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# Studies on rooting characteristics of Karonda cultivars in response to growth regulators

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**Abstract**
The experiment entitled "Studies on propagation through semi hard wood cuttings in karonda" was carried out at College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari District. The semi hard wood cuttings of karonda cultivars *viz.,* pink-fruited plants and green-fruited plants were treated with different growth regulators treatments (IBA and NAA) along with control and the experiment was carried out in Factorial Randomised Block Design with 3 replications comprising 14 treatment combinations. The experiment results indicate that among cultivars, semi-hardwood cuttings of green fruited plant performed better than semi-hardwood cuttings of pink fruited plant with respect to rooting parameters like percentage of rooting, survival percentage, number of roots per cuttings, length of longest root per cuttings and percentage of establishment in main field at 90 DAP. Among growth regulator treatments, IBA @ 8000 ppm was found best and in case of interaction effects it was found that the combination of semi-hardwood cuttings of green fruited and IBA @ 8000 ppm was observed to be significantly superior with respect to rooting parameters.

**Keywords:** Karonda cultivars, growth regulators, IBA, NAA

## Introduction
Karonda (*Carissa carandas* L.) 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. It grows well under tropical and sub tropical climatic conditions (Panda *et al.*, 2014) [14]. Karonda is found wild in Bihar, West Bengal and South India. It is commonly used as a thorny live hedge plant in commercial plantations in the Varanasi district of Uttar Pradesh. It is a drought tolerant plant that flourishes well in areas with high temperatures and wide range of solis. It is a non- traditional fruit crop which thrives well as a rainfed crop. Once established, the plant hardly needs any care and gives yield with minimum management (Banik *et al*., 2012) [2]. Fruits are sour and astringent in taste and are rich source of iron (39.10 mg/100 g) and vitamin C (9-11 mg/100 g). It is also rich in pectin. Its fruits have antiscorbutic properties and are a very useful to cure anaemia. Ripe fruits of pink fruited and green fruited cultivars are sub-acidic to sweet in taste with a peculiar aroma and can be used in the preparation of fruit products such as jelly, sauce and carissa cream or jellied salad. Vegetative propagation by cuttings has advantage in maintenance of good agronomic characteristics, encouraging the production and multiplication of true to type plants. Therefore various growth regulators like IBA and NAA have been used to increase percentage of rooting by increasing the number and quality of roots produced per cutting. Increase in percentage of rooting in cuttings treated with IBA is due to the enhanced hydrolysis of carbohydrates, accumulation of metabolites at the site of application, synthesis of new proteins, cell enlargement and cell division (Singh *et al*., 2011) [23]. As scare information was available on propagation studies on karonda cultivars the present experiment was conducted.

## Materials and methods
The present experiment was carried out during the period of 2017-18 at college farm, College of Horticulture, Dr. Y. S. R. Horticultural University, Venkataramannagudem, Tadepalligudem, West Godavari District.

## Preparation of cuttings
Cuttings were taken from 8 months old shoots which were cut to 4 - 5 nodes each. Length of the cuttings used for planting was 20 - 22 cm.

The leaves were removed from the cuttings and were trimmed to the required length by removing the portions from both ends of cutting just above and below the nodes. The basal end of the cuttings was given a slanting cut to expose maximum absorbing surface for effective rooting and the cuttings were treated with plant growth regulators by quick dip method for 5 seconds and were allowed to dry for 15 minutes under shade and planted in poly bags containing rooting media (red soil, farm yard manure and cocopeat in the ratio of 2: 1: 1).

**Observations Recorded**

Five sprouted cuttings were selected randomly from each treatment per replication. These five cuttings were labeled for recording observations throughout the study.

Following observations were made at the end of 90$^{th}$ day by removing cuttings carefully from the polyethylene bags without damaging the root system for recording the data. Polyethylene bags were removed carefully and the cuttings along with ball of earth were placed in water to remove the soil particles and then further washed thoroughly to clean roots.

**Percentage of rooted cuttings (%)**

It can be calculated by using the following formula

$$\text{Percentage of rooted cuttings (\%)} = \frac{\text{Number of cuttings rooted}}{\text{Total Number of cuttings}} \text{x } 100$$

**Survival percentage of rooted cuttings**

The total number of rooted cuttings survived under each treatment in three replication was recorded and survival percentage of rooted cuttings was calculated.

**Number of roots per cutting (No.)**

Total number of roots per cuttings were calculated by counting the number of roots present.

**Length of the longest root per rooted cutting (cm)**

The length of longest root of each rooted cutting was measured by measuring scale from the base to the tip of root and the mean length was calculated.

**Percentage of establishment in main field (%)**

This was calculated based on the number of rooted cuttings survived in a month after planting in the main field.

**Statistical Analysis**

The data was analyzed using computer software programmed by the method of variance outlined by Panse and Sukhatme (1978). Statistical significance was tested by F value at 5 per cent level of significance. Critical difference at 0.05 level was worked out for the effects which were significant. The results have been depicted graphically where ever necessary.

**Results and discussions**

**Percentage of rooted cuttings (%)**

Significant differences were observed among the type of cultivars, growth regulator treatments and their interactions on percentage of rooted cuttings in karonda (Table 1). Among the type of cultivars, semi hard wood cuttings of green fruited plants recorded the highest percentage of rooting (34.73%) when compared to semi hard wood cuttings of pink fruited plants (31.21%). IBA @ 8000 ppm performed the best with 43.48 percentage of rooting and this was followed by NAA @ 2000 ppm (37.95%) while the minimum percentage of rooting (26.38%) was observed in control among the growth regulator treatments,. There existed a significant interaction between type of cultivars, growth regulator treatments, highest percentage of rooting (45.51%) was recorded by cuttings of the green fruited plant treated with IBA @ 8000 ppm. Bhusal (2001) [4] showed that the rooting abilities varied among species and varieties (0-100%). Rough lemon and lemon had 100 per cent rooting while Tengu and Kuno Satsuma mandarin had recorded zero per cent rooting. Cuttings treated with different concentrations of IBA solution coupled with endogenous application of auxins to the cuttings could improve the percentage of rooting as reported by Melgarejo *et al*. (2000) [16]. There is a decrease in the percentage of rooting with increase in the concentration of IBA after 8000 ppm concentration, signaling that when the exogenous auxin concentration reached its point of maximum efficiency it causes inhibitory action (Hartmann *et al.,* 2011) [12]. The present results are in accordance with the findings of Ahmed *et al.* (2017) [1] in grape cuttings, Dey *et al.* (2017) [9] and Deepika *et al*. (2015) [8] in karonda cuttings.

**Table 1:** Effect of growth regulators on percentage of rooting (%) in semi hard wood cuttings of karonda cultivars

| Concentration of growth regulators | Cultivars | | Mean |
|---|---|---|---|
| | $V_1$ (Pink fruited plant) | $V_2$ (Green fruited plant) | |
| $G_1$ (IBA @ 7000 ppm) | 23.23 (28.79) | 27.50 (31.60) | 25.36 (30.20) |
| $G_2$ (IBA @ 8000 ppm | 43.86 (41.45) | 50.93 (45.51) | 47.39 (43.48) |
| $G_3$ (IBA @ 9000 ppm) | 32.56 (34.77) | 23.26 (28.82) | 27.91 (31.80) |
| $G_4$ (NAA @ 1000 ppm) | 25.04 (30.00) | 33.45 (35.32) | 29.24 (32.66) |
| $G_5$ (NAA @ 2000 ppm) | 31.50 (34.13) | 44.43 (41.78) | 37.96 (37.95) |
| $G_6$ (NAA @ 3000 ppm) | 17.19 (24.47) | 28.41 (32.19) | 22.80 (28.33) |
| $G_7$ ( Control) | 17.72 (24.88) | 21.90 (27.88) | 19.81 (26.38) |
| Mean | 27.30 (31.21) | 32.84 (34.73) | |
| | V | T | V x T |
| SE(m) ± | 0.20 | 0.37 | 0.53 |
| CD at 5% | 0.59 | 1.10 | 1.56 |

(Figures in parenthesis indicates angular transformed values)

**Survival percentage of rooted cuttings (%)**

Semi hard wood cuttings of green fruited plants recorded highest survival percentage of rooted cuttings (24.12%) when compared to semi hard wood cuttings of pink fruited plants (17.53%) (Table 2). Among growth regulator treatments, IBA @ 8000 ppm performed the best with regard to the survival percentage of rooted cuttings (33.82%) followed by NAA @ 2000 ppm (27.42%) while the minimum percentage of rooting (12.43%) was observed with control. In case of interaction effect highest survival percentage of rooted cuttings (36.00%) was recorded by the cuttings of green fruited plant treated with IBA @ 8000 ppm. Lowest value was recorded in

untreated pink-fruited semi-hardwood cuttings (11.59%). The above results may be due togenetic factors and the production of thinner roots much profusely produced by the application of IBA. Thinner root system improves the water absorption capacity of plants which reduces mortality rate in the nursery. IBA has greater chemical stability and low mobility in plants, which results in prolonged benefits giving better chance of success as reported by Das and Prasad (2014) [6]. Such observations were also made by Chaudhari *et al.* (2018) [5] in wax apple, Fadli *et al.* (2017) [10] in citrumelo, Kareem *et al.* (2013) [13] in guava and Rajkumar *et al.* (2016) [21] in pomegranate.

**Table 2:** Effect of growth regulators on survival percentage of rooted cuttings (%) in semi hard wood cuttings of karonda cultivars

| Concentration of growth regulators | Cultivars | | Mean |
|---|---|---|---|
| | $V_1$ (Pink fruited plant) | $V_2$ (Green fruited plant) | |
| $G_1$ (IBA @ 7000 ppm) | 6.90 (14.95) | 11.16 (19.34) | 9.03 (17.15) |
| $G_2$ (IBA @ 8000 ppm | 27.53 (31.63) | 34.60 (36.00) | 31.06 (33.82) |
| $G_3$ (IBA @ 9000 ppm) | 6.93 (15.02 ) | 2.79 (23.69) | 4.86 (19.35) |
| $G_4$ (NAA @ 1000 ppm) | 16.23 (17.11) | 8.71 (24.30) | 12.47 (20.70) |
| $G_5$ (NAA @ 2000 ppm) | 17.12 (22.87 ) | 15.17 (31.97) | 16.14 (27.42) |
| $G_6$ (NAA @ 3000 ppm) | 28.10 (9.55) | 12.08 (20.27) | 20.09 (14.91) |
| $G_7$ ( Control) | 4.38 (11.59) | 5.57 (13.27) | 4.975 (12.43) |
| Mean | 15.31 (17.53) | 12.86 (24.12) | |
| | V | T | V x T |
| SE(m) ± | 0.36 | 0.68 | 0.96 |
| CD at 5% | 1.06 | 1.98 | 2.81 |

(Figures in parenthesis indicates angular transformed values)

**Number of roots per cutting (No.)**

The data related to the number of roots per cutting were significantly influenced by the type of cultivars and concentration of growth regulators Table 3. Among the different cuttings, semi hard wood cuttings of green fruited plants recorded more number of roots (4.90) and less number of roots were observed in semi hard wood cuttings of pink fruited plants (4.30). Cuttings treated with IBA @ 8000 ppm recorded maximum number of roots per cutting (5.89) followed by NAA @ 2000 ppm (5.25) and control recorded minimum number of roots per cuttings (3.24). Among interaction the green fruited plants cuttings treated with IBA @ 8000 ppm recorded highest number of roots (5.92). Significant difference was observed between cultivars, this may be due to the genetic factors (Lalith, 2017). Among different concentrations of IBA and NAA treatments, the increase in number of roots was probably due to hormonal effect and accumulation of other internal substances and their downward movement as reported in citrus species (Pandey *et al*., 2003) [18]. These results were also in conformity with Ribeiro *et al*. (2010) [22] in Prunus species and Galavi *et al*. (2013) [11] in grapes.

**Table 3:** Effect of growth regulators on number of roots per cutting (No.) in semi hard wood cuttings of karonda cultivars

| Concentration of growth regulators | Cultivars | | Mean |
|---|---|---|---|
| | $V_1$ (Pink fruited plant) | $V_2$ (Green fruited plant) | |
| $G_1$ (IBA @ 7000 ppm) | 11.91 (3.58) | 24.86 (5.08) | 18.38 (4.33) |
| $G_2$ (IBA @ 8000 ppm | 33.53 (5.86) | 34.08 (5.92) | 33.80 (5.89) |
| $G_3$ (IBA @ 9000 ppm) | 20.40 (4.62) | 26.06 (5.20) | 23.23 (4.91) |
| $G_4$ (NAA @ 1000 ppm) | 17.25 (4.26) | 22.26 (4.82) | 19.75 (4.54) |
| $G_5$ (NAA @ 2000 ppm) | 24.33 (5.03) | 29.00 (5.47) | 26.66 (5.25) |
| $G_6$ (NAA @ 3000 ppm) | 13.10 (3.74) | 18.26 (4.38) | 15.68 (4.06) |
| $G_7$ ( Control) | 8.26 (3.03) | 11.01 (3.46) | 9.63 (3.24) |
| Mean | 18.39 (4.30) | 23.64 (4.90) | |
| | V | T | V x T |
| SE(m) ± | 0.05 | 0.09 | 0.13 |
| CD at 5% | 0.14 | 0.27 | 0.39 |

(Figures in parenthesis indicates square root transformed values)

**Length of the longest root per rooted cutting (cm)**

It is evident from the results furnished in the Table 4 which shows significant difference in the length of the longest root per cutting, in the type of cultivar, growth regulator as well as their interactions effect. The mean length of longest root per cutting was maximum in semi-hardwood cuttings of green fruited plants (6.23 cm) and the minimum length of longest root was observed in semi-hardwood cuttings of pink fruited plants (5.31 cm). Among the different concentrations of IBA and NAA treatments, cuttings treated with IBA @ 8000 ppm recorded the highest value (7.69 cm), followed by (6.56 cm) cuttings treated with IBA @ 9000 ppm while the minimum length of longest root per cutting was recorded by the control (4.24 cm). The interaction effect between cultivar types and the concentration of growth regulators treatment were found to be significant with respect to length of the longest root per cutting. The longest root per cutting (8.24 cm) was found in the semi-hardwood cuttings of green fruited type, treated with IBA @ 8000 ppm. The increase in length of the root in cuttings with green fruited type may be due to the genetic factors. In case of cuttings treated with growth regulators highest root length was observed in IBA treatment, this may be due to the enhanced hydrolysis of carbohydrates, accumulation of metabolites at the site of application, synthesis of new proteins, cell enlargement and cell division induced by the auxins (Singh *et al*., 2011) [23]. Results were confirmatory with the findings of Rahman *et al.* (2004) [20], Bhatt and Tomar *et al.* (2011) [3] in citrus, Kareem *et al.* (2013) [13] in guava, Khajehpour *et al.* (2014) [14] in olive, Deepika *et al.* (2015) [8] and Dey *et al.* (2017) [9] in karonda.

**Table 4:** Effect of growth regulators on length of the longest root per rooted cutting (cm) in semi hard wood cuttings of karonda cultivars

| Concentration of growth regulators | Cultivars | | Mean |
|---|---|---|---|
| | **$V_1$ (Pink fruited plant)** | **$V_2$ (Green fruited plant)** | |
| $G_1$ (IBA @ 7000 ppm) | 4.95 | 6.20 | 5.57 |
| $G_2$ (IBA @ 8000 ppm | 7.14 | 8.24 | 7.69 |
| $G_3$ (IBA @ 9000 ppm) | 5.90 | 7.22 | 6.56 |
| $G_4$ (NAA @ 1000 ppm) | 4.71 | 6.08 | 5.39 |
| $G_5$ (NAA @ 2000 ppm) | 5.99 | 6.13 | 6.06 |
| $G_6$ (NAA @ 3000 ppm) | 4.52 | 5.24 | 4.88 |
| $G_7$ ( Control) | 3.94 | 4.54 | 4.24 |
| Mean | 5.31 | 6.23 | |
| | V | T | V x T |
| SE(m) ± | 0.06 | 0.12 | 0.18 |
| CD at 5% | 0.19 | 0.37 | 0.52 |

**Percentage of establishment in main field (%)**

The data pertaining to the percentage of establishment in main field is furnished in the Table 5. A significant difference was observed among the cultivar types, growth regulators as well as on their interaction effect. Among cultivars semi-hardwood cuttings of green fruited plants showed a better establishment percentage (87.04%) and the lowest was recorded under semi-hardwood cuttings of pink fruited plants (77.47%). IBA @ 8000 ppm showed a better establishment percentage (96%) among different concentrations of IBA and NAA, while the lowest was recorded in the control (66.83%). Interaction effect caused on the cuttings of the cultivars treated with growth regulators showed a significant difference. IBA @ 8000 ppm treated semi-hardwood cuttings of green fruited plants showed the maximum field establishment percentage (99%). Significant variation among cultivars may be due the genetic make up of the plants and other better rooting parameters of green fruited plants. At 8000 ppm of IBA concentration, the root parameters increased proportionately, which in turn led to the absorption of more water and nutrients from the ground (Sivaji, 2012) [24]. This might be the reason for the maximum percentage establishment of rooted cuttings treated with IBA @ 8000 ppm. The above results are justified by the similar findings in rose by Dawa *et al.* (2017) [7].

**Table 5:** Effect of growth regulators on percentage of establishment in main field (%) in semi hard wood cuttings of karonda cultivars

| Concentration of growth regulators | Cultivars | | Mean |
|---|---|---|---|
| | **$V_1$** (Pink fruited plant) | **$V_2$** (Green fruited plant) | |
| $G_1$ (IBA @ 7000 ppm) | 72.66 | 86.00 | 79.33 |
| $G_2$ (IBA @ 8000 ppm | 93.00 | 99.00 | 96.00 |
| $G_3$ (IBA @ 9000 ppm) | 74.00 | 91.00 | 82.50 |
| $G_4$ (NAA @ 1000 ppm) | 82.33 | 87.00 | 84.66 |
| $G_5$ (NAA @ 2000 ppm) | 84.00 | 97.00 | 90.50 |
| $G_6$ (NAA @ 3000 ppm) | 71.00 | 81.00 | 76.00 |
| $G_7$ ( Control) | 65.33 | 68.33 | 66.83 |
| Mean | 77.47 | 87.04 | |
| | V | T | V x T |
| SE(m) ± | 0.27 | 0.50 | 0.71 |
| CD at 5% | 0.79 | 1.48 | 2.09 |

(Figures in parenthesis indicates angular transformed values)

## Conclusion

Among the cultivars, semi hard wood cuttings of green fruited plants and among the different growth regulators, IBA @ 8000 ppm performed the best with respect to rooting parameters. Among the interactions, semi hard wood cuttings of green fruited plants treated with IBA @ 8000 ppm was found to be best in terms of all the rooting parameters.

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