International Journal of Innovative Agriculture & Biology Research 3(1):6-11, Jan-Mar 2015

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EFFECT OF DIFFERENT SOIL MEDIA ON THE ROOTING AND GROWTH OF *DELONIX REGIA* STEM CUTTINGS IN MAIDUGURI

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ABSTRACT

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 on determining the effect of different soil types on the rooting and growth of *Delonix regia* stem cuttings. The treatments consisted of three different soil types (River sand, Top soil and a mixture of River sand + Top soil + Cow dung at ratio 1:1:1). The experiment was factorially combined and laid in a complete randomized block design with four replications. The results indicated that soil mixture gave the higher results in all measured parameters followed by top soil, and least result was recorded in river sand.

Keywords: Soil media, *Delonix regia*, stem cuttings, vegetative

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 to the various organs necessary to form a whole new plant (Wiesman and Jaenicke,2002). Plant cuttings is one of the most common methods of vegetative reproduction which is, today, used extensively due to low cost. Today, reproduction by foliate semi hardwood cuttings has been taken into consideration as a turning point in the affair of development of the new grassy or woody cultivars and species (Hartmann *et al.*, 1997).Soil medium is a factor which has influence on the percentage of cuttings which are to be rooted and kind of the root created on it. Cultivation environment must have enough humidity and oxygen and is free from the pathogenic factors. Considering available facilities or economical situations, ornamental plants are reproduced by various methods. In most cases, production of ideal plant from seeds is not possible because most ornamental plants are heterozygote and their seeds produce various plants. In addition to these, some plants, due to genetic reasons (incompatibility between pollen grain and gynoecium, polyploid) or undesirable environmental conditions (such as inappropriateness of temperature and relative humidity for pollination) do not produce seeds and the vegetative reproduction must be used to proliferate them.

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*. It is 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 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. Considering the importance of this species there is the need to ensure its continuous

propagation and conservation. However, the successful conservation of the species will to a large extent depend on the identification of suitable soil medium for its propagation. Thus the aim of this work is to investigate the effectiveness of these soil media on the cuttings of the study species.

MATERIALS AND METHODS

Fresh cuttings of *Delonix regia* were taken on 14th June 2014, from healthy trees growing within the University of Maiduguri. Only phenotipically healthy trees, with young and new branches were selected. The materials were taken from the same branch position in the morning and placed in boxes filled with moist clean sand and transported to the propagation area. The cuttings were separated by sterile secateurs. 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 (Kareem *et al.* 2005). The river sand was obtained from river Ngadda along Bama Road Maiduguri on 6th June, 2014 and was sterilized by stirring the sand in hot water at 82°C to kill pathogens and was allowed to cool on the second day, while the top soil was obtained in the nursery where the experiment was conducted. The potting mixture was prepared by ensuring homogenous combination of pulverized cow dung manure, river sand and top soil in a ratio of 1:1:1. All the soil media were filled into standard polythene bags of dimension 14x11x5cm^3.The filled polythene bags were watered for 7 days before planting. The soil samples were analyzed according to the method reported by Rechards (1977) to determine the pH, the exchangeable cation, value of nitrogen (N), the phosphorous (P) and the soil organic matter.

The experiment was conducted at a nursery in Maiduguri, Borno State, Nigeria. The experiment was established in randomized complete block design (RCBD), there were a total of 100 cuttings of *Delonix regia* planted on each of the 3 soil media (river sand, top soil, and soil mixture) at 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 seedlings 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 Number of root per cuttings was recorded using 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

Soil Sample Analysis

The results on soil analysis are shown in Table 1. The result showed variations in the properties of the different growth media studied. The pH value of river sand from River Ngadda and top soil from F.G.C Maiduguri were 7.25 and 6.76 respectively. Results on EC showed that top soil from F.G.C Maiduguri site gave higher percentage (68.10%) than that of river sand from river Ngadda (30%).Result on nitrogen percentage indicated that the river sand from river Ngadda had (0.07%) which was lower than top soil from F.G.C Maiduguri site (0.11%).The phosphorous value in river sand from river Ngadda was very low (2.45mg/kg), when compared to the top soil from F.G.C Maiduguri site which had moderate phosphorous value (13.65mg/kg). The potassium value in top soil from F.G.C Maiduguri site was higher (0.58com$^{(+)/kg}$) than the potassium value in river sand from river Ngadda (0.12com$^{(+)kg}$).The amounts of organic carbon and organic manure in top soil from F.G.C Maiduguri site were higher (0.43 and 0.74 % respectively) than those in river sand from river Ngadda (0.29 and 0.50 % respectively).

Table 1. Soil Sample Analysis

Soil Media	Loca Tion	PH in H_2^O	EC $Uscm^{-1}$	% N	$P_{mg/kg}$ Soil	K^+ $Cmol^{(+)}/kg$ S0il	% ⟶ O.C	⟵ O.M
River sand	River Ngadda	7.25	30.00	0.07	2.45	0.12	0.29	0.50
top soil	F.G.C site	6.76	68.10	0.11	13.65	0.58	0.43	0.74

Cuttings sprouting

Effect of soil media on rate of sprouting

The effect of soil media on cutting sprouting is shown in Table 2. Results showed that cuttings planted on soil media gave the highest sprouting rate (8.400 – 15.800) followed by top soil (6.800 – 15.800), the least rate of sprouting was recorded in cuttings planted on river sand (4.800 – 14.600). Similarly soil mixture and top soil showed no significant different ($p< 0.05$) with one another throughout the period of observation. Both the two soils showed no significant different ($p<0.05$) with river sand throughout the 4 MAP except at 1 MAP.

Table 2. Effect of soil media on rate of sprouting

	Months After Planting (MAP)			
	1	**2**	**3**	**4**
Soil media				
River Sand	4.8000^b	11.800^b	14.000^a	14.600^a
Top soil	6.8000^a	12.400^{ab}	15.800^a	15.800^a
Soil mixture	8.4000^a	14.800^a	14.600^a	15.800^a
SEM	0.9776	1.4023	1.4901	1.4901

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

Effect of soil media on percentage sprouting

The mean sprouting percentage for soil media and IBA concentration is shown in Table 3. Sprouting percentage ranged from 0.8000 – 13.200%, 0.80000-15.2000%, and 0.0000-14.8000% for river sand, soil mixture, and top soil respectively. Throughout the 16 weeks, the highest sprouting percentage was consistently recorded from cuttings planted on soil mixture, while the lowest sprouting percentage was observed in cuttings planted on river sand. Consequently the result showed that sprouting percentage was significantly ($p<0.05$) higher in soil mixture and river sand than in top soil in the first two weeks, but after four weeks sprouting percentage from the all soil media showed no significant difference ($p<0.05$) between treatments.

Table 3. Germination percentage

	Water							
	2	**4**	**6**	**8**	**10**	**12**	**14**	**16**
Soil Media								
River sand	0.8000^a	2.4000^b	9.800^a	11.200^b	12.800^a	13.200^a	13.200^a	13.200^a
Top soil	0.0000^a	7.2000^a	11.000^a	14.800^{ab}	14.800^a	14.800^a	14.800^a	14.800^a
Soil mixture	0.8000^a	7.4000^a	11.600^a	14.200^{ab}	14.800^a	15.200^a	15.200^a	15.200^a
SEM	0.2413	0.8956	1.6783	1.5632	1.4868	1.5291	1.5291	1.5291

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

Cuttings growth:

Effect of soil media on cuttings height

The effect of soil media on plant height is shown in Table 4. There were significant ($p<0.05$) variation in the height of cuttings planted on soil mixture than those planted on the other soils throughout the four months period of study.

Results from one to four (1-4MAP) consistently showed that cutting planted on soil mixture with the mean plant height of (15.140-21.144cm) was significantly taller ($p<0.05$) than the other treatments and exhibited significantly ($p<0.05$) faster growth than the other two soil types. While cuttings on river sand and top soil showed no significant difference ($p<0.05$) throughout the 4MAP except at the 2MAP where top soil (16.560cm) outgrown river sand (16.212cm) and was significantly ($p<0.05$) higher.

Table 4: Effect of soil media on cuttings height

	Mean of plant height(cm) at month after planting (MAP)			
Soil media	1	2	3	4
River sand	0.0000^{b}	16.212^{c}	18.468^{b}	19.464^{b}
Top soil	0.0000^{b}	16.560^{b}	18.468^{b}	19.116^{b}
Soil mixture	15.1400^{a}	17.248^{a}	19.354^{a}	21.144^{a}
SEM	0.0343	0.1109	0.1621	0.3568

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

Effect of soil media on cuttings diameter

The effect of soil media on the cutting diameter of *Delonix regia* after 16 weeks of planting (WAP) is shown in Table 5. Result indicated that both the effect of soil media and IBA started manifesting after 10 WAP of observation.

The results consistently showed that cuttings in soil mixture had significantly ($p<0.05$) higher (3.708-4.0400cm) diameter than the other two treatments, followed by top soil (0.0000-3.5520cm), the lowest was recorded in river sand (0.000-3.212cm).

Table 5: Effects of soil media on cuttings diameter

	Weeks After Planting (WAP)			
	10	12	14	16
Soil media				
River sand	0.0000^{b}	0.0000^{c}	3.0400^{c}	3.212^{c}
Top soil	0.0000^{b}	3.0840^{b}	3.2920^{b}	3.5520^{b}
Soil mixture	3.7080^{a}	3.9360^{a}	4.0400^{a}	4.0400^{a}
SEM	0.0623	0.0550	0.0574	0.0466

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

Effect of soil media and IBA on number of leaves

The effect of soil media on number of leaves is shown in Table 6. Results at 1 MAP expressed significantly ($p<0.05$) higher foliage in cuttings planted on top soil (8.000), then soil mixture (5.000) and river sand (1.6000). Similarly at 2 MAP top soil was significantly ($p<0.05$) higher than river sand which in turn showed no significant ($p<0.05$) difference with soil mixture. At 3 and 4 MAP results showed no significant different ($p<0.05$) between all the soil media.

Effect of soil media on root length and root number

The effect of soil media on root length and root number of cutting of *Delonix regia* is shown in Table 7. Result indicated that there was no significant ($p<0.05$) difference in the root lengths of the cuttings planted on soil mixture (12.545cm) and top soil (12.605cm) after 4 MAP. Both soil mixture and top

soil showed significant differences ($p<0.05$) with river sand. In respect to the number of roots, result showed no significant difference ($p<0.05$) in all the soil media.

Table 6.Effect of soil media on number of leaves

	Months After Planting (MAP)			
	1	2	3	4
Soil media				
River Sand	1.6000^{c}	10.000^{b}	13.600^{a}	13.600^{a}
Top soil	8.0000^{a}	14.400^{a}	14.400^{a}	14.400^{a}
Soil mixture	5.000^{b}	12.200^{ab}	14.800^{a}	14.800^{a}
SEM	0.9230	1.7372	1.2584	1.2584

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

Table 7.Effect of soil media on root length and root number

	Root Length (cm) at 16 WAP	Root Number at 16 WAP
Soil media		
River Sand	8.475^{b}	1.1500^{a}
Top soil	12.605^{a}	1.1500^{a}
Soil mixture	12.545^{a}	1.1500_{a}
SEM	0.2914	0.1673

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

DISCUSSION

Effect of soil media on growth and rooting of *Delonix regia* stem cuttings

The cuttings planted on the soil mixture had the best result, although river sand had the fastest sprouting rate of 3 cuttings at 14 DAP which was later outnumbered by soil mixture. The result is in line with the work of Kareem *et al.*(2005) on *Albizia lebbeck* cuttings and they found that cuttings planted on potting mixture (cow dung + top soil + washed river sand) had the fastest sprouting rate. The nutrient status of the soil also probably determined the growth rate of the cuttings, nutrient status of soil mixture consisting of river sand, cow dung manure and top soil in ratio 1:1:1 was higher than that of top soil alone and top soil in turn was high than that of washed and sterilized river sand (Kareem *et al.,* 2002).Root length, plant height, number of leaves, and plant diameter were also significantly higher in soil mixture and top soil than river sand, this could be due to increased aeration and drainage leading to increased porosity that promotes root growth and development, also that nutrients in the soils are mostly found at top soil. Similar observation was reported by Olosunde and Fawusi (2003) that materials added to the top soil to form a good rooting medium included animal dung and animal composting. Soil mixture and top soil supported the longest cutting, the wider cutting and the highest number of leaves and sprouting percentage probably due to the high level of moisture content of the soils. (Scalabrelli *et al.,* 1983).the significance performance of cutting on soil mixture could also be attributed to better aeration and water drainage because high aeration are responsible for promoting root development (Olabunden and Fawusi, 2003, Puri and Thompson, 2003).Therefore the type of soil media used can have a major effect on the rooting and growth capacity of cuttings. An appropriate soil media generally has to have an optimal volume of gas filed pore space and oxygen diffusion rate adequate for the needs of respiration (Fonteno and Nelson, 1990). According to Caron *et al.,*(2000), media physical properties should not be constrained to just measurements of air filled porosity, water holding capacity and bulk density, but also gas exchange characteristic. The highest number of leaves, plant height and root length recorded in soil mixture may be due to easy translocation of water and minerals to the above ground parts of the cuttings considering the fact that it contain the combination of both river sand and top soil.

CONCLUSION

In conclusion, it is possible to get faster seedlings of *Delonix regia* through vegetative propagation by cuttings and also proper mixture of soil with other animal dungs at suitable ratio can enhance faster yield in the rooting and growth of the cuttings.

ACKNOWLEDGEMENT

We acknowledge the guidance of Dr. Abba Umar of the Department of Biological sciences, University of Maiduguri, Professor Buba Satsawa of the Department of Crop Sciences, University of Maiduguri, the technical assistance of Mallam Saleh of Soil science Laboratory University of Maiduguri and all staff of Green Comfortium nursery.

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