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### Effect of seasonality on budding and air-layering propagation techniques in carambola (*Averrhoa carambola* L.) under foothills condition of Arunachal Pradesh

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#### ABSTRACT

Carambola (*Averrhoa carambola* L.) popularly known as star fruit belongs to oxalidaceae. It is an important underutilized fruit crop in North Eastern Region of India growing in subtropical zones of all the eight states. Its medicinal utility for treatment of jaundice is acknowledged by local healers as well as elders. Its evergreen nature, roundish to weeping canopy forms, leaves that mimic the fruits of any size make carambola one of the choicest fruit trees amongst garden lovers too. Most fruits contain no or least number of seeds that pose difficulty in propagation. Therefore, an experiment was conducted during 2019-20, to understand possibilities to explore vegetative propagations viz. budding and air-layering in carambola. In air-layering, the success rate of 29.75% and 32.85% were recorded for those prepared during spring and rainy season respectively. However, for I-budding as vegetative propagation, the success rate was recorded as 41.00 % and 49.25 % for those executed during spring and rainy season respectively. This indicates that rainy season is the congenial period as propagation techniques of budding and air-layering in carambola under the foothills condition of Arunachal Pradesh.

#### 1. Introduction

Carambola (*Averrhoa carambola* L.) is an underutilized attractive fruit of the family oxalidaceae. It is a subtropical evergreen tree, usually 6 to 9 m in height with roundish to weeping type of canopy. The fruit has distinctive five ridges running down its sides which in cross section appear in form of a star hence also called as 'Star fruit' having light to dark yellow in colour when ripe and smooth with a waxy cuticle while the flesh is light yellow, translucent, crisp and very juicy, with or without fiber (Margen, 1992). It is gaining importance due to their significant role in human health, nutrition, medicinal and therapeutic uses like jaundice treatment, income security, aesthetic and ecological balance. Padun and Singh (2018) explored the rich diversity of carambola having different fruit shape, size and fruit weight ranging from 83.50 g to 300.00 g / fruit and sweetness ranging from 5.00 to 14.90<sup>o</sup> Brix in Arunachal Pradesh. Lalmuanpuii *et al.* (2019) also observed the prevalence of variation in quality parameters of carambola in North East India having a range of TSS (4.80 to

14.50<sup>o</sup>Brix), oxalic acid (0.01% to 0.06%), ascorbic acid (28.00 to 65.00 mg/ 100g) and acidity (0.13 % to 1.32%). Generally carambola fruits have two distinct morphotypes viz. sour type which are richly flavoured, with more oxalic acid and sweet type having mild-flavored, blended with lesser oxalic acid. Carambola is believed to have originated from Malaysia- Indonesia belt (Zewen and DeWet, 1982). However, Pijpers *et al.* (1986) indicated the centre of origin of carambola as Sri Lanka or India. This fruit crop has also been predominantly cultivated in other Southeast Asian countries for many centuries. The fruits are rich source of reducing sugars, ascorbic acid and minerals, such as K, Ca, Mg and P (Haick, 1952). The fruits have the potential for preparation of a number of preserved products notably pickles, jam, jelly, preserved, beverages, etc. as well as there is increase in consumers' preference for fresh consumption (Padun and Singh, 2018). The leaves are antipyretic, anthelmintic and are documented to be helpful for curing scabies, fractured bones and various types of poisoning, intermittent fevers and elimination of intestinal

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worms (Kirtikar *et al.*, 1989). Besides, ripe fruit pulp along with little common salt is consumed against jaundice, bleeding piles and for cleansing utensils especially copper/brass made in Manipur (Singh *et al.*, 2014).

North East Region of India mainly Arunachal Pradesh, Assam, Manipur and Meghalaya has a rich source of genetic diversity of carambola having different fruit shapes, sizes and fruit quality having sour and sweet in taste (Lalmuanpuii *et al.*, 2019). Although carambola is grown in East Siang district of Arunachal Pradesh as underutilized and minor fruit crops for home state garden or in the wild form, but due its medicinal value and as desert fruit purpose, there is demand in the market which is sweet in taste. Looking at the importance of this underutilized fruit crop and high price value, the demand for its sweet genotypes planting material is also increasing for fresh consumption. However, the farmers have been using planting materials of seedling origin with unknown yield potential and fruit quality. Therefore, this is the time to assess appropriate vegetative propagation techniques and to identify congenial time of propagation, which is pre-requisite for strengthening of carambola production in India. Therefore, the present research was initiated to explore the suitable propagation technique of budding and air layering as vegetative plant propagation methods for carambola, which is traditionally propagated through seeds.

## 2. Materials and methods

The present investigations were carried out to explore budding and air-layering as vegetative propagation techniques for carambola. It was conducted during 2019-20 on trees planted at the Fruit Research Farm (28.080 East Latitude and 95.326 North Longitude), Department of Fruit Science, College of Horticulture and Forestry, Central Agricultural University (Imphal), Pasighat, Arunachal Pradesh. The experiment was laid out in a randomized block design (RBD) with seven treatments and four replications with one plant in each replication for air layering.

The details of the treatments are as here under:

T<sub>1</sub> = NAA 1000 ppm,

T<sub>2</sub> = IBA 1000 ppm, T<sub>3</sub> = IBA 1000 ppm + NAA 1000 ppm

T<sub>4</sub> = NAA 10,000 ppm, T<sub>5</sub> = IBA 10,000 ppm T<sub>6</sub> = IBA 10,000 ppm + NAA 10,000 ppm

T<sub>7</sub> = Control.

The treatments were imposed during spring season (February-March) and rainy season (June-September). The numbers of air layering per treatment per replication are 20 (five number of air-layer in four directions of the canopy) and each treatment was replicated three (3) times of total 60 numbers for each treatment. As no attempt has been made earlier to standardize the vegetative propagation method of carambola using plant growth regulator, an investigation was

therefore made in this direction based on underexploited fruit crops like water apple (1000 ppm IBA as reported by Paul and Aditi, 2009), Jackfruit (10,000 ppm IBA reported by Tomar, 2011), and rambutan (2500 ppm as reported by Bhattacharjee *et al.*, 2018). The PGRs *viz.* IBA and NAA were used in different concentrations of seven (7) treatments along with a control in every replication during the spring season (February-March) and rainy season (June-September). To evaluate for suitable vegetative plant propagation techniques, I-budding was also evaluated during spring season (February-March) and rainy season (June-September) on one year old rootstocks of carambola using the scion of local sweet genotype maintained in the Fruit Research Farm under the Department of Fruit Science, College of Horticulture & Forestry, CAU, Pasighat having the IC No. 0633712-IC No. 0633719 from NBPGR, New Delhi. For two seasons *viz.* spring and rainy 100 numbers of budded plants are evaluated on the seedling rootstock for evaluating its success rate and survival percentage. The successful percentage of air-layering (in terms of profuse root formation) and budding (in terms of sprouted scion buds) was derived by using following formula:-

$$\text{Successfully rooted air - layering} = \frac{\text{No. of rooted air - layerages}}{\text{Total No. of air - layering prepared initially}} \times 100 \%$$

$$\text{Successful Scion Sprouted} = \frac{\text{No. of nurseries with scion buds successfully sprouted}}{\text{Total No. of budded plants prepared initially}} \times 100 \%$$

The statistical analysis of the data on the mean values of success % of air-layering and budding was analyzed using M State soft and its standard error (S Em ±) was calculated by using follow formula (Chandal, 1993).

$$S \text{ Em} \pm = \frac{\sqrt{\text{MSE}}}{r} \times 100 \%$$

Where, MSE = Mean error sum of square  
r = Number of replication.

## 3. Results and discussions

The effect of different combinations of PGRs showed significant influence on air-layering on carambola resulting in better success rate in terms of profuse rooting as compared to those of control (Table 1). Girdling was done on the selected pencil thickness size branches and removal of about five (5) cm width barks and these were covered with moist soil (Soil+FYM in 1:1 ratio). The rooting media were wrapped with transparent polythene for maintaining moisture. Rooting takes place in 3-4 month depending on the rainfall and humidity during spring and rainy season. It was observed that maximum rooting in the air-layering was recorded in those layerages of T-3 (treated with combinations of IBA-1000 ppm and NAA-1000 ppm) prepared during rainy season

exhibiting 41.00 % success which was at par with T<sub>2</sub> (IBA-1000ppm) during rainy season (June month) that exhibited 39.00 % success as compared to control (18.00 %). Ghosh and Bera (2015) reported wide range of success rate (20-60%) for air-layering in carambola under red and lateritic zones of West Bengal in which maximum success in June month (60%) followed by July month (30%).

The successful sprouting of scion buds in I-budding is influenced by the season and sap flow stage of the cambium in plants. Seedling rootstocks of carambola attaining pencil size thickness have shown their optimum sap flow stage during spring and rainy season. The 'I' shape dormant scion bud of sweet genotype is inserted inside the cut made in the seedling rootstock about 10-15 cm above the ground. These are immediately wrapped with plastic polythene strips binding from bottom portion spirally moving upward with 200 gauge of 1.2 to 1.8 cm width. After the scion is wrapped tightly, the budded nurseries were kept under the partial shade net house condition. Good nursery management practices (GNMP) for the budded plants were take care regularly. After about three weeks or 21 days, buds were seen sprouting. The shoots of the rootstocks of such nurseries were pruned off at five (5) cm above the budded portion (graft joint) and allowed the scion to sprout further.

Investigation for different seasons of budding on carambola revealed that rainy season (June month) was more congenial for this propagation technique exhibiting 55.00 % success followed by July month 54.00% success as compared other season (Table 2).

Besides, investigations also revealed that carambola responded better to budding as propagation technique as compared to that of air-layering. Conducive season for vegetative propagation is during higher humidity period and optimum sap flow stage of both rootstock and scion shoots. Till now there are limited reports on the standardization of budding techniques for this important underutilized fruit crop in India. However, Ghosh and Bera (2015) had reported that the success rate of grafting in carambola under red and lateritic zone conditions of West Bengal range from 45-88% reporting congenial period is June-July month (88.19%). The variation on the success rate of budding and air-layering in carambola might be due to the congenial environmental factors mainly relative humidity which influences the success of it.

**Table 1.** Air-layering in carambola (*Averrhoacarambola* L.) and its rooting success rate

Treatment	Successful Rooting % (Spring season)	Successful Rooting% (Rainy season)
T <sub>1</sub> = NAA 1000ppm	28.00	33.00
T <sub>2</sub> = IBA 1000 ppm	37.00	39.00
T <sub>3</sub> = IBA 1000 ppm + NAA 1000 ppm	39.00	41.00
T <sub>4</sub> = NAA 10000ppm	25.00	29.00
T <sub>5</sub> = IBA 10000ppm	31.00	33.00
T <sub>6</sub> = IBA 10000ppm + NAA 10000ppm	29.00	34.00
T <sub>7</sub> = Control	18.00	21.00
<b>Mean</b>	<b>29.75</b>	<b>32.85</b>
<b>CD@5%</b>	<b>09.32</b>	<b>09.97</b>
<b>SE±m</b>	<b>04.02</b>	<b>04.29</b>

**Table 2.I-** budding method in carambola (*Averrhoacarambola* L.) and its sprouting success rate.

Month (Treatments)	Successful Scion Bud Sprouting %
February (Spring season)	40.00
March (Spring season)	42.00
June (Rainy season)	55.00
July (Rainy season)	54.00
August (Rainy season)	51.00
September (Rainy season)	37.00
<b>Mean</b>	<b>46.50</b>
<b>CD@5%</b>	<b>09.57</b>
<b>SE±m</b>	<b>03.59</b>

#### 4. Conclusion

From the present investigation it can be observed that budding and air-layering can be explored as vegetative propagation techniques for carambola during the month of June-July (rainy season) due to uniform rainfall and congenial relative humidity resulting in higher percentage of success rate. Further, it is also revealed that I-budding vegetative propagation is better as compared to that of air-layering with better success rate which can be recommended for the North East agro-climatic condition in the future.

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#### 6. Disclaimer:

The authors do hereby declare that they have no conflict of interest within themselves

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