2012 International Conference on Environmental, Biomedical and Biotechnology
IPCBEE vol.41 (2012) © (2012) IACSIT Press, Singapore

Effects of Cutting Positions and Different Levels of Indolebutyric Acid (IBA) on the Survival and Rooting Ability of Tindalo [Afzelia rhomboidea (Blanco) Vidal]

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Abstract. The effects of cutting positions and different levels of IBA on the survival and rooting ability of Tindalo (*Afzelia rhomboidea*) were investigated. Cutting positions significantly affected by most of the parameters evaluated except the percent callused cuttings without developed roots. The highest percent survival (82.76%), percent rooting (83.66%), number (3.53 cm) and longest (5.58 cm) adventitious roots and shoots (2.04 cm) were exhibited by top most cuttings, while the lowest emerged from bottom cuttings. Top cuttings found comparable to middle cuttings. Different IBA levels significantly influenced the percent survival, percent rooting and the percent callused cuttings without roots but not affecting the number and length of adventitious roots and shoots. Stem cuttings treated with 1000 ppm IBA exhibited the highest percent survival (80.05%) and percent rooting (81.61%) but found comparable to cuttings treated with 500 ppm. Interaction between cutting positions and IBA levels was significant on percent callused cuttings without roots that developed. Findings of the study implies that Tindalo can best propagated by cuttings from the top and middle of the stem using 500 ppm IBA treatment to effectively induce maximum survival and rooting, and to economically regenerate quality planting stocks of Tindalo making it available to the desired recipients.

Keywords: Stem cuttings, Survival, Rooting, Afzelia romboidea, Indolebutyric Acid

1. Introduction

Tindalo [*Afzelia rhomboidea* (Blanco) Vid.] of the family Caesalpiniaceae is an endemic tree in the country that plays an important role in ecosystem processes such as in biochemical and hydrological cycles. It also provides habitat for wildlife and offers protection against soil erosion (Pandey, 2002). In this era of global warming, endemic trees help mitigate the effects of climate change and maintain ecosystem functioning (Forest and White, 2002).

Tindalo is a leguminous tree species and it is considered as one of the finest wood in the country (Florido, 2001). It belongs to the Molave type forest which is valued for its natural beauty and durability (DENR, 2001).

At present, the global conservation status of Tindalo is endangered both on 2001 by the Genetic Resource Conservation for Timber of the Philippines (Fernando, 2001) and in July 2002 by the Rainforest Action Network (2002).

To improve its endangered status, cutting and gathering of Tindalo requires special permission from the DENR as embodied under DENR Administrative Order (DAO) No. 78 series of 1987. The DENR also launched the National Forestation Program where Tindalo was listed as one of the priority species for secondary forest sites as a regeneration strategy for the specie but Aguda, (2003) asserted that quality planting materials are still limited.

Vegetative propagation technique by stem cutting has been recognized as a method of mass propagating exact copies of desirable plants for clonal plantation, reforestation and for commercial purposes (Follosco-Edminston, 2002). Hudson (1997), also asserted that due to the shortened time requirements for cuttings of superior trees to root and grow, this method of reproduction is fast becoming a very important nursery management tool that answers the dilemma of speeding up the process of planting stock production.

This study was carried out to determine the best position of the stem cuttings in the branch and the most economical level of IBA concentration to effectively induce maximum survival and rooting for the regeneration of quality planting stocks of Tindalo through stem cuttings making it available to nursery and plantation owners.

2. Materials and Methods

Wildlings with straight stem and healthy leaves, 0.1 to 0.2 meters high were earth balled from forest areas at Magulon, Lamut, Ifugao. These were raised and acclimatized in the Quirino State College nursery condition. They were used 3 months after collection, at which time; the stem and shoots where already 0.9 m. long with 6-10 nodes.

A total of 360 stem cuttings were obtained from the seedlings for the study. These were separated into three types; the first, contained nodes 1-3 (top), second, had node numbers 4-6 (middle) and third, contained nodes 7-9 (bottom). Leaves were reduced to half of their original sizes to reduce water loss through transpiration.

The cuttings were treated with indolebutyric acid (IBA), all at five levels of 0, 500, 1000, 1500 and 2000 ppm. Their bases were evenly immersed at 2 cm deep in their respective rooting solution for 30 minutes. After auxin treatment, the cuttings were set in germination tray containing sterilized river sand at a rate of 24 cuttings per tray. Thereafter, the trays were placed in an improvised propagating chamber covered with clear plastic and watered in the morning and afternoon with fine meshed sprayer. The complete randomized design in a 3 x 5 factorial experiment was used in setting the cuttings.

Assessment was done after 3 months, for the following parameters;

- Percent survival
- Percent rooting
- Percent callused cuttings without roots that developed
- Number and length of adventitious roots and;
- Length of shoots of Tindalo stem cuttings

3. Results and Discussion

3.1. Percent Survival

Percent survival was significantly influenced by cutting positions and levels of IBA treatment but not significantly affected by the interaction between cutting positions and levels of IBA (Table 1).

Highest survival rate (82.76%) was observed in the cuttings emerging from top position while cuttings taken from the bottom position exhibited the lowest (50.43%). Middle cuttings (70.33%) were significantly greater than the bottom cuttings (50.43%) but it was found comparable to top cuttings (Table 2). This means that the younger the cuttings, the higher survival can be expected. Aminah et al., (1991) explained that cuttings taken from basal part of the stem have more matured and suberization of cells may inhibit survival and root formation.

Among the levels of IBA treatment used, 1000 ppm had the highest percent survived cuttings (80.05%) followed by 500 ppm (74.72%) and the least was exhibited by the control (44.55%). IBA treatment levels significantly increased the percent survival of Tindalo stem cuttings; however results showed that higher IBA levels were found comparable to 500 ppm of IBA treatment. This showed that 500 ppm of IBA was found the most economical among the IBA levels (Table 3).

The data further showed that 1000 ppm of IBA was the optimum concentration that induced the highest percentage of survival in Tindalo cuttings; however, a decrease of its percent survival was observed as IBA levels applied increases.

3.2. Percent Rooting

The cutting positions and IBA levels significantly increased the percentage of rooted Tindalo cuttings, while their interaction had no significant effect on rooting of Tindalo cuttings (Table 1).

Top cuttings produced significantly the highest rooting percentage (83.66%) while the bottom cuttings recorded the lowest (53.26%). The middle cuttings were found comparable to top cuttings (Table 2). This means that best rooting performance was achieved using the top and middle cuttings.

IBA levels came out to have great effect on rooting of Tindalo cuttings. The different levels of IBA concentrations applied induced rooting that was significantly higher than the untreated cuttings (0 ppm). Cuttings treated with 1000 ppm recorded the highest rooting of 81.61% but found comparable to cuttings treated with 500 ppm, 1500 ppm, 2000 ppm with percent rooting of 75.72%, 75.61% and 67.66% respectively. The data further showed that 500 ppm of IBA is the most economical level to induce root formation of Tindalo cuttings (Table 3).

Table 1: Summary of the analysis of variance of the different parameters assessed in the study

Treatments	% Survival	% Rooting	% Callused cut - tings w/o roots	Number of Adv. Roots	Length of Adv roots	Length of shoots
Cutting Position (C)	9.88**	9.72**	< 1 ns	11.04**	14.89**	3.53*
IBA levels (T)	4.33**	4.37**	8.75**	2.14 ns	1.09 ns	<1 ns
C X T	<1 ns	1.34 ns	2.88**	1.13 ns	<1 ns	1.04 ns
CV (%)	9.6	7.4	4.26	23.12	5.29	7.01

** Significant at 1% * Significant at 5% ns = not significant

3.3. Percent Callused Cuttings with out Roots that developed

Percent callused cuttings with out roots that developed was not affected by the cutting positions but significantly affected by the different levels of IBA and its interaction effect with cutting positions (Table 1). It means that the IBA treatments had affected the percent callused cuttings without roots regardless of cutting positions.

The different levels of IBA treatment in Tindalo stem cuttings significantly decreased the percentage of callused cuttings without roots that developed. Results showed that cutting treated with 1500 ppm, 2000 ppm and 1000 ppm of IBA were not significantly different from each other; however, cuttings treated with 500 ppm of IBA were also found comparable to cuttings with 1000 ppm and 2000 ppm IBA treatment. It was also found that most of the dead cuttings when observed were those treated with 1500 ppm and 2000 ppm. And when these were uprooted and examined they were rotten and there were no traces of callus and root formation. This means that 500 ppm of IBA was still the most effective level and most economical among the IBA level that significantly decreased the percentage of callused cuttings with out roots (Table 3).

IBA levels of 1500 ppm and 2000 ppm were too high which produced toxic substances inhibiting callus and root development that eventually causes death of the stem cuttings. Pollisco (2002), explained that the effective concentrations of rooting hormone is that below the toxic point that is optimal for callus and root formation.

Table 2: Summary of results of the parameters investigated as affected by the different cutting positions.

Different Cutting Positions	% Survival	% Rooting	% Callused cuttings w/o roots	Number of Adv. Roots	Length of Adv roots	Length of shoots
Top most cuttings	82.76 a	83.66 a	14.16	3.53 a	5.58 a	2.04 a
Middle Cuttings	70.33 a	72.00 a	9.16	1.42 b	2.76 b	1.67 b
Bottom cuttings	50.43 b	53.26 b	6.16	1.00 b	1.83 b	0.94 b
F computed	9.88**	9.72**	< 1 ns	11.04**	14.89**	3.53*
CV (%)	9.6	7.4	4.26	3.12	5.29	7.01

Column means followed by common letter are not significantly different at 5% level based on DMRT.

3.4. Number and Length of Adventitious Roots

The effect of cutting positions were significant on the number and length of adventitious roots of Tindalo cuttings but not affected by the different IBA levels and the interaction effect between cutting positions and IBA levels (Table 1).

The highest number of roots (3.53) and the longest length (5.58 cm) were significantly exhibited by the topmost cuttings followed by stem cuttings severed from the middle part with number and lengths of 1.42 cm and 2.76 cm respectively. Better rooting of top cuttings may be explained by the possibility of higher concentration found in the terminal bud of the plant (Hartman et al.,1990). This confirmed that top cuttings of Tindalo are more active and best materials for vegetative reproduction.

3.5. Length of Adventitious Shoots

The length of adventitious shoots was significantly affected by the location from which the cuttings were obtained (Table 1). Comparison of treatment means showed that top cuttings had significantly longer adventitious shoots (2.04 cm) than the shoots emerged from the middle position (1.67 cm) and the bottom position (0.94 cm); however, the data showed that the middle cuttings produced adventitious shoots that were comparable to the shoots developed in the bottom cuttings (Table 2).

Different levels of IBA concentration showed no significant effect on the length of adventitious shoots (Table 3). The concentration of endogenous auxin rises to the point that roots are initiated on the callus after which, the roots will produce cytokinins that will be transported acropetally. As the concentration of cytokinins accumulates, it stimulates shoot formation (Eartey, 2007). This probably explains why within the three-month duration of the study, IBA application was significant in root formation but not in shoot development.

Table 3: Summary of the effects of IBA levels on the different parameters evaluated.

Different Levels of IBA	% Survival	% Rooting	% Callused cuttings w/o roots	Number of Adv. Roots	Length of Adv roots	Length of shoots
T0 - Control	44.55[b]	47.61[b]	23.61 [a]	1.28 [a]	2.24 [a]	1.34[a]
T1 - 500 ppm	74.72[a]	75.72[a]	13.88 [b]	2.48[a]	3.84 [a]	2.08[a]
T2 -1000 ppm	80.05 [a]	81.61[a]	8.33 [bc]	2.80[a]	4.05[a]	1.52[a]
T3 - 1500 ppm	73.83 [a]	75.61 [a]	0 [c]	1.97 [a]	3.88 [a]	1.11 [a]
T4 - 2000 ppm	66.05[a]	67.66 [a]	4.16 [bc]	1.88 [a]	2.95 [a]	1.71 [a]
F computed	4.33**	4.37**	8.75**	2.14 [ns]	1.09 [ns]	<1 [ns]
CV (%)	9.6	7.4	4.26	3.12	5.29	7.01

Column means followed by common letter are not significantly different at 5% level based on DMRT.

4. Conclusion

The study found that Tindalo stem cuttings were effectively rooted and survived using the top and middle cuttings and with the use of 500 ppm of IBA concentration to economically produce cloned seedlings. This shows that young cuttings of Tindalo combined with lower dose of IBA have been found appropriate for the production of quality Tindalo seedlings through stem cuttings available for nursery and plantation owners.

However, further studies recommended in evaluating the influence of auxin type, leaf size, age of cuttings and different propagation media in order to be more successful in the regeneration of quality planting materials of Tindalo through stem cuttings and help establish baseline data in the clonal propagation program of Tindalo.

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