Proceedings of 15th of Agricultural Research Symposium (2016) 407-410

Multiplication of Teak (*Tectona grandis*) by Using Stem Cuttings and Sapling Cuttings: Effect of Indole Butyric Acid and Roocta Commercial Hormone

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ABSTRACT

Teak (*Tectona grandis*) is an important plantation tree species in the tropics. Teak seeds have poor germination ability. Therefore, an alternative method is required for mass multiplication of teak trees. The study was performed to explore multiplication techniques of teak by using sapling cuttings (C_1) and stem cuttings (C_2). Cuttings were planted in order to test three treatments, distilled water (H_1), 500 ppm Indole Butyric Acid (H_2) and Roocta commercial hormone (H_3). The cuttings were dipped in Indole Butyric Acid solution for 24 h before planting. Roocta commercial hormone was applied in its powder form just before plant. Sand (M_1) and sand: top soil: compost; 1:1:1 (M_2) two rooting media were used. Pencil sized 4 cm length cuttings were used for experimental planting. All the cutting types were raised inside a protected house. Treatments were arranged with Three Factor Factorial Design with three replicates. The cuttings were removed from the rooting medium 60 days after establishment. Observations were recorded on several parameters. H_3 recorded the highest values for number of leaves, maximum leaf length and maximum leaf area. The highest number of leaves was recorded in C_1 cutting type. The highest number of shoots were recorded in $C_1M_1H_1$ interaction. The highest shoot length was recorded in M_2H_3 interaction. The highest number of callus were recorded in M_1H_1 interaction, M_1C_1 interaction and C_1H_1 interactions. Therefore sapling cutting (C_1), sand media (M_1) and Roocta hormone (H_3) can be used for vegetative propagation of teak to get higher growth.

KEYWORDS: Multiplication techniques, Sapling cuttings, Stem cuttings, *Tectona grandis*

INTRODUCTION

Teak *(Tectona grandis)* is a highly valuable and most demanded timber producing tree of the tropics suitable for monoculture planting. Higher demand in national and international timber markets for teak wood is mainly due to superior physical and mechanical properties of timber. Teak has been introduced to Indonesia, Malaysia, Sri Lanka, Africa, South America, Central America and Australia, while it is widely distributed in natural forests in India, Myanmar, Laos and Thailand under different climatic conditions (Anon, 2012).

Increase the extent of teak plantations has been a vital necessity according to fulfill wood requirements of the current global population. This can be achieved with the improvement of the quality of planting stock, which gives more quality timber in shorter rotations. Although, teak seeds are abundant, natural regeneration is variable. As seeds have low viability up to 20-35% (Hedegart, 1974) Therefore, teak forests are generally regenerated artificially by seeds. Teak seeds are often affected by a number of eco-climatic factors such as hard pericarp which limits water and oxygen supply to seed, physiological immaturity of seed and chemical inhibiters present in the pericarp (Tewari, 1992).

Vegetative propagation can play a key role in tree improvement programs as a means of large scale multiplication of superior clones or tested plus trees. Vegetative propagation for teak was done by traditional methods and tissue cultural techniques (Akram and Aftab, 2009).

Vegetative propagation of *Tectona grandis* is not a common practice in Sri Lankan forest tree nurseries due to lack of knowledge on the performance of this practice as mass propagation technique.

Therefore, the objective of this study was to understand the individual as well as interactive effects of cutting types, media types and Indole Butyric Acid, Roocta treatments on early growth performances of teak seedlings. Furthermore, findings of this study to be usefulness in developing a technology for large scale multiplication of teak plants. The standardization of this research methodology would be of enormous benefit for teak planters and producers in various ways.

MATERIALS AND METHODS

Location

The study was conducted at the Forest Research Center, Kumbalpola, Kurunegala from January to May 2016.

Layout of Experiment

Treatments were arranged in Three Factor Factorial Design with three replicates. There were three treatments. Eight plants per replicate planted in root trainers in order to test three different treatments. Further, two of media sand (M_1) and sand: top soil: compost; 1:1:1(M_2) were used to test their effect on growth performances.

Collection of Materials

Superior plus trees of teak were selected from a 14 year aged monoculture teak plantation located at Kumbalpola, for obtaining stem cuttings (C_2). The sapling cuttings (C_1) were taken from 3 year old saplings which germinate from seeds exclusively for the experiment.

Treatments

The control was dipped in distilled water (H_1) for 24 h before planting. All the other cutting types were treated with 500 ppm Indole Butyric Acid (H_2) and Roocta commercial hormone (H_3). Roocta hormone is a blend of auxin, Indole Butyric, Indole Acetic Acid and Naphthalene Acetic Acid. The cuttings were dipped in Indole Butyric Acid solution for 24 h before they plant. Roocta was applied in its powder form just before plant as the third treatment method.

Establishment of Cuttings

Pencil sized 4 cm length cuttings were used for experimental planting. Slant cut was made at the bottom of each cutting in order to increase the surface area for rooting. All the cutting types were raised in root trainers in a mist chamber at 36/30 °C (day/night) and 85±2% relative humidity with insect proof UV treated polythene roof. pH was maintained at 7 for better results.

Measurements of Growth Parameters

Therefore, the cuttings were carefully removed from the rooting medium 60 days after the establishment. Earlier trials had shown that, rooting of teak cuttings can be measured after 60 day. Observations were recorded on following growth parameters.

Number of Shoots

The number of shoots on a cutting was counted.

Number of Leaves

The number of leaves on the cutting was counted.

Leaf Length (cm)

The length of the leaf was recorded from the tip of the leaf to the base of the leaf.

Leaf Area (cm^2)

The total leaf area was measured using grid method.

Shoot Length (cm)

The length of the shoot was recorded from the end of the shoot to the base of the cutting.

Formation of Callus

Callus formation was recorded at the base of the stem cutting.

Statistical Analysis

Data were analyzed by using Analysis of variance (ANOVA) with MINITAB 17 statistical package.

RESULTS AND DISCUSSION

Table 1 illustrates the effect of individual experimental conditions and their interactive effect on predetermined growth parameters of young teak seedlings.

Growth Parameters

Number of Shoots

Table 2 shows average number of shoots in different treatment combinations. Average number of shoots ranged from 0.5 to 1.75 and the highest average number of shoots (1.75) were recorded in $C_1M_1H_1$ combination. The lowest average number of shoots (0.5) were recorded in $C_1M_1H_2$ combination. Further, according to the p values of Table 1, cutting type, treatment and interaction effect of media and treatment combination, cutting type and treatment. combination, media cutting type and treatment combination have effects on number of shoots (Table 2).

Number of Leaves

Cutting type and treatment have effects on number of leaves (Table 1). Table 3 shows effect of three different treatments on leaf area, leaf length and number of leaves of young teak plants.The highest mean number of leaves (2.93) were recorded in H_3 whereas the lowest mean number of leaves (0.86) were recorded in H_2 treatment. However, number of leaves in H_1 and H_3 were not significantly different (Table 3). Further, effect on cutting type on number of leaves shows in the Table 4. C_1 cutting type had the highest mean number of leaves (2.43) whereas C_2 cutting type had the lowest mean number of leaves (1.94).

Table 1. P values for leaf area, number of shoots, shoot length, number of leaves, leaf length and callus formation

Source	Leaf area	Number of shoots	Shoot length	Number of leaves	Leaf length	Callus
Media	0.772	0.070	0.820	0.307	0.535	0.002*
Cutting type	0.413	0.008*	0.017*	0.012*	0.278	0.929
Treatment	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
Media*Cutting type	0.172	0.375	0.224	0.315	0.260	0.009*
Media*Treatment	0.317	0.018*	0.021*	0.154	0.155	0.000*
Cutting type*Treatment	0.417	0.017*	0.057	0.543	0.124	0.000*
Media*Cutting type*Treatment	0.356	0.001*	0.336	0.124	0.452	0.202

**p values are significantly different at 0.05 level*

Table 2. Mean number of shoots

Cutting type	Media	Hormone	Mean number of shoots
C_1	M_1	H_1	1.75^{a}
C_1	M_1	H_2	0.5^{b}
C_1	M_1	H_3	0.96^{a}
C_1	M_2	H_1	1^{c}
C_1	M_2	H_2	0.92^{b}
C_1	M_2	H_3	1.21^{abd}
C_2	M_1	H_1	1.17^{ab}
C_2	M_1	H_2	1.08^{ab}
C_2	M_1	H_3	1.36^{abd}
C_2	M_2	H_1	0.63^{ad}
C_2	M_2	H_2	0.58^{abd}
C_2	M_2	H_3	0.63^{ac}

Means in same superscript letters are not significantly different at 0.05 probability level. C_1– Sapling cutting, C_2-Stem cutting, M_1-Sand, M_2-Sand: top soil : compost ; 1:1:1, H_1-Control, H_2-500 ppm IBA, H_3-Roocta commercial hormone

Leaf Length (cm)

Further, results reveal that, treatment has an effect on leaf length according to the p values in Table 1. According to the Table 3, the highest mean leaf length (4.09 cm) was recorded in $H_3$and the lowest mean leaf length (0.78 cm) was recorded in H_2. Although, mean leaf length in H_1 and H_3 were not significantly different.

Leaf Area (cm^2)

Based on the results of ANOVA test, treatment has an effect on leaf area (Table 1). H_3 treatment recorded the highest average leaf area (6.47 cm^2) while the lowest average leaf area (1.09 cm^2) was recorded in H_2 treatment. Values for H_1 and H_3 were not significantly different (Table 3).

Shoot Length (cm)

Cutting type, treatment, media and treatment interaction have effects on shoot length (Table 1). The highest shoot length (2.18 cm) was recorded in M_2H_3 combination and the lowest shoot length (0.38 cm) was recorded in M_1H_2 combination. Shoot lengths measured in M_1H_1, M_1H_3 and M_2H_3 combinations were not significantly different from each other (Table 6).

Callus Formation

Callus formation is important to root initiation. Therefore, different conditions and results are shown in the Table 5, 6 and 7. M_1H_1, M_1C_1, C_1H_1 interactions were recorded the highest callus formation for root initiations in both cutting types.

Table 3. Variation of leaf area, mean leaf length, mean number leaves in three different hormone levels

Hormone	Mean of leaf area	Mean of leaf length	Mean number of leaves
H_1	6.32^{a}	3.37^{a}	2.76^{a}
H_2	1.09^{b}	0.78^{b}	0.86^{b}
H_3	6.47^{a}	4.09^{a}	2.93^{a}

Means in a column same superscript letters are not significantly different at 0.05 probability level. H_1-Control, H_2-500ppm IBA, H_3-Roocta hormone

Table 4. Variation of number of leaves in two types of cuttings

Cutting type	Mean of number of leaves
C_1	2.43^{a}
C_2	1.94^{b}

Means in a column same superscript letters are not significantly different at 0.05 probability level.C_1-Sapling cutting, C_2- Stem cutting

Table 5. Variation of callus formation in two types of cuttings grow in two growing media

Media	Cutting type	Mean callus formation
M_1	C_1	0.26^{a}
M_1	C_2	0.19^{a}
M_2	C_1	0.04^{a}
M_2	C_2	0.11^{ab}

Means in a column same superscript letters are not significantly different at 0.05 probability level. C_1 - Sapling cutting, C_2- Stem cutting, M_1- Sand, M_2-Sand: top soil: compost; 1:1:1

CONCLUSIONS

In this experiment, among three used hormones Roocta (H_3) recorded the highest value for number of leaves, leaf length and leaf

Table 6. Variation of average shoot length and callus formation in cuttings treated with two types of hormone and grow in two growing media

Media	Hormone	Shoot length mean cm	Callus formation
M_1	H_1	2.08^a	0.46^a
M_1	H_2	0.38^b	0.04^b
M_1	H_3	1.75^a	0.19^b
M_2	H_1	1.06^{ab}	0.08^b
M_2	H_2	0.45^b	0^b
M_2	H_3	2.18^a	0.15^{bc}

Means in a column same superscript letters are not significantly different at 0.05 probability level. M_1- Sand, M_2- Sand: top soil: Compost; 1:1:1, H_1- Control, H_2- 500ppm IBA, H_3- Roocta commercial hormone

Table 7. Variation of callus formation in two types of cutting types treated with three hormone levels

Cutting type	Hormone	Mean callus formation
C_1	H_1	0.36^a
C_1	H_2	0.04^a
C_1	H_3	0.04^{ab}
C_2	H_1	0.17^b
C_2	H_2	0^a
C_2	H_3	0.29^a

Means in a column same superscript letters are not significantly different at 0.05 probability level. C_1- Sapling cutting, C_2- Stem cutting, H_1- Control, H_2- 500ppm IBA, H_3- Roocta commercial hormone

area. The highest number of leaves was recorded in sapling cutting (C_1). The highest number of shoots were recorded in $C_1M_1H_1$ interaction. The highest shoot length recorded in M_2H_3 interaction. The highest number of callus were recorded in M_1H_1 interaction, M_1C_1 interaction and C_1H_1 interaction. Therefore, the findings of this study revealed that sapling cutting (C_1), sand media (M_1) and Roocta hormone (H_3) can be used as preliminary guidelines for vegetative propagation of teak to get higher growth performances in young teak plants.

ACKNOWLEDGEMENTS

The authors wish to express their sincere gratitude to Mrs. R.M.D. Alawathugoda, Chief Research Officer, Forest Research Center, Kumbalpola, Boyagane for her kind permission to conduct this research at Forest Research Center and all the staff members of Forest Research Center for their support. Thanks to Dr. N.R. Abeynayake, head of the Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, and Miss. S.T. Rathnayake for their guidance in statistical analysis.

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