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Influence of pruning date on fruit yield of guava (*Psidium guajava* L.) under subtropics

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Abstract

Effect of pruning dates on fruit yield of guava was studied in a trial conducted on two guava cultivars *i.e.,* Allahabad Safeda and Sardar for five consecutive years. As compared to pruning in February and March, pruning from April through June, enhanced number of shoots and flowering percentage. Shoot growth reduced in May and June pruned trees. Total yield during winter was increased significantly ($p < 0.05$) in May and June pruned trees than the unpruned trees of both the varieties. Harvest in winter season was significantly increased by May pruning. Pruning from February to March did not respond well for winter fruiting. Penetration of photosynthetic photon flux was generally greater in canopies of pruned trees than in unpruned trees during May and June. In all the years, the quantum of fruit yield harvestable during December and January increased significantly by May pruning.

Key words: Guava, *Psidium guajava*, pruning date, light penetration, shoot induction, flowering, yield.

Introduction

In subtropics, guava bears varying amount of fruit throughout the year. In north India, major crop usually ripens from July to mid-October (rainy season). A small distinct crop is produced from November to mid-February (winter season). Though, the quantum of production is high in rainy season (Rathore and Singh, 1974, Singh *et al.,* 2000), it offers poor quality due to insipidness (Singh *et al.,* 1996) and infestation of pest (Rawal and Ullasa, 1988) in comparison to winter season. On the contrary, in winter season quality fruits are produced and fetches high monetary returns (Singh *et al.,* 2000). This necessitates for developing effective crops regulating technique in guava for manipulating winter season crop as a major one thus, making guava cultivation highly profitable, sustainable and export oriented. Several methods have been tried to induce new vegetative growth during rainy season so that bumper crop is obtained in subsequent winter season (Shigeura and Bullock, 1976, Singh *et al.,* 2000). Coordination of the fruiting cycle can help in maintaining fruit supplies during most months (Lopez *et al.,* 1982, Manica *et al.,* 1982, Lopez and Perez, 1977, Quijada *et al.,* 1999 and Shatat, 1993).

Guava fruit harvest peaks can deviate with prevailing weather conditions and cultural practices because flowers are produced on new growth. Irrigation (Singh *et al.,* 1997), fertilization (Shigeura and Bullock, 1976), defoliation and pruning (Singh *et al.,* 1996, Shigeura and Bullock, 1976, Shatat, 1993) can be used to stimulate new growth and influence fruiting in guava. Several workers have reported increased yield, fruit size and qualitative attributes of guava as a result of pruning at different periods. This improvement is attributed to better light penetration into fruit bearing portions of the tree canopy. Determination of the pruning effects on light penetration within guava trees may enable canopy designing for improved fruit yield and quality. Major objective of the present study was to determine the influence of different pruning dates on light penetration, flowering and fruiting pattern in two guava cultivars.

Materials and methods

Fifteen years old budded guava trees of cultivars, 'Allahabad Safeda' and 'Sardar', spaced at 6m X 6m, never been selectively pruned were selected in an orchard of Central Institute for Subtropical Horticulture, Rehmankhera, Lucknow. Uniform trees with an average height of ~ 6.09m (Sardar), 5.25m (Allahabad Safeda) and average canopy width of 2.75, 2.41, 2.97 and 2.73m and 3.72, 3.19, 3.53 and 3.25m in N, S, E and W directions, respectively were used. Different sets of pruning experiments were initiated in February, 1991 and continued annually through 1998. Branchlets to their half length (50%) from the apex on entire tree, in different months, were pruned (headed back).

Experiment A: During 1991 to 1993, fifteen trees, each of Sardar and Allahabad Safeda were pruned in the 1st week of February, March, April, May and June. Unpruned trees were kept as control for comparison with pruned trees in terms of shoot growth, flowering and fruiting pattern. The experiment was laid out in randomized block design with six treatments replicated four times and one tree per replication for each cultivar. A ground surface area corresponding to the tree canopy was cleared for fertilization with 600g N, 300g P_2O_5, and 300g K_2O, annually.

Experiment B: In 1994-95 (based on yield distribution pattern during winter under Exp. A), nine trees each of 'Allahabad Safeda' and 'Sardar' were pruned on 15th and 30th April, May and June.

Experiment C: Based on yield assessments obtained in experiment B, the experiment was modified and six trees, each of 'Allahabad Safeda' and 'Sardar' were pruned on 15th and 30th day of May and June during 1995-96.

Experiment D: On the basis of the previous results (experiment

A, B and C) in relation to response of pruning dates for distribution of yield particularly during winter, the date of pruning operation finally concentrated in May and June. Six trees each of 'Allahabad Safeda' and 'Sardar' were pruned during 1996-1998. Experiments were replicated eight times with two trees per replication.

Photosynthetic photon flux (PPF) was measured with an LI-1000 quantum sensor and LI-189/ datalogger LI- 1000 (LI- COR Instruments, Inc., Lincon, NE) at ground level and 2m height of the canopy. All the measurements were taken on uniform overcast days between 10.00 and 12.00 h. Observations were recorded on shoot growth, percent flowering and yield in different seasons/ months. Pooled data were subjected to analysis of variance.

Results and discussion

Shoot growth and flowering: Shoot growth was influenced greatly by pruning treatments in different months of operation (Table 1). Shoots arising from February and March pruned trees were larger (measured after 4 months) than unpruned trees. More number of new shoots emerged from the pruned branches than from unpruned ones. 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. The vegetative growth response of guava trees to pruning treatments seems to vary with the month of operation and cultivar. It could be seen from Table 1 that shoots produced after pruning (below cut point), in cv. Sardar exhibited more length than Allahabad Safeda. In general, May was found to be the best month for pruning, which resulted in shortening of shoot growth from 24.0-21.0 cm to 16.5-12.0 cm in Sardar and Allahabad Safeda, respectively.

The percent flower bud formation on new shoot was affected by different dates of pruning operations (Table 1) and May pruned trees produced maximum flowering shoots during July to September, in Sardar (70%) and Allahabad Safeda (73%) as compared to (26%) under control. Horizontal shoots from pruned trees had more blossoms than similar shoots in the tops of the pruned trees, probably because of reduced shoot growth.

Yield pattern: In Experiment A, May and June pruned trees significantly yielded higher than control in both the cultivars. This increased yield in winter was a result of significant reduction in rainy season crop load. These results clearly show that the cropping pattern of guava can easily be manipulated to obtain a desired harvest as well as a good yield during winter (Table 2).

In Experiment B (Table 3), the effect of pruning date on the shifting of rainy season crop to winter season was more pronounced. More winter crop was recorded on the trees pruned on 15th May and 30th June. This phenomenon was common in both the cultivars. Total yield (rainy crop + winter crop) was also higher under pruning treatments, with the major crop in winters. The effect of 15th and 30th May pruning appeared more pronounced than June pruning.

Results of Experiment C conducted with four pruning dates to find out the best date of pruning in May and June revealed that the pruning on 30th May is superior for producing higher yield in winters as well as total yield in both the cultivars (Table 4). The table clearly show that total winter yields of both cultivars was higher in all the pruning treatments. However, winter yield showed an increasing trend when pruned after 15th May.

Table 1. Effect of different pruning dates on growth and per cent flowering in 'Sardar' and 'Allahabad Safeda' guava trees

Pruning dates	Shoot Length	Percent flowering (%)				
		April	June	July	Aug.	Sept.
Experiment A						
February	A 23.93	73.3	-	20.0	-	-
	B 14.95	69.9	-	9.9	-	-
March	A 24.35	79.9	-	13.3	-	-
	B 18.26	60.0	36.6	13.3	-	-
April	A 20.09	-	33.3	13.3	-	-
	B 15.87	-	26.6	40.0	13.3	-
May	A 16.29	-	-	40.0	40.0	33.3
	B 7.13	-	-	60.0	20.0	-
June	A 11.72	-	-	50.6	33.6	20.0
	B 11.10	-	-	53.2	20.0	13.3
Control	A 19.43	72.0	-	14.0	-	-
	B 16.75	48.0	-	13.0	4.0	-
Experiment B						
15th April	A 22.5	-	34.0	11.0	15.0	-
	B 19.5	-	23.0	46.2	-	-
30th April	A 21.0	-	38.0	13.0	17.0	-
	B 17.2	-	29.2	53.0	3.9	-
15th May	A 13.0	-	-	38.0	37.5	21.0
	B 9.7	-	-	34.0	27.0	9.7
30th May	A 12.5	-	-	46.0	43.7	6.4
	B 8.0	-	-	43.3	-	-
15th June	A 14.0	-	-	54.0	16.0	-
	B 13.5	-	-	41.0	37.0	11.0
30th June	A 13.5	-	-	57.0	23.0	3.2
	B 14.0	-	-	38.0	46.2	13.2
Control	A 23.5	67.0	-	11.0	-	-
	B 18.5	37.0	-	9.7	2.3	-
Experiment C						
15th May	A 23.25	-	-	34.0	31.0	7.2
	B 19.92	-	-	27.0	36.0	2.7
30th May	A 19.70	-	-	21.0	45.0	10.2
	B 18.20	-	-	17.0	48.0	6.1
15th June	A 16.95	-	-	14.0	56.0	15.3
	B 18.07	-	-	9.0	59.0	14.0
30th June	A 16.41	-	-	13.0	54.0	10.0
	B 13.26	-	-	7.0	51.0	20.0
Control	A 23.00	-	-	9.0	12.0	-
	B 19.00	-	-	7.0	4.4	-
Experiment D						
30th May	A 17.51	-	-	14.5	53.5	2.0
	B 15.01	-	-	13.0	58.0	2.0
30th June	A 15.93	-	-	10.0	54.0	3.0
	B 15.75	-	-	9.0	59.0	2.0
Control	A 24.00	-	-	17.0	3.0	-
	B 21.00	-	-	19.0	7.0	-

A = Sardar, B= Allahabad Safeda

In two-year trials (Experiment D) with on both cultivars, pruning was carried out once on 30th of each month (May to June). Compared with unprunned control, pruning had significant effect on crop distribution in winter months and total yield in both the

cultivars. May pruning however, concentrated the harvest in November, December and January (Table 5).

Table 2. Effect of pruning months on 'Allahabad Safeda' and 'Sardar' guava harvest in different season

Pruning (Months)	Seasons			
	Sardar		Allahabad Safeda	
	Rainy	Winter	Rainy	Winter
February	57.10 ^{b}	17.99 ^{e}	35.20 ^{b}	8.41 ^{e}
March	43.51 ^{c}	19.94 ^{d}	28.95 ^{c}	12.87 ^{d}
April	29.89 ^{d}	24.35 ^{c}	15.07 ^{d}	15.26 ^{c}
May	12.90 ^{e}	68.00 ^{b}	3.42 ^{e}	67.25 ^{a}
June	14.72 ^{e}	70.52 ^{a}	1.00 ^{e}	61.78 ^{b}
Control	70.22 ^{a}	24.39 ^{c}	53.33 ^{a}	12.32 ^{d}

Mean separation by Duncan's multiple range test ($p < 0.05$)

Table 3. Effect of six pruning dates on yield of guava cv. 'Allahabad Safeda' and 'Sardar'

Pruning dates	Sardar yield (kg/ tree)		Allahabad Safeda yield (kg/ tree)		Total Yield (kg/ tree)	
	RS	WS	RS	WS	S RS+WS	AS RS+WS
15th April	18.00 ^{b}	27.00 ^{e}	7.00 ^{c}	38.20 ^{d}	45.00 ^{c}	45.20 ^{d}
30th April	11.80 ^{c}	31.10 ^{d}	7.50 ^{b}	43.00 ^{c}	42.90 ^{c}	50.50 ^{e}
15th May	1.50 ^{e}	83.00 ^{b}	3.20 ^{d}	89.20 ^{a}	84.50 ^{b}	92.40 ^{a}
30th May	0.37 ^{e}	97.64 ^{a}	1.00 ^{f}	91.20 ^{a}	98.01 ^{a}	92.20 ^{a}
15th June	3.65 ^{d}	78.18 ^{c}	3.20 ^{d}	79.00 ^{b}	81.83 ^{b}	82.20 ^{b}
30th June	1.00 ^{e}	83.80 ^{b}	2.00 ^{e}	79.00 ^{e}	84.90 ^{b}	81.00 ^{c}
Control	55.70 ^{a}	23.70 ^{e}	39.50 ^{a}	23.50 ^{e}	79.40 ^{b}	63.00 ^{d}

Mean separation by Duncan's multiple range test ($p < 0.05$)
S= 'Sardar'; AS= Allahabad Safeda'; RS= Rainy Season;
WS= Winter Season.

Table 4. Effect of four pruning dates on yield of guava cv.'Allahabad Safeda' and 'Sardar'

Pruning dates	Sardar yield (kg/ tree)		Allahabad Safeda yield (kg/ tree)		Total Yield (kg/ tree)	
	RS	WS	RS	WS	S RS+WS	AS RS+WS
15th May	11.10 ^{b}	84.10 ^{d}	7.10 ^{b}	81.65 ^{c}	95.20 ^{b}	88.75 ^{bc}
30th May	9.37 ^{b}	106.23^{a}	6.55 ^{c}	90.08 ^{a}	115.60 ^{a}	96.63 ^{a}
15th June	2.87 ^{c}	95.15 ^{c}	4.75 ^{d}	86.05 ^{b}	98.02 ^{b}	90.80 ^{b}
30th June	1.12 ^{c}	97.62 ^{b}	2.35 ^{e}	85.50 ^{b}	98.74 ^{b}	87.85 ^{c}
Control	75.89 ^{a}	39.20 ^{e}	52.57 ^{a}	13.88 ^{d}	115.09 ^{a}	66.45 ^{d}

Mean separation by Duncan's multiple range test, ($p < 0.05$)
S= 'Sardar'; AS= Allahabad Safeda'; RS= Rainy Season;
WS= Winter Season

Table 5. Yield distribution pattern of 'Sardar' and 'Allahabad Safeda' guava as influenced by pruning dates

Pruning Dates		Mean fruit yield (kg / tree) July	Aug.	Sept.	Nov.	Dec.	Jan.	Total yield RS	WS
30th May	A	6.0	30.0 ^{b}	2.0	15.0 ^{a}	64.0 ^{a}	21.0 ^{a}	38.0 ^{b}	100.0 ^{a}
	B	-	12.5 ^{a}	-	25.0 ^{a}	57.0 ^{a}	21.0 ^{a}	12.5 ^{b}	103.0 ^{a}
30th June	A	3.0	23.0 ^{c}	-	6.2 ^{b}	71.0 ^{b}	20.0 ^{a}	32.2 ^{c}	97.0 ^{b}
	B	-	9.0 ^{c}	-	12.0 ^{b}	25.0 ^{c}	36.0 ^{c}	9.0 ^{c}	73.0 ^{b}
Unpruned	A	6.0	54.0 ^{a}	6.0	2.0 ^{c}	34.0 ^{c}	11.0 ^{b}	66.0 ^{a}	47.0 ^{c}
(Control)	B	9.0	38.5 ^{b}	3.5	8.0 ^{c}	30.0 ^{b}	11.0 ^{b}	51.0 ^{a}	48.0 ^{c}

Y= Means with five replications; - = No fruits;
Mean separation by Duncan's multiple range test, ($p < 0.05$)

All treatments exhibited almost similar pattern of light penetration prior to pruning, although Allahabad Safeda had greater light than Sardar. Availability of PPF at ground level and 2m height of the canopy was influenced by the pruning performed in May and June. Considerable improvement in light environment in the canopy was noticed after pruning in both the cultivars (Table 6).

Table 6. Percent available PPF within pruned and non pruned 'Allahabad Safeda' and 'Sardar' guava tree canopies

Pruning date		Available PPF (%) Before pruning 0m*	2m	After pruning 0m	2m
30th May	A	6.0*	10.0	53.0	83.0
	B	7.0	11.0	59.0	85.0
30th June	A	8.2	26.5	38.0	95.0
	B	16.0	27.6	39.0	93.0
Unpruned	A	5.0	6.0	9.0	10.0
	B	8.0	9.0	9.5	14.0

A = Sardar, B= Allahabad Safeda
* Height from the ground level where sensor was placed for PPF measurements

The shoot growth response of guava trees to pruning treatment seems to vary with cultivars and months. May and June pruning were more effective for controlling shoot growth than pruning in other months.

As a striking effect of pruning, winter season crop yield increased which was more apparent in the treatment imposed after April. The flowering was also shifted in all pruning treatments given April onwards. This seems not only because of new shoot production in later months but also due to removal of flowering shoots, which might have contributed significantly to rainy season crop thereby reducing the next season (winter) crop. The shifting of heavy crop from rainy season to winter has been noticed by several workers (Shigeura and Bullock, 1976, Singh *et al.*, 1997, Lopez *et al.*, 1982.) mainly by reducing the crop load of rainy season which is achieved by removal of flowers, fruitlets (Quizada *et al.* 1999) or new emerging shoots (Singh *et al.*, 1996). Winter season crop yield was not much affected when the pruning was performed as early as in February and March (Table 1) because the shoots formed under these treatments were conditioned for flowering in April ultimately with very less contribution for winter season yield. May and June pruning induced major flowering in August responsible for better winter crop.

Pruning response of Sardar and Allahabad Safeda was almost similar suggesting that the treatment can be recommended not only for Sardar and Allahabad Safeda, rather for several other cultivars also. The similar behaviour of both the cultivars seems to be because of dominating influence of environment on the production of new shoots as well as their flowering habit independent to genotypic effect.

The pruning treatments not only produced more winter season crop but also the total yield as compared to control. This seems to be because of production of large number of flowering shoots, diversion of stored food materials for healthy shoots, flowering after rainy season crop,

better flowering and higher fruit set and lastly improved the light environment of the canopy which is helpful in flower production on new shoots.

Pruning experiments on guava conducted in different parts of the world have shown superiority of few dates over others in relation to fruit yield (Lopez and Perez, 1977, Lopez *et al.*, 1982, Manica *et al.*, 1982, Shigeura and Bullock, 1976, Quizada *et al.*, 1999). The differences in suitable dates for pruning in different growing areas differ due to geographical position of the location influencing time of growth and flowering cycles.

Therefore, it can be concluded that shifting of rainy season crop to winter months in guava cultivars with the help of pruning in May was economically effiecient. Hence, the pruning treatment may be effectively used for commercial exploitation of guava in winter months for domestic as well as export markets.

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