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Original Research Papers

Advancing fruiting season in Annona cv. Arka Sahan through pruning

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Abstract: Annona cultivar 'Arka Sahan', an inter-specific hybrid of Annona atemoya × A. squamosa comes to harvest during August-September under mild tropical climate, which coincides with monsoon rains resulting in poor fruit quality and high susceptibility to anthracnose and fruit fly. An attempt was made to advance the fruiting in this hybrid through pruning during 2016- 17 and 2017-18. The effect of three pruning levels (25, 50 and 75% of previous season's growth) at five different times (60, 75, 90, 105 and 120 days after final harvest of previous crop) on flowering and fruiting were compared. Early sprouting, flowering and fruit harvest were recorded in trees pruned to 75% of the past season's growth in both the years. Earliest fruits were harvested 271 (3rd week of June) and 268 (2nd week of June) days after pruning in trees pruned during first week of October in 2016-17 and 2017-18 respectively (P<0.05). Bigger fruits with lesser seeds per 100 g of pulp (P<0.05) were harvested from trees pruned to 75% and 25% levels in the first and second year, respectively, irrespective of pruning time. Tree canopy following pruning at 75%level recorded higher light interception and photosynthetic rate (P<0.05). Pruning time and levels significantly influenced the biochemical constituents of leaf and shoot. The fruiting in cultivar 'Arka Sahan' could be thus advanced by 8-9 weeks to June from the normal season of August-September with comparable or better fruit quality by pruning 75% of the last season's growth during October.

Keywords: Annona, biochemical constituents, fruit quality, off-season , pruning.

INTRODUCTION

Sugar apple (Annona squamosa L.), also known assweet sop, sugar apple, sitaphal or sharifa and ascustard apple in India is a native of tropical Americaand West Indies, introduced to India. The fruits aregenerally used fresh, while some products like custardpowders and ice-creams are prepared from the fruits.'Arka Sahan' is an inter-specific hybrid between A.atemoya (var. Island Gem) × A. squamosa (var.Mammoth). It is a vigorous plant. Its mature fruitstake about 6-7 days to ripe. The creamy white colourflesh is juicy with mild pleasant aroma and tender withfewer seeds (9/100 g pulp) and large segments. Theedible pulp is remarkable for its sweetness with 22.8per cent total sugars and measures more than 300Bas against 240B in Mammoth (Jalikop and Kumar 2007). Flowering in annona occurs on current seasongrowth arising after natural leaf fall during late winter. In annona, flower bud formation is restricted to early shoot development, and is extra-axillary, borne opposite to leaves (George and Nissen 1991). The leafimposed para-dormancy of axillary bud is present inannona (George and Nissen 1987). Soler and Cuevas(2008) reported off-season (winter season) fruitproduction through shoot pruning followed by tipping the newly emerged shoots in cherimoya. Normal fruiting time of 'Arka Sahan' grown under the mildtropical climate is August-September, which coincides with monsoon rains resulting in deterioration of fruit quality due to anthracnose incidence and fruit flyinfestation during the rainy period. Flowering can bemanipulated by modifying the timing of bud break inannona species to get fruit out of season. For this leaffall is prerequisite to open up the sub-petiolar axillarybud residing under the leaf petiole. We attempted tomake the annona hybrid 'Arka Sahan' to flower andfruit early through pruning, which could induce earlydefoliation, bud sprouting and formation of new shootsand flowers and thus advance fruiting season to summer months. The pr uning techniques wer estandardized in terms of time and severity, keeping inview the flowering and fruiting behavior of the cultivar'Arka Sahan'.

MATERIALS AND METHODS

The experiment was conducted at ICAR - IndianInstitute of Horticultur al Resear ch, Benga luru (Karnataka state, India) during two consecutive years,2016-17 and 2017-18. The experimental materialconsisted of eight-year-old one hundred and twentyuniform plants of Annona cv. Arka Sahan planted ata distance of 5m × 5m. The treatments comprised offive pruning times (T_1, T_2, T_3, T_4 & T_5) and three shootpruning levels (L_1, L_2, & L_3). Pruning was performed after 60, 75, 90, 105 or 120 days after final harvest of the previous crop. Pruning levels consisted of removal of 25 per cent (one-fourth of shoot length), 50 per cent (half of shoot length) or 75 per cent (two-third of shoot length) of the previous season's growth.Each treatment was replicated four times in a factorialrandomized block design. Two trees were observed ineach replication under each treatment for collection ofdata. Eight trees that were not pruned and giving newshoot growth naturally by the end of March followingleaf abscission during late winter served as external check for comparison of treatment effects againstnatural fruiting as these could not be fitted effectivelyinto the factorial design involving pruning time andintensity. Standard package of practices were adopted for maintena nce of a ll the tr ees dur ing the experimentation.

The number of days required for sprouting andflowering was assessed by recording the days taken for the emergence of fist spr out a nd flower respectively after the treatment imposition. The durations of the first and last harvest were calculated from the date of imposing the treatments to the first fruit harvest and the last fruit harvest respectively. Thetotal fruit yield per tree was recorded at harvest bymeasuring the weight of fruits harvested and values were expressed in kilogram. Fruit weight (g) wasrecorded using electronic balance. The total solublesolids (TSS) were measured using digital refractometerand expressed as degree Brix. Titrable acidity wasestimated by adopting the titrametric method of A.O.A.C (1975) using phenolphthalein indicator andthe values were expressed in terms of percentage citricacid equiva lent. Pulp content (%) of fr uit wasdetermined using the following formula:

$$Pulp\left(\%\right)=\frac{Pulpweight}{Fruitweight}\times 100$$

The number of seeds per 100 g of pulp was calculated by using the following formula:

$$Number of seeds per 100 g of pulp=\frac{Number of seeds in fruit}{Pulp weight of fruit}\times 100$$

Gas exchange parameters such as net photosynthesis (P , µmol m-2 s-1), transpiration rate (E, mmolm-2 s-1) and stomatal conductance (gs, mmol m-2s-1) were recorded in three fully expanded leaves of each plant using portable photosynthesis system (LCpro+, ADC BioScientific limited, UK) during morning hours of clear and sunny conditions between 09:30 h and 11:30 h at two stages viz., fruit set (March, 2018) and rapid fruit growth (May, 2018) stage in the second year (2017-18) of study. Photosynthetically active radiation (PAR) below the tree canopy was measured using the LI-191SA Line Quantum Sensor (Li-Cor, Lincoln, NE) on uniformly overcast days between 12:00 h and 13:00 h at the fruit set and rapid fruit growth stages (FSS and RFGS) during 2017-18. The total leaf chlorophyll content was measured at FSS using spectrophotometer (UV 1650PC, Shimadzu, Japan) at wave lengths of 645 and 663 nm as per Hiscox and Isrealstam (1979). Total sugar in shoot was estimated after the harvest of fruits following the method of Somogyi, (1952).

Statistical analysis was done separately for the parameters studied for each year using OPSTAT (Sheoran et al., 1998) and discussed at $P < 0.05$ for significance of difference between their mean values.

RESULT AND DISCUSSION

Physiological and biochemical characteristics: Pruning, especially its levels, significantly influenced the amount of light interception at both fruit set stage (FSS) in March and rapid fruit growth stage (RFGS) in May ($P<0.05$) (Table 2). Higher light interception in different treatments could be related to longer shoot length and higher number of leaves and leaf area in 75 per cent pruned trees ($P<0.05$). Differential light interception within tree canopies can also influence vegetative growth, flower initiation, fruit set, fruit size and fruit quality (Marini and Marini, 1983). Higher light interception was also associated with higher photosynthetic rate of leaves at both fruit set and rapid fruit growth stage. Pruning provided open canopy area and resulted in maximum interception of sunlight for

Table 1 :
Details of timing and level of pruning

Treatments	Pruning level	Pruning time
T1L1 T1L2 T1L3	25% pruning 50% pruning 75% pruning	60 DAFH* (1st week of October)
T2L1 T2L2 T2L3	25% pruning 50% pruning 75% pruning	75 DAFH (3rd week of October)
T3L1 T3L2 T3L3	25% pruning 50% pruning 75% pruning	90 DAFH (1st week of November)
T4L1 T4L2 T4L3	25% pruning 50% pruning 75% pruning	105 DAFH (3rd week of November)
T5L1 T5L2 T5L3	25% pruning 50% pruning 75% pruning	120 DAFH (1st week of December)

*Days after final fruit harvest

higher rate of photosynthesis (Singh and Singh 2007). Similar results were recorded by Sharma et al. (2006) that the light interception was significantly influenced by pruning intensity in mango, being higher for pruned trees than for not pruned ones. The highest value of diffuse light availability below the canopy was recorded for severely pruned trees than for trees not pruned. Higher photosynthetic rate was recorded in trees pruned to 75 per cent level compared to 50 and 25 per cent levels ($P<0.05$) (Table 2). Higher photosynthetic rate reflects more metabolic activity in these leaves which could be attributed to interception of more light by the leaves. The trees pruned to 75 per cent produced longer shoots carrying more leaves, which harvested more light. Similar results were observed by Sharma et al. (2006) in mango where higher photosynthetic rate was recorded in leaves of pruned trees than trees not pruned. However, stomatal conductance was not affected much due to pruning in the present study (Data not presented). It ranged from 0.07 to 0.18 mmol m^{-2} s^{-1} among the treatments. The leaf chlorophyll content is considered as an important index of the metabolic activity of plants. At both FSS and RFGS, chlorophyll content exhibited differential pattern in response to different levels of pruning (Table 2). Accumulation of higher chlorophyll content in leaf could be related to the higher light interception which favoured the synthesis of more chlorophyll. Light interception by 75 per cent level pruned trees was higher at both fruit set and rapid growth stages. The lower chlorophyll content in the other treatments may be attributed to limited chlorophyll synthesis for want of conducible environmental conditions (Sritharan et al., 2010). Although, there was significant influence of pruning time and pruning levels on chlorophyll content at fruit set stage, no consistent results were evident over the years. At fruit set, the amount of chlorophyll content varied from 1.5 to 3.1 mg/g in the first year and from 1.2 mg to 3.2 mg/g in the second year. At rapid fruit growth stage, in the first year, pruning treatments did not influence the chlorophyll content while in the second year, significant influence was recorded with chlorophyll content varying from 2.0 to 2.8 mg/g ($P<0.05$). Sharma and Chauhan (2003) reported higher chlorophyll content in leaves of pruned peach tree leaves as compared to trees not pruned. However, total leaf chlorophyll content was recorded similar for both pruned and unpruned mango trees during April and July while during November it was recorded highest in pruned trees (Schaffer and Gaye 1989). Presence of higher amount of sugar in shoots of trees pruned at 25 per cent level in the present study, could be attributed to poor translocation of sugar for the growth of shoot or more towards the developing fruits which was also reflected in terms of relatively, smaller shoot and less number of leaves in 25 per cent pruned trees. However, sugar accumulation in shoot was recorded more in the second year (506.2 mg/100 g) over the first year (457.4 mg/100 g) which could be related to the favourable environmental condition prevailed including higher rainfall (average 2.41 mm per month), relative humidity (average 76.32%) and maximum temperature (average 29.74° C) in the second year (October to July) than the first year (rainfall 1.76 mm & relative humidity 68.47%). Shoots that emerged from 75 per cent pruning treatments were longer, which also reflected better translocation and utilization of sugar in the growth of shoot. Overall, total sugar content was affected by pruning levels, the results are in conformity with those of Bagchi et al. (2008) who observed that pruning up to 10 cm with complete removal of old leaves showed significant effect on increasing reducing sugars (36.7 mg/g) than other treatments and control.

Growth and yield characteristics: Pruning led to leaf fall followed by sprouting of sub petiolar axillary buds on the shoot. Irrespective of pruning time, the number of days required for sprouting has become shorter with the increase of pruning levelduring both the years with minimum number of days to sprout for those pruned in December first week and October first week in first and second years, respectively ($P<0.05$) (Table3). Early sprouting in trees pruned to 75 per cent level

Table 2 :
Effect of pruning time and pruning levels on light interception, photosynthetic rate, total leaf chlorophyll and total sugar in Annona cv. Arka Sahan

Treatments	Light interception (%) 2017-18		Photosynthetic rate (μmol m^{-2} s^{-1})	Total leaf chlorophyll (mg g^{-1})		Total sugar (mg/100 g)	
	FSS	RFGS	2017-18	2016-17	2017-18	2016-17	2017-18
T1L1	21.8	65.1	7.9	3.1	3.2	399.3	480.0
T1L2	41.5	82.6	7.7	2.5	2.5	352.0	415.0
T1L3	58.8	92.0	10.8	2.9	3.1	181.5	249.3
T2L1	19.6	66.3	5.7	2.3	2.2	372.0	410.8
T2L2	40.6	75.9	5.8	2.9	3.0	427.8	504.0
T2L3	55.7	90.6	7.2	2.3	2.3	182.5	299.0
T3L1	24.4	71.9	4.5	2.3	2.4	467.5	531.0
T3L2	32.5	80.2	4.8	2.0	1.8	408.8	472.0
T3L3	59.4	85.2	8.7	2.2	2.1	278.8	327.8
T4L1	21.0	70.4	7.6	1.7	1.2	589.5	698.0
T4L2	47.4	76.9	8.0	1.5	2.9	570.5	573.0
T4L3	58.4	84.1	8.7	2.0	3.1	326.5	539.0
T5L1	24.6	73.4	6.8	1.8	2.6	458.8	411.0
T5L2	40.6	80.5	6.4	1.6	2.5	427.0	498.0
T5L3	58.7	92.7	7.5	1.9	1.8	364.0	431.0
External Check	20.3	60.2	7.6	3.0	3.1	350	465
TC.D. (*P*=0.05)	-	3.00	1.11	0.03	0.04	6.71	8.39
LC.D. (*P*=0.05)	2.81	2.33	0.86	0.03	0.03	5.20	6.50
T x LC.D. (*P*=0.05)	6.28	5.20	1.92	0.06	0.07	11.62	14.53

T: Time of pruning; L: Level of pruning

Table 3 :
Effect of pruning time and levels on sprouting, flower initiation, fruit yield and its pattern of Annona cv. Arka Sahan

Treatments	Sprouting (days)		Flower initiation (days)		First harvest (days)		Final harvest (days)		Fruit yield per tree (kg)		Fruit yield per TCSA (kg/cm^2)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T1L1	85.3	104.7	100.6	132.8	297.5	307.5	307.5	320.0	12.0	20.2	0.10	0.14
T1L2	57.5	60.7	75.7	74.5	285.0	279.5	302.0	306.3	10.1	14.9	0.07	0.09
T1L3	23.3	13.7	42.9	26.3	271.0	268.9	299.5	302.5	11.1	16.1	0.09	0.11
T2L1	60.5	104.6	77.7	126.1	290.0	291.0	305.0	301.8	10.2	17.7	0.08	0.13
T2L2	28.0	90.1	45.4	105.3	277.5	266.0	296.3	295.0	11.2	15.7	0.09	0.10
T2L3	17.5	20.0	35.3	33.9	271.0	245.0	287.0	295.0	11.3	17.0	0.08	0.10
T3L1	41.6	44.9	54.2	54.8	269.0	276.8	279.0	285.5	9.0	18.9	0.08	0.14
T3L2	25.5	32.6	42.9	55.6	269.8	265.8	278.0	284.5	10.0	19.4	0.09	0.14
T3L3	16.3	17.6	48.2	42.2	271.3	235.0	287.3	281.0	10.1	16.8	0.09	0.11
T4L1	31.5	62.9	44.4	76.1	269.0	261.5	284.0	266.8	8.7	20.5	0.07	0.13
T4L2	19.2	39.6	33.8	55.7	270.8	252.5	284.0	276.0	9.3	16.4	0.07	0.10
T4L3	16.2	18.4	56.8	44.0	276.3	236.8	285.0	271.5	10.8	15.2	0.08	0.10
T5L1	25.2	45.1	38.5	59.8	270.0	246.8	283.0	258.3	9.8	20.6	0.07	0.12
T5L2	20.9	33.5	37.8	45.6	271.0	236.5	283.0	255.0	10.5	19.1	0.07	0.12
T5L3	14.7	17.3	50.8	40.6	274.5	222.5	283.0	244.8	11.3	16.4	0.08	0.09
External Check	118	135	133	145	321	329	335	338	14.2	20.1	0.09	0.14
TC.D. (*P*=0.05)	3.06	5.10	4.39	5.07	3.98	2.55	3.25	4.78	0.21	1.27	0.01	0.01
LC.D. (*P*=0.05)	2.37	3.95	3.40	3.93	3.08	1.98	2.52	3.70	0.16	0.98	-	0.01
T x LC.D. (*P*=0.05)	5.29	8.84	7.61	8.78	6.89	4.42	5.64	8.28	0.36	2.20	-	-

T: Time of pruning; L: Level of pruning

could be attributed to very few leaves or no leaf left on such shoots and with less number of buds available on the shoot, the reserve metabolites from trunk could have contributed to early release of these buds. Similar results were observed in cherimoya (Soler and Cuevas, 2008) and guava

(Shaban and Haseeb, 2009), where severely pruned trees gave early sprouting. Also, early flowering occurred in trees pruned to 75 per cent level ($P<0.05$). In a less vigorous cultivar of sugar apple, Balanagar, early shoot growth during winter could be induced under similar climatic condition through chemical defoliation (Chander et al., 2019). Since flowering is on current season growth in Annona and concomitant with the shoot growth, early sprouting resulted in early flowering in both the years. However, in the first year, flowering was earlier on trees pruned to 50 per cent level during November and December despite early sprouting in those pruned to 75 per cent level. It was observed that there was continuous vegetative growth in 75 per cent pruned trees. Similar results were reported in custard apple (George and Nissen, 1987), cherimoya (Soler and Cuevas, 2008) and atemoya (Olesen and Muldoon, 2012). Pruning treatments significantly influenced the flowering and fruiting period of Annona cv. 'Arka Sahan' (Table 3). Earliest fruits were harvested from the treatments imposed in 1st week of October, at 75 per cent pruning level (T_1L_3) with minimum days (271) to harvest by 2nd week of June in first year ($P<0.05$). A consistent result was recorded for early harvest (2nd week of June) with 75 per cent pruned trees in second year for all pruning time. Early harvest from 75 per cent pruned trees could be attributed to advanced flowering and fruit set in these trees. Observations recorded on final harvest exhibited significant differences with pruning time and pruning level (Table 3). In both the years, the final harvest extended longer for the 25 per cent pruned trees ($P<0.05$). Final harvest in case of 75 per cent pruning was completed earlier than 25 per cent or 50 per cent pruning. Early harvest in these trees could be attributed to earlier induction of flowering and pollination than the other treatments. The results are in conformity with those reported by Vinay et al. (2014) in custard apple and Adhikari and Kandel (2015) in guava. Higher yield was obtained from trees pruned during 1st week of October at 25 per cent level (T_1L_1) while for rest of the pruning treatments greater yield was recorded from 75 per cent pruned trees in the first year. However, in the second year, maximum yield per tree was obtained from 25 per cent pruned trees (Table 3). Higher yield in respective years could be attributed to bearing of larger size of fruits and occurrence of prevailing congenial environmental conditions during the fruit growth. Also, accumulation of more sugars in the shoot of 25 per cent pruned trees at harvest reflect more availability of assimilates to fruits on these trees. Fruits were harvested near to normal season from trees pruned to 25 per cent level which could have advantage of prevailing congenial environmental condition than other treatments. The results are in conformity with Kumar et al. (2010) in peaches and Choudhary and Dhakare (2018) in sugar apple, where heavy pruning (90 cm) gave lesser yield than light or trees not pruned but medium pruning (30- 45 cm) recorded higher yield per tree. The yield per TCSA was not influenced much with pruning treatments, which could be attributed to lesser effect of pruning treatments on trunk growth (Table 3). In the second year, comparatively higher yield per tree was recorded although there was not much improvement in trunk growth. Higher yield in second year could be more related to the increase of yield per tree rather than trunk circumference.

Fruit quality characteristics: There was consistent significant effect of pruning levels on fruit weight and pulp content in both the years ($P<0.05$) (Table 4). Higher fruit weight and pulp content in 75 per cent pruned trees could be attributed to the better growth of shoot with higher number of leaves which resulted in higher synthesis of photosynthates in these shoots. The higher amount of accumulated photosynthates could have contributed for bigger size of fruits. Similar results were reported in custard apple (Olesen and Muldoon, 2009; Choudhary and Dhakare, 2018) and ber (Gupta and Gill, 2015). However, in the second year, trees pruned at 25 per cent level recorded the maximum fruit weight and pulp content which could be due to availability of sufficient stored carbohydrates, confirmed with the estimation of higher sugar in the developed shoot. Similar trend was observed on other fruit quality parameters including fruit volume, fruit length, fruit width and fruit circumference with the pruning treatments imposed over two years (data not presented). Results indicated that irrespective of pruning time, comparatively fewer seeds per 100 g of pulp were recorded in 75 per cent and 25 per cent pruning levels in the first and second years, respectively ($P<0.05$). As the fruit size including fruit weight, volume, and pulp content was recorded more in these treatments this could have lowered the proportion of seed per unit of pulp. Similar findings were also observed by Chander and Kurian (2019) in sugar apple and Teaotia and Singh (1971) in guava where lesser percentage of seed was recorded in

Table 4 :
Effect of pruning time and pruning levels on fruit quality attributes of Annona cv. Arka Sahan

Treatments	Fruit weight (g)		Pulp content (%)		Seeds per 100 g of Pulp		TSS (°B)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T1L1	248.1	432.9	59.9	80.1	29.1	12.4	36.3	33.9
T1L2	301.5	350.8	69.5	70.5	22.7	15.4	35.2	32.0
T1L3	316.5	363.6	64.2	76.2	21.9	16.1	34.5	31.8
T2L1	257.9	394.0	63.6	80.3	24.1	12.1	37.0	33.6
T2L2	265.6	361.5	66.3	75.2	25.6	15.2	35.4	33.0
T2L3	310.7	421.4	67.7	73.3	20.3	15.0	32.8	31.8
T3L1	278.9	468.7	65.8	79.0	27.1	12.4	35.5	33.8
T3L2	308.9	452.8	66.8	78.6	24.2	15.4	36.7	32.8
T3L3	289.7	394.5	68.2	66.2	22.2	18.2	35.0	31.3
T4L1	262.5	456.0	66.5	80.0	26.1	13.5	36.3	32.6
T4L2	250.8	402.7	68.5	77.4	24.2	13.4	36.1	32.4
T4L3	275.0	385.8	70.8	74.3	19.2	15.5	35.3	31.7
T5L1	262.9	451.2	62.3	79.1	25.7	13.5	36.0	33.5
T5L2	273.1	408.7	65.8	69.7	28.6	13.1	35.7	32.9
T5L3	278.7	441.4	66.6	73.9	23.9	16.1	35.9	32.2
External Check	300	375	61.4	66.1	23.2	15.8	31.8	30.2
TC.D. (P=0.05)	-	36.73	2.72	-	-	-	0.60	-
LC.D. (P=0.05)	18.23	28.45	2.11	2.34	2.62	1.39	0.47	0.54
T x LC.D. (P=0.05)	-	-	-	5.22	-	-	1.04	-

T: Time of pruning; L: Level of pruning

heavier fruit obtained from pruned trees. Pruning influences quality of the fruits by regulating carbohydrate allocation to the developing fruits (Palanichamy et al., 2011). Early pruning during October-November resulted in increased level of total soluble solids (TSS) of the fruit than the later or trees not pruned ($P<0.05$) (Table 4). The prevailing congenial temperature during fruit growth and maturation could have contributed for accumulation of more sugar in the developing fruits as the fruits come to harvest earlier in these pruned trees. In both the years, comparatively higher value of prevailing average maximum temperature (31.11, 31.50°C) was recorded from flowering to fruit maturity (February to June) for October-November pruned trees than the late pruned trees wherein lesser average maximum temperature (30.73, 30.33°C) was recorded from flowering to fruit maturity (April to August). The results are in conformity with those of Kadam et al. (2018) in custard apple cv. Dharur-6 where fruits from light pruned (20 cm) trees recorded maximum TSS content. In contrast, heavy pruning resulted in accumulation of more TSS in grapes (Zabadal et al., 2002) and peach (Chitkara et al., 1991). There were no consistent trends of acidity content of fruit pulp although higher level of acidity was observed in trees pruned to 75 per cent level (data not presented). Chitkara et al. (1991) and Kumar et al. (2010) recorded increased acidity level with the increase of pruning severity in peaches. Similar results were obtained by Mehta et al. (2012) in guava and Kadam et al. (2018) in custard apple cv. Dharur-6.

Induction of off-season crop with better quality is a new technique in sugar apple production that could enable the growers to get better market and profitability. Fruiting could be advanced by 8-9 weeks to June with pruning at 75 per cent level during October in Annonacv. Arka Sahan from the normal fruiting season of August - September.

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