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Rejuvenation study on old and senile sapota plant *cv.* cricket ball under coastal zone of Odisha

Sahoo AK, Tarai RK, Das BC and Sethy BK

Abstract
The experiment entitled "Rejuvenation study on old and senile sapota plant *cv.* Cricket Ball under coastal zone of Odisha" was carried out at Horticulture Research Station, Department of Fruit Science &Horticulture Technology, College of Agriculture, Odisha University of Agriculture & Technology during the year 2013-2017. The investigation was undertaken on uniform 55 year old plantation of Sapota cv. Cricket Ball. The experiment was laid out in split plot design in which pruning was under main plot and spraying of plant growth regulators were kept in sub-plot. Observations on yield and yield attributing characters like number of flowers per shoot, fruit set (%), flower drop (%), days taken from flowering to fruit maturity, number of fruits per tree and physico-chemical parameters like fruit weight (g), fruit volume (cc), fruit size, seed (%), peel (%), pulp (%), TSS (°Brix), titratable acidity (%), total sugar (%), reducing sugar (%),ascorbic acid (mg/100g pulp) were observed. The collected data were analysed through SAS and represented in the tables.
It was observed that the treatment combination P_2G_3 (clipping of terminal shoots + NAA@50ppm)recorded highest fruit yield (19.34kg/tree) in the 3rd year after pruning. Subsequently in the 4th year after pruning, the treatment combination P_3G_3 (pruning of tertiary branches + NAA@50ppm) produced highest yield (20.57kg/tree) and the treatment combination P_5G_3 (primary pruning + NAA@ 50 ppm) recorded highest fruit set% (17.85%) andmaximum TSS (25.50 °Brix) content was recorded in the treatment combination P_5G_2 (pruning of primarybranches + GA_3@20 ppm).

Keywords: Fruit set (%), GA_3, IAA, NAA, pruning, sugar, TSS, yield

Introduction
Sapota (*Manilkara zapota*) is one of the important fruit crop belongs to the family Sapotaceae. It is native of Mexico and Central America and is now grown on commercial basis in India. In India, sapota is commercially grown in the Maharashtra, Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu and West Bengal states. However, Odisha occupied the 7thposition in production of sapota in India. It covers the area of about 3,360 ha and producing 15,720MT of fruits. The productivity of sapota is 4.68t/ha which is much below than national average productivity 12.09 t/ha [2].
In India, most of the sapota orchards present are old and unproductive. Due to lack of regular canopy management practices, they become senile and there is a decline both in quality and quantity of produce after some period of time. Because of this orcharding becomes economically non-viable and non-remunerative. For overcoming this problem, large scale uprooting and replacement with new plantations will be a costlier and long term affair. Therefore, an attempt has been made to standardize a technology for restoring the production potential of existing plantations by a technique called Rejuvenation. Another major problem confronting sapota crop is heavy flower and fruit drop. The plant growth regulators have been reported to influence the flowering, fruit set, fruit retention, ripening advancement characters and quality characters of several fruit crops. Among the various causes of fruit drop, the simplest one is decline in the level of endogenous auxin [1]. Sapota fruit crop is neglected to usage of growth promoting substances and adoption of modern technology to maintain tree productivity of old senile orchard by the farmers due to lack of proper awareness. Keeping this in view, the study was under taken on "Rejuvenation study on old and senile sapota *cv.* Cricket Ball under coastal zone of Odisha" during the year 2013-17.

Materials and Methods
The experiment entitled "Rejuvenation study on old and senile sapota plant *cv.* Cricket Ball under coastal zone of Odisha" was carried out at Horticulture Research Station, Dept. Of Fruit Science& Horticulture Technology, College of Agriculture, Orissa University of Agriculture & Technology during the year 2013-2017. The investigation was undertaken on uniform 55 year old plants of sapota variety Cricket Ball.

The research was laid out in a Split plot Design in which pruning was under main plot and spraying of plant growth regulators were kept in sub-plot. Both main plot and sub-plot have five treatments each. The flowering of December-February and July-September season were utilized for the studies. All the plants were nourished uniformly by providing the similar cultural practices such as ploughing, harrowing, fertilization, irrigation and plant protection measures during the entire period of studies.

Pruning was done during November, 2013 and five different plant growth regulators in different concentration were sprayed after flowering during February and August. Plants of each treatment were selected and marked and kept for recording various observations. Ten shoots selected randomly from all direction of each tree were tagged and used for recording the observations on flowering, fruit set, fruit drop etc. For physico-chemical analysis of fruit, ten numbers of mature fruits were randomly selected from each observational plant and same fruits were used for recording the different fruit quality parameters. Data collected on 3rd and 4th year after pruning and were analysed through statistical software SAS which are presented in the table.

The treatment combinations were as follows

$T_1 – P_1G_1$ (No pruning + Spraying of Water);$T_2 – P_1G_2$ (No pruning + 20 ppm GA_3 foliar spraying); $T_3 – P_1G_3$ (No pruning + 50 ppm NAA foliar spraying);$T_4 – P_1G_4$ (No pruning +100 ppm IAA foliar spraying); $T_5 – P_1G_5$ (No pruning +20 ppm 2,4-D foliar spraying); $T_6 – P_2G_1$ (Tip clipping of terminal shoots + Spraying of Water); $T_7 – P_2G_2$ (Tip clipping of terminal shoots +20 ppm GA_3 foliar spraying);$T_8 – P_2G_3$ (Tip clipping of terminal shoots +50 ppm NAA foliar spraying);$T_9 – P_2G_4$ (Tip clipping of terminal shoots +100 ppm IAA foliar spraying); $T_{10} – P_2G_5$ (Tip clipping of terminal shoots +20 ppm 2,4-D foliar spraying);$T_{11} – P_3G_1$ (Pruning of Tertiary branches + Spraying of Water); $T_{12} – P_3G_2$ (Pruning of Tertiary branches +20 ppm GA_3 foliar spraying); $T_{13} – P_3G_3$ (Pruning of Tertiary branches +50 ppm NAA foliar spraying); $T_{14} – P_3G_4$ (Pruning of Tertiary branches +100 ppm IAA foliar spraying); $T_{15} – P_3G_5$ (Pruning of Tertiary branches +20 ppm 2,4-D foliar spraying) ; $T_{16} – P_4G_1$ (Pruning of Secondary branches + Spraying of Water); $T_{17} – P_4G_2$ (Pruning of Secondary branches +20 ppm GA_3 foliar spraying); $T_{18} – P_4G_3$ (Pruning of Secondary branches +50 ppm NAA foliar spraying); $T_{19} – P_4G_4$ (Pruning of Secondary branches +100 ppm IAA foliar spraying); $T_{20} – P_4G_5$ (Pruning of Secondary branches +20 ppm 2,4-D foliar spraying); $T_{21} – P_5G_1$ (Pruning of Primary branches + Spraying of Water); T22 – P_5G_2 (Pruning of Primary branches +20 ppm GA_3 foliar spraying); $T_{23} – P_5G_3$ (Pruning of Primary branches +50 ppm NAA foliar spraying); $T_{24} – P_5G_4$ (Pruning of Primary branches +100 ppm IAA foliar spraying) and $T_{25} – P_5G_5$ (Pruning of Primary branches +20 ppm 2,4-D foliar spraying).

Results and Discussion

The findings of the research are based on the various parameters viz., plant growth, yield contributing characters; and fruit physico-chemical properties. The observations were recorded during course of investigation are presented and discussed below.

i. Interaction effect of different level of pruning and plant growth regulators on yield contributing characters of plant

Number of flowers per shoot: From the data presented in the Table 1 & 2, it is obvious that both pruning intensity and plant growth regulators have non-significant effect on the number of flowers per shoot in both the years of study. Among the combined treatments of pruning level and PGR, highest average number of flowers per shoot (11.05&11.77) were observed in the unpruned tree (P_1) with spraying of plant growth regulator NAA@50 ppm (G_3); whereas, lowest number of flowers per shoot (1.77&5.78)was observed in the treatment combination P_5G_1 in the year 2015-2016 (3rd year) and 2016-2017 (4thyear), respectively. But independently, both pruning and PGR have significant effect on flowering. Number of flower per shoot increased from 2.61 in 2015-2016 (3rd year) to 7.21 in the year 2016-2017 (4th year) in the treatment P_5 (pruning of primary branches). It is clear indication that number of flower per shoot increased as the time of pruning advanced. It was approximately three times more as compared to first year flowering. Present finding is in agreement with the findings of Kaur [10]. Again, plant growth regulators have significant effect on number of flowers per shoot. Maximum average number of flowers per shoot (10.33) was recorded in the treatment G_3 (NAA@50ppm). Chavan*et al.* [8] found NAA@ 150 ppm produced more number of flowers (54.0) per shoot in sapota.

Flower drop (%): Data presented in the table 1 & 2 showed that interaction effect of pruning and PGR have no effect on the flower drop percent. However, maximum percent of flower drop (92.46%) & (91.31%) were recorded in the treatment interaction P_1G_1 (control)and lowest percent of fruit drop 82.15% & 78.52% were recorded in the treatment combination P_5G_3 (pruning of primary branches followed by spraying of NAA@50ppm) in 3rd and 4th year, respectively. It is observed that with the increased pruning intensity ,there was decrease in flower drop percentage. This might be due to indirect effect of pruning which alters the growth hormones in the plant. Pruning probably increases the quantity of growth promoting hormones auxin and gibberellins in the pruned plant. Due to counteraction of auxin & GA against ABA which prevent formation of abscission layer in the pedicel and ultimately reduced the flower drop and fruit drop in pruned trees. Abscisic acid causes dissolution of middle lamella and primary walls of the cell at the base of pedicel & peduncle which leads to detachment of plant organ. However, auxin counteracts with the ABA and Ethylene and enhanced the auxin: ABA ratio that ultimately prevents flower and fruit drop. Due to this, flower drop percent and fruit drop percent decreased. Present result is in line with the findings of Chauhan *et al.* [7] & Vejendla *et al.* [21] in mango; and Yadav *et al.* [22] in ber. According to Yadav *et al.* [22] fruit drop reduced significantly with NAA 10 ppm (34.80%) followed by NAA 20 ppm (36.17%) whereas Vejendla *et al.* [21] reported that decreased in fruit drop with low concentration of NAA might be attributed to the prevention of abscission layer formation.

Fruit set (%): Fruit set% of sapota *cv.* Cricket Ball did not respond well to interaction among different level of pruning and plant growth regulators. However, it is observed from the table 1 & 2 that the treatment combination P_5G_3 recorded highest per cent of fruit set (17.85%& 21.48%) whereas lowest (7.5 4%& 8.68%)fruit set (%) was observed in the treatment combination P_1G_1 (control)during 3rd and 4th year,

respectively.The present finding is in agreement with the findings of Kaur [10] who also found higher fruit set% by pruning in ber. The pruning treatments appreciably improve the fruit quality. Better fruit set of pruned trees result from increased water and nitrogen supply to the remaining wood but not from increased photosynthates resources. Stomatal opening lasted longer in pruned tree than unpruned trees. Since hormonal levels are modified by pruning, it is possible that pruning increases fruit set as a direct result of growth hormones. Rajput *et al.* [16] found higher fruit set due to NAA application. It seems to have helped to increase the fruit set either by improving pollen germination or by helping the growth of pollen tubes and thus facilitate in timely fertilization before the stigma loses its receptivity or the style becomes non-functional.

Days taken from flowering harvesting: The interaction among the different level of pruning and different types of hormone could notably influence the duration of fruit maturity. From the table 1 & 2, it is apparent that the treatment combination P_5G_3 took minimum number of days (180.50 &189.67) from flowering to fruit maturity while it is found maximum (210.50 & 231.67 days) under the treatment combination P_1G_2in the 3rd and 4th year, respectively.

The decreased fruit maturity period by pruning might be due to enhanced rate of supply of photo assimilates. Due to pruning the canopy is open up making the leaves photosynthetically active. Because of this, stomata remains open for longer period and ultimately there is increased photosynthesis and faster translocation of photosynthates from leaf to fruit which ultimately reduces the duration of fruit maturation.

The delay in fruit maturity might be due to counteraction of ethylene bio-synthesis process by gibberellins; there by slowing down the ethylene production which ultimately delay the process of ripening. Early ripening by the growth regulators like auxin particularly NAA, may be due to its action on ethylene production. Auxin maybe interacting with the bio-synthesis of ethylene and induces production of ethylene and enhanced the respiration rate in the fruit early. As ethylene is a fruit ripening hormone, it leads to early maturation and ripening of apple [3].

Number of fruits per tree: It was observed that with the increased pruning intensity, the number of fruits per tree was decreased initially. But later there was increase in fruit number per tree each year gradually. From the table 1 & 2, maximum number of fruits per tree (163.33 & 184.50) was recorded in the treatment combination P_2G_3; whereas, lowest number of fruits per tree (7.0 & 16) were obtained in the treatment combination P_5G_1in the 3rd and 4th year, respectively. This result was also in accordance with the findings of Chauhan *et al.* [7]. The application of GA_3 also increased number of fruits and yield and it might bedue to GA mediating process for faster translocation and mobilization of stored metabolites or photosynthates from source to sink. Vejendla *et al.* [21] also observed that the plants received with NAA at 50 ppm produced highest number of fruits per plant (88/plant) in mango *cv.* Amrapali.

Fruit yield (kg/plant): It is observed from the table 1 & 2that pruning intensity and different growth regulators interaction have synergistic effect on increasing the fruit yield. In the year 2015-2016(3rd year), maximum yield (19.34 kg/tree) was observed in the treatment combination P_2G_3. At the same time, lowest yield (0.77kg/tree) was recorded in the treatment combination P_5G_1. But, during the year 2016-2017 (4th year), highest yield per tree(21.57 kg/tree) was recorded in the treatment combination P_3G_3 and lowest yield per tree (1.93 kg/tree) was recorded in the treatment combination P_5G_1.Higher fruit yield was also reported by Lal& Mishra [12] by pruning who reported that shoots which receive more solar radiation accumulated more photosynthates for normal bearing in mango. In 1st two year of pruning, the fruiting was comparatively lesser due to severity of pruning & it took time for development of new shoots. But in case of clipping& shoot removal the yield was increased per tree and per hectare. The yield was higher compared to the control. This is because of removal of over crowing branches & better penetration of sun light. In severely pruned trees the maturity & production of shoots were drastically reduced & the yield was less. Rajput *et al.* [15] revealed that application of NAA and GA_3 at 15 ppm or 30 ppm on guava 'Allahabad Safeda' significantly increased the yield of fruits per tree. Lal *et al.* [13] noted that the increased yield under this growth regulators treatment was associated with increase the number offruits, low percentage of fruit drop, more fruit retention and increased fruit size and weight.

ii. Interaction effect of different level of pruning and plant growth regulators on physico-chemical properties of fruits.

Fruit volume (cc): From the data presented in the table no-3 & 4, it is observed that both pruning intensity and growth regulators have significant effect on fruit volume. The treatment combination P_5G_2produced highest fruit volume 125.3 cc & 126.1 cc; whereas lowest fruit volume 68.9 cc & 66.3 cc was recorded in the treatment combination P_1G_1in the 3rd and 4th year, respectively.

The increased in fruit volume might be due to greater size of fruit and certain changes in metabolism of fruit which reflected in more accumulation of water and enhanced deposition of soluble solids. Exogenous application of GA_3 increased the sink strength of treated organs with strong movement of metabolites takes place from weaker sink to stronger sink depending upon the hormonalm level. Lal *et al.* [13] noted that the maximum fruit volume (178.33 cc) in 50 ppm GA_3treatment.Ray *et al.* [19] found significant increase in volume as well as weight of sapota fruit cv. Cricket Ball with the spray of GA_3@100 ppm.

Fruit weight (g): The interaction effect of pruning intensity and growth regulators greatly influenced the fruit weight and it was remained statistically significant. However, it is observed from the table no-3& 4 that with the increased pruning intensity, fruit weight also increased and among the growth regulators GA_3@20 ppm is found superior. That mean, the treatment combination of pruning primary branch followed by spraying of GA_3@20 ppm (P_5G_2) showed the best interaction towards increasing the fruit weight (151.50 g) when compared with other treatment combination; and lowest fruit weight (89.05g) was recorded in the treatment combination P_1G_1.

However, in the year 2016-2017 (4th year), it was noticed that the treatment combination P_4G_2produced maximum fruit weight (146.67 g) and lowest fruit weight (87.42g) was recorded in the treatment combination P_1G_1.

Pruning effectively regulates the density and number of photo-synthetically active leaves and it helps in maintaining a balance between source & sink. Recently mature leaves are

the major source of photo-assimilates which are transported to sinks like buds, developing leaves, flowers, fruits & root and thus a coordination between source & sink is maintained in the plant system. Excessive vegetative growth, more number of unproductive & unwanted shoots; high crop load, etc. are important factors that create an imbalance between source & sink. In such cases pruning can be an effective intervention to restore the balance. Due to which fruit volume and size increased. The present findings are in agreement with Lal and Mishra [12].

The reason for increased fruit weight under GA_3@ 50 ppm might be due to increased fruit size and accumulation of more pulp. Ramesh *et al.* [17] found that spray of GA_3 had maximum impact to increase the weight of fruit. It may be due to the involvement ofGA_3 to increase in the cell division and translocation of food material which might be responsible to improve the weight of fruits.

Fruit Pulp weight (%): From the table no. 3 & 4, it is observed that pulp percentage of fruit was non-significantly increased as compared to control due to use of advanced technology like pruning and growth regulators. Among the different treatment interactions, the combined effect of treatment combination P_5G_2 produced maximum percentage (87.18% & 87.18%) of pulp and lowest percentage of pulp (78.90% & 78.21%) was recorded in the treatment combination P_1G_1in the 3rd and 4th year, respectively.

The present findings are in agreement with Lal and Mishra [12] who recorded highest average mango fruit pulp in third order pruned trees which was found at par with the fruits obtained from first and second order pruned trees, while lowest fruit weight were obtained in control. Maurya and Singh [14] stated that GA_3 stimulated the functioning of number of enzymes in the physiological process which probably caused an increase in pulp percentage. Least fruit pulp percent in control may be due to slow rate of cell division and cell elongation due to lack of sufficient amount of GA & auxin in the fruit.

Seed weight percentage: Interaction effect of pruning intensity and growth regulators had non-significant effect on seed percent in sapota fruit. However, among the 25 different treatment combinations, lowest seed percent 0.71% & 0.72% was recorded in the treatment combination P_5G_2; whereas, highest seed percent (2.10%& 20.9%) was produced by treatment combinationP_1G_1(control) in the 3rd and 4th year, respectively.

Seed weight (%) found statistically significant to various growth regulators sprayed during the study.Bhujabal *et al.* [5] observed that there was decreased seed number and weight of seed due to NAA andGA_3. Gibberelic acid was more effective than NAA to cause reduction in seed number and weight of seed in sapota. However, effect of pruning on seed weight was found statistically non-significant.

TSS (°Brix) content of fruit: The interaction effect of pruning intensity and growth regulators on fruit TSS content are statistically not found significant. However, maximum amount of TSS (25.50 °Brix&24.25 °Brix)was recorded in the treatment combination P_5G_2; whereas lowest amount of TSS (22.15 °Brix &22.23°Brix)was found in the treatment combination P_1G_1 (control) in the 3rd and 4th year, respectively.

There was increasing trend of TSS content in the fruit with the increased in severity of pruning in the both the years. The increased rate of photosynthesis led by more light penetration into the interior tree and increased leaf to fruit ratio; consequently more synthesis of carbohydrates and other metabolites and their translocation to the fruit tissue that leads to increase in TSS. Similar result was also reported by Bhagawati *et al.* [4] in guava.

Maximum TSS and sugars by the application of GA may be due to GA increased the sink potential of the fruit due to which prioritization of fruit for assimilates increased as compared to other sinks and ultimately transfer of photosynthetic and its deposition in the fruit occurs in an enhanced rate. Ramesh *et al.* [18] stated that increased TSS of fruit is due to increase in the mobilization of carbohydrates from source to sink.

Total sugar content (%): Data obtained from the experiment and presented in the table no. 3 & 4, reveal that the interaction effect of pruning intensity and growth regulators have no significant effect on total sugar content of the fruit. However, there are variations in total sugar content among the 25 different treatment interactions. Maximum percentage of total sugar (20.62% & 19.67%) was recorded in the treatment combination P_5G_2 and lowest percentage (17.31%& 16.23%) of total sugar was obtained in the treatment combination P_1G_1 (control) in the 3rd and 4th year, respectively.

The total soluble solids content of fruits recorded positive correlation with total sugar content while it was negatively correlated with titratable acid content of sapota fruits [6]. This might be the reason of high amount of total sugar content in fruit harvested from severely pruned tree. Similar result was also reported by Bhagawati *et al.* [4] in guava. According to Bhujaba l *et al.* [5] the treatment GA_3 (150 ppm) was significantly found superior in respect of total sugar (16.24%) than NAA application in sapota.

Titratable acidity (%) of fruit: The titratable acidity of fruit was statistically non-significant to different treatment combination. However, lowest titratable acidity (0.131% & 0.157%) was recorded in the treatment combination P_5G_2 while it was recorded highest (0.196% & 0.196%) in the treatment combination P_1G_1 (control) in the 3rd and 4th year, respectively.

It was observed that the titratable acidity content in the fruit decreased significantly with the increased pruning intensity. Reduction in acidity with increased pruning severity may be due to conversion of acid into sugar or it's utilization in metabolism. Bhagawati *et al.* [4] in guava reported similar findings. Ascorbic acid content increased with the increased pruning severity, which might be due to prevention of oxidation of ascorbic acid. Kher *et al.* [11] reported in their study that lowest acidity was recorded with 90 ppm GA_3 in guava which might be either due to speedy conversion into sugars and their derivatives by reactions involving reverse glycolytic pathways or might have been used in respiration or both.

Ascorbic acid (mg/100g) content of fruit: The interaction effect of pruning and plant growth regulators had non-significant effect on ascorbic acid content in fruit. However, among the combined treatments of pruning and plant growth regulators, highest quantity of ascorbic acid (15.31mg/100g &15.46 mg/100g pulp)was observed in the primary branch pruned tree (P5) with spraying of plant growth regulator NAA@20 ppm (G3) in both the years; whereas, lowest amount of ascorbic acid (12.47 mg/100g &12.66 mg/100g pulp) was observed in the treatment combination P_1G_1in the

3rd and 4th year, respectively. Sahoo *et al.* [20] reported that ascorbic acid content in sapota fruit increased with the increased pruning severity, which might be due to prevention of oxidation of ascorbic acid. Kacha *et al.* [9] found that an application of NAA@ 150 ppm on phalsa fruit significantly increased ascorbic acid content due to the possible catalytic influence of this auxin on biosynthesis of ascorbic acid from sugar or inhibition of oxidative enzymes or both.

Table 1: Interaction effect of different level of pruning and plant growth regulators on yield contributing characters of plant on 3rd year after pruning

Treatment	Treatment Combinations	No. of flowers per shoot	Flower drop%	Fruit set%	days taken from flowering to fruit mature	No. of Fruits per tree	Yieldper tree (kg)
T1	P1G1	8.10	92.46	7.54	205.17	105.67	9.40
T2	P1G2	9.18	91.57	9.79	210.50	130.17	14.20
T3	P1G3	11.05	87.64	12.04	187.67	152.33	15.83
T4	P1G4	8.63	91.12	8.88	196.00	124.83	11.61
T5	P1G5	9.58	88.87	11.13	194.17	131.83	12.92
T6	P2G1	7.30	91.14	8.86	200.83	125.50	12.86
T7	P2G2	8.23	89.28	10.72	204.83	144.50	17.94
T8	P2G3	10.23	86.96	13.04	187.50	163.33	19.34
T9	P2G4	8.35	90.43	9.57	195.33	130.17	14.26
T10	P2G5	8.92	88.40	11.60	192.00	137.00	15.65
T11	P3G1	6.23	89.56	10.44	196.33	88.83	10.37
T12	P3G2	7.88	88.14	11.86	199.50	124.00	17.37
T13	P3G3	10.20	84.15	15.85	185.17	135.83	18.54
T14	P3G4	7.38	88.93	11.07	193.00	109.83	13.47
T15	P3G5	8.50	86.48	13.52	189.33	115.00	14.76
T16	P4G1	4.33	89.27	10.73	194.50	62.00	7.83
T17	P4G2	5.08	87.87	12.13	201.33	83.33	12.37
T18	P4G3	6.63	83.67	16.33	181.67	93.17	13.32
T19	P4G4	5.53	88.27	11.73	190.83	71.33	9.37
T20	P4G5	6.02	85.88	14.12	185.67	77.33	10.64
T21	P5G1	1.77	88.81	11.19	193.50	7.00	0.77
T22	P5G2	2.60	87.57	12.43	203.17	14.00	1.98
T23	P5G3	3.27	82.15	17.85	180.50	18.00	2.17
T24	P5G4	2.32	88.17	11.83	192.00	9.00	1.23
T25	P5G5	3.10	85.57	14.43	184.00	13.00	1.66
SE(m) ±	P X G	0.19	1.88	1.80	1.16	3.47	0.45
CDat5%		NS	NS	NS	3.32	9.92	1.29

Table 2: Interaction effect of different level of pruning and plant growth regulators on yield contributing characters of plant on 4th year after pruning

Treatment	Treatment Combinations	No. of flowers per shoot	Flower drop%	Fruit set%	days taken from flowering to fruit mature	No. of Fruits per tree	Yield per tree (kg)
T1	P1G1	8.45	91.31	8.69	223.67	127.00	10.63
T2	P1G2	9.57	89.47	10.53	231.67	149.00	15.39
T3	P1G3	11.77	86.20	13.80	201.33	170.00	17.01
T4	P1G4	9.03	90.33	9.67	212.33	143.00	12.52
T5	P1G5	10.40	87.52	12.48	209.00	155.00	14.14
T6	P2G1	8.22	90.21	9.79	217.83	146.00	13.74
T7	P2G2	9.63	87.76	12.24	227.00	167.00	19.38
T8	P2G3	11.28	85.30	14.70	198.83	185.00	20.67
T9	P2G4	9.17	88.73	11.27	209.50	160.00	15.98
T10	P2G5	10.45	86.58	13.42	204.00	160.00	17.15
T11	P3G1	7.27	88.61	11.39	214.00	134.00	14.24
T12	P3G2	8.92	86.03	13.97	220.33	151.00	19.65
T13	P3G3	10.72	81.36	18.64	193.33	172.00	21.57
T14	P3G4	8.62	87.20	12.80	211.67	148.00	16.73
T15	P3G5	9.38	84.38	15.62	198.83	148.00	17.44
T16	P4G1	6.90	87.89	12.11	210.67	73.00	8.48
T17	P4G2	8.17	84.68	15.32	216.00	102.00	13.87
T18	P4G3	9.62	80.19	19.81	191.33	120.00	15.43
T19	P4G4	7.63	86.68	13.32	208.83	99.00	11.64
T20	P4G5	8.72	82.47	17.53	196.00	131.00	12.22
T21	P5G1	5.78	87.26	12.74	208.00	16.00	1.94
T22	P5G2	7.63	85.78	14.22	214.33	27.00	3.89
T23	P5G3	8.28	78.52	21.48	189.67	31.00	4.34
T24	P5G4	6.47	86.06	13.94	205.50	21.00	2.58
T25	P5G5	7.90	81.59	18.41	194.33	25.00	3.24
SE(m) ±	P X G	0.27	1.56	1.56	0.90	5.88	0.54
CD at 5%		NS	NS	NS	2.58	16.82	1.55

Table 3: Interaction effect of different level of pruning and plant growth regulators on Physico-chemical property of fruit on 3rd year after pruning

Treatment	Treatment Combinations	Fruit Volume (cc)	Fruit weight (g)	Fruit pulp weight%	Seed weight%	TSS (^{0}B)	Total sugar (%)	Titratable acidity (%)	Ascorbic acid (mg/100g)
T1	P1G1	68.93	89.05	78.90	2.10	22.15	17.31	0.19	12.47
T2	P1G2	90.47	109.46	82.85	1.05	23.90	18.69	0.17	12.73
T3	P1G3	84.22	104.04	82.06	1.24	23.53	18.31	0.17	13.91
T4	P1G4	73.04	93.15	79.91	1.89	22.43	17.59	0.18	13.15
T5	P1G5	80.08	98.22	81.13	1.56	22.92	17.96	0.18	13.54
T6	P2G1	82.20	102.29	80.59	1.81	22.70	17.68	0.18	12.65
T7	P2G2	100.92	124.43	83.80	0.70	24.65	18.95	0.16	13.02
T8	P2G3	96.70	118.40	82.94	1.06	24.28	18.76	0.17	14.63
T9	P2G4	86.72	109.34	81.26	1.64	23.35	17.95	0.18	13.56
T10	P2G5	92.35	114.13	82.12	1.38	23.83	18.40	0.17	13.96
T11	P3G1	94.47	116.35	82.17	1.63	23.44	18.13	0.17	13.9
T12	P3G2	121.04	139.98	85.28	0.82	25.27	19.84	0.15	13.48
T13	P3G3	114.90	136.61	84.44	0.96	24.82	19.30	0.15	14.62
T14	P3G4	102.62	122.54	82.87	1.43	23.91	18.47	0.17	13.76
T15	P3G5	109.97	128.41	83.69	1.21	24.41	18.90	0.16	14.12
T16	P4G1	112.97	126.30	84.04	1.46	23.71	18.66	0.17	13.68
T17	P4G2	124.93	148.47	87.54	0.76	25.46	20.59	0.14	13.97
T18	P4G3	120.05	142.16	87.23	0.90	25.16	19.98	0.15	15.09
T19	P4G4	115.98	131.11	84.90	1.30	24.20	18.97	0.16	14.42
T20	P4G5	118.20	137.70	85.71	1.08	24.64	19.49	0.16	14.63
T21	P5G1	114.03	125.50	84.14	1.46	23.75	18.66	0.16	13.77
T22	P5G2	125.30	151.50	87.98	1.32	25.51	20.62	0.13	14.04
T23	P5G3	118.27	146.75	86.65	0.86	25.21	19.96	0.14	15.31
T24	P5G4	117.17	133.02	84.83	1.27	24.23	18.87	0.16	14.85
T25	P5G5	119.62	139.60	85.68	1.02	24.66	19.51	0.15	15.04
SE(m) ±	P X G	2.05	1.55	0.11	0.46	0.14	0.24	0.003	0.21
CD at 5%		5.86	4.44	NS	NS	NS	NS	NS	NS

Table 4: Interaction effect of different level of pruning and plant growth regulators on Physico-chemical property of fruit on 4thyear after pruning

Treatment	Treatment Combinations	Fruit Volume (cc)	Fruit weight (g)	Fruit pulp weight%	Seed weight%	TSS (^{0}B)	Total sugar (%)	Titratable acidity (%)	Ascorbic acid (mg/100g)
	P1G1	68.93	87.42	78.21	2.09	20.23	16.23	0.197	12.66
T2	P1G2	90.47	106.84	82.13	0.97	21.32	17.85	0.181	12.82
T3	P1G3	84.22	102.79	81.21	1.19	21.22	17.33	0.186	13.99
T4	P1G4	73.04	91.22	79.03	1.97	20.42	16.52	0.194	13.30
T5	P1G5	80.08	95.76	80.35	1.55	20.88	16.98	0.190	13.63
T6	P2G1	82.20	98.73	79.50	1.90	20.65	16.72	0.192	12.95
T7	P2G2	100.92	120.81	82.73	0.87	22.17	18.42	0.174	13.36
T8	P2G3	96.70	116.55	81.83	0.97	21.75	17.97	0.179	14.58
T9	P2G4	86.72	105.71	80.49	1.61	20.97	17.02	0.187	13.71
T10	P2G5	92.35	112.31	81.20	1.30	21.30	17.40	0.183	14.06
T11	P3G1	94.47	111.66	81.28	1.62	21.43	17.17	0.188	13.39
T12	P3G2	121.04	137.69	84.54	0.76	22.92	18.65	0.170	13.58
T13	P3G3	114.90	132.10	83.75	0.85	22.57	18.18	0.175	14.66
T14	P3G4	102.62	119.90	81.89	1.31	21.77	17.32	0.184	13.98
T15	P3G5	109.97	125.43	82.68	1.12	22.13	17.83	0.179	14.25
T16	P4G1	112.97	112.54	83.29	1.31	21.82	17.50	0.183	13.74
T17	P4G2	124.93	146.68	86.77	0.73	23.70	19.08	0.162	14.18
T18	P4G3	120.05	139.56	85.41	0.99	23.20	18.72	0.168	15.23
T19	P4G4	115.98	127.02	84.17	1.63	22.47	17.83	0.178	14.52
T20	P4G5	118.20	135.84	84.82	1.08	22.75	18.30	0.174	14.81
T21	P5G1	114.03	121.65	83.12	1.58	22.33	17.97	0.177	13.91
T22	P5G2	125.30	146.04	87.18	0.72	24.25	19.67	0.158	14.28
T23	P5G3	118.27	143.67	85.67	0.93	23.60	19.10	0.161	15.46
T24	P5G4	117.17	129.49	84.03	1.37	22.67	18.25	0.172	14.62
T25	P5G5	119.62	134.47	84.94	1.16	23.12	18.60	0.166	14.95
SE(m) ±	P X G	1.18	1.28	0.05	0.45	0.22	0.18	0.002	0.13
CD at 5%		3.37	3.67	NS	NS	NS	NS	NS	NS

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