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Original Article

Studies on Hormonal Effects on Rooting of Marcotting and Stem-Cuttings of Akee Apple (*Blighia sapida* K. D. Koenig)

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Abstract

The effect of hormone on the rooting of stem-cuttings and marcotting of akee apple was studied using a combination between Indole -3- Butyric Acid (IBA) and 1- Naphthalene Acetic Acid (NAA). Stem-cuttings from mature akee trees from Challenge, Jalala and Ganmo in Ilorin, were treated with different dilutions of the liquid hormone in the combination of 1.0% Indole-3- butyric acid + 0.5% 1-Naphthaleneacetic acid before propagating them in a non-mist propagator. Marcotting was also carried-out on trees, using the hormonal combination of different dilutions. Observations and the results obtained revealed that the hormonal combination had significant effect on the rooting of stem-cuttings and marcotting. Both marcotting and stem cuttings did not produce at the end of the experiment roots in the absence of the hormonal treatment; a particular aspect was marcotting that initials produced roots. On the other hand, both marcotting and stem cuttings produced roots with the hormonal treatments; more roots were produced using the combination of 2,000 ppm of IBA and 1,000 ppm of NAA, compared with lower concentrations of the hormone mixtures. After callus formation, 2,000 ppm of IBA and 1,000 ppm of NAA combination gave the best results within stem-cuttings. Based on the results obtained, it was concluded that the combination of IBA and NAA in appropriate concentration promoted rooting in Akee apple and therefore are highly valuable for the vegetative propagation of this species through stem cutting and marcotting.

Keywords: akee apple, hormone, dilutions, marcotting, stem-cuttings, rooting, propagator

Introduction

Ackee is native to tropical west Africa including Benin, Cameroun, Cote d' Ivoire, Ghana, Guinea, Liberia, Nigeria, Senegal and Togo. It was introduced into the Caribbean area by slave traders in the 18th century and has spread across the region. It is the national fruit of Jamaica, where it is commercially cultivated (Ekué, 2011). It was named *Blighia sapida* in honor of Captain William Bligh who in 1793 took plant samples to Kew gardens in South London (Lewis, 1965; Lancashire, 2005; Rajendra *et al.*, 2013).

The fleshy arils of the ripened fruits are edible, but highly toxic when the fruit is still immature; they are consumed fresh, dried and grounded into powder and added to sauces for its oil content as an alternative to sesame seeds or peanuts, fried or parboiled with seasoning; dried arils are the commonest form on local markets in Benin (Ekué, 2011). The ripened arils are also processed in brine or canned and exported to the United Kingdom (Morton, 1987; Rajendra *et al.*, 2013). The fruits are a good source of purified oil, have a high nutritive value and thus make up an important portion of the fatty acid intake of the consumers; it also contain protein, calcium, potassium and vitamins (Lancashire, 1995; Rajendra *et al.*, 2013). The seeds are poisonous and used for catching fish; the seeds and capsules contain saponins which lather in water and are used as a soap substitute and in soap-making (Ekué, 2011). In Brazil, repeated small doses of an aqueous extract of the seeds have been used to expel parasites (Morton, 1987).

All parts of the tree (bark, capsule, seeds, roots and leaves) are used as medicines in the treatment of a wide variety of ailments such as cold, fever, water retention (edema) and epilepsy. In Cuba, a mixture of ripped arils, sugar and cinnamon is used to treat dysentery; the bark is used in the preparation of an ointment for pain relief in the Ivory Coast (Ekué, 2011). The wood is termite resistant and used for making furniture; it is also used for charcoal production. The tree is also planted to beautify the environment (Morton, 1987).

The economic potential of akee plant is not fully tapped in Nigeria and other West African countries, partly because of dearth of knowledge on its propagation and reliance on trees that are growing in the wild. The akee industry which is fully developed in Jamaica generated revenue of approximately US$ 400 million in 2005 (Ekué, 2011).

Propagation of akee by seeds is common, but seedlings are not true-to-type and results in varying size and quality (Crane and Balerdi, 2008). Seeds are planted within few days of

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extraction from fruit, because they are affected by desiccation. Once planted, seeds may take 2-3 months to germinate. Seedlings should be protected from domestic livestock until they are at least 2 m tall (Ekué, 2011). Vegetative propagation methods have not been developed in Africa, but grafting, budding and rooted cuttings are recommended for plant production in Florida, USA (Ekué, 2011). As a result of the great demand of true-to-type plants, stem-cuttings and marcottting propagation can be alternative methods for producing valuable and inexpensive plants (Rajendra *et al.*, 2013).

The application of root-promoting substances such as auxins helps the stimulation of root development and increases uniformity of rooting. Therefore, new plants are propagated in shorter period of time and with low cost (Blazich, 1988; Dirr and Heuser, 2006; Hartmann *et al.,* 2011; Rajendra *et al.*, 2013). IBA is one of the most effective and widely used auxin in vegetative propagation (Dirr and Heuser, 2006; Hartmann *et al.,* 2011). Both IBA (Indole-3- butyric acid) and NAA (1-Naphthaleneacetic acid) stimulates adventitious rooting (Copes and Mandel, 2000).

The objective of the current research was to determine the effect of different dilutions of IBA and NAA combination also known as *Dip 'n' grow*, on rooting of marcotting and stem-cuttings in Akee apple.

Materials and Methods

Study site and biological material

The research was conducted at the University of Ilorin, Ilorin, Kwara State, Nigeria, between February and November. In the hereby study, IBA (Indole-3- butyric acid) was used in combination with NAA (1-Naphthaleneacetic acid) in a liquid formulation known as *Dip 'n' grow* with the following composition: 10,000 ppm IBA + 5,000 ppm NAA (1.0% Indole-3- butyric acid + 0.5% 1-Naphthaleneacetic acid). The combined formulation was diluted into 2,000 ppm IBA + 1,000 ppm NAA and 1,000 ppm IBA + 500 ppm of NAA which were used for the treatment of stem-cuttings and marcotting.

Experimental procedures

Stem-cuttings with reasonable numbers of buds were collected from mature and disease-free trees located at Challenge, Jalala and Ganmo in Ilorin, outside the University campus, using secateurs; they were kept fresh by proper moistening. At the site of propagation, the segments were made into desirable sizes with at least three buds above the slant cut made below a leaf node. Harmann *et al.* (2002) reported that retention of leaves or parts of leaves on stem is necessary for the production of auxins and rooting cofactors that are translocated to the cutting base and promote rooting; therefore some leaves were retained with the buds under experiment.

These stem-cuttings were divided into three groups: one group was transferred into the non-mist propagator filled with seasoned sawdust, without treating their bases with hormone (control group). The other two groups were treated with dilutions of hormone: one group with 2,000 ppm IBA + 1,000 ppm NAA and the other group with 1,000 ppm IBA + 500 ppm by dipping their bases in the hormone before transferring them into the non-mist propagator. Knapsack sprayer was used to deliver light wetting every other day and root-checking was carried-out on occasions. Rooted cuttings were potted into polythene bags filled with seasoned sawdust.

Marcottings were made on the trees in the raining season, during May; branches with growths from previous year were selected; slant incisions were made on the stems from previous year at about 20 cm away from their tips. The incised surfaces were brushed with the different dilutions of the hormones (2,000 ppm IBA + 1,000 ppm NAA and 1,000 ppm IBA + 500 ppm) and seasoned sawdust was pressed into incised regions. Some portions of the stems above and below the treated regions were covered with seasoned sawdust in polythene bags tied firmly on the stems. The control group was not treated with hormone; they were all tagged according to the dilution of hormones used. After three months, they were examined for rooting.

Some marcots that did not produce root initials/vigorous roots after three months, were found to have formed calluses and were made into stem-cuttings. The surfaces were gently scrapped, retreated with the same dilutions of hormone initially used during marcotting and were transferred into the non-mist propagator. Ten stem-cuttings were treated with 2,000 ppm IBA + 1,000 ppm NAA, other 10 stem-cuttings were treated with 1,000 ppm IBA + 500 ppm and 8 stem-cuttings were untreated (control). They were checked on occasionally for rooting success.

The results obtained were subjected to Friedmanns' test. Those that produced root initials/vigorous rooting were noted to calculate percentage of rooting per dilution of hormone.

Results and Discussion

Rooting of akee apple by stem-cuttings was difficult, as typical of most tree species; without hormone, no rooting was observed. The use of 1,000 ppm IBA + 500 ppm NAA on stem-cuttings did not influence rooting, but 2,000 ppm IBA + 1,000 ppm NAA influenced 10% rooting (Fig. 1)

Remarkably, rooted stem-cuttings of akee apple retained all leaves, which was in agreement with a report of Reuveni and Raviv (1981), saying that a positive correlation exists between rooting and leaf retention of cuttings.

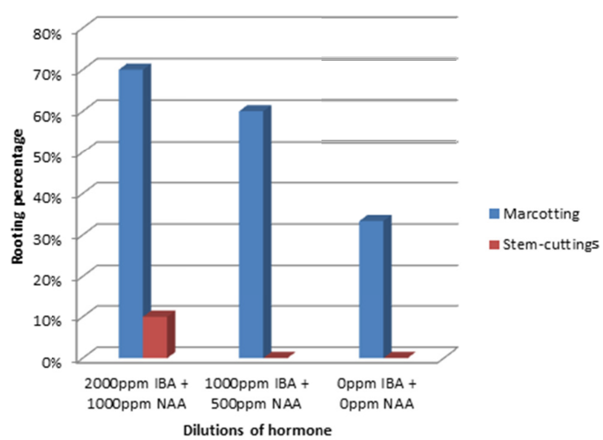

Fig. 1. Rooting percentage of different dilutions of hormone on akee apple marcotting and stem-cuttings

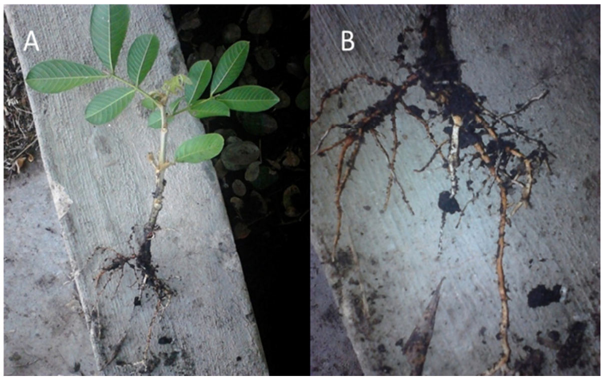

Fig. 2. Sample of akee apple rooting achieved with 2,000 ppm IBA + 1,000 ppm NAA treated cuttings after three months; A. Leafy rooted stem cutting; B. Vigorous rooting of same cutting in close up

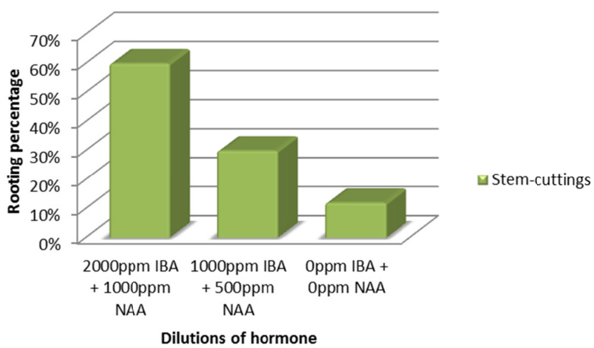

Fig. 4. Rooting percentages of different dilutions of hormone in stem-cuttings after callus formation

Fig. 2 shows samples of rooting achieved with the use of 2,000 ppm IBA + 1,000 ppm NAA. Two factors can be considered in further studies for better results: lesser time between collection of cuttings and propagation, as this increases freshness of the cuttings, and high humidity without water logging the medium since water soaked medium makes the cuttings to rot.

Rooting percentages of 33.33%, 60 and 70% were observed with control, 1,000 ppm IBA + 500 ppm NAA and 2,000 ppm IBA + 1,000 ppm NAA respectively in marcotting of akee apple (Fig. 1).

Fig. 3 (A, B, C). Samples of akee apple rooting in marcottings after three months

The length and numbers of root revealed the significant effect of hormone (Fig. 3). The highest rooting percentage, the longest roots and the highest number of roots were obtained in marcotted stems treated with 2,000 ppm IBA + 1,000 ppm NAA, while those of control marcotted stems were majorly root initials (Figs. 1 and 3). The results of this research is in agreement with the report of Rajendra *et al.* (2013) who recorded 100% success with treatments of 3,000 ppm and 3,500 ppm IBA, a higher concentration of hormone, that gave better rooting successes. After a similar work on air-layering of Litchi, Mukhopadhaya (1986) reported the lowest success in control and increasing trend in rooting with up to 2,500 ppm. Marcotting was carried out in the rainy season and this could have influenced rooting success. Maiti (1985) and Rahman *et al.* (2002) worked on *Litchi chinensis,* a member of the family (Sapindaceae) along with akee apple, and reported that rainy season is the suitable time for marcotting.

The rooting percentages of stem-cuttings treated with different dilutions of hormone after callus formation showed that 12.5% rooting can be achieved without hormone, 30% with 1,000 ppm IBA + 500 ppm NAA and 60% with 2,000 ppm IBA + 1,000 ppm NAA (Fig. 4).

The numbers of stem-cuttings that were alive at specific dates were recorded until they rooted and analyzed result presented on Table 1 revealed that significant differences existed in the response of the stem-cuttings to the dilutions of hormone used after callus formation ($P < 0.05$).

Callus formation increased rooting compared to earlier rooting results when callus was not involved. Girouard (1967) reported that callus formation is a precursor to adventitious rooting. Also, the hereby result is in conformity with a report on semi-woody avocado by Ernst and Holtzhausen (1987)

Table 1. Friedman's test for comparison among dilutions of hormone used after callus formation

Date	2,000 ppm IBA + 1,000 ppm NAA	1,000 ppm IBA + 500 ppm NAA	0 ppm IBA + 0 ppm NAA	Rank A	Rank B	Rank C	Sum A	Sum B	Sum C
14/08/2014	10	10	8	2.50	2.50	1.00	20	13	9
21/08/2014	10	10	8	2.50	2.50	1.00	F	8.857143	
08/09/2014	7	3	3	3.00	1.50	1.50	*p*	0.012	
20/09/2014	7	3	3	3.00	1.50	1.50			
24/09/2014	7	3	3	3.00	1.50	1.50			
04/10/2014	6	3	2	3.00	2.00	1.00			
12/10/2014	6	3	1	3.00	2.00	1.00			

Significant at 0.05

saying that treatment of cuttings with an auxin is more likely to succeed if done after callus formation and differentiation have occurred. Other factors that might have also contributed are wounding and increased leaf area. Robert (1957) reported that wounding stems of Rhododendron cuttings increased the percent of rooting; scratching done on the bark of the stem-cuttings of akee apple could inflict wounds and thus contributed to an increase in rooting. Lima *et al*. (2003) reported that an increase in leaf area positively influenced the percentage of rooting and the survival of Guaco (*Mikania* spp.). After callus formation, leaf reduction was not carried out on stem-cuttings and this could have also influenced the increase in rooting.

Marcotting has the advantage of higher percentage of rooting and eliminating the stress of frequent wetting as required in stem-cuttings. There are, however, three factors that might make the use of cutting more favourable than marcotting. They are:

1. More materials are available for cuttings since a branch used for one marcot can be used for more than one cutting. Also branches that are difficult to access are easily cut-off to be used for cuttings.
2. It is easier to perform root-check in cuttings, while marcotting is difficult to monitor for roots unless transparent plastic are used. Therefore rooting is noticed earlier in cuttings.
3. Rooted cuttings are easier to handle and they adapt easily when potted. Rooted marcots are difficult to handle, whereas the root system is not sufficiently developed to sustain the top portion of the new plant when potted.

Conclusions

Based on the results obtained from the current study conclusion can be made that marcotting and stem-cuttings are effective vegetative methods of propagating true-to-type *Blighia sapida*. It is therefore recommended that IBA and NAA should be seen as valuable hormones for vegetative propagation of the plants through these methods and at least 2,000 ppm IBA + 1,000 ppm NAA should be used because of the increase in rooting percentage, longer roots and higher numbers of roots that it guarantees. It is also recommended that little or no leaf reduction to be undertaken on stem-cuttings of the plant.

References

Blazich FA (1988). Chemical and formulations used to promote adventitious rooting. In: Davis TD, Haissig BE, Sankhla N (Eds). Adventitious root formation in cuttings. Dioscorides Press, Portland, OR pp 132-149.

Crane JH, Balerdi CF (2008). Ackee growing in the Florida home landscape. University of Florida.

Copes DL, Mandel NL (2000). Effects of IBA and NAA treatments on rooting Douglas-fir stem cuttings. New Forests 20:249-257.

Dirr AM, Heuser CW Jr (2006). The reference manual of woody plant propagation: From seed to tissue culture. Varsity Press, Inc., NC.

Ekué MRM (2011). *Blighia sapida*, ackee conservation and sustainable use of genetic resources of priority food trees species in sub-Saharan Africa. Biodiversity International.

Ernst AA, Holtzhausen (1987). Callus development- a possible aid in rooting avocado cuttings. Proceedings of the first world Avocado congress. South African Avocado Growers' Association Yearbook 10:39-41.

Girouard RM (1967). Initiation and development of adventitious roots in stem cuttings of *Hedera helix*. Anatomical studies of mature growth phase. Canadian Journal of Botany 45:1883-1886.

Hartmann HT, Kester DE, Davis-Júnior FT, Geneve RL (2002). Plant propagation: principles and practices, 7th ed. Englewood Clipps, New York, NY, USA,

Hartmann HT, Kester DE, Davies FT, Geneve RL (2011). Hartmann and Kester's plant propagation: principles and practices, 8th ed. Prentice Hall, NJ.

Lancashire R (1995). *Jamaican ackee*. The Department of Chemistry, University of the West Indies, Mona Campus, Jamaica. Retrieved 2016 May 27 from http://www.chem.uwimona.edu.jm/lectures/ackee.html.

Lancashire RJ (2005). The Jamaican national fruit. Retrieved 2016 May 15 from *http://www.chem.uwimona.edu.jm*.

Lewis CB (1965). Carbon abundance in chondritic meteorites. Science 149(3681):317-317.

Lima NP, Biasi LA, Zanette F, Nakashima T (2003). Produção de mudasporestaquia de duasespécies de guaco. Horticultura Brasileira 21(1):106-109.

Maiti SC (1985). Fruits of India: tropical and subtropical. In: Bose TK (Ed). Naya Prokash Publishers, Calcutta, India pp 388-408.

Morton J (1987). Akee. In: Fruits of warm climates. Miami, Florida pp 269-271.

Mukhopadhaya TP (1986). Litchi. In: Propagation of tropical and subtropical horticultural crops. Bose TK, Mitra SK, Sadhu MK (Eds). Naya Prakash, Calcutta, India pp 285-295.

Rahman MN, Amin MN, Islam MS, Begum MM, Uddin MA (2002). Rooting and survival of air-layering in Litchi as influenced by layering time and plant growth regulators. Pakistan Journal of Biological Sciences 5:1259-60.

Rajendra PM, Dion ML, Jeff St AC (2013). Studies on propagation of Jamaican Ackee (*Blighia sapida* L.) by Air-layering. HortScience 48(10):1288-1300.

Reuveni O, Raviv M (1981). Importance of leaf retention in rooting of Avocado cuttings. Journal of American Society and Horticulture Sciences 106(2):127-130.

Robert LT (1957). Effects of several methods of wounding on the rooting of cuttings of Rhododendron. Journal American of the Rhododendron Society 11(2).