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Effect of Time of Shoot Pruning on Yield and Fruit Quality in Meadow Orchard of Guava

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ABSTRACT

A study the effect of time of half shoot pruning on yield and quality in meadow orchard of guava was conducted after subjecting it to different time of shoot pruning and their combination. Findings revealed that half shoot (50%) pruning significantly influenced yield and quality attributes of guava. Half shoot pruning in April results in equal yield in rainy and winter season crop during both the year. Lowest yield recorded in unpruned control in winter season crop. However, highest total yield per year was recorded in unpruned control during both the year with inferior fruit quality. Winter season crop obtained with increased TSS, ascorbic acid and total sugars.

Key words: *Psidium guajava, Meadow orchard, Pruning, Guava yield, Fruit quality*

INTRODUCTION

Guava (*Psidium guajava* L.) trees are hardy, prolific bearer, long lived, drought tolerant and need comparatively less attention which makes its cultivation more remunerative. It is a favoured crop among fruit growers due to its wide adaptability and higher return per unit area. But, of late, this crop has exhibited a paradigm shift in the production system, from subsistence farming to commercial production. Although, there is increase in area and production of fruits during last decade in the country, productivity did not show significant increase. Generally guava is cultivated through traditional planting system. In which it is very difficult to achieve desirable level of production. Moreover, in this system guava plant takes 4-5 years for coming into commercial bearing and thus maximise the overall cost of production per unit area, because large plants provide low production per unit area. The increasing importance of guava as a commercial tropical fruit crop, both for table purposes and processing, demands its wide spread cultivation ensuring regular cropping and higher production. Plant spacing is one method used to obtain efficient and profitable land use. Its basic function is to confine the exploitation zone of the plant with regard to light, water, and nutrients so the highest total yield positional can be reached in the smallest possible area[16]. With ever increasing land costs, and the need for early returns on invested capital, there is a worldwide trend toward high density plantings/meadow orcharding.

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Meadow orchard in guava is one of the techniques where higher number of plants/unit area is accommodated compared with the conventional planting density. Under meadow orcharding where fruiting starts with first year a precise level of pruning is also required to make the balance between vegetative and reproductive phase. Pruning can be used for crop regulation[7]. 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 appears as well[2]. In this way, pruning helps in both ways, firstly to regulate crop[5] and secondly to manage high density[4]. The efficient training and pruning can maintain the proper canopy size of the guava plant. Keeping in view the present investigation, effect of time of shoot pruning on yield and fruit quality attributes in meadow orchard of guava was conducted.

MATERIAL AND METHODS

The research was conducted at Horticulture Research Centre, Pattarchatta of G.B. Pant University of Agriculture & Technology, Pantnagar Uttarakhand. Pantnagar has a humid sub-tropical climate with hot humid summers and cold winters. The maximum and minimum temperature range 33°- 42°C and 4° - 8°C during summer and winter, respectively. The soil texture of experimental field is sandy loam with *p*H 8.0. The experimental material consisted of one year old uniform grafted plants of guava cv Pant Prabhat planted in a meadow orchard. These plants were maintained under uniform cultural schedule throughout the period of experiment.

The treatments consists seven different combinations of time of shoot pruning and one unpruned control. In this way there were eight treatments replicated four times in Randomised Block Design with two plants as a treatment unit. The orchard was planted during October, 2009 under single hedge row system of planting as spacing of 2 m (row to row) x 1 m (plant to plant) accommodating 248 plants in a plot size of 35 m x 20 m (700 m^2) or 5000 plants per hectare. After a period of one year (in month of October 2010), all the plants were topped at a uniform height of above 60-80 cm from the ground level for initiation of new growth below cut end. During the month of January, 2011, all the plants were topped to a uniform height of 1.0 m from the ground level for initiation of new growth below the cut ends. After 20-25 days of topping, new shoots emerged out. In general 4-5 shoots retained below the cut point of the topping. As shoots mature, generally after a period of 3-4 months, then they reduced by 50 % of their total length (half shoot pruning) to that new shoots emerge below the cut point. This is done to attain the desired tree canopy architecture and strong framework. After pruning, new shoots emerges on which flowering takes place. The emerged shoots are allowed *to* grow for 3-4 months before they are again pruned by 50 % (half shoot pruning).

The following observations were recorded for physical fruit variables, yield per plant and physico-chemical attributes. Physical fruit variables, fruit weight, diameter, length and volume were measured as per the standard procedures. Fruit yield per plant was computed by multiplying the total number of fruits on each plant with mean fruit weight for that plant for rainy and winter season crop separately. A representative sample of ten fruits per plant per treatment per replication was taken randomly from all the directions of the plant to take observations on physical variables of fruits for both seasons. Chemical fruit quality parameters like TSS (°B) using hand refractrometer, pectin content (%), titrable acidity (%) and ascorbic acid (mg/100g pulp) as per Ranganna[11] sugars with the help of AOAC[1] was calculated. The experiment was conducted twice, *i.e.* 2010-11 and 2011-12. The pooled data of two years were statistically analyzed for analysis of variance in Randomized Block Design[17].

Details of treatments as follows: PA: half shoot pruning in April, PJ: half shoot

pruning in July, PO: half shoot pruning in October, PAJ: half shoot pruning in April and July, PAO: half shoot pruning in April and October, PJO: half shoot pruning in July and October, PAJO: half shoot pruning in April, July and October, and CUN: unpruned control.

RESULTS AND DISCUSSION

Yield attributes

The number of fruit and fruit yield per plant compared to control was significantly influenced by half shoot (50%) pruning in rainy and winter season. Being aimed to reduce the rainy season crop, the pruning treatments affected the fruit number and consequently fruit yield in both the crops *i.e.* rainy and winter season (Table 1). The unpruned treatments produced highest number of small fruits per plant with lower fruit weight and more yield in rainy season crops and subsequently lower yield in winter season, while, half shoot pruned treatments observed almost equal number of fruits and yield per plant with quality fruits in winter season fruiting. Total annual yield per plant was higher in unpruned plants during both the years. The maximum (7.66 kg.) fruit yield per plant was recorded in unpruned control followed by treatment PO and PJO during rainy season. In winter season, highest (3.86 kg.) fruit yield per plant was recorded in case of treatment PA followed by treatments PAJ. The minimum (1.04 kg.) fruit yield per plant was obtained in the treatment unpruned control, as it recorded the lowest number of fruits during winter season. These findings are in accordance with Lal *et al.*[7]**.** The total annual fruit yield did not differ significantly, while it showed significant difference among the treatments. Maximum (8.79 kg) total annual yield per plant was recorded with the treatment PO followed by unpruned control and PJO. Yield in terms of quintals per hectare followed same trend as yield in terms of kg/ plant. Increase in fruit number and fruit yield/ plant under 50% shoot pruning may be attributed to the proper balance between the vegetative and reproductive growth of the plants. The highest yield from unpruned plant during the rainy season was due to higher percentage of fruit set and least flower/ fruit drop, which ultimately resulted in production of higher yield during rainy season. Since unpruned plant got exhausted because of the heavy crop load during the previous season, they produced less number of flower buds for winter season and subsequently lower yield in winter. The decrease in the yield parameters in pruned plants was a consequence of pruning which reduced the fruiting area on one hand and promoted the vegetative growth at the expense of reproductive growth. These findings are in accordance with Lal *et al.*[7]**.** Similar findings also reported by Pilania *et al.*[10] and Sah *et al.*[14] by 50 % shoot pruning of guava in April.

Physico-chemical attributes

Fruit weight was recorded significant difference by the application of time of shoot pruning treatments during rainy season crop. However, during winter season did not found any significant effect on fruit weight (Table 1). The variation among the treatments for fruit weight was found significant. The fruit weight was recorded maximum (220.62 g.) and minimum (152.00 g.) in the treatment CUN and PAO, respectively in rainy season and in winter season reverse trend was recorded, the maximum (197.12 g.) and minimum (180.00 g.) fruit weight was recorded in the treatment PJ and CUN, respectively. At a glance of data presented in Table 1 clearly indicated that time of shoot pruning treatments did not significantly affected the fruit length in rainy season and had significant effect in winter season fruiting. Maximum (5.42 cm) and minimum (4.91 cm) fruit length was observed with treatment PAJ and PAO in rainy season and in winter season, the maximum (6.80 cm) and minimum (6.25 cm) was recorded in the treatment CUN and PJO. Fruit diameter follow similar trend as fruit length. The highest (6.24 cm) and minimum (5.75 cm) fruit diameter was found with treatment PAJO and PJO in rainy season, respectively, while, during winter season crop maximum (7.43 cm) and minimum (6.98 cm) fruit diameter was found with treatment PA and, PJO, PAJO, respectively. All the time of shoot pruning

treatments increased the size and weight of fruits during both the seasons as compared to unpruned plants. In general, it was observed that fruits produced during rainy season were smaller in size as compared to winter season. Data on fruit size reveals that maximum fruit length and diameter were found with treatment which was pruned and lower fruit size was found with unpruned plants. In rainy season crop, reduction in size and weight of the fruits in unpruned plants was associated with the heavier crop loads which caused the drain on the food reserves of the plants and increasing competition among the growing fruit population for the food supply. Similar reports have also been made by Lal[7]. Similar findings also reported by Pilania *et al.*[10]**,** by 50 % shoot pruning in guava.

Different time of shoot pruning treatments increased fruit volume significantly during both rainy and winter season crop. However, fruit volume did not show any specific trend. In general, it was observed that fruit volume followed same trend as fruit weight and fruit size. The highest fruit volume was recorded with the unpruned treatments during both the rainy and winter season crop of both the years and lower fruit volume with the treatments PA, PJ and PJO. Shoot pruning treatments had significant effect on total soluble solids of fruit during winter season cropping. During rainy season, maximum TSS (8.50 %) was recorded with treatment PAJO and minimum value for TSS (7.87 %) was recorded with treatment PAO followed by CUN. In winter season crop, maximum TSS (11.15 %) was recorded with treatment PA followed by PAJO. While, minimum value for TSS (9.98 %) was recorded with treatment CUN followed by PO. However TSS value did not show any specific trend. The lower TSS content during rainy season in unpruned plants was associated with the heavier crop load which caused the drain on the food reserves of the plant and increasing competition among the growing fruit numbers for the food supply. It is evident from the data presented in Table 2 indicated that time of shoot pruning treatments had significant effect on total titratable acidity of fruit during winter season cropping. The lowest total titratable acidity was found with treatment PAJO followed by treatment PA and PAO. However, highest total titratable acidity was recorded with treatment CUN in both rainy and winter season crop during both the years. Similar to TSS, the application of various time of shoot pruning treatments did not show significant effect on ascorbic acid content of the fruit. Ascorbic acid content of fruit increased with time of shoot pruning. Unpruned plants gave lower content of ascorbic acid during both the seasons of the year *i.e.* 2010-11 and 2011-12. However, the maximum ascorbic acid content was found with treatment PAJO followed by treatment PAJ, PA. Minimum ascorbic acid content was recorded with treatment CUN during both the seasons of both the years. Critical examination of the data on effect of various time of shoot pruning treatments on total sugars presented in Table 2 showed that all the pruning treatments affected total sugar significantly in both rainy and winter season crops during both the years. During rainy season, maximum total sugar content was recorded with treatment CUN, while minimum total sugar was recorded with pruned treatments during both the years. In winter season, similar trend was observed. Application of various treatments affected reducing sugar content significantly in winter seasons of both the year. Maximum reducing sugar was recorded with unpruned treatments during both rainy and winter season cropping and minimum reducing sugar was recorded in treatment PJO and PAJ during rainy and winter season crop, respectively. Application of various time of shoot pruning treatments significantly affected non reducing sugar during both the season of cropping (i.e. rainy and winter season crop). Maximum non reducing sugar was recorded with treatment PAJO during rainy and winter season crop, and minimum non reducing sugar was recorded with treatment PAJ and PA during rainy and winter season crop, respectively. The data presented in Table 2 revealed that various time of pruning treatments had no significant effect on pectin content during both rainy and

winter season crop. There was non significant effect of various treatments on TSS: acid ratio in rainy season and, showed significant results during winter season fruiting. It pertinent from the data presented in Table 2 that various time of shoot pruning treatment had non significant effect on sugar: acid ratio of the fruit during rainy and winter season crop. There was significant difference among the treatments for sugar acid ratio. In general, winter season fruits were superior as compare to rainy season fruits more especially with respect to total soluble solids, ascorbic acid, total sugars and pectin content. The present finding is in accordance with Sachan *et al.*[13] and Singh *et al.*[15]**.** This superiority of winter season crop is due to low temperature prevailed at the time of fruit ripening during winter season. Low temperature not only retards the excessive loss of respiratory substances[6] but also increases the translocation of photosynthates from leaves to another part of the plant including fruits[18]**.** In guava, vegetative growth is almost at a stand still during winter season[12] due to lower temperature and this leads to the accumulation of more food reserve within the plant, particularly in the fruit[3]. Lal *et al.*[7], have also reported the favourable effect of pruning on size, weight and TSS contents of fruits of guava.

Table 1: Influence on quality attributes of guava by different pruning time

Treatment	Yield (kg/ plant)			Yield (q/ha)			Fruit weight (g.)		Fruit volume (ml)		Fruit length (cm)		Fruit diameter (cm)		TSS (%)	
	Rainy	Winter	Total yield/year	Rainy	Winter	Total yield/ year	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
PA	4.29	3.86	8.15	21.48	18.52	40.00	166.75	183.87	177.13	206.00	5.23	6.37	6.05	7.43	8.17	11.45
PJ	4.78	1.97	6.75	23.90	6.48	30.38	181.50	197.12	199.37	175.00	5.33	6.62	6.18	7.01	8.33	11.05
PO	7.07	1.72	8.79	31.87	8.04	39.91	181.12	183.12	199.50	192.50	5.28	6.66	6.08	7.12	8.10	10.82
PAJ	3.36	3.05	6.41	16.12	14.74	30.86	175.12	190.25	196.50	190.00	5.42	6.56	6.06	7.20	8.14	11.15
PAO	2.25	2.23	4.48	11.27	9.24	20.51	152.00	188.37	209.00	195.00	4.91	6.44	5.85	7.19	7.87	11.27
PJO	6.64	1.67	8.31	30.94	8.17	39.11	180.87	181.50	203.75	191.25	5.24	6.25	5.75	6.98	8.27	11.10
PAJO	2.60	2.29	4.89	13.01	10.80	23.81	152.62	186.75	218.50	196.25	5.31	6.47	5.94	6.98	8.50	11.36
CUN	7.66	1.04	8.7	35.45	5.09	40.54	220.62	180.00	229.37	215.00	5.29	6.80	6.24	7.22	8.05	9.98
CD at 5%	3.57	1.12	NS	NS	5.19	NS	23.91	NS	6.54	12.51	NS	0.072	NS	NS	NS	0.72

Table 2: Influence on physico-chemical status of guava by different pruning time.

Treatment	Total Titrable Acidity (%)		Ascorbic acid (mg/100g pulp)		Total sugar content (%)		Reducing sugars (%)		Non- reducing sugars (%)		Pectin content (%)		TSS: acid ratio		Sugar: acid ratio	
	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter	Rainy	Winter
PA	0.137	0.152	117.71	129.32	5.592	5.546	3.179	3.426	2.413	2.120	0.43	0.52	60.00	76.46	35.93	37.60
PJ	0.159	0.167	114.75	125.18	5.249	6.178	3.106	3.525	2.142	2.326	0.42	0.52	54.16	68.32	37.34	36.99
PO	0.165	0.162	115.18	127.00	5.661	6.259	3.160	3.562	2.500	2.697	0.44	0.48	50.03	68.28	40.03	37.37
PAJ	0.141	0.146	121.22	138.75	4.957	5.971	3.184	3.379	1.772	2.591	0.45	0.50	60.15	78.18	37.60	42.98
PAO	0.136	0.143	117.70	136.75	5.617	5.693	3.181	3.401	2.435	2.292	0.44	0.52	58.60	83.56	40.05	43.11
PJO	0.150	0.150	119.93	128.72	4.982	6.161	2.988	3.572	1.993	2.589	0.44	0.48	56.38	76.10	34.57	40.51
PAJO	0.132	0.135	130.34	143.70	5.553	5.653	3.067	3.499	2.486	2.153	0.48	0.50	64.28	83.54	41.64	41.71
CUN	0.169	0.182	107.57	121.27	6.110	7.010	3.21	3.617	2.900	3.392	0.43	0.46	47.99	55.13	33.63	38.92
CD at 5%	NS	0.018	NS	NS	0.17	0.59	NS	0.022	0.20	0.065	NS	NS	NS	13.99	NS	NS

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