MACROPROPAGATION OF *SHOREA GUISO* USING STEM CUTTINGS

H. P. Patricio[1], Y. T. Castañeto[2,*], A. P. Vallesteros[2] & E. T. Castañeto[2]

[1]*DENR- ERDS - 02, Carig, Tuguegarao City, Philippines*
[2]*NVSU College of Forestry Bayombong, 3700 Nueva Vizcaya Philippines*

Shorea guiso (guijo) of the family Dipterocarpaceae is one of the most important hardwood species used in general construction, beams, joist and other parts of houses, and wood material for vehicle framing (native carts and carriages). It is widely distributed in the Philippines and a dominant species in primary forest at low altitude (Florido *et al.* 1998). In logging operations, *S. guiso* and other dipterocarps were not spared from indiscriminate cutting. A major portion of our dipterocarp forest has been devastated and transformed into grassland and brushland.

To save *S. guiso* from extinction the Department of Environment and Natural Resources (DENR) had embarked on several conservation and regeneration strategies and considered *S. guiso* as one of the priority species for reforestation of unproductive logged-over areas and enrichment planting under established reforestation areas. Initial attempts to regenerate this species in logged-over areas using wildings revealed that the survival and growth were very low. The effort to regenerate this species is seriously hampered by its phenological characteristics (PCARRD 1977) such as irregular flowering and fruiting, poor seed viability and unavailability of seeds or mother trees.

As an alternative production strategy, the objective of this study was to determine the possibility of using stem cuttings for propagating *S. guiso* and to determine the effects of different rooting media, levels of IBA and their interaction on rooting and survival of macropropagated *S. guiso*.

Stem cuttings were collected from 19-month-old *S. guiso* in a hedge garden of the Magat Forest Research Station. The average stem diameter of cuttings was 0.3 cm. The cuttings were separated into two-node with a pair of leaves from the apex. The base of each cutting was cut with a slant. The leaves were cut into half of their original size to reduce transpiration. Cuttings were disinfected by soaking in a prepared Rover fungicide (six tablespoonfuls of fungicide per 16 l of water) containing an active ingredient of chlorothalonil for 30 min. The cuttings were bundled into 24 pieces representing the number of assessment units per treatment, and basal 0.5–1.0 cm was dipped into distilled water (0 ppm), 500 ppm or 1000 ppm prepared indolebutyric acid (IBA) solutions for an hour. A total of 216 cuttings were placed in one non-mist propagator with a dimension of 150 × 300 × 500 cm supported by a flat bar frame and enclosed with a transparent polyethylene plastic sheet gauge number 8. There were three replications (blocks) with 8 cuttings per replication and 24 cuttings per treatment.

Rooting media were pure river sand (T_1), partly decomposed rice hull (T_2) and a 1:1 ratio by volume pure river sand and partly decomposed rice hull (T_3). Each rooting medium was sterilized by direct exposure to sunlight for five days, then drenched with fungicide as described above before placing it in a Hiko tray. A Hiko is a black plastic tray of 21 cm width, 34 cm length and 10 cm height. It has 24 holes with 4.5 cm diameter and 10 cm height.

The experimental design was a 3 × 3 factorial experiment in completely randomized design (CRD). Treatment A represents the rooting media [pure river sand (T_1), partly decomposed rice hull (T_2), combination of river sand and partly decomposed rice hull (T_3)], while treatment B represents IBA concentrations [distilled water (0 ppm), 500 ppm, 1000 ppm] with a total of nine possible treatment combinations replicated three times. Assessment of treatment effects was done after 100 days using % survival (percentage of cuttings with roots and shoots divided by the total number of cuttings planted), number and length of adventitious roots (measured using a ruler), % cuttings with shoots (total number of cuttings with shoots divided by the total number of cuttings planted), % cuttings with roots (total number of cuttings with roots divided by the total number of

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** Author for correspondence. E-mail: yul0216@yahoo.com*

cuttings planted). These parameters were analysed using analysis of variance (ANOVA). Duncan's multiple range test (DMRT) was used as described by Gomez and Gomez (1984) in the comparison of treatment means.

ANOVA in Table 1 showed that survival of cuttings were affected by rooting media, concentration of IBA and its interaction. Number of adventitious roots was only affected by the concentration of IBA. Length of adventitious roots was affected by the concentration of IBA and interaction between rooting media and concentration of IBA.

Per cent survival (with roots and shoots) of *S. guiso* in different rooting media after 100 days showed significant differences between treatments (Table 2). Survival of cuttings ranged from 71 to 83%. The combination of river sand and rice hull (A_3) had the highest mean survival (83%), while rice hull (A_2) gave the lowest survival (71%). There was an increase of 17% survival using river sand and rice hull over that of using rice hull alone. The use of pure river sand (A_1) as rooting medium was comparable with a combination of river sand and rice hull (A_3) with 80%. The same finding was noted in rooting percentage in Edea provenance of *Lovoa trichilioides* where rooting percentage increased using coarse sand (78%) than a combination of coarse sand and forest topsoil (45%) as observed by Tchoundjeu and Leakey (2001). Contrasting result was found in *Milicia excelsa*. Cuttings inserted in pure sawdust and in a mixture of coarse sand and sawdust displayed higher rooting percentages than those in coarse and fine sand (Ofori *et al.* 1996).

However, using different rooting media did not improve the production of adventitious roots (number and length) of *S. guiso* cuttings (Table 2). The average number of adventitious roots was 6 and 7, while length was 3.3 to 3.7 cm.

Application of IBA increased % survival by 16% for cuttings treated with 500 ppm IBA (86%) over untreated (74%) cuttings (Table 3). However, doubling the concentration of IBA to 1000 ppm did not improve the survival. Untreated *S. guiso* cuttings (B_1) and those treated with 1000 ppm IBA (B_3) had shorter roots, while those stem cuttings that received 500 ppm IBA (B_2) had tough and long adventitious roots with several second-order roots or root hairs. In *Milicia excelsa*, 0.2% IBA treatment increased the final rooting percentage by 9% above that of the control (Ofori *et al.* 1996). Likewise, hormone application in *Eucalyptus camaldulensis* increased the root number and root vigour but not the rooting percentage (Pong-anan & Wongmanee 1990). Similarly, in *Intsia bijuga*, treating cuttings with IBA did not give significant differences in per cent survival of cuttings (Castañeto & Inhumang 2004).

The mean number of adventitious roots formed ranged from 6 to 8 (Table 3). Cuttings treated with 500 ppm IBA (B_2) gave the highest number of adventitious roots, over those of the control and those treated with 1000 ppm IBA. The number of adventitious roots was improved in 500 ppm IBA (8) as compared with the untreated (6) cuttings. The same finding was noted in *E. camaldulensis*, which gave

Table 1 Summary of the analysis of variance on % survival, number and length of adventitious roots of *S. guiso* cuttings

Source of variation	% Survival	Adventitious root	
		Number	Length (cm)
Rooting media (A)	10.76 **	1.78 ns	0.69 ns
Concentration of IBA (B)	11.62 **	9.34 **	19.44 **
A × B	3.42 *	1.20 ns	3.90 *
CV (%)	7.36	18.84	20.43

* Significant ($p < 0.05$), **highly significant ($p < 0.01$), ns not significant

Table 2 Per cent survival of *Shorea guiso* cuttings as affected by rooting media

Rooting media	% Survival	Adventitious root	
		Number	Length (cm)
A_1 = River sand	80 ab	7.0 a	3.3 a
A_2 = Rice hull	71 b	6.0 a	3.7 a
A_3 = River sand and rice hull	83 a	7.0 a	3.5 a
Fc	10.76 **	1.75 ns	0.69 ns

** Highly significant ($p < 0.01$), ns not significant a higher root number through hormone application (Pong-anan & Wongmanee 1990). However, using 1000 ppm IBA for *S. guiso* did not increase the number of adventitious roots.

The length of root produced by the stem cuttings ranged from 2.6 to 4.6 cm (Table 3). Cuttings treated with 500 ppm IBA (B_2) produced the longest root (4.6 cm) as compared with the untreated cuttings and those treated with 1000 ppm IBA (B_3) with a mean of 2.6 and 3.4 cm respectively. Shorter roots were developed on untreated (B_1) *S. guiso* cuttings and those treated with 1000 ppm IBA (B_3). Those stem cuttings that received 500 ppm IBA (B_2) had tough and long adventitious roots with several second-order roots or root hairs.

Interaction of rooting media and levels of IBA in the study revealed significant differences in per cent survival and length of adventitious roots (Table 4). Survival ranged from 63 to 95%. The highest survival (95%)was observed on cuttings planted in a mixture of pure river sand and rice hull treated with 500 ppm IBA (A_3B_2). The said treatment, however, was comparable to those cuttings planted in pure river sand and treated with 500 ppm IBA with 84% survival (A_1B_2).

Length of root ranged from 2.1 to 5.7 cm. Rice hull treated with 500 ppm IBA (A_2B_2) produced the longest root with a mean of 5.7 cm. This was significantly longer as compared with the rest of the treatments. Stem cuttings that were rooted in pure river sand and without IBA (A_1B_1) with a mean of 2.1 cm produced the shortest root.

During harvesting of *S. guiso* stem cuttings, profuse rooting was noted in all cuttings treated with IBA as compared with the control. The elongated roots exhibited by cuttings rooted in partly decomposed rice hull treated with 500 ppm IBA (A_2B_2) can be an advantage in the growth and development of *S. guiso*.

Based on the above findings macropropagation of *S. guiso* through stem cuttings from 19-month- old seedlings is feasible as shown in the higher per cent survival of rooted cuttings. Application of 500 ppm IBA and using rice hull and sand as rooting media would improve survival and rooting.

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Table 3 Per cent survival, number and length of adventitious roots of *Shorea guiso* cuttings as affected by IBA

IBA level (ppm)	% Survival	Adventitious root	
		Number	Length (cm)
B_1 = 0 (control)	74 b	6 b	2.6 b
B_2 = 500	86 a	8 a	4.6 a
B_3 = 1000	75 b	6 b	3.4 ab
Fc	11.62 **	9.34 **	19.44 **

** Highly significant ($p < 0.01$) ns Not significant

Table 4 Per cent survival and length of adventitious roots of *Shorea guiso* cuttings as affected by interaction effects of rooting media and levels of IBA

Rooting media × Levels of IBA	% Survival	Adventitious root	
		Number	Length (cm)
A_1B_1 Sand/0 ppm IBA	77 bc	5 a	2.1 e
A_1B_2 Sand/500 ppm IBA	84 ab	9 a	3.8 bcd
A_1B_3 Sand/1000 ppm IBA	80 bc	6 a	4.0 bc
A_2B_1 Rice hull/0 ppm IBA	63 d	6 a	2.6 de
A_2B_2 Rice hull/500 ppm IBA	79 bc	7 a	5.7 a
A_2B_3 Rice hull/1000 ppm IBA	72 cd	5 a	2.9 cde
A_3B_1 Sand & Rice hull/0 ppm IBA	83 bc	7 a	3.0 bcde
A_3B_2 Sand & Rice hull/500 ppm IBA	95 a	9 a	4.3 b
A_3B_3 Sand & Rice hull/1000 ppm IBA	72 cd	6 a	3.2 bcde
Fc	3.42 *	1.20 ns	3.90 *

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