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Effects of plant extracts and auxins on sprouting and rooting of stem cuttings of *Spondiathus preussii* Engl Var

Efectos de extractos vegetales y auxinas sobre la brotación y enraizamiento de esquejes de tallo de Spondiathus preussii Engl Var

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ABSTRACT

The study assesses the influence of growth regulators on stem cuttings of *Spondiathus preussii*. Synthetic auxin and plant extracts at 150mgL-1, 250mgL-1, and 500mgL-1and 30%, 50%, and 70% were evaluated with a view to promoting its conservation. Cuttings of three physiological ages (apical, middle and basal) were set in two growth media (Sharp river sand and well decomposed sawdust). Cuttings were assigned to Indole Butyric Acid, Naphthalene Acetic Acid, Coconut milk extracts, Pawpaw seeds extract and *Bryophyllum pinnatum* Leaf Extract. Percentage sprouting, shoots numbers and leaf number were monitored for 8 weeks. Rooting parameters of cuttings and callus formation were also recorded. Data were analyzed using ANOVA at (α 0.05). Pawpaw seed extracts (PSE) 70% gave the highest sprout (11.26), followed by Naphthalene Acetic Acid (NAA) 500mgL-1 having the least (0.00). Pawpaw seed extracts (PSE) 70% had highest shoot and leaf numbers (15.7) and (62.71) respectively. Indole Butyric Acid (IBA) 250mgL-1 had the highest rooted stem cuttings and number of (0.22 and (0.33) respectively. Similarly, PSE 30% had the highest callus formations (1.89). The results of this study shows that stem cuttings and plant extracts has significant ($p<0.05$) implication and is a potential, viable and economical method of improving sprouting of *S. preussii*.

Keywords: Growth Regulators, growth media, Stem cuttings, *Spondianthus preussii*

RESUMEN

El estudio evalúa la influencia de los reguladores del crecimiento en esquejes de tallo de *Spondiathus preussii*. Se evaluaron auxinas sintéticas y extractos de plantas a 150 mgL-1, 250 mgL-1 y 500 mgL-1 y 30%, 50% y 70% con miras a promover su conservación. Se colocaron esquejes de tres edades fisiológicas (apical, media y basal) en dos medios de crecimiento (arena afilada de río y aserrín bien descompuesto). Los esquejes se asignaron a ácido indolbutírico, ácido naftaleno acético, extractos de leche de coco, extracto de semillas de papaya y extracto de hoja de Bryophyllum pinnatum. Se monitoreó el porcentaje de brotación, el número de brotes y el número de hojas durante 8 semanas. También se registraron los parámetros de enraizamiento de esquejes y formación de callos. Los datos se analizaron utilizando ANOVA a (α 0,05). Los extractos de semillas de papaya (PSE) al 70 % dieron el mayor brote (11,26), seguido del ácido naftaleno acético (NAA) 500 mg L-1 que tuvo el menor (0,00). Los extractos de semillas de papaya (PSE) del 70% tuvieron el mayor número de brotes y hojas (15,7) y (62,71) respectivamente. El ácido indolbutírico (IBA) 250 mgL-1 tuvo los esquejes de tallo enraizados más altos y el número de (0,22 y (0,33) respectivamente. De manera similar, PSE 30 % tuvo las formaciones de callos más altas (1,89). Los resultados de este estudio muestran que los esquejes de tallo y Los extractos de plantas tienen implicaciones significativas (p<0,05) y son un método potencial, viable y económico para mejorar la brotación de *S. preussii*.

Palabras clave: Reguladores de crecimiento, medios de crecimiento, Esquejes de tallo, *Spondianthus preussii*

INTRODUCTION

Spondianthus preussii commonly known as rat poison tree belongs to the family Euphorbiaceae. It is a large swamp loving tree which attained a height of about 30m with the bole often branching low down, with smooth or slightly scaly bark. The species extends from Liberia to Gabon in Africa (Keay, 1989). The leaves and bark of the tree are poisonous and can serve as biorodenticides. It is a valuable timber species which can be utilize as raw material for the ever increasing forest industry. Cunningham (1993) report that forest resources can be utilized as raw materials such as poles and fuel wood for domestic consumptions, regulation of water and climate, protection from desertification and satisfaction of recreational needs. Forest Trees improves sites by draining waterlogged soils, shading out weeds, enriching impoverished soils and control soil erosion, also use as carvings, fencing posts, charcoal productions, fuel wood, building material and tool handles (Eckman and Deborah, 1993). It also provides habitat for wildlife (Pandey, 2002). Mitigates the effects of climate change and maintain ecosystem functioning and balance (Forest and White, 2002). The stem bark of *S. preussii* was reported to be toxic to brine shrimps and caused chromosomal damage in rat lymphocytes Sowemimo *et al.,* (2007). Its seeds are used as fish poison and toxic to other organisms (Neuwinger, 2000). The lumber is popular for heavy construction work, harbour works and railway sleepers. It is a preferred wood for furniture, carving, paddle, stools and agricultural implements (Laird, 1999). Efforts aimed at planting this tree species have been unsuccessful due to the low germination rate under natural conditions (IITO, 2003). Despite all the benefits derived from this tree species, little efforts are being placed upon its domestication, which had been thwarted and resulted to poor seedlings production.

This has occurred as a result of many reasons, ranging from lack of knowledge in their reproductive biology and inadequate silvicultural techniques (Akinyele, 2010). The large scale propagation of *S. preussii* from seed is not ideal as a result of the terrain where these trees are found. Consequently, this however calls for a substitutionary means of propagation using stem cuttings otherwise referred to as macro propagation. Vegetative propagation or macro propagation is an effective alternative means of raising plants seedlings for species with irregular seed supply. In the tropical and swamp forest zones, seed supply and variability among trees are major problems in tree planting programmes. Other problems associated with macro propagations has been a rising conflict regarding the type of auxin most suitable for the growth and root development of most stem cuttings *as* it played a positive role on the growth and development of vegetative parts of plants. Thus Macro propagation can be one of the ways of overcoming the problems of sprouting and rooting of stem cuttings. Vegetative propagation techniques are the most effective method of producing planting stocks for rehabilitation and enrichment planting of forest (Ismail *et al.,* 2002).

Studies on the factors that affect sprouting and rooting of *S. preussii* are therefore required. A study involving the use of auxins and plant extracts of the species will help to encourage increased cultivation and domestication of the species and its integration into exist plantations system. auxins have been found to influence the rooting performance of stem cuttings seedling. It is therefore, necessary to find a suitable auxin and plant extracts that will improve rooting and sprouting of *S. preussii* in the nursery before they are introduced into the plantation to guarantee good seedlings for plantation establishment. Information from this study will provide the basic knowledge about the rooting and sprouting of the species that can be used for afforestation and reforestation projects. Knowing the auxin and plant extracts requirements of *S. preussii* is important in producing quality seedlings that are capable of surviving insensitive field conditions

S. preussii being a slow growing and low fruiting species (Achigan-Dako *et al.* 2015), requires alternative forms of propagation which could facilitate the speedy production of planting materials when establishing large scale plantation for afforestation programme and genetic conservation of the species. Hence, this study investigated the influence of plant growth regulators on *S. preussii* stem cuttings for genetic conservation and mass production of the species. Specifically, the study therefore investigates the effects of cutting position and different concentrations of plant growth regulators on sprouting and rooting of *Spondianthus preussii*

MATERIALS AND METHODS

Study Site: The study was conducted at the Forest Nursery of the Department of Forest Resources Management University of Ibadan Nigeria. Geographically, the site is located at latitude 070 26’ 984”N and longitude 0030 53’ 818”E. The altitude is 209m above sea level. The mean annual rainfall ranges from 1,117.1mm –

1,693. The annual temperature ranges from an average minimum of 24.6⁰C to average maximum of 31.5ºC. The relative humidity reaches a minimum of 52% in February and a maximum of 83% in August (Akinyele, 2010).

Collection of Propagules: Cuttings of *S. preussii* were collected from selected plus trees from the Etelebu natural swamp forest of Akenfa Epie in Yenagoa local government of Bayelsa State, Nigeria. The collected cuttings were carefully preserved in a box with moist foliage arranged in layers and transported for about eight hours to the study site.

Preparation of plant extracts: Mature fruits and leaves were collected from fruit trees and herbs of *Carica papaya*, *Cocos nucifera* and leaves of *Bryophyllum pinnatum*. Seeds were extracted from *C. papaya* (pawpaw) fruit and washed thoroughly in clean water; the seeds were sun dried for 120hours. The sun dried seeds were crushed to powder form using a sterilized electric blender to obtained 100g/v of seeds powder.. Leaves and fruits of *B. pinnatum* (Miracle leaf) and *Cocos nucifera* (coconut) were washed separately in clean water. Dry weight equivalent of each was crushed fresh using a sterilized electric blender to obtained 100g/v of extracts. The ground parts were measured out in a digital weighing balance into a separate container that was duly labeled. Two Hundred milliliters (200ml) of ethanol of ninety eight percentages (98%) was transferred into each container containing the crushed parts. This was allowed to stand for 72hours. The extracts were separated again by filtration using 2mm mesh cheesecloth into a newly labeled beaker to obtained 100g/wt/v of the extracts. Sterilization of extracts were done by applying 125mg of streptopenicillin (a mixture of 62.5 mg of streptomycin & 62.5 mg of penicillin) as suggested by Gupta and Banerjee (1970). Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) were purchased in powering forms; this was prepared by weighing out 15mg, 25mg and 50mg of each auxin powdered. Fifty (50ml) of ethanol plus Fifty (50ml) of sodium hydroxide (NaOH) were measured out and poured into each powdered weight in a conical flask. Each mixture was shaken properly to allow for dissolution of the powdered auxin.

Experimental Design and Procedure: Stem cuttings of three physiological ages (apical, middle and basal) of *S. preussii,* were assigned to the five (5) treatments such as Indole Butyric Acid, Naphthalene Acetic Acid, Coconut milk extracts, Pawpaw seeds extracts and *Bryophyllum pinnatum* Leaf Extract. The base of the cuttings were dipped into the extracts using the quick dip method (Oni 1987, Akinyele, 2010, Alfred and Akinyele 2013), and allowed to evaporated in air before setting in a well decomposed sawdust and sharp river sand in the propagator. Cuttings were assessed weekly for eight weeks (8wks). The concentrations for each treatment were 150mg/l, 250mg/l, and 500mg/l and 30%, 50%, and 70% respectively for both auxin and plant extracts treatments. Two hundred and sixteen (216) cuttings of *S. preussii* were used per treatment, this was replicated thrice (3), in completely Randomized Design (CRD). A total of one thousand and eighty (1080) cuttings were used. The experiment was arranged in a 2x3x5 factorial design in completely randomized design. 105 The factors are; Growth media, cutting position and hormones with each having 2, 3 and 5 levels respectively.

Data Collection and Data Analysis: The initial heights of cuttings in the polypots were recorded to determine subsequent girth and growth increment. In addition, weekly numbers of leaves produced by the species were recorded. The seedling increment such as shoot height were measured using meter rule, collar diameter increment was determine using digital venier caliper and shoot number as well as number of leaf produced weekly were counted. Data were statistically analyzed using Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) at 5% level of significance and least significant difference (LSD) at 5% probability level was used to separate significant mean. Treated cuttings of *Spondiathus preussii* were all allowed to grow for eight weeks (8wks), Table 2 the following variable were assessed during these period, they includes spouted cuttings, shoot numbers, leave number per cutting. The following were assessed at the end of the eight weeks: rooted cuttings, root number, root length and callus formation.

RESULTS

Analysis of variance results for plant growth regulators on stem cuttings of *Spondiathus Preussii* on root growth characters are presented in Table 1. Sprouted cuttings shoot numbers, leaf numbers, rooted cuttings, number of root, root length and numbers of callus cuttings varied significantly for growth media, cutting positions, and growth regulator

Sprouted Cuttings: There were significant different (α =0.05) on growth regulators for percentage sprouting and the interaction between growth medium, cutting positions, and cutting positions and growth regulators (Table 1). Cuttings treated with pawpaw seed extract (PSE70%) had the highest mean percentage sprout 11.26%, NAA 500mg L-1 had the least sprouted mean percentage value 0.02%.

Shoot Number: There were significant differences in effects of growth regulators, cutting positions and the interaction between cutting positions and growth regulators on shoot numbers produced (Table1). Basal cutting position was observed to have the highest shoot number Table 2. Basal Cuttings treated with PSE 70% had the highest mean shoot number of 15.7%, the least mean values was observed for Apical and middle stem cuttings treated with NAA 500mg L-1 0.00.

Leaf Numbers: The effect of growth regulators was significant (α = 0.05) on cutting positions, the different growth regulators and their interactions. The interaction effect of cutting position and growth regulators Table 1. Basal cuttings treated with PSE 70% were recorded as highest percentage mean leaf number of 62.71%. While the least leaf number recorded for 0.00 was observed with apical and middle cutting position treated with NAA 500mg L-1. The result do not differed significantly (α = 0.05) from each other.

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Table 1: Analysis of variance table for Sprouted cuttings, Shoot numbers, Leaf numbers, Rooted cuttings, Number of root, Root length and Number of callus cuttings

Growth regulators and plant extracts	Sprouted cuttings	Shoot numbers	Leaf numbers	Rooted cuttings	Number of root	Root length	Number of callus cuttings
Growth media	0.8292ns	0.7050ns	7499ns	0.39ns	1374ns	0.4085 ns	0.3304 ns
Cutting Position	0.0000***	0.0000***	0.0000**	0.11 ns	0.5180ns	0.2841 ns	0000***
Growth Regulators	0.0000***	0.0000***	0.0000**	0.005 **	0.0208*	0.0165 *	0.0007***
GM*CP	0.0530 ns	0.1588 ns	0.1512ns	0.47 ns	0.7845ns	0.3119 ns	0.0181 *
GM *GR	0.0925 ns	0.2685 ns	0.4118ns	0.05 *	0.4863ns	0.4421 ns	0.3282 ns
CP *GR	0.0001***	0.0030 **	0.0042**	0.002 **	0.0597ns	0.0870 ns	0.2434 ns
GM * CP * GR	0.0165 *	0.1558 ns	0.2526ns	0.00 ***	0.0002**	0.0004***	0.1033 ns

* = significant different at $\alpha_{0.05}$ ns = significant different at $\alpha_{0.05}$

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Table 2: Effects of Growth Hormones and plant extracts on Stem Cuttings of *Spondiathus preussii* PSE= Pawpaw seed extracts, CME = Coconut milk extracts, BLE = *Bryophyllum pinnatum* leaf extracts, IBA = Indole Butyric Acid, NAA = Naphthalene Acetic Acid

Variables	Cutting Positions	PSE 30	PSE 50	PSE 70	CME 30	CME 50	CME 70	BLE 30	BLE 50	BLE 70	NAA 150	NAA 250	NAA 500	IBA 150	IBA 250	IBA 500
Sprouted cuttings	Apical	3.95	2.83	1.74	2.64	0.57	1.47	0.86	0.86	1.16	1.47	0.86	0.00	2.83	0.48	0.57
	Middle	3.31	3.81	7.69	4.59	2.83	4.59	1.47	2.83	1.16	1.47	0.86	0.00	2.83	2.83	1.47
	Basal	9.81	9.81	11.26	9.81	8.14	8.14	1.47	0.86	1.47	1.47	0.86	0.02	7.24	4.09	5.95
Shoot number	Apical	4.81	4.29	2.79	4.86	1.17	2.57	1.83	1.21	0.45	1.75	1.18	0.00	4.69	0.86	1.21
	Middle	4.59	4.88	9.71	4.81	4.69	6.67	2.52	3.95	2.36	3.02	1.67	0.00	3.48	1.17	3.43
	Basal	11.00	10.43	15.07	12.79	11.64	11.79	3.57	1.29	2.76	2.50	1.55	0.05	9.43	6.83	7.69
Leaf number	Apical	18.55	18.40	12.62	18.90	4.55	9.00	7.05	5.07	1.62	6.99	4.76	0.00	15.76	3.42	4.48
	Middle	18.40	18.43	36.62	18.55	18.14	25.24	10	13.36	8.62	11.25	6.67	0.00	14.48	4.40	13.29
	Basal	43.74	40.76	62.71	50.40	42.98	45.71	14.64	5.57	11.29	9.29	5.95	0.19	36.07	19.95	29.17
Rooted cuttings	Apical	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Middle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Basal	0.00	0.17	0.17	0.00	0.00	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00
Number of root	Apical	0.00	0.00	0.00	0.00	0.11	0.06	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Middle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Basal	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.22

Root length	Apical	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Middle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Basal	0.13	0.00	0.06	0.00	0.07	0.01	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.04
Number of callus cuttings	Apical	1.89	0.00	1.78	0.00	0.00	0.00	1.17	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Middle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.00	1.28	0.00	1.11	0.00	0.00
	Basal	0.00	1.72	0.00	0.00	1.72	1.67	0.00	0.00	0.00	1.39	0.00	1.06	0.00	1.17	1.17

Rooted Stem: There were significant differences in effects of growth regulators, and interaction between growth medium, cutting positions and growth regulators on rooted cuttings (Table1). The assessment of rooted cuttings shows that basal cuttings treated with IBA 250mgL-1 had the highest rooted mean value 0.22, Table 2. Naphthalene acetic acid (NAA) at different levels does not significantly differ from one another. The assessment for cutting positions and hormones at different levels shows that Apical and middle cuttings was not significantly different (α = 0.05)

Number of Roots: There were significant differences in effects of growth regulators, and interaction between growth medium, cutting positions and growth regulators on numbers of roots produced (Table 1). Basal Cuttings treated with Indole butric acetic acid (IBA 250mgL-1) had the highest number of root with mean value 0.33, IBA 500mgL-1 had 0.22, Coconut milk extract (CME 50%) and PSE 70% had 0.11 respectively. Naphthalene acetic acid (NAA) and *Bryophyllum* leaf extract (BLE) at different levels and other hormonal levels do not significantly differ from one another (α = 0.05).

Root length: There were significant differences in effects of growth regulators, and interaction between growth medium, cutting positions and growth regulators on root length produced (Table 1). The assessment shows that hormonal level at Indol butric acetic acid (IBA) 250mgL-1 had the highest root length mean value 0.22; Pawpaw seed extract (PSE) 70% had 0.13, CME 70% had the least root mean length value with 0.01, Table 2. NAA and other hormonal levels do not significantly (α = 0.05) differ from each other.

Callus Formation: There were significant differences in effects of cutting positions and growth regulators, and the interaction between growth medium and cutting positions on callus formations (Table 1) The assessment of callus formation in cutting positions differs significantly (α = 0.05). the results shows that apical cuttings treated with PSE 70% had the highest mean callus value 1.89, basal cuttings treated with CME had 1.72 and the least was recorded for apical stem cuttings treated with Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) which had the least with 0.00, these results differ significantly (α = 0.05) from each other.

Effects weekly Growth assessment on Collar diameter, Leaf number, Shoot number and

Shoot height: There was steady increase in shoot height with weeks increase. Shoot height was obvious from week one to the fourth week of data collection, after which the height was constant to the eight weeks of the experiment Fig 1.

Collar diameter: The collar diameter data recorded for the growth of *Spondiathus preussii* for a growth period of eight weeks, as illustrated in figure 2 shows that the trends of increase in collar diameter general increase with weekly increase. The diameter increase was obvious during week one to week four of data collection, while from week four to the end of the experiment the diameter begins to show decrease.

Shoot number: There was general increase in the number of shoot produced with weekly increase in the number of shoot production in seedlings of *Spondiathus preussii,* shoot production increases during the first week of data collection to the fourth week. The rate of production becomes low from the fourth week to the end of the experiment.

Leaf number: The result in fig 4 shows that there was general increase in the number of leaf produced from week one to the fourth week, the rate leaf production becomes low from the fourth week to the end of the experiment.

Correlation between Collar diameter, Leaf number, Shoot number and Shoot height: Leaf number positively correlate with collar diameter, the result shows that the higher the leaf number the higher the collar diameter and vice vase but the relationship was not significant. Shoot number positively correlate with collar diameter, this result shows that the higher the shoot number the higher the collar diameter and vice vase but the relationship was not significant. Shoot number positively correlate with leaf number, this result shows that the higher the shoot number the higher the leaf number and vice vase. The relationship is highly significant. Shoot height positively correlates with collar diameter, the result shows that the higher the shoot height, the higher the collar diameter and vice vase. The interrelationship is highly significant. Shoot height positively correlates with leaf number, this result shows that the higher the shoot height the higher the leaf number and vice vase. The interrelationship was highly significant. Shoot height positively correlates with shoot number, the result shows that the higher the shoot height, the higher the shoot number and vice vase. The interrelationship was highly significant. Generally, the correlation between other characters with collar diameter was positive but not significant and values were similar.

DISCUSSION

Effects of auxin and cutting position on sprouting percentage of *Spondiathus preussii:* Though the result was not consistent within treatment as well as among cutting position. It was observed that basal cutting had the highest percentage sprout. Vegetative propagation by stem cutting is a useful method for growing plants with desire characteristic (Saifuddin *et al.,* 2013). Sprouting of cuttings was greatly affected by cutting positions and growth regulators in the study. Saifuddin *et al.,* (2013) had also reported that basal cutting response better than apical cuttings which show poor response to cutting survive. Similarly, the study agrees with the finding of (Washa, 2014) which reported that semi-hardwood and hardwood cutting callused and sprouted highly compared to softwood and root cuttings because their cells are not special for elongation. This result was in contrast with the report of (Adekola and Akpan 2012) which states that growth hormone applications had no significant effect on survival and sprouting behavior of *Jatropha curcas*. The results correspond favourably with the report of (Kochar *et al.,* 2005) which noted that IBA is more effective in case of *J.curcas* which increased the number of sprout per cutting in different species of *Jatropha.* The result equally disagrees with the report of (Onefeli and Akinyele, 2014) which reported that the higher number of sprouted cuttings was observed from upper nodal position treated hormonal concentration than that of middle and basal nodes which may be due to closeness of the upper nodes cuttings to the meristematic part of the plants, where endogenous hormone are naturally produced. The interaction effects of growth media, cutting positions and hormones shows that basal cuttings propagated in sawdust had the highest sprout percentage mean Table 2. Sprouting potential of stem cutting is one of the critical steps in plant propagation of woody plants; this varies from plant to plant and species to species (Noor-un-Nisa *et al.,* 2013). This result was in accordance with the study of (Wahab *et al.,* 2001) which reported that better sprouting from semi hardwood cutting of guava treated with NAA 2000ppm.

Effects of suxin and Cutting Positions on Shoot Numbers of *Spondiathus preussii*: Shoot growths are important yield determining factors in plants especially for young plants. In this study, some observation stands out clearly with regard to the influence of growth regulators on the initiation and development of shoot. Shoot growth were either affected favourably or unfavourably depending on the kind and concentration of hormone used. The study revealed that basal cutting had the highest mean shoot number as compared to middle and apical cuttings. Basal cutting treated with high concentration of synthetic growth regulator had the highest shoot number as compared to middle and apical cuttings respectively Table 2. This result was in close proximity with the work of (Balogun *et al.,* 2013) which reported that application of hormone induced highest number of shoot, nodes and leave per stem explant. Similarly, the result was in contrast with the work of (Akwatulira, 2011) which reported that the highest percentage of shoot regeneration was recorded for softwood cutting which produced the highest number and largest root and shoot. This result also agrees with the report of (Azamal and Mohinder 2007) that reported that treatment of cuttings with high IBA concentration increases the number of leave and shoot formation in stem cutting. Similarly, the result disagrees with the work of (III-whan and schuyler 2004) whose finding shows that the highest number of shoots per explant was observed along the basal segment of the cotyledon overall cytokinin and auxin treatment tested. Similar result was observed by (Sally 2012). Shoot elongation was best achieved by IBA 150ppm. The interaction effects of cutting positions and hormone shows that basal cuttings treated with plant extract had the highest mean shoot number. This agrees with the report of (Puffy *et al.,* 2008) which reported that basal cuttings treated with hormone had greater fresh mass than basal cutting treated without hormone.

Effects of auxin and Cutting Position on Leaf Number of *Spondiathus preussii:* The presented result revealed that the basal cutting positions treated with PSE 70% had the highest percentage leaf number Table 2. This was in consonance with the study of (Ofodile *et al;* 2013) which reported that the highest number of leaf was produced in sharp sand, similar finding was observed by (Puffy *et al.,* 2008) which reported that basal cuttings had thicker circumferences and more number of leaf as compared to apical cuttings. This result also conform with the report of (Puffy *et al.,* 2008) which reported that Seradix No 2 hormone (0.3% IBA) increased fresh mass, stem circumference, number of roots and number of leave for both apical and basal cuttings. The result compared favourably with the work of (Gehlot *et al.,* 2014) whose finding shows that application of IBA 250mgL-1 showed better result of number of leave per root mini-cuttings. Similar result was recorded by (Azamal and Mohinder 2007) who mentioned that treatment with IBA increased the mean number of leaf and shoot in stem cuttings.

Effects of Hormonal Treatment on Rooted Cuttings of *S. preussii:* The study on root development of *S. preussii* in terms of number of rooted cuttings had variable rate with different hormonal levels. The result shows that the development of highest number of rooted cuttings was recorded for basal cuttings treated with hormone.

It was observed that almost all treatments including pawpaw seed were able to induce rooting of cuttings. However the percentage rooted cutting varies with treatments, and application of IBA 250mg L-1 was found to be more effective. This agrees with the work of Dickens *et al* (2010) which reported that there was a pronounced effect of seed extract and IBA on rooting percentage of stem cuttings. Maryam *et al.,* (2014) when connecting the effects of treatments on the rooting of the *Azalea alexander's* cuttings, reveals that application of indole butyric acid (IBA) at different level can led to significant increase in root percentage compared to control treatment. The result findings also concord with the work of Nandi *et al.,* (2002) which reported that IBA was more effective for root induction in stem cutting of *C. deodara*. The finding disagrees with the work of Puffy *et al.*, (2008) which reported that apical cuttings treated with hormone had similar rooted cutting as compared to apical cuttings without the application of hormone. The result also disagree with the report of Maya *et al*., (2010) which reports that soft wood cuttings with 1-2 nodes, 4-3cm length, less than 5mm diameter treated with 2.5mgL-1 IBA had the highest rooting The result of the study show that cuttings propagated in sawdust at IBA 250mg/l had the highest percentage mean value Table 2. This report disagrees with that of (Animah *et al.,* 2006) which reported that rooting of cuttings was higher in cutting propagated in coconut husk compared with sand and their mixtures. High aeration in rooting media is responsible for promoting metabolic activities and enhancing root initiation in stem cuttings (Yeboah and Amoah 2009). The type of growth media used can also have influence on the rooting capacity of stem cuttings. The purpose of treating the cutting with different hormone is to increase the rooting percentage of the cuttings (Ullah *et al,* 2005). The highest mean percentage value observed in sawdust may be attributed to the high water retention capacity of sawdust. This report corroborates with the report of Miabondou *et al*; (2002) which reported that the good rooting and survival of cuttings in sawdust may be explained by the high water retention of sawdust. The result also agrees with the report of Tchoundjeu *et al;* (2002) which explained that cuttings of *Prunus africana* rooted eventually well in sawdust and in mixture of sand and sawdust than sand alone. The observation could be explained by high moisture holding capacity and good aeration of the sawdust media.

Effects of auxin on number of roots: This study shows that cuttings treat with IBA had the highest number of root. this conform with the report of Puffy *et al;* (2008) whose work revealed that root number were significantly affected by the application of different levels of hormone at different days of planting. They further note that numbers of root produced were significantly improved when rooting hormone was applied. Similarly, the studies of AL-Barazi (1982) reported that treated cuttings with growth regulators increased root number as well as uniformity of roots in adult *Posticoa vera*. This result was in consonance with the report of Mesen *et al* (1997) which observed that increasing concentration of IBA will inhibited bud growth but higher rooting percentage. There were significant interaction between growth media, cutting position and hormone on number of roots. Apical cuttings propagation in River sand at IBA 250mgL-1 shows highest percentage mean value for number of roots. This result was in consonance with the report of Mesen *et al* (1997) which observed that increasing concentration of IBA will inhibited bud growth but higher rooting percentage were recorded for gravel and sand than in sawdust. The study showed that interactive effect of cutting position, growth media and hormone on number of roots were additive.

Effects of auxin and cutting position on root length: The result shows that the cutting treated with Indole Butyric Acid had highest root length as compared to all other hormones. This result follows the report of Sally (2012) which reported that root elongation was best achieved in IBA 150mgL-1, with significant enhancement by full leaf cutting. Similarly, it was observed that root length of seedlings increased in the presence of IBA and α-nephthalene acetic acid (Wotavora-Novatna *et al;* 2007). Also, this result agrees with the finding of Dolor *et al* (2010) which reported that root length was influence by Indole Butyric

Acid and pawpaw seed extract. Similarly, the study was in consonance with the report of Onofre (2013) which reported that older stem part and lower hormone concentration application would mean greater potential for propagating rubber tree through stem cuttings. The report of Saifuddin *et al;* (2013) which reported that higher root length were observed in cuttings taken from the basal position could also be said to support the finding of this study.

Effects of auxin and Cutting Position on Callus Formation: Though most of the cuttings for the experiment did not root, the result reveals that apical cuttings treated with PSE had the highest callus percentage. This agrees with the report of (Kurakawa *et al*; 2007) which reported that the upper position of the node callus more than other position as a result of the level of auxin present in the apical meristem. The result shows that hormone application can support root formation. Similar, finding of Sakpere *et al*; (2014) was observed that media supplemented with hormones in combination with kinetin give the highest cumulative percentage callus induction. The result on the interaction of callus formation reveals that basal cuttings propagated in sawdust has the highest callus mean which shows that callus can best be form in cutting propagated with sawdust than other growth media. This result disagrees with the study of (Owuor *et al;* 2009) which reported that single node cuttings had the similar survival with double node stem cuttings in sand substrate

Effects weekly Growth assessment on Collar diameter, Leaf number, Shoot number and Shoot height: The result shows that there was increase in collar diameter, shoot height, shoot number and leaf number of *Spondiathus preussii*, during the first week of data collection to the fourth (Fig 1-4). The superior of weekly increase exhibited by the stem cuttings during the first week of data collection to the fourth could be attributed to availability of more food reserves in stem cuttings. This work was in consonance with the observation (Offiong, 2008), who reported that seeds with large dimensions are likely to have large embryo which enhances good germinability. On the other hand, the reduction in the weekly assessment obtained from *Spondiathus preussii* could be attributed to relatively lower food reserve in the stem cuttings, the stage of maturity, and genetics factors. This finding agrees with the observations of Faluyi (1986), who reported better growth in cashew (*Anacadium accidentale*) from large nuts than small nuts. Oni and Bada (1992) also reported that seed from large nuts showed better germination and growth than seeds from small nuts. They further reported that seed size can be used as a parameter for predicting germination and seedling growth rate both in the nursery and a brief period following establishment.

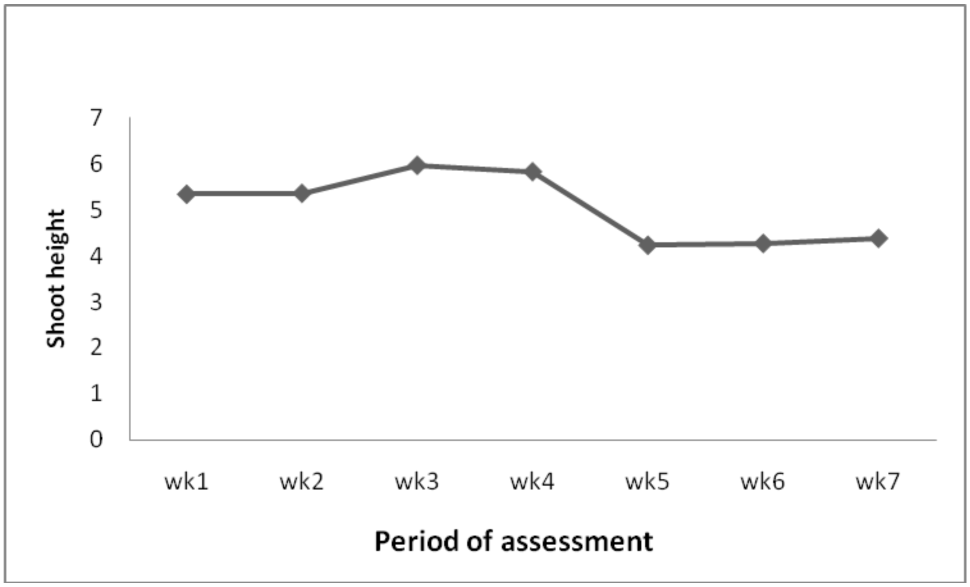

Fig 1: Weekly assessment of shoot height for seedlings of *Spondiathus preussii*

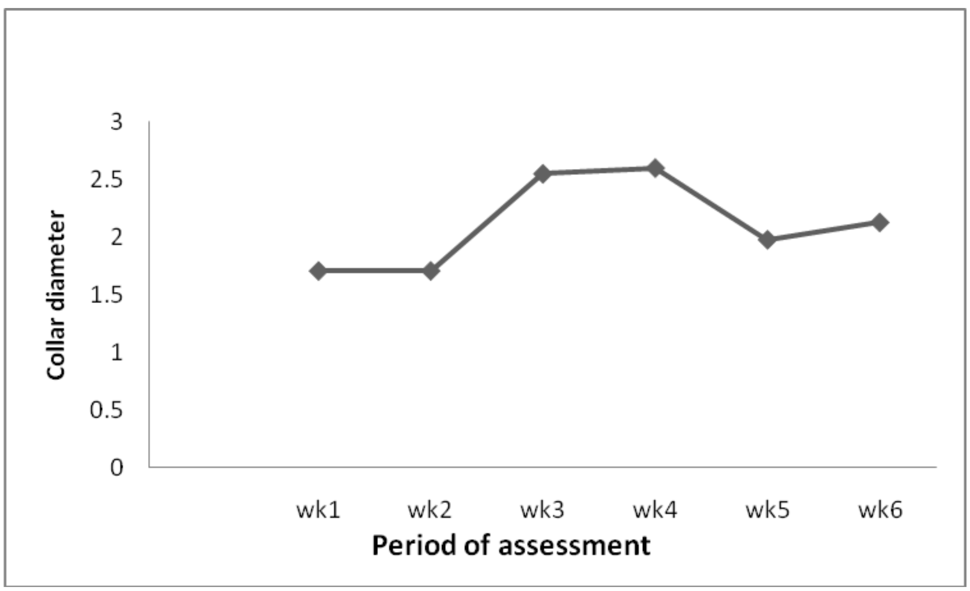

Fig 2: Weekly assessment of collar diameter for seedlings of *Spondiathus preussii*

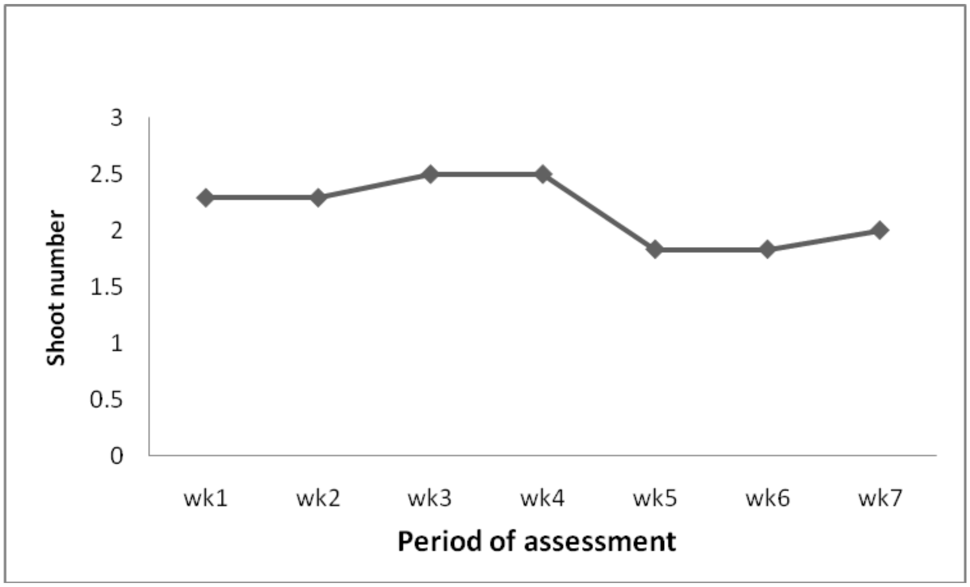

Fig 3: Weekly assessment of shoot number for seedlings of *Spondiathus preussii*

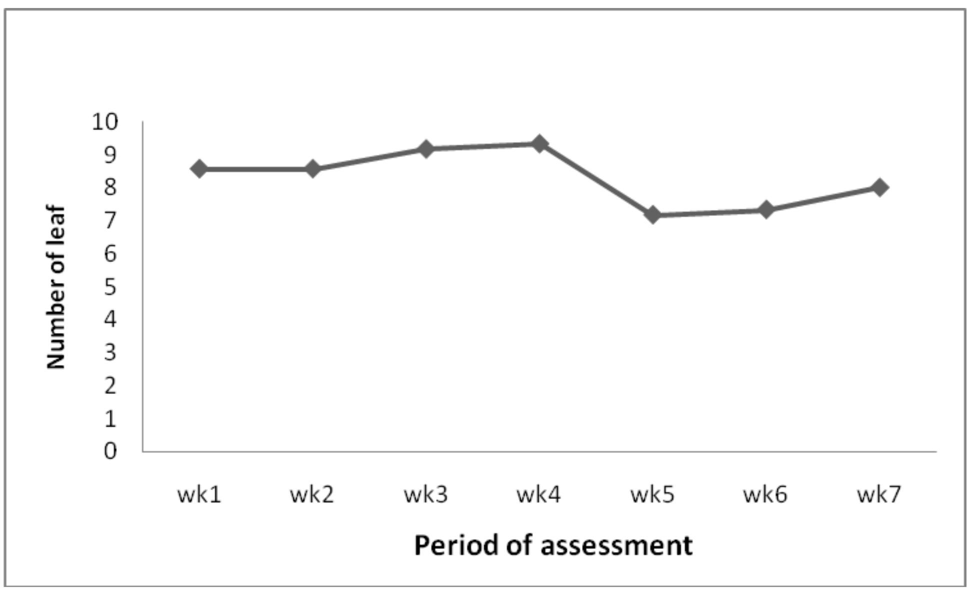

Fig 4: Weekly assessment of leaf number for seedlings of *Spondiathus preussii*

Correlation between Collar diameter, Leaf number, Shoot number and Shoot height: The variations observed among the seedling growth characteristics such as collar diameter, shoot height, numbers of leaves, and numbers of shoot during the first week of data collection to the fourth can be attributed to the increase in weekly difference observed. The study on correlation effects reveals that shoot number and shoot height, of *Spondiathus preussii seedlings*, were highly significant (α = 0.05) Table 3. This result agrees with the report of (Makueti *et al;* 2013) who reported that the growth variables revealed that significant variation existed in collar diameter, numbers of leaves and numbers of vigorous twigs. They further reported that significant variation existed only in seedlings' height among growth studied variables. The result shows that Leaf number positively correlate with collar diameter, the result revealed that the higher the leaf numbers the higher the collar diameter. Collar diameter and leaf number which provide a measure of photosynthetic and transpiration area are indicators of seedling quality in *Spondiathus preussii* (Sileshi *et al;* 2007) the result presented corroborate with the report of (Lambers *et al*. 2008) who reported that a high LAR enables plants to grow fast.

Table 3: Correlation between Collar diameter, Leaf number, Shoot number and Shoot height

Variable	Collar diameter	Leaf number	Shoot number	Shoot height
CD	1			
LN	0.436	1		
SN	0.4	.990**	1	
SH	0.389	.963**	.990**	1

***. Correlation is significant at the 0.01 level (2-tailed).*

CONCLUSIONS

The present study has revealed that basal cutting positions have higher percentage mean sprout and leave number. Apical cuttings produce high callus formation for *Spondiathus preussii.* The study also reveals that sprouting ability as well as other parameters was higher with the application of pawpaw seed extracts (PSE). Thus the species is sensitive to application of pawpaw seed extracts and the best concentration for a successive sprout of vegetative propagation of stem cuttings of this species was PSE 70%. Data obtained in this experiment suggest that rooting ability of apical cutting position of *Spondiathus preussii* can be improved by the application of indole butyric acetic acid (IBA) with appropriate concentration. The cuttings were found to be sensitive to IBA concentration. Higher rooted mean cuttings and more root number can be obtained with IBA 250mgL-1 since root number is important to consider the type of growth media used.

RECOMMENDATIONS

For large scale production of seedlings of *Spondiathus preussii* to promote conservation of the species, treatment of stem cuttings should be done by dipping the base of the stem cuttings in non synthetic auxin that is environmentally friendly to improve sprouting, leave number and callus formation in cuttings. The use of IBA

250mgL-1 should also be encouraged for root production in stem cuttings. Further research is needed on the effects of growth media on sprouting, leave production and callus formation.

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