The Pharma Innovation Journal 2018; 7(8): 335-338

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(8): 335-338

www.thepharmajournal.com
Received: 11-06-2018
Accepted: 13-07-2018

Sahu CK
Department of Fruit Science and Horticulture Technology, College of Agriculture, Orissa university of Agriculture and Technology Bhubaneswar, Odisha, India

Patel MK
Department of Fruit Science and Horticulture Technology, College of Agriculture, Orissa university of Agriculture and Technology Bhubaneswar, Odisha, India

Panda CM
Department of Fruit Science and Horticulture Technology, College of Agriculture, Orissa university of Agriculture and Technology Bhubaneswar, Odisha, India

Correspondence
Sahu CK
Department of Fruit Science and Horticulture Technology, College of Agriculture, Orissa university of Agriculture and Technology Bhubaneswar, Odisha, India

Effect of pruning and plant growth regulator on physico-chemical quality of sapota (*Manilkara zapota* L.) *cv*. cricket ball

Sahu CK, Patel MK, and Panda CM

Abstract
An experiment was carried out during 2017-18 in Horticulture Research Station, Bhubaneswar under Department of Fruit Science & Horticulture Technology, College of Agriculture, Orissa University of Agriculture & Technology to find out the study the effect of pruning and plant growth regulator like GA_3, IAA, NAA, 2, 4-D on Physico-chemical quality of rejuvenated sapota plant. Variation due to divergence in genotypes was found significant so far as the Physico-chemical quality is concerned, highest fruit weight (138.066g), pulp weight (120.076g), TSS (24.686^{0}B), ascorbic acid (14. 63g/100g) and acidity (0.146%) were observed in primary branch pruned trees. Among the growth regulators, NAA@50ppm produced highest ascorbic acid (14.666mg/100g) whereas GA_3@20ppm produced highest fruit weight (134.494g), pulp weight (115.974g), TSS (24.908^{0}B) and lowest acidity (0.15%), seed weight (1.116g). Hence it is concluded that the combined effect pruning and growth regulator simultaneously have significant effect on yield and quality.

Keywords: Pruning, plant growth regulator, physico-chemical quality, fruit weight, pulp weight, yield and quality

Introduction

Sapota produces a large number of flowers throughout the year in different flushes. The fruit quality of October-November flowering (Hasth bahar), which matures during August–September is somewhat poor as against July-August (Mrig bahar) flowering. The crop of July-August flowering matures in April-May, when the price is comparatively lucrative. The major problem confronting sapota crop is heavy flower and fruit drop (Patil and Narwadkar, 1974; Farooqui and Rao, 1976). Thus the regulation of flowering is one of the most important practical aspect of sapota cultivation.

India is considered to be the largest producer of sapota in the world. In India at present the total area & production under sapota is estimated as 107,000 hectares & 1294,000 metric tonnes with a productivity of 12.1 mt/ha (National Horticulture Board 2015-16). The productivity is very high in Karnataka and Gujurat. It has become most popular fruit crop in Gujurat, Maharastra, Karnataka, Tamil Nadu, Andhra Pradesh and Kerala.

Standardization of canopy management by way of training or pruning to maintain the tree size and to increase productivity has tremendous scope in high density planting of sapota. In senile plant, the yield is decreasing drastically and alternatively vegetative growth increases exponentially. So in order to balance the vegetative and reproductive growth of sapota plant, pruning of branches is felt necessary although fruiting occurs on newly emerged shoots. So to get fruiting from old, unproductive plants pruning is a very good and successive phenomenon for farmers to get some benefit.

Growth regulating chemicals govern all stages of crop development by using these at particular stage of fruit growth and development to have its maximum effect. Different groups of plant growth regulators like auxins, gibberellins and growth retardants at various concentrations have been reported to influence the flowering, fruit set, fruit retention, ripening advancement characters and quality characters of several fruit crops (Das and Mohapatra, 1976). Induction of flowering through chemical means is one way of tackling the problem of excessive vegetative growth and erratic flowering habit (Khader & Rao, 1983). Among the various causes of fruit drop, the simplest one is hormonal imbalance i.e. decline in the level of endogenous auxins (Addicot and Lynch, 1995). Among the synthetic auxins tested in this regards, the NAA has been found to be the most effective in chickoo. Keeping this in view, an

experiment on "Effect of pruning and plant growth regulator on Physico-chemical quality of fruit quality of sapota (*Manilkara zapota* L.) *cv*. Cricket Ball" was designed with the following cutting edge objectives

- To study the effect of pruning and plant growth regulator like GA_3, IAA, NAA, 2, 4-D on Physico-chemical quality rejuvenated sapota plant.

Materials method

Horticulture Research Station, Bhubaneswar under Department of Fruit Science & Horticulture Technology, College of Agriculture, Orissa University of Agriculture & Technology during the year 2017-18. The experiment was laid out in a split plot design with twenty five treatments replicated twice. In the main plot five levels of pruning and sub plot five levels of growth regulators were studied for their sole and interaction effect. However the 1st pruning was done in 55 years old sapota plant in the year 2013 but subsequently in the present year only 4 healthy shoots with good crotch angle were selected to maintain the primary branch of the pruned tree. Remaining shoots were thinned out periodically to develop a sturdy framework with open centre system. In secondary and tertiary branch pruned trees, thinning was done. Five levels of pruning were (P_1) control, (P_2) tip clipping of terminal shoots, (P_3) pruning of tertiary branches, (P_4) pruning of secondary branches,(P_5) pruning of primary branches and five levels of growth regulators were (G_1) control, (G_2) 20 ppm GA_3, (G_3) 50 ppm NAA, (G_4) 100 ppm IAA, (G_5) 20 ppm 2,4-D as foliar spraying. Observation were taken on physico-chemical quality of fruit, Fruit weight (g), Peel weight (g), Pulp weight (g), Seed weight (g), Fruit moisture (%),Total soluble solid (TSS) (^{0}Brix), Titrable acidity (%),Reducing, Non- reducing and Total sugar, Ascorbic acid content in sapota juice (mg/100g) and analysis and interpretation of data were done by using the method given by Gomez and Gomez (1984) in split plot design.

Results

Highest fruit weight (138.066g) was recorded in P_5 but P_1 (99.564g) recorded lowest weight of fruit. Among growth regulators used for study G_2 recorded highest fruit weight (134.494g) and the lowest one was G_1 (111.73g). It indicates the good source sink relationship which is reflected in fruit weight. To make a balance between sources & sink pruning plays a great role in regulating the density and number of photo-synthetically active leaves. The 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 act as an effective intervention to restore the balance. The present findings corroborates with the findings of Lal and Mishra (2008), Bhagawati (2015), Ahmed *et al*. (2016) and Sahoo *et al*. (2017).

Minimum peel weight (16.938g) was observed in the fruit of P_5 and maximum peel weight (18.438g) found in P_2. Among growth regulators applied minimum peel weight (17.802g) found in G_2 and maximum (18.582g) found in G_1. Pruning has significant effect on fruit pulp content. Maximum pulp weight (120.076g) was observed in P_5 and minimum pulp weight found in P_1 (79.674g). Similarly among growth regulators maximum pulp weight (115.9748g) was recorded in G_2 and minimum weight found in G_1 (91.29g). The total soluble solids in fruits harvested from pruned trees increased due to the increased rate of photosynthesis led by more light penetration into the interior tree canopy. Highest Total soluble solid (TSS) in heavy pruning treatments may lead to more synthesis of carbohydrates other metabolites and their translocation to the fruit tissues. Similar result was also reported by Kaundal *et al*. (2002) [10], Lal and Mishra (2008) and Kumar *et al.* (2010).

GA_3 stimulated the functioning of a number of enzymes in the physiological process which probably caused an increase in pulp percentage. These findings corroborates with the findings of Dikshit *et al*. (2004) [7], Singh *et al*. (2009), Agrawal and Dikshit (2008) [2] and Daberao *et al*. (2016) [6, 9].GA_3 was more effective than NAA to cause reduction in weight of seed of sapota. Garasiya *et al.* (2013) reported lowest no of seeds (303.60) per fruit in the treatment GA_3@100ppm which was at par with the treatment NAA@40ppm (305.65) in guava.

Lowest seed weight 1.456g was recorded in P_5 (primary branch pruning) and highest seed weight 1.524g found in P_1. Similarly G_2 recorded lowest seed weight (1.116g) and the highest weight found in G_1.

It was observed that both the application of pruning and growth regulators have the significant effect on TSS. P_5 recorded the maximum TSS content (24.686˚Brix) and minimum (22.946˚Brix) in P_1 Similarly maximum TSS (24.616˚Brix) was found in G_3 and minimum TSS (23.148˚Brix) in G_1. Maximum TSS and sugars may be due to increased sink potential of fruit by GA_3 due to which assimilates of fruits increased as compared to other sinks and ultimately transfer of photosynthates and its deposition in fruit occured in a faster rate. Rastegar *et al*. (2015) stated that sapota ripening was associated with an increase in total soluble solids, which is linked with increase in cell wall hydrolysing enzyme during ripening

Pruning and growth regulators showed significant effect on titrable acidity. Minimum acidity (0.146%) found in P_5 and maximum acidity (0.178) found in P_1 with P_2 (0.166%).Similarly G_2 recorded lowest acidity (0.15%). and maximum acidity (0.168%) found in G_1.Maximum reducing sugar (10.812%) found in P_5 and minimum reducing sugar (10.648%) found in P_1 Similarly G_2 recorded highest reducing sugar (11.844%) and lowest (9.658%) found in G_1. Maximum non reducing sugar (8.444%) found in P_5 and minimum (7.112%) found in P_1. Similarly G_2 recorded highest non reducing sugar (8.134%) and lowest (7.54%) in G_1. Similarly, reducing and non-reducing sugar content of the fruit were increased with increase in severity of pruning Similar result also reported by Lal and Mishra (2008) and Yadav *et al*. (2016) [18]. Patil (2006) [13] reported that both reducing and non-reducing sugar were more in GA_3 as compared to NAA. The treatment GA_3 (150 ppm) recorded highest percentage of reducing sugar (10.28%) and highest percentage of non-reducing sugar (5.96%) in sapota.

It was observed that the titrable acidity of the fruit decreased significantly with increase in pruning intensity Reduction in acidity with increase in pruning severity may be due to conversion of acid into sugar or it's utilization in metabolism. Maharajan and Dhillon (2002) in peach and Bhagawati *et al.* (2015) in guava reported similar findings. Ascorbic acid content in fruits of different treatments was varied significantly with severity in pruning. Maximum ascorbic acid (14.63 mg/100g pulp) was observed in P_5 and minimum

(13.03 mg/100g pulp) in P_1. Similarly G_3 recorded maximum ascorbic acid (14.666 mg/100g pulp) and minimum ascorbic acid (12.66 mg/100g pulp) in G_1. Kher *et al*. (2005) [11] reported in their study that lowest acidity was recorded with 90 ppm GA_3 in guava due to either conversion into sugar and their derivatives by reactions involving reverse glycolytic pathways. The moisture content of the fruit were remained statistically non significant to different growth regulators sprayed during the study.

Conclusion

The fruit set and retention percentage remained highest due to enhanced photosynthesis and accumulation of food reserves. Considering the quality of fruits it resulted a better fruit weight, pulp weight, TSS, reducing and non reducing sugar and ascorbic acid with minimum peel weight and seed weight. The quality characters like fruit weight, pulp weight, TSS, reducing and none reducing sugar were greatly influenced by spraying of GA_3@20ppm.

Table 1: Effect of pruning on Physico-chemical quality of sapota (*Manilkara zapota* L.) *cv*. Cricket Ball.

S.I No	Fruit weight (g)	Peel weight (g)	Pulp weight (g)	Seed weight (g)	Total soluble solid (TSS) (0Brix)	Titrable acidity (%),	Non-Reducing sugar	Reducing sugar	Ascorbic acid (mg/100g)
P1	124.58	18.09	104.6	1.83	23.67	0.16	8.6	9.67	13.77
P2	149.77	16.09	134.57	1.07	25.53	0.13	8.54	12.08	14.07
P3	146.21	16.22	127.74	1.26	25.27	0.14	8.71	11.57	15.33
P4	132.26	17.32	113.29	1.68	24.27	0.15	8.23	9.87	14.86
P5	137.51	16.97	120.18	1.44	24.67	0.15	8.14	10.87	15.12
Mean	138.066	16.938	120.076	1.456	24.686	0.146	8.444	10.812	14.63
SEm(±)	0.901	0.047	0.656	0.007	0.045	0.002	0.099	0.062	0.087
CD (5%)	3.536	0.183	2.576	0.029	0.175	0.009	NS	NS	0.341

Table 2: Effect of plant growth regulator on Physico-chemical quality of sapota (*Manilkara zapota* L.) *cv*. Cricket Ball.

S.I No	Fruit weight (g)	Peel weight (g)	Pulp weight (g)	Seed weight (g)	Total soluble solid (TSS) (0Brix)	Titrable acidity (%),	Reducing sugar	Non- reducing sugar	Ascorbic acid (mg/100g)
G1	109.84	19.38	89.36	1.14	23.47	0.17	11.74	7.62	13.65
G2	124.94	19	104.82	1.13	24.32	0.16	11.81	7.53	14.65
G3	139.34	17.46	120.74	1.11	24.78	0.15	11.66	8.09	14.63
G4	148.58	17.08	130.38	1.13	25.26	0.14	11.93	8.89	15.07
G5	149.77	16.09	134.57	1.07	25.27	0.14	12.08	8.54	15.33
Mean	134.494	17.802	115.974	1.116	24.616	0.152	11.844	8.134	14.666
SEm(±)	0.263	0.065	0.34	0.005	0.054	0.002	0.056	0.077	0.06
CD (5%)	0.777	0.192	1.002	0.015	0.161	0.007	0.165	0.229	0.178

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