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ROOT GENERATION OF KARONDA (*CARISSA CARANDAS* L.) CUTTINGS IN RESPONSE OF SUCROSE AND IBA

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ABSTRACT

A field experiment entitled "Root generation of karonda (*Carissa carandas* L.) cuttings in response of sucrose & IBA" was conducted during the year 2023-24 at Central Nursery Scheme, VNMKV, Parbhani with a view to study the effect of sucrose & IBA on sucrose & IBA on root generation of karonda cuttings. The application of Sucrose-4% + IBA 8000 ppm (T11) gave better results based on growth parameters minimum days taken for first sprouting (11.46), maximum number of sprouted cuttings (13.50), length of sprout (3.55 cm), total number of roots per cutting (53.00), length of longest root (8.98 cm), primary roots per cutting (7.60), secondary roots per cutting (45.60), mean root length (7.09 cm).
***Keywords*:** IBA, Karonda cuttings, Rooting, Sprouting, Sucrose.

Introduction

Karonda, known as 'Christ Thorn Tree' is a large dichotomously branched evergreen shrub with short stem and strong thorns in pairs belongs to the family Apocyanaceae, with chromosome number 2n=22. It grows well under tropical and sub-tropical climatic conditions (Panda *et al*., 2014). The area under minor fruit crops in India is around 238 thousand hectares with an annual production of 1977 thousand metric tonnes (Anonymous, 2018a).

The total area under karonda cultivation in India is 2,38,000 Mha, with annual production 19,77,000 MT and an average productivity is 8.30 MT/ha (Anonymous, 2018a). In Maharashtra karonda mainly cultivated in North Konkan, Western Ghat and Hilly region. In Maharashtra alone, the area under minor fruit crops is 996 hectares, with scattered plantation on bunds of field as fencing with a production of 1,722 metric tonnes (Anonymous, 2018b).

The chemical investigations on C. carandas had led to the isolation of several substances including β-sitosterol, lupeol, mixture of cardenolides, carissone and a new substance, carindone (Singh and Rastogi, 1972). A natural 'food colourant cum nutraceuticals supplement' was prepared from the ripe karonda fruits. The formulation had been named as 'Lalima'. Karonda fruits are sour, elegantly sweet and astringent in taste and are an excellent source of iron along with a good amount of vitamin C to strengthen the immune system. It also provides phosphorous, vitamin A, and calcium. Fruits are eaten fresh or are used in pickle making, jam, jelly, chutney, and for culinary purposes (Chundawat, 1995).

Its fruit is used in the ancient Indian herbal system of medicine, ayurvedic, to treat acidity, indigestion, fresh and infected wounds, skin diseases, urinary disorders and diabetic ulceras well as biliousness, stomach pain, constipation, anemia, skin conditions, anorexia and insanity. The roots serve as a stomachic, an anthelmintic medicine for itches and also as insect repellents. The researchers suggested the potential anti-cancer value of this medicinal plant fruit for future development of therapeutic drugs (Dua, 2013).

Sucrose is good source of carbohydrate which gives direct energy to the cuttings. High sugar level affects rooting by reducing the level of nitrogen which is essential for rooting process (Yeboah *et al*., 2009). The greater number of leaves with sucrose 4 per cent has been observed. As a greater number of leaves are produced, they start manufacturing photosynthates which contribute to initiation of rooting (Deepika *et al*., 2015). Prajwala *et al*. (2019) showed that among growth regulator treatments, IBA 8000 ppm was found best with respect to rooting parameters. Exogenously applied auxins supplement endogenous auxin levels, which initiates certain anatomical and physiological changes resulting in increased length and number of primary roots. High enrichment of sucrose affects rooting as it accumulates massive carbohydrates and also act as a carbon skeleton for the synthesis of organic compounds that are used for the establishment of root traits in cuttings (Deepika *et al*., 2015).

Seed propagation brings genetic variability and leads to low yield and poor quality of fruits. Vegetative propagation is advocated for eliminating variability in seedling plantation.

Propagation through cuttings is the best and less expensive method (Upadhyay and Badyal, 2007). The use of plant growth regulators encourages the production of hydrolyzing enzymes, including amylase and protease. To achieve a high survival rate, growing medium and growth regulators are frequently used nowadays (Voruganti *et al*., 2022). A good method of vegetative propagation with highest success percent survival is required in karonda. Therefore, considering above points, the present investigation carried out to know the effect of sucrose & IBA on root generation of karonda cuttings.

Materials and Methods

The experiment on "Root generation of karonda (*Carissa carandas* L.) cuttings in response of sucrose & IBA" was carried out at Central Nursery Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, during monsoon season, 2023-24. The experiment was laid out in Randomized Block Design in 16 treatments with 2 replications. The treatments were T_1-Sucrose-3%, T_2-Sucrose-4%, T_3-Sucrose-5%, T_4-IBA-7000 ppm, T_5-IBA-8000 ppm, T_6-IBA-9000 ppm, T_7-Sucrose-3% + IBA-7000 ppm, T_8-Sucrose-3% + IBA-8000 ppm, T_9-Sucrose-3% + IBA-9000 ppm, T_{10}-Sucrose-4% + IBA-7000 ppm, T_{11}-Sucrose-4% + IBA-8000 ppm, T_{12}-Sucrose-4% + IBA-9000 ppm, T_{13}-Sucrose-5% + IBA-7000 ppm, T_{14}-Sucrose-5% + IBA-8000 ppm, T_{15}-Sucrose-5% + IBA-9000 ppm and T_{16}-Control.

Semi-hardwood cuttings of uniform thickness, free of disease, were taken from mother plants. Twenty-centimeter-long cuttings with four to five nodes were taken from the semi- hardwood section of the chosen branches. The cuttings were treated with plant growth regulators by quick dip method for 5 seconds and planted in polybags containing rooting media (Soil: Sand: FYM in the ratio of 1:1:1). Five sprouted cuttings were selected randomly from each treatment per replication. These five cuttings were labeled for recording observations throughout the study. Before planting, all cuttings received a Carbendazim (0.1%) treatment to prevent fungal infection. Observations were taken with respect to the growth and root parameters are days taken for first sprouting, number of sprouted cuttings, length of sprout, total number of roots per cutting, length of longest root, primary roots per cutting, secondary roots per cutting, mean root length.

Results and Discussion

Growth and root parameters

Significant difference was observed in days taken for first sprouting, number of sprouted cuttings, length of sprout, total number of roots per cutting, length of longest root, primary roots per cutting, secondary roots per cutting, mean root length due to sucrose and IBA. Increase in growth parameters is due to sucrose provides energy to Karonda cuttings, supporting root development and preventing dehydration, while IBA (Indole-3-butyric acid) promotes root initiation by stimulating cell division. Together, sucrose enhances energy availability for root growth, and IBA stimulates the biochemical processes needed for root formation, leading to faster and more successful rooting, improved root quality, and better overall growth of the cuttings. Five plants are tagged in each treatment plot, observation were made on several growth and root parameters like days taken for first sprouting, number of sprouted cuttings, length of sprout, total number of roots per cutting, length of longest root, primary roots per cutting, secondary roots per cutting, mean root length.

Days to first sprouting (Days)

Application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly minimum number of days to first sprouting (11.46 DAP). This might be due to sucrose supports the energy needs, while IBA stimulates the physiological processes necessary for root initiation. Together, they can accelerate the time it takes for cuttings to sprout compared to other treatments. Growth regulators like IBA helps the cuttings to sprout earlier because they make better use of nitrogen, stored carbohydrates, and other resources (Chandramouli, 2001). Because sucrose is a good source of carbohydrates, it gives the cuttings immediate energy, which encourages early sprouting (Dey *et al*., 2017). Similar results were reported by Maanik *et al*. (2022) in karonda cuttings.

Number of sprouted cuttings

Among all the treatments application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum number of sprouted cuttings (13.50). This may be due to the combination of 4% sucrose and 8000 ppm IBA is effective for increasing the number of sprouted karonda cutting as it provides both an ample energy source and a strong hormonal stimulus, optimizing the conditions necessary for rooting and sprouting. An increase in rooted cuttings is the result of higher IBA concentrations, and this increases nutrition and moisture absorption resulting in the greatest quantity of sprouted cuttings (Mewar and Naithani 2016). The results align with Singh (2014) in pomegranate hardwood cuttings, Mehta *et al.* (2018) in pomegranate and Maanik *et al.* (2022) in karonda cuttings.

Length of sprout (cm)

Among all the treatments application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum length of sprout (3.55 cm). The combination of 4% sucrose and 8000 ppm IBA is effective in promoting longer sprouts in karonda cuttings as it provides a robust energy source and stimulates strong rooting. This leads to better overall plant health and growth, allowing the cuttings to develop longer and more vigorous sprouts compared to other treatments. The auxins activated shoot growth which results the elongation of stems and leaves through cell division accounting in longest sprout. It may be due to species, favorable climatic conditions in mist to increase the length of sprout in pomegranate cuttings (Mehta *et al.* 2018). The results are in conformity with Singh *et al.* (2014) in Citrus limon and Tanuja and Rana (2018) in karonda (*Carisa carandas* L.) cv. Pant Manohar.

Total number of roots per cutting

Among all the treatments application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum total number of roots per cutting (53.00). Growth in roots is the result of hormones, internal substance accumulation, and their downward movement (Pandey *et al*., 2003). According to reports, IBA increases the quantity of roots per cutting by hydrolyzing polysaccharides, which gives meristematic tissues energy for root primordial development (Husen and Pal, 2007). Because IBA stimulates auxin in the root system and distributes carbohydrates to the cuttings' base, it causes earlier and faster root growth. improving roots as a result, as noted in *Prunus species* (Riberio *et al*., 2010).

Length of longest root (cm)

Application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum length of longest root (8.98 cm). Cuttings treated with auxins have longer roots because of the enhanced hydrolysis of carbohydrates, metabolite accumulation at the application site, synthesis of new protein, cell expansion, and cell division (Singh *et al*., 2011). According to Kesari *et al.* (2010), treating cuttings with IBA encourages the translocation of metabolites and glucose metabolism, which in turn impacts the onset of rooting and lengthens and multiplies the number of roots. These outcomes are in line with the research by Dey *et al.* (2017), which found that IBA 8000 ppm and 4 per cent sugar produce better outcomes.

Primary roots per cutting

Application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum primary roots per cutting (7.60). Auxin treatment induced higher number of primary and secondary roots which might have resulted in elongation of these roots through cell division (Debnath and Maiti, 1990). Similar outcomes were mentioned by Singh (2014) in pomegranate, Singh *et al.* (2015) in phalsa and Tanuja and Rana (2018) in karonda cuttings.

Secondary roots per cutting

Application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum secondary roots per cutting (45.60). This may be due to the reason that the combination of 4% sucrose and 8000 ppm IBA is effective in increasing the number of secondary roots per karonda cutting because it provides a balanced supply of energy and hormonal support. Sucrose supplies the necessary carbohydrates for sustaining root development, while IBA promotes the formation and proliferation of secondary roots. This synergy results in a more extensive and well-branched root system compared to other treatments that might not offer the same level of support for both energy provision and hormonal stimulation. auxin treatment induced higher number of primary and secondary roots which might have resulted in elongation of these roots through cell division (Debnath and Maiti, 1990). Comparable outcomes were noted by Singh (2014) in pomegranate and Tanuja and Rana (2018) in karonda cuttings.

Mean root length (cm)

Application of Sucrose-4% + IBA-8000 ppm (T11) recorded significantly maximum mean root length (7.09 cm). Auxin treatment of cuttings increases the amount of carbohydrates hydrolyzed, metabolites accumulated at the application site, new protein synthesis, cell enlargement, and cell division, all of which led to the initiation of rooting and an increase in the length and number of roots in cuttings (Kesari *et al*., 2010 and Singh *et al*., 2011). Since carbohydrates are thought to be the source of energy and the carbon skeleton for the development of roots, sucrose, a form of carbohydrate, serves as both a source of energy and a building block (Correa *et al*., 2005).

Conclusions

On the basis of present study, it can be concluded that the growth and root parameters like days taken for first sprouting, number of sprouted cuttings, length of sprout, total number of roots per cutting, length of longest root, primary roots per cutting, secondary roots per cutting, mean root length were found significant with treatment Sucrose-4% + IBA 8000 ppm (T11).

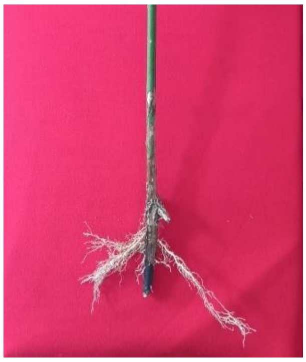
Hence, application of Sucrose-4% + IBA 8000 ppm (T11) is found significantly superior over rest of the treatments in respect of growth and root parameters.

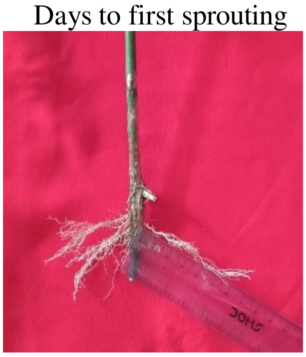
Table 1: Effect of sucrose and IBA on various growth and root parameters

Treatments	Days taken for first sprouting (Days)	Number of sprouted cuttings	Length of sprout (cm)	Total number of roots per cutting	Length of longest root (cm)	Primary roots per cutting	Secondary roots per cutting	Mean root length (cm)
T_{1}-Sucrose-3%	16.45	6.50	1.14	20.50	5.71	3.40	17.00	4.25
T_{2}-Sucrose-4%	13.65	10.00	2.08	32.50	7.07	5.40	27.00	5.13
T_{3}-Sucrose-5%	15.55	7.50	1.50	23.00	6.68	3.80	19.00	4.48
T_{4}-IBA-7000 ppm	15.15	8.00	1.70	25.00	6.74	4.20	21.00	4.49
T_{5}-IBA-8000 ppm	12.80	12.00	2.93	38.50	7.20	6.40	32.00	5.31
T_{6}-IBA-9000 ppm	13.10	11.50	2.23	37.00	7.17	6.20	31.00	5.30
T_{7}-Sucrose-3% + IBA-7000 ppm	16.40	7.00	1.35	21.50	6.64	3.60	18.00	4.37
T_{8}-Sucrose-3% + IBA-8000 ppm	13.59	10.50	2.10	35.00	7.13	5.80	29.00	5.26
T_{9}-Sucrose-3% + IBA-9000 ppm	14.77	8.50	1.84	26.50	6.84	4.40	22.00	4.59
T_{10}-Sucrose-4% + IBA-7000 ppm	14.60	9.00	1.98	28.00	6.92	4.60	23.00	4.74
T_{11}-Sucrose-4% + IBA-8000 ppm	11.46	13.50	3.55	53.00	8.98	7.60	45.60	7.09
T_{12}-Sucrose-4% + IBA-9000 ppm	12.56	12.50	3.20	49.50	7.27	7.00	42.00	6.50
T_{13}-Sucrose-5% + IBA-7000 ppm	14.37	9.50	2.00	30.00	6.97	5.00	25.00	4.81
T_{14}-Sucrose-5% + IBA-8000 ppm	12.35	13.00	3.30	52.00	8.83	7.40	44.40	7.01
T_{15}-Sucrose-5% + IBA-9000 ppm	13.52	11.00	2.16	35.00	7.15	5.80	29.00	5.27
T_{16}-Control	17.67	6.00	1.07	13.00	5.48	3.20	9.60	4.12
S.E(m).±	**0.52**	**0.26**	**0.17**	**3.34**	**0.58**	**0.31**	**3.95**	**0.13**
C.D. at 5%	**1.59**	**0.79**	**0.53**	**10.26**	**1.79**	**0.97**	**12.16**	**0.41**


Days to first sprouting


Length of sprout


Total number of roots


Length of longest root


Primary and secondary roots


Cutting after 90 DAP

Plate 1: Photographs showing effect of sucrose and IBA on various growth and root parameters

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Conflict of Interest

The authors declare no conflicts of interest. They bear sole responsibility for the content and composition of the paper.

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