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Effect of various IBA Concentrations on the Rooting and Growth of *Delonix regia* Stem Cuttings in Maiduguri

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Reforestation in the arid zone depends on the successful propagation of trees. Vegetative propagation may serve as a good alternative to propagation by seed. This study was carried out in a nursery in Maiduguri, Borno State, Nigeria. The study was focused to determine the effects 4 various concentrations of indole butyric acid (IBA) on the rooting and growth of Delonix regia stem cuttings. The treatments consisted of four concentrations of IBA (1000ppm, 2000ppm, 3000ppm, 4000ppm) and control. The experiment was factorially combined and laid in a complete randomized block design with four replications. The results indicated that application of IBA at 2000-3000ppm compared to 1000ppm and 4000ppm gave significantly ($p<0.05$) higher results in all measured parameters. Cuttings treated with IBA in respective of concentration gave higher results than those without IBA (control) in all parameters except root number where treated cuttings were at par with control.

Keywords: IBA, *Delonix regia*, rooting, stem cuttings, vegetative propagation.

INTRODUCTION

The vegetative (asexual) propagation of plants is the process, when an exact copy of the genome (clone) of a mother plant (ortet) is made and continued in new individuals. It is ensured by meristematic, undifferentiated cells that can differentiate into the various organs necessary to form a whole new plant (Wiesman and Jaenicke, 2002). Clone is a group of plants derived from a single ortet by asexual reproduction. All members (ramets) of a clone have an identical genotype to a single source plant and tend to be uniform.

Propagule is a plant derived from vegetative propagation, including tissue culture and rooted cutting, capable of developing into an adult (Burley et al.,2004). Evidence suggests that auxin increases rooting percentages, shortens the rooting period and ensures improved uniformity in plants (Hartmann et al., 2002). While some Proteaceae species favour bottom heat conditions for rooting, other cuttings are difficult to root, and could respond differently to auxin treatments (Hartmann et al., 2002). In this respect auxin formulations supplied at different concentration and growth conditions need further investigation and may improve rooting percentages (Hartmann et al., 2002) and produce desirable rooting results.

Delonix regia (Boj.ex Hook.)Raf., the flamboyant or flame tree, is a very popular and beautiful ornamental tree. The genus Delonix belongs to the legume family Fabaceae and subfamily Caesalpinioideae. Native to Madagascar (Puy et al., 1995), introduced into Nigeria as an exotic ornamental tree to supplement the native species (Lancaster, 1982). A tall and reaching a height of more than 15 m and a girth of 2 m under favorable conditions, compound leaves of Delonix regia are

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bipinnate and feathery, up to 60 cm long, pinnate 11-18 pairs, petiole stout. It is a leguminous species like Acacia species, being a deciduous tree; it sheds its leaves during the dry season therefore, reducing the rate of evaporation and transpiration. It enriches the soil fertility. Despite the potential uses of this species, when propagated from seeds, its early growth is very slow due to presence of dormancy and rooting of cuttings has been reported to not yielding desirable seedlings. Considering the importance of this species there is the need to ensure its continuous propagation and conservation, hence the aim of this research is to determine the effect of different concentrations of Indole-3-butyric acid (IBA) on the rooting ability and growth of stem cuttings of *Delonix regia.*

MATERIALS AND METHODS

The experiment was done at the Finchaa Sugar Estate Fresh cuttings of Delonix regia were taken on 14th June 2014, from healthy trees by growing within the University of Maiduguri. The materials were taken from the same branch position in the morning and placed in boxes filled with moist cleans and transported to the propagation area. The cuttings were separated by sterile socatuoar. An effort was made to ensure uniformity in selection of cuttings as stem length of the cutting were determined at 15 cm and diameter range between 2-3 cm. The experiment was established in randomized complete block design (RCBD), there were 5 levels of IBA, for each IBA level 5 cuttings of Delonix regia were assigned and each treatment was replicated 4 times (5x5x4). There were a total of 100 cuttings of Delonix regia planted in standard polythene bags of dimension 14x11x5cm3 filled with a soil mixture of river sand + top soil + pulverized cow dung manure at ratio 1:1:1. Stem base of each cutting from each group was treated with one of the IBA solutions 1000, 2000, 3000, and 4000 ppm of IBA except the control (without IBA treatment). The time for each treatment was 5 seconds; treated basal ends of each stem cutting were air dried for 5 minutes before careful insertion in to a depth of 3-4 cm. Weeds were removed at regular intervals of two (2) weeks. The cuttings were watered twice daily. The period of study was 16 weeks.

The rate of cuttings sprouting was determined by the number of days taken by the cutting to commence sprouting, sprouting percentage was obtained by dividing the number of sprouted cutting with the total number of cuttings planted and multiply by 100, plant height (cm) was measured weekly using meter rule which involved measuring of the vertical distance of each sampled seedling from the basal region (soil surface) to the tip of the plant/crown point (Kareem et al., 2002), root length (cm) was measured using meter rule. The number of roots per cutting was recorded by physical counting. Number of leaves was taken by physical counting of the leaves and collar girth (cm) was determined by wrapping a thread round the basal region of the sampled seedlings stem and stretching the thread on a meter rule to determine its dimension (stem width). The data collected were subjected to Analysis of Variance (ANOVA). Means were separated using Least Significance Difference (LSD) at $P < 0.5$ level of significance.

RESULTS

Cuttings Sprouting

The effects of IBA concentrations on cuttings sprouting are shown in Table 1. Results show that IBA at 3000ppm gave the most sprouted cuttings (6.333 – 18.333) followed by 2000ppm (5.667 – 16.667), then 1000ppm (10.00 – 14.667), then 4000ppm (5.333 – 14.333) while the lowest rate of sprouting was recorded in control (3.000 – 10.000). At 1 MAP 1000ppm was significantly higher ($P<0.05$) than the other treatments, also at 2 MAP 1000ppm was significantly higher ($p<0.05$) than 4000ppm and control while 2000ppm and 1000ppm were not significantly different ($P<0.05$) from one another. Consequently, at 1 MAP and 4 MAP the cuttings treated with 4000ppm were at par with control, but at 2 MAP and 4 MAP cuttings treated with IBA were significantly higher ($p<0.05$) than control.

Effects of IBA Concentrations on Percentage Sprouting

The mean sprouting percentage for IBA concentration is shown in Table 2 percentage sprouting was higher in cuttings treated with 3000ppm and 2000ppm (18.000 and 16.333%) than those in control, 1000ppm and 4000ppm (9.333, 15,667, and 12.667). Although at week 16, 1000ppm, 2000ppm and 4000ppm were not significantly ($p<0.05$) different, the results indicated a significant difference ($p<0.05$) between 3000ppm and the other treatments at week one. Subsequent results from week 4 – 16 indicated no significant difference ($p<0.05$) between 1000ppm & 3000ppm. Similarly, at all the weeks all treatments were significantly different ($p<0.05$) from control except at week one and two where 1000ppm and 2000ppm were at par with control.

Cuttings Growth

Effects of IBA Concentrations on Cuttings Height

The effect IBA on plant height is shown in Table 3. Results indicated that there is significant ($p<0.05$) difference in cuttings treated with 3000ppm being taller (22.073cm) than all the other treatments throughout the 4 MAP. The mean height of 3000ppm ranged from (5.1400 – 22.073cm) over the four month period of study. Result at 1 MAP showed no significant difference ($p<0.05$) between the cuttings treated with IBA and control, but from 2 MAP, the treated cuttings grew significantly ($p<0.05$) higher than control except at 4 MAP where control and 1000ppm were at par. Also at 2 MAP 2000ppm showed significantly ($p<0.05$) higher mean than 1000ppm and 4000ppm, except at 6 MAP where 2000ppm and 4000ppm showed no significant ($p<0.05$) difference.

Effects of IBA Concentrations on Cuttings Diameter

The effect IBA concentrations on the cutting of Delonix regia after 16 weeks of planting (WAP) is shown in Table 4. Result indicated that at 10 WAP, 1000ppm, 2000ppm and 3000ppm were significantly ($p<0.05$) higher than control and 4000ppm. At 12 WAP, 1000ppm, 2000ppm and 3000ppm were also significantly ($p<0.05$) different from control and 4000ppm. However, at 14 and 16 WAP, 3000ppm showed significantly ($p<0.05$) wider diameter than the other treatments while 1000ppm and 2000ppm were not significantly ($p<0.05$) different from one another. Also at 14 & 16 WAP, all the treatments were significantly ($p<0.05$) higher than control.

Effects of Soil Media and IBA Concentrations on Number of Leaves

The effects of IBA concentrations are shown in Table 5. The result indicated that 3000ppm was the most foliated (6.667-18.333) followed by 2000ppm (7.333-16.000), then 1000ppm

Table 1. Effects of IBA concentrations on rate of sprouting

	Months After Planting (MAP)			
	1	2	3	4
IBA Concentration(ppm)				
Control(0.00)	3.000^{c}	7.333^{c}	10.000^{c}	10.000^{c}
1000	10.000^{a}	14.333^{ab}	14.667^{ab}	14.667^{ab}
2000	5.667^{b}	13.667^{b}	16.667^{ab}	16.667^{ab}
3000	6.333^{a}	17.667^{a}	18.333^{a}	18.333^{a}
4000	5.333^{bc}	12.000^{b}	14.333^{b}	14.333^{c}
SEM	1.2621	1.8103	1.9237	1.9237

Mean indicated by the same letter are not significantly (P< 0.05) different from one another using LSD

Table 2: Mean percentage sprouting IBA concentrations

	Weeks							
	2	4	6	8	10	12	14	16
IBA Concentration (ppm)								
Control(0.00)	0.0000^{c}	1.3333^{d}	4.000^{c}	6.667^{c}	8.667^{c}	9.333^{c}	9.333^{c}	9.333^{c}
1000	0.3333^{bc}	7.6667^{ab}	13.667^{ab}	15.000^{ab}	15.333^{ab}	15.667^{ab}	15.667^{ab}	15.667^{ab}
2000	0.0000^{c}	6.3333^{bc}	10.667^{b}	14.667^{ab}	16.000^{ab}	16.333^{ab}	16.333^{ab}	16.333^{ab}
3000	1.6667^{a}	9.0000^{a}	16.333^{a}	18.000^{a}	18.000^{a}	18.000^{a}	18.000^{a}	18.000^{a}
4000	0.6667^{b}	4.0000^{c}	9.333^{b}	12.667^{b}	12.667^{b}	12.667^{bc}	12.667^{bc}	12.667^{bc}
SEM	0.3116	1.1562	2.1667	2.018	1.9194	1.9741	1.9741	1.9741

Mean indicated by the same letter are not significantly(P< 0.05) different from one another using LSD

(5.333-15.333), 4000ppm (4.333-12.333) and the lowest was control (2.000-9.333). Throughout the period of the study, cuttings treated with 1000ppm, 2000ppm and 3000ppm were significantly(P<0.05) higher than control and 4000ppm. However, 4000ppm was not significantly different (p<0.05) from the control throughout the 4 MAP except at 2 MAP.

Effects of IBA Concentrations on Root Length and Root Number

The IBA concentrations on the cutting of *Delonix regia* is shown in Table 6. The result indicated high significant (p<0.05) difference in the lengths of roots of cutting treated with IBA than control except in 1000ppm which was at par with control. While result showed no significance (p<0.05) difference in all the treatments with control in regard to root number.

Table 3: Effects of IBA concentrations on cuttings height

Mean of plant height(cm) at month after planting (MAP)				
IBA Concentration(ppm)				
Control(0.00)	5.0000[b]	16.073[d]	17.387[d]	18.167[c]
1000	5.0267[b]	16.420[c]	18.173[c]	18.787[c]
2000	5.0200[b]	16.813[b]	19.253[b]	20.167[b]
3000	5.1400[a]	17.693[a]	20.760[a]	22.073[a]
4000	5.0467[b]	16.367[c]	18.173[c]	20.247[b]
SEM	0.0443	0.1432	0.2092	0.4607

Mean indicated by the same letter are not significantly (P< 0.05) different from one another using LSD

Table 4: Effects of IBA concentrations on cuttings diameter

Weeks After Planting (WAP)				
	10	12	14	16
IBA Concentration(ppm)				
Control(0.00)	1.0067[c]	2.1267[c]	3.2133[c]	3.3133[d]
1000	1.3533[a]	2.3867[ab]	3.5000[b]	3.6533[b]
2000	1.3600[a]	2.4067[ab]	3.4467[b]	3.5733[bc]
3000	1.3000[ab]	2.4933[a]	3.7067[a]	3.9600[a]
4000	1.1600[bc]	2.2867[c]	3.4200[b]	3.5067[c]
SEM	0.0805	0.07100	0.0574	0.0602

Mean indicated by the same letter are not significantly (P< 0.05) different from one another using LSD

DISCUSSION

Results of this study showed that application of IBA led to significant increase in the root length and in all the growth parameters recorded when compared to control (without IBA). This corresponds with the results of other researchers (Blythe et al., 2004, Khosh kuy, et al., 2009). This is also similar to the findings of Maryam et al. (2014) which indicated that IBA in three level 1000, 2000, and 300mg/L led to a significant increase in rooting percentage of Azalea alexander's cuttings when compared to control. The reason for the positive effect of IBA on the rooting and growth of Delonix regia's cutting can be attributed to effects of auxin on the stimulation of initial/first cellular division of the root's initiator as reported Khosh kuy et al.(2009). It was observed that IBA (3000ppm) has a more significant effect on all the growth parameters and rooting compared to 1000ppm, 2000ppm and 4000ppm in all the soil media. This result is supported by Blythe et al. (2004), where he studied various concentrations of IBA and NAA on the rooting of cuttings of Camellia japonica and observed that concentration of 3000ppm of IBA led to increase in rooting of cuttings at a noticeable rate. Also, they expressed that employment of auxin with high concentration on the stem cutting can prevent the cuttings from sprouting and even growth and development of branch and foliage (Karamy and Salehi, 2010). These results also correspond with results obtained by Mirsolaimani and Rahemi (2008), who reported that an increase of concentration of IBA to up to 2000ppm led

Table 5. Effects of IBA concentrations on number of leaves

	Months After Planting (MAP)			
	1	2	3	4
IBA Concentration(ppm)				
Control(0.00)	2.0000[c]	6.667[c]	9.333[c]	9.333[c]
1000	5.3333[ab]	13.000[ab]	15.333[ab]	15.333[ab]
2000	7.3333[a]	12.333[b]	16.000[a]	16.000[a]
3000	6.6667[ab]	17.000[a]	18.333[a]	18.333[a]
4000	4.3333[bc]	11.667[b]	12.333[bc]	12.333[bc]
SEM	1.1916	2.2427	1.6246	1.6246

Mean indicated by the same letter are not significantly (P< 0.05) different from one another using LSD

Table 6. Effects of IBA concentrations on root length and root number

	Root Length (cm) at 16 WAP	Root Number at 16 WAP
IBA Concentration(ppm)		
Control(0.00)	10.187[b]	1.0667[a]
1000	10.187[b]	1.0667[a]
2000	11.327[a]	1.1333[a]
3000	11.600[a]	1.2667[a]
4000	11.720[a]	1.1333[a]
SEM	0.3365	0.1673

Mean indicated by the same letter are not significantly (P< 0.05) different from one another using LSD

to increase of three attributes of number, length, and fresh weight of branch/foliage (shoots) and its decrease again in higher concentration. And this is probably why 1000ppm and 4000ppm showed significantly (P<0.05) lower result in all the measured parameters when compared to 2000ppm and 3000ppm in this study. These researchers believe that the high concentration of auxin can lead to destruction of tissues of cutting's bottom (Mirsolaimani and Rahem, 2008). In 2010, Karamy and Salehi through studying the effect of two kinds of synthetic auxin NAA and IBA on the rooting of cuttings of Tecomella undulate in two seasons of the late autumn and winter expressed that a significant difference was observed between NAA and IBA hormones in rooting. NAA with concentration of 3000mg/L and IBA with concentration of 4000mg/L had the highest percentage of rooting (Karamy & Salehi, 2010). Noori (2013), by studying the effect of IBA on the cutting of Ficus benjamina's stalk, declared that the best concentration for rooting in IBA is 2000 – 3000 ppm, which it has been shown that the various harmonic concentrations can have an influence on the rooting noticeably (Noori, 2013). In connection with superiority of treatments of IBA with 2000ppm and 3000ppm compared to 1000ppm and 4000ppm observed in this study are similar to a research conducted by Tewchunjell et al. on the pharmaceutical species of

Pausinystalia johimber in 2004 (Tenjeu et al., 2004). Moallemi and Chehrazi (2005) showed that treatment of cuttings of Bougainvillea glabra with hormone caused the length of root in each cutting compare to control to be increased significantly, but a significant difference was not observed among the various concentrations of IBA.

CONCLUSION

It is possible to get faster seedlings of Delonix regia through vegetative propagation by cuttings and also a proper mixture of soil with other animal dungs and adequate concentration of IBA (2000ppm-3000ppm) can enhance faster yield in the rooting and growth of the cuttings.

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