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Effective Cutting type in the Rooting of *Dalbergia melanoxylon* in Tanzania

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ABSTRACT
A study was conducted to assess the effective type of cutting in rooting of *Dalbergia melanoxylon*, a woody and non-domesticated species but of highly valued wood and wide spread in tropical Africa and overharvested. Softwood, semi-hardwood, hardwood and root cuttings were excised in wet season and dry season 2010. Soil rhizosphere of the sampled plants was used as potting media in a non-mist propagator in a split plot design. Rooting test was monitored for 3 months during the two seasons. Parameters recorded during the experiment included the proportion of cuttings that rooted, callused, sprouted and the number of roots per cutting.
The data were analyzed according to objectives and variables of the study using SPSS software. Results from each experiment were analyzed separately using ANOVA in SPSS software, while differences between treatment means were compared using Duncan Multiple Range Test. Results indicated 100% rooting softwood cuttings, 37% in root cuttings and none of the semi-hardwood and hardwood cuttings rooted. Softwood cuttings of less than 15gms outperformed others in rooting of *D. melanoxylon* followed by root cuttings. Plant propagators are advised to use softwood cuttings.

***Keywords*:** *Dalbergia melanoxylon*, non-mist propagator, root cuttings, semi-hardwood, softwood

INTRODUCTION

A cutting is any detached plant part which under favorable conditions will produce a new plant identical to the parent plant. Cuttings are classified into stem (softwood, semi-hardwood and hardwood cuttings), leaf bud cuttings and root cuttings. The type of cutting selected depends on the environment, season and the type of the plant (Magingo *et al*., 2001).

Softwood cuttings (<15g) are taken during the growing season, semi-hardwood cuttings (>15g) are taken from mid to the end of growing season, hardwood cuttings (>30g) are taken during the dormant season (Magingo *et al*., 2001).

All stem cuttings can be planted immediately after harvest or stored at 5^{o}C up to the time of planting. They are normally planted upright in a medium with top 2 to 3 buds above the medium (Magingo *et al*., 2001). Easier rooting of wood cuttings is initiated by making wounds at the basal side of a cutting.

Factors affecting rooting of cuttings vary with plant species, physical and physiological factors of the plant and the optimal conditions for rooting. For the case of physical factors, Leakey *et al*., (1990) suggested that the standard stem cuttings should have at least 1 to 4 nodes, 50 to 60mm long, leaf area of about 50cm^2, position of nodes depends on plant species. All these influence root initiation because they affect amount of stored food, transpiration and health of a cutting. Successful propagation of plant cuttings occur using optimum propagating conditions, optimum physical factors of cuttings, optimum physiological factors of cuttings, good rooting media and use of a non-mist propagator (Leakey *et al*, 1990). Optimum propagating conditions of plant cuttings include high humidity above 90%, moderate temperature (30-40^{0}C), low light intensity, suitable nutrients and rooting medium, protected cutting and rooting media from rain, winds, pests and pathogens (Leakey *et al*, 1990). Recommended physiological factors for rooting of cutting include origin of the plant species, age of the part of the plant to be used and ability of the cutting to produce endogenous growth hormone (auxin) (Leakey *et al*., 1990). Good rooting medium is the one which allows good aeration, retains high moisture, does not get water logged and promote root development (Leakey *et al*., 1990). Recently, researchers have preferred to use non-mist propagators as these provide a very practical and successful system for vegetative propagation of trees in many parts of the world. This study intended to investigate which cutting type can root easily for *D. melanoxylon.*

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***Dalbergia melanoxylon* plant**

Dalbergia melanoxylon Guill & Perr is a flowering plant that belongs to Family Leguminoseae and sub-family Papilionoidea. It is also known as African Blackwood, Zebrawood, African ebony and Mpingo (IUCN, 2008). It is a native to dry regions of Africa.

Status of *Dalbergia melanoxylon* in Tanzania

Dalbergia melanoxylon in Tanzania is classified as Lower Risk / near threatened, it means, it is neither endangered nor of least concern although it may be near threatened if propagation efforts are not instituted and therefore need conservation attention in Tanzania (Arbonnier, 2004).

Propagation efforts of *D. melanoxylon* in Tanzania

As an effort towards propagation of *D. melanoxylon* in Tanzania, the African Blackwood Conservation Project (ABCP) was established in 1996 (Msanga, 1999). Its purpose was to replenish the population of the African Blackwood, to sensitize the community on economic and ecological importance and seedling production for propagation of the species as well as conducting research on the species. Efforts by ABCP used natural regenerative method which is associated with low regenerative ability and therefore efforts were not very successful. Because of the extensive use of this wood for carvings, instrument and woodworking trades, its supply have been decreasing due to exploitation at an unsustainable rate (Msanga, 1999). Although the tree grows in other parts of Africa, the major supply is from Tanzania and Mozambique, countries which have ideal climatic conditions and a characteristic suitable to the specific uses of the wood materials for instrument and carving trades.

Because of over exploitation from its natural habitat, the tree is now commercially depleted in Kenya and in some areas of Tanzania. If present exploitation continued with no attempts to replant the trees. The ABCP propagation efforts were not based on advanced seedling production techniques but were based on seed germination which was limited by low seed viability and germinability. *D. melanoxylon* has not been cultivated extensively.

Previous Studies on *D. melanoxylon* in Tanzania

The IUCN (2008) reported that *D. melanoxylon* on one side have low regeneration ability while on the other hand is over harvested such that it is threatened in African countries like Kenya and categorized as Low/Risk near threatened in Tanzania. Previously, studies by Nshubemuki (1993), Mbuya (1994), Sharman (1995), and Msanga (1999) reported low seed viability of less than 30% in *D. melanoxylon* which is also associated with low seed germination and that the growth rotation period of the species is 70 to 100 years to attain a harvestable age. These reports are supported by recent studies conducted by Abornner (2004), Amri (2008), Washa (2008). Amri, (2010) Washa and Nyomora (2012) and Washa *et al* (2012). A study by Amri, (2008) reported that *Dalbergia melanoxylon* has low seed viability, seed germination and seedling rotational period. In a related study seed viability varied with different time of seed harvesting. On the other hand, Amri (2010) reported an increased rooting ability of 70% stem cuttings using root promoting hormones (IBA). This study intended to investigate what type of cutting is best rooted for propagation of *D. melanoxylon*

MATERIAL AND METHODS

Sampling procedures

Ten (10) individuals *Dalbergia melanoxylon* of within an approximate age between 1 to 2 years and separated by at least 20 meters apart were selected and labeled in Kilwa, Kilosa and Babati Districts of Tanzania. The criteria for selection were prevalence of dense populations of *Dalbergia melanoxylon*, habitat heterogeneity and their different geographical locations in Tanzania. A total of 100 softwood, 100 semi-hardwood and 100 hardwood cuttings each measuring 20cm long each, as well as 120 root cuttings measuring 10cm long each. Root was sampled according to Leakey *et al* (1990). Root cuttings were taken from the top soil within 15 cm of the tree root-soil zone. Roots were traced from their attachment to the stem before severing them from their stems using a matchet. A total of 120 kg of soil sample from soil rhizospheres were collected 5mm from their roots and used for potting medium in non-mist propagator. All samples were secured in cool boxes maintained at 5^{o}C and transported to Botany Department of the University of Dar es Salaam for rooting tests.

Experimental set-up and parameters assessed

A split plot experimental design was used in non-mist propagator whereby populations from the three sites were assigned to the main plot and cutting types were designated as sub plots. Each main plot used soil from its respective site. Treatment of cuttings was done according to Magingo *et al*., (2001). Stem cuttings were inserted in the medium at a depth of 20mm while root cuttings were inserted in the medium at a depth of 15mm as described by Leakey *et al*., (1990). Recordings were taken once a week and at every instance of opening the propagator, a thin spray of water was applied to maintain high and constant humidity. Parameters observed included sprouting, callus formation and rooting. Fungicide was occasionally sprayed inside the propagators to protect roots from rottening. Rooting experiments were conducted between January to August 2013

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Data analysis

Results from each experiment were analyzed separately. Significance of treatment means were tested using two ways ANOVA, while differences between treatment means were compared using Duncan Multiple Range Test.



a b c

Plate 1. (a) Rooted softwood (b) Rooted root cuttings (c) Sprouted callused hardwood and semi-hardwood but not rooted

RESULTS

Table 1 indicated significant differences at ($P<0.05$) in rooting between cutting types, that is 100% in softwood cuttings, 37% in root cuttings and none of the semi-hardwood and hardwood cuttings rooted as presented by Plate 1. Table 2 indicated that there were no significant differences in rooting percentage between different populations which averaged 1.75%, 1.60% and 1.50% of rooting for Kilosa, Babati and Kilwa provenances respectively.

Table 1: The proportion of rooting, callusing and sprouting between cutting types

	Rooting parameters		
Cutting type	Rotting	Callusing	Sprouting
Softwood	100	50 ±4	50 ±9
Semi-hardwood	00	50 ±4	90 ±9
Hardwood	00	50 ±4	85 ±9
Root	37	67 ±4	70 ±9

Table 2: The proportion of rooting parameters between sampling sites

Parameter	Location			
Rooting parameter	Kilosa	Babati	Kilwa	Mean
Rooting status (%)	1.73	1.60	1.50	1.30 ±0.42
No. roots/cutting	0.95	0.91	2.01	1.30 ±0.50
Root length (cm)	0.94	1.02	8.22	3.37 ±0.52

DISCUSION

Using a non-mist propagator in this study was to provide equal optimal rooting conditions to all of the used type of cuttings but also was to protect the cuttings and rooting medium from winds, rain drops and pests (Leakey *et al*., 1990). Differences in tissue allocation to different parts of the plant in high plants seem to be a reason for different ability of rooting in these parts of the plant (Esau, 2006). Actively dividing cells in high plants are of two types namely

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apical meristematic cells and lateral meristems which are divided into intercaraly meristem, cambium and cork cambium cells (Esau, 2006).Both types are concern with growth of the plant body where as apical meristems are for elongation of the plant part and the lateral meristems are for increase in width of the plant body (Esau, 2006). The two growth characteristics occur in different direction of the plant where as elongation occur at the tip of root or the tip of the shoot while increase in width occur in horizontal direction of the plant (Esau, 2006). This is to say apical meristems are found at root tips and shoot tips of plants and lateral meristems are found at the side of the plant. Softwood cuttings which are taken by counting node 1 to node 3 from the tip of the shoot are mostly leafy and mostly less than 15gms by weight. They have initial cells which divide continuously thought the life of the plant, as they divide the derivative cells tends to accumulate in tip areas as a result the tip areas elongate upward or downward. On the other hand accumulation of derivative cells in the side of the plant by lateral meristems a plant increase horizontally this is why semi-hardwood and hardwood cuttings in this study callused and sprouted highly compared to softwood and root cuttings because their cells are not special for elongation. Softwood and root cuttings rooted because their cells are special for elongation.

CONCLUSION AND RECOMMENDATION

Dalbergial melanoxylon, a woody and non-domesticated species can be easily rooted by softwood cutting of less than 15gms by weight in a non-mist propagator. Root cuttings can be hardly be used in case of absence of the softwood cuttings. Propagators can use softwood cuttings to enhance propagation of the species.

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