaction gave significant effect in the year 2019 and 2020. The interaction effect of pruning time 5th June with 60% pruning intensity (T_2P_2) gave highest fruit yield. Lowest fruit yield was recorded in pruning 20th June with 30 percent pruning intensity (T_3 P_1) in both the years. Nautiyal *et al.* (2020) [5] reported, pruning severity with complete removal of non-fruiting shoots significantly decreased the yield in rainy season crop and subsequently increased the yield in winter season crop. Meena *et al.* (2016) [16] studied the 45 cm shoot length pruning in May also caused early shoot emergence, early flowering, more canopy spreading and heavy fruiting than the normal fruiting in control. The result depicted that pruning thrice a year to 50% of shoot length resulted in maximum yield in the summer season as well as in winter season crop and total yield per hectare.

Table 2: Effect of pruning time, pruning intensity and bagging on Fruit yield (ton/ha) of guava

Treatments	Fruit yield (ton/ha)	
A. Pruning time	2019	2020
T_1 (Pruning on 20th May)	7.52	7.69
T_2 (Pruning on 5th June)	7.97	8.15
T_3 (Pruning on 20th June)	7.07	7.23
SE(m±)	0.214	0.219
CD (P=0.05%)	0.624	0.639
B. Pruning intensity		
P_1 (30% Pruning)	7.26	7.42
P_2 (60% Pruning)	7.78	7.96
SE(m±)	0.174	0.179
CD (P=0.05%)	0.509	0.522
C. Bagging		
D_1 (Bagging at 10 DAFS)	7.25	7.41
D_2 (Bagging at 20 DAFS)	7.79	7.97
SE (m±)	0.174	0.179
CD (P=0.05%)	0.509	0.522
D. Treatment vs Control		
Treatment (T)	7.52	7.69
Control (C)	3.45	3.85
SE (m±)	0.427	0.438
CD (P=0.05%)	1.247	1.277

Economic studies

Analysis of economic factor like cost of cultivation, gross return, net return and cost-benefit ratio are important to evaluate the effect of treatment from practical point of view to farming community as well as to the research workers. Variation in cost of cultivation was recorded for pruning time, pruning intensity and bagging, which are increase with the levels of all the factors because they are major inputs. The gross income of the different treatments was calculated by multiplying the market unit value (Rs/kg.) with respective treatment yield of fruit. The net return and cost-benefit ratio were calculated accordingly.

The economics as affected by different pruning time, pruning intensity and bagging treatments included in the study have been presented in Table 3. Among all the pruning time, pruning intensity and bagging treatments, highest average cost of cultivation (Rs 114954 ha^{-1}) was realized under 20th June pruning time with 60 percent pruning intensity and bagging 20 days after fruit set, due to more cost involved in severe pruning, bagging cost as well as labour cost for applying it on field. Lowest cost of cultivation was recorded (Rs 53746 ha^{-1}) in control treatment were no pruning treatment and no bagging was done during both the years of investigation.

Gross return is directly related to the price of the fruit in market among different combinations. The highest gross return is Rs 203811 ha^{-1} was recorded with the treatment 5th June pruning time, 60 percent pruning intensity and bagging 20 days after fruit set, whereas lowest value Rs is 109500 ha^{-1} was recorded in control treatment. In respect of net return and cost-benefit ratio, the maximum value were obtained in 5th June pruning time with 60 percent pruning intensity and bagging 20 days after fruit set, showed highest values (Rs 203811 ha^{-1} and 1:1.79, respectively). The minimum net return and cost-benefit ratio (Rs 55754 ha^{-1} and 1:1.03, respectively) was recorded under control. Thakre *et al.* (2016) [15] reported highest cost-benefit ratio (1:2.96) with one leaf pair pruning of fruited shoots in guava. Contrary to this Mahadevan *et al.* (2017) [4] recorded highest cost-benefit ratio with 30 cm pruning. Nautiyal *et al.* (2020) [5] observed highest cost-benefit ratio with thinning-out of non-fruiting shoots. All though bagging is laborious work, which also increase input cost but it improves the appearance and quality of guava fruits an also protects the fruits from pest infestation (Sharma *et al*., 2014) [7].

Table 3: Economics of guava production under different treatments

S. No.	Treatment	Pruning Cost (Rs)	Bagging Cost (Rs)	Common Cost (Rs)	Total Cost of cultivation (Rs)	Gross Return (Rs)	Net Return (Rs)	B:C Ratio
1.	Control	-	-	53746	53746	109500	55754	1:1.03
2.	T1P1D1	13148	44322	51986	109456	296800	187344	1:1.71
3.	T1P1D2	13148	45998	51986	111132	304200	193068	1:1.73
4.	T1P2D1	9446	49127	51986	110559	303800	193241	1:1.740
5.	T1P2D2	9446	50914	51986	112346	311200	198854	1:1.770
6.	T2P1D1	13148	45365	51986	110499	303000	192501	1:1.742
7.	T2P1D2	13148	47041	51986	112175	310320	198145	1:1.76
8.	T2P2D1	9446	49870	51986	111302	310000	198698	1:1.78
9.	T2P2D2	9446	51957	51986	113389	317200	203811	1:1.79
10.	T3P1D1	13148	39517	51986	104651	290800	186149	1:1.778
11.	T3P1D2	13148	45998	51986	111132	298200	187068	1:1.68
12.	T3P2D1	9446	46408	51986	107840	297800	189960	1:1.761
13.	T3P2D2	9446	53522	51986	114954	305200	190246	1:1.65

Conclusion

The minimum cost of cultivation Rs 55754 ha^{-1} was computed under control treatment, while maximum cost of cultivation Rs 114954 ha^{-1} was obtained in treatment 20th June pruning with 60 percent pruning intensity and bagging 20 days after fruit set. The highest gross return and net return Rs 317200 and 203811 was achieved in treatment 5th June pruning with 60 percent pruning intensity and bagging 20 days after fruit set, respectively and the lowest gross return and net return (Rs 109500 and Rs 55754 ha^{-1}) was recorded under control treatment. The maximum cost-benefit ratio (1:1.79) was computed with treatment combination of 5th June pruning time with 60 percent pruning intensity and bagging 20 days after fruit set. The lowest cost-benefit ratio (1:.03) was recorded in control treatment. The economics in terms of benefit-cost ratio of guava was also recorded highest in treatment *i.e.* pruning on 5th June with 60 percent pruning intensity and bagging 20 days after fruit set.

Therefore, pruning of guava trees in the first week of June with 60 percent pruning intensity of annual shoot growth and bagging 20 days after fruit set can be recommended to obtain higher yield with quality fruit and maximum return for guava growers of Eastern Uttar Pradesh.

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