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EFFECTS OF NATURAL GROWTH HORMONES ON THE VEGETATIVE PROPAGATION OF *Treculia africana* A. Trecul.

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Abstract
Phytohormones have been found to be a reliable growth enhancer. This study therefore investigated the potentials of natural plant hormones on the rooting and survival ability of the species. The cuttings of T. africana were set in sixteen germination trays containing sterilized river with 3 replicates. The experiment had fifteen treatments and one control and was laid out in a Completely Randomized Design (CRD). Data were collected weekly for number of leaves per cuttings; shoot height (cm), root length, number of roots, shoot collar diameter and survival percentage (%). Data were analyzed using Analysis of Variance (ANOVA) and Least Significant Difference was used to separate the means. The result show significant differences in number of leaves and root length (P<0.05). However, there were no significant differences (P>0.05) in survival percentage, number of root and collar diameter. The highest Mean shoot height (11.03±2.03 cm), number of roots (5.0±0.65), Survival percentage (79.7±5.6 %) and Root length (0.98±0.07) were recorded for T_{10} (75% of Moringa leaf extract + 50% of orange juice) while control treatment (T_{10}) had the least values in all the growth variables. It is therefore established from the study that Moringa leaf extract and Orange juice had significant influence on the growth variables of T. africana stem cuttings

Key Words: *Growth regulators, Moringa leaf extracts, Vegetative propagation, Treculia africana, Concentration*

Introduction

The tropic is endowed with great diversity of fruit tree species that have provided humans with basic food and nourishment for ages. *Treculia Africana* (A. Trecul) commonly known as African bread fruit is one of these beneficial tree species. It is a native to West and tropical Africa; belonging to the family Moraceae and one of the four members of the genera *Treculia*. It grows commonly in evergreen and deciduous forests, often by streams but may sometimes be planted in plantation as it is in Nigeria where it is very common in the Western and Eastern states (Nuga and Ofodile, 2010).

According to Fasasi (2007) *T. africana* is a large tree which grows in wet and

forest areas of tropical Africa; it is generally cultivated in the tropics and its tree could grow up to 40-50 ft high. The seeds from the fruit are edible and are of high nutritional values. It has been estimated that the fruit may contain as much as 1,500 seeds, (Ajayi, 2008) whose length is about 8.5mm (Nwokocha and Williams, 2011). The seeds are used in the preparation of delicacies in most communities in Nigeria. It is highly valued and enjoyed mostly by the Igbos and Yorubas of the south eastern and southwestern Nigeria, where it is referred to as "*ukwa"* and "*afon"* in local parlance respectively (Fasasi, 2007).

African breadfruit is a traditionally important edible fruit tree whose importance is due to the potential use of its seeds, leaves, timber, roots and bark. It is increasingly becoming commercially important in Southern Nigeria hence, Baiyeri and Mbah (2006) described it as an important natural resource which contributes significantly to the livelihood of the poor. Despite the dietary and economic importance of African breadfruit, it has remained an under-utilized species till now and its potentials remain under-exploited. Coupled with this problem is the serious threat of erosion of its genetic resources as well as its extinction. *Treculia africana* is currently included in the list of endangered species of Southern Nigeria (Meregini, 2005) and this is quite worrisome. As a matter of fact, the species is urgently in need of conservation measures. Ijeoma (2006) noted that African breadfruit products are indispensable to rural people for regular or supplementary food supply and as sources of cash income. However, scientific investigations into improved use and conservation of this fruit tree have been inadequate. Therefore addressing the challenges and promotion of widespread planting and consumption of African breadfruit is expedient (Muojekwu *et al*., 2017).

Regeneration of the species in the natural forests has been poor, probably due to its moderate light demanding nature, deforestation and forest degradation activities, yearly and consistent collection of the fruit for consumption and sale, and unfavourable climatic conditions in the forest for seed germination (Onyekwelu and Fayose, 2007). According to WAC (2005) Regeneration of *T. africana* under natural forest conditions takes place via seeding, where fallen seeds are usually eaten by small animals, which assist in dispersing them.

In seeing to a more positive result in the raising of *T. africana*, the use of plant hormones was adopted, this study therefore investigated the potentials of natural plant hormones (phytohormones) on the rooting and survival ability of the fruit tree. Plant hormones regulate the development of different parts of the plant and they include gibberilins, cytokinins, auxins, ethylene, zeatin and indole acetic acid (Muojekwu *et al*., 2017). According to their specific functions, they can inhibit or promote development in fruit trees, and they can naturally be extracted from available sources like, *Moringa oleifera*, orange juice, aspirin, yeast, pawpaw juice and coconut water (Williams, 2011). The need for the promotion and growth enhancement of indigenous fruit tree species as an alternative to snacks and also as a means of supplementing food nutrients brings up the rise for concentrating on raising indigenous fruit tree species with a better technological, practical and economical knowledge imbibing the use of natural hormones.

Hence, the need for this to assess the efficiency of natural growth hormones on the growth and development of the vegetative propagation of *Treculia africana.*

Materials and Methods

Study Location

The study was carried out in the nursery of the Department of Forestry and Wildlife Management, Adekunle Ajasin University Akungba-Akoko, Ondo State, Nigeria. The area lies between latitude 7 º28' 85" N - 7 º28' 86" N and longitude 05º 44' 46" E - 05º44' 48" E. The climate is predominately rainforest characterized by two seasons: the wet season (between April-October) and the dry season (between October-March) with a mean annual rainfall of 1250 mm and the mean annual temperature ranging from 18 - 33ºC (Olabode, 2014)

Experimental Procedure

A total number of 40 uniform size juvenile seedlings of *T. africana* were procured from the Ondo State Forestry office, Akure, while fifty pieces of oranges were procured from the Olu-Ikare Market, Ikare Akoko,Ondo State. Fresh leaves of *Moringa oleifera* J. lamarck were harvested from a standing tree in the campus of Adekunle Ajasin University, Akungba Akoko.

After collection of the seedlings they were kept moist, to prevent dehydration, the natural hormones were obtained from the two sources, (Moringa leaf and orange juice). Orange juice were extracted after been cut using a well sterilized knife, the Orange juice was manually extracted, and further sieved using a medium sized sieve thrice to have the juice free of its seeds and measured out using a calibrated measuring cylinder (50ml). The Moringa leaves were blended using an electric blender, Kenwood Blender 1.5L-BL440a with 20cl of water, the blended *moringa* was sieved and kept in a freezer to avoid microbial infection. The two were again sieved and filtered with 40mls of distilled water to obtain various concentrations (0%, 50%, 75%, and 100%). The concentrations were gotten using a 40mls measure of the natural hormone to be 100%, to obtain 50%, 40mls of the natural hormone was mixed with 20mls of distilled water, then to obtain 75% concentration, 40mls of natural hormone was also mixed with 10mls of distilled water. The stem cuttings where dipped into the prepared hormone, using the quick dip method (Akinyele, 2010), while the hormones was also set using distilled water.

The stem cuttings were set in sixteen germination trays with 3 replicates, each treatment combination having ten cuttings, the medium used was sterilized river sand, the cuttings where kept in a mist propagator . Watering was done once weekly to avoid dehydration. The experiment was laid out in a Completely Randomized Design (CRD). The experiment had fifteen treatments and one control, each having ten cutting with three replicates.

MO = 0% of moringa leaf extract, M1 = 50% of moringa leaf extract, M2 =75% of moringa leaf extract, M3 = 100% of Moringa leaf extract, G0 = 0% of orange juice, G1= 50% of orange juice, G2 = 75% of orange juice, G3 = 100% of Orange juice

Thus, treatment combination is as follows:

M0G0 = Control (T_1), MOG1 = 50% of orange juice (T_2), M0G2 = 75% of orange juice (T_3), M0G2 = 75% of orange juice (T_4), M0G3 = 100% of orange juice (T_5), M1G0 = 50% of Moringa leaf extract (T_5), M1G1 = 50% of Moringa leaf extract +

50% of orange juice (T_6), M1G2 = 50% of moringa leaf extract + 75% of orange juice (T_7), M1G3 = 50% of Moringa leaf extract+ 100% of orange juice (T_8), M2G0 = 75% of Moringa leaf extract (T_9), M2G1 = 75% of Moringa leaf extract + 50% of orange juice (T_{10}), M2G2 = 75% Moringa leaf extract + 75% of orange juice (T_{11}), M2G3 = 75% of Moringa leaf extract + 100% of orange juice (T_{12}), M3G0 = 100% of Moringa leaf extract (T_{13}), M3G1 = 100% of Moringa leaf extract + 50% orange juice (T_{14}), M3G2 = 100% of Moringa leaf extract + 75% of orange juice (T_{15}) and M3G3 = 100% of Moringa leaf extract + 75% of orange juice (T_{15}),

After 6 weeks, data were collected weekly for number of leaves per cuttings, shoot height (cm), root length, number of roots, shoot collar diameter and survival percentage (%). Data were analyzed using Analysis of Variance (ANOVA) and Least Significant Difference was used to separate the means.

Result and Discussion

The results obtained from the Analysis of variance (ANOVA) on the effects of natural growth hormone on the growth variables of *T. africana* stem cuttings are presented in table1. There were significant difference in number of leaves and root length ($P<0.05$). On the other hand, there were no significant differences ($P<0.05$) in survival percentage, number of root and collar diameter. According to (Mona 2013) , plants growth regulators such as auxins stimulate the initiation of roots and the growth of lateral roots and causes root cells to grow longer in fruit trees. They also help the formation of xylem and phloem (Akinyele, 2010). The significant difference among the treatments on leaf production and root length depict that plant growth hormones have important role on the plant metabolism. Muojekwu *et al*. (2017) reported that rooting compounds, being liquid or powders, when applied properly aid in rooting of moderate to difficult-to-root species, accelerate root initiation, improve rooting uniformity, increase the number of roots produced and ultimately reduce shrink and rooting time. Of course, when rooting hormones and other cultural practices are combined with optimal environmental conditions, results are high-quality and well rooted liners. In contrast to this, the insignificant differences among the treatments on other growth variables assessed could be attributed to genetic make up of *T. africana* inbuilt with natural growth regulator (Shiva *et al*., 2014).

Table 1: Analysis of Variance (ANOVA) for the Effect of Different Concentrations of Natural Growth Hormones on Collar diameter, Number of leaves Shoot height, Root length, Survival percentage and Root length of *Treculia africana* cuttings

Parameters	SV	Df	SS	MS	F-cal	P-Value
Collar Diameter	Treatments	15	0.003	0.001	0.655	0.738^{ns}
	Errors	32	0.006	0.000		
	Total	47	0.009			
Number of leaves	Treatments	15	8.967	0.996	1.758	0.003*
	Errors	32	3.516	3.516		
	Total	47	12.483			
Shoot height	Treatments	15	12.203	2.878	1.045	0.399 ^{ns}
	Errors	32	11.175	2.612		
	Total	47	23.378			
Root length	Treatments	15	4.283	0.365	3.507	0.002*
	Errors	32	3.223	0.410		
	Total	47	7.506			
Percentage survival	Treatments	15	2333.333	259.259	1.468	0.227^{ns}
	Errors	32	3533.333	176.667		
	Total	47	5866.667			
Number of roots	Treatments	15	26.133	2.904	1.340	0.278^{ns}
	Errors	32	23.996	2.137		
	Total	47	50.129			

***=** significant at P<0.05, ns = not significant at P>0.05

Table 2 shows effects of different concentrations of natural growth hormones on mean values of Collar diameter, Number of leaves Shoot height, Root length, Survival percentage and Root length of *Treculia africana* cuttings. The T_7 (50% of Moringa leaf extract + 75% of orange juice), the highest collar diameter with a mean value of 0.71±0.54 cm, followed by T_{15} (0.32± 0.14 cm) and T_{13} (0.28±0.02 cm).The least men value of 0.10±0.00 cm was recorded for T_0. The higher mean values of growth variables obtained from other treatments compared to control treatment could be ascribed to influence of growth hormones in Moringa extract and Orange juice on the stem cuttings of the species. This finding corroborates assertion of Malami *et al*. (2017) who found that fresh *Moringa oleifera leaf* extracts leaves have been shown to have high zeatin content which enhances growth of *Vigna Unguiculata*. Zeatin is one form of the most common naturally occurring cytokinin in plants. It is derived from adenine, which occurs in the form of a cis- and a trans-isomer and conjugates. It promotes growth of lateral buds and when sprayed on meristems stimulate cell division to produce vigorous seedlings (Mallami *et al*., 2017).

The highest mean leaf number was recorded for T_5 (3.67±0.33), followed by T_{11} (3.64±0.30) while T_0 had the least value of 1.00±0.31 (Table 2). This corroborates Mallami *et al*. (2017) who

reported that Moringa leaf extract proved efficient in number of leaves production. Also, `Ali *et al*. (2014) reported natural plant extracts such as fruit juices and extracts from immature maize embryo could enhance the usefulness of plants as renewable resources of valuable chemicals and can be optimized to play an increasingly significant role on improvement of plant growth.

Mean shoot height was highest in T_{10} (11.03±2.03 cm) followed by T_3 (10.90±2.06 cm) while control treatment (T_0) had the least mean value of 7.00±0.65 (Table 2). According to Ubalua *et al*. (2015) orange juice as it is obtainable in many other plant extracts play major role on growth enhancement of plants. Highest mean number of root was produced by T_{10} (5.0±0.65). This was followed by T_8 (4.20±0.65) and T_7 (3.90±0.65) while T_0 had the least (1.78±0.65) (Table 2).

The process of root initiation, elongation of root initials, and root growth and development is influenced by different plant hormones in plant growth (Hartmann *et al*., 2007). Various hormones regulate and/or influence the rooting process in different ways. They induce the initial meristematic activity and stimulate the elongation and development of roots formed, promote growth of the new roots and protect cuttings from pathogens during the entire rooting period (Davis and Haissig 1990; Wiesman and Lavee 1995). These findings depict that *Moringa oleifera* extract and orange juice components have effective growth regulating potentials.

Survival percentage was highest in T_{10} (79.7±5.6 %) followed by T_{12} (66±7.1%) and T_8 (65±3.3 %) while T_0 had the least value of 44.0±3.5 %(Table 2). The least survival percentage that was below average in the treatment that had no application of Moringa leaf extract and Orange juice could be attributed to the fact that extracts from combination these plant species act as growth enhancer. This is in line with Yasmeen (2011) who found that Moringa leaf extract was a potential natural growth enhancer.

Table 2 shows that Root length was highest in T_{10} (0.98±0.07) followed byT_{13} (0.90±0.02) and T_{14} (0.85±0.04) while T_0 had the least mean value of 0.3±0.01. These findings conform to report of Ubalua *et al*. (2015) who asserted that the use of natural fruit juices as growth hormones, carbon and vitamin sources for in vitro and in vivo regeneration and propagation of plantlets and seedlings have been so effective.

Table 2: Effect of different concentrations of natural Growth Hormones on mean values of Collar diameter, Number of leaves Shoot height, Root length, Survival percentage and Root length of *Treculia africana* cuttings

Treatments	Collar diameter (cm)	Number of leaves	Shoot height (cm)	Number of roots	Survival percentage (%)	Root length (cm)
T_0	0.10±0.03 ^{e}	1.00±0.31 ^{a}	7.00±0.65 ^{c}	1.78±0.65 ^{bc}	44.0±3.5 ^{d}	0.3±0.01 ^{e}
T_1	0.16±0.01 ^{bc}	2.00±0.58 ^{b}	7.15±4.08 ^{b}	3.10±0.65 ^{c}	60.8±4.0 ^{c}	0.4±0.01 ^{e}
T_2	0.22±0.04 ^{cd}	2.67±0.33 ^{ab}	7.90±5.17 ^{b}	2.00±0.65 ^{e}	59±7.0 ^{bc}	1.2±0.11 ^{f}
T_3	0.17±0.02 ^{c}	3.00±0.58 ^{c}	10.90±2.06 ^{d}	3.20±0.65 ^{c}	56±3.6 ^{bc}	1.4±0.00 ^{f}
T_4	0.14±0.00 ^{b}	2.67±0.33 ^{ab}	8.33±6.97 ^{c}	2.89±0.65 ^{c}	51±5.1 ^{d}	0.4±0.03 ^{e}
T_5	0.14±0.00 ^{b}	3.67±0.33 ^{bc}	8.10±5.73 ^{c}	3.32±0.65 ^{ab}	51.8±7.3 ^{d}	0.5±0.07 ^{de}
T_6	0.22±0.04 ^{d}	1.67±0.33 ^{a}	8.73±1.78 ^{c}	2.91±0.65 ^{bc}	64±4.0 ^{b}	0.55±0.01 ^{d}
T_7	0.71±0.54 ^{f}	2.00±0.58 ^{b}	7.40±0.67 ^{b}	3.90±0.65 ^{ab}	62±2.8 ^{b}	0.54±0.01 ^{d}
T_8	0.25±0.04 ^{d}	2.67±0.33 ^{ab}	8.13±0.59 ^{c}	4.20±0.65 ^{ab}	65±3.3 ^{b}	0.78±0.00 ^{bc}
T_9	0.17±0.02 ^{c}	2.33±0.33 ^{b}	8.60±0.35 ^{c}	1.80±0.65 ^{f}	55±4.9 ^{e}	0.4±0.02 ^{e}
T_{10}	0.15±0.00 ^{bc}	3.00±0.58 ^{c}	11.03±2.03 ^{e}	5.0±0.65 ^{a}	79.7±5.6 ^{a}	0.98±0.07 ^{a}
T_{11}	0.16±0.01 ^{bc}	3.64±0.30 ^{bc}	8.33±0.58 ^{c}	2.65±0.65 ^{d}	63±2.9 ^{b}	0.62±0.13 ^{c}
T_{12}	0.27±0.07 ^{f}	3.00±0.58 ^{c}	8.57±0.41 ^{c}	2.42±0.65 ^{cd}	66±7.1 ^{b}	1.23±0.01 ^{a}
T_{13}	0.28±0.02^{f}	2.33±0.33 ^{b}	8.17±0.33 ^{c}	3.10±0.65 ^{c}	64±4.3 ^{ab}	0.90±0.02 ^{b}
T_{14}	0.19±0.02 ^{c}	1.33±0.33 ^{a}	8.43±0.47 ^{c}	3.50±0.65 ^{b}	58±2.6 ^{c}	0.85±0.04 ^{b}
T_{15}	0.32±0.14 ^{f}	2.67±0.33 ^{ab}	7.57±0.12 ^{b}	3.80±0.65 ^{ab}	61±4.4 ^{bc}	0.70±0.00 ^{d}

Mean ± SD of the same superscript down the column differ significantly (P≤0.05)

Conclusion

In vegetative propagation of fruit tree species, root and shoot production are crucial indices to judging the efficiency of the applied natural growth hormones. The prolonged gestation period in indigenous fruit tree species has been a major setback to investments and the mass production of it. This constraint has led to scientists coming up with growth regulators supplements for root initiation and shoot development in various indigenous and exotic fruit tree species. Vegetative propagation has been an efficient means of preserving selected traits in fruit tree species. Moringa leaf extract and Orange juice that were used as natural growth regulators proved to be effective as economic and environmental friendly growth hormones when compared to control treatments. The combined effects of Moringa leaf extract at 75% and Orange juice at 50% with significant influence on the growth variables of *T. africana* is an indication that appropriate concentration of growth hormone is very essential.

Therefore, Moringa leaf extract at 75% + Orange juice at 50% could be used to enhance the growth of *T. africana* stem cuttings and extensive and further studies should be given to the utilization of natural hormone supplements in the nursery to have a firm assurance as to if it would be favorable for field experiments.

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