J. Bamboo and Rattan, Vol. 1, No. 3, pp. 193–198 (2002)

Also available online - www.vsppub.com

A note on culm yield and above-ground biomass of *Gigantochloa levis* raised by tissue culture and branch cuttings planting materials

ABD. RAZAK OTHMAN *

Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur, Malaysia

Abstract—A preliminary assessment to compare the culm and above-ground biomass productivity of *Gigantochloa levis* planting trial using tissue culture and branch cutting plantlets was conducted. Assessment of growth performance was based on the culm composition and above-ground biomass production. The results indicate that for the first 4 years after planting, branch cuttings grow vigorously compared to tissue culture plantlets. However, after 5 years there is no significant different in culm size between tissue culture and branch cuttings plantlets.

Key words: Culm and biomass productivity; tissue culture; branch cuttings planting.

INTRODUCTION

The government is encouraging the planting and utilization of bamboo to supplement timber. This is due to the fact that bamboo offers great variety of uses and possesses excellent qualities which are not found in other plants. Faced with the consequences of timber shortages in the near future, integrated approaches to forest production for products other than timber have been looked into. Based on research and development activities, bamboo could be expected to be a potential alternative to support the increased demand in the production of timber-based high-value products.

However, the main problem faced by the bamboo industry is the lack of continuous supply of quality bamboo. Most of the bamboo resources for the secondary industries came from natural stands, especially in disturbed areas such as logged-over forests and also along river banks. Although bamboo resources are quite substantial, the distribution and growth of bamboo in natural stands makes it unviable to support any industry with large capacity.

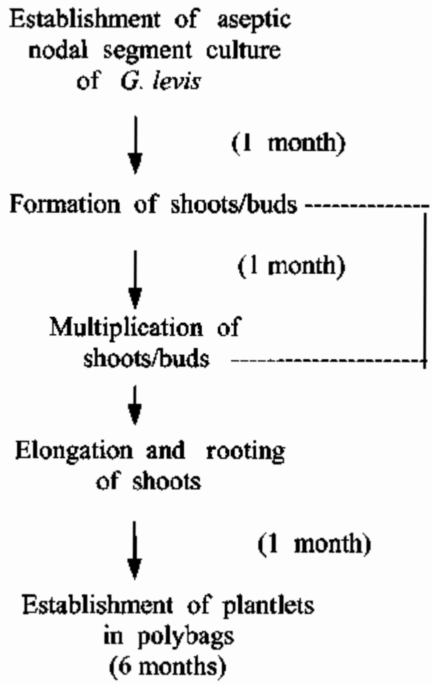
*Phone: 03-62702313. Fax: 62779643. E-mail: abdrazak@frim.gov.my

The main problem faced by the bamboo-based industry was to assure a continuous supply of uniform quality resources. This can only be overcome by establishing bamboo plantations on a large-scale basis. One of the main limiting factors for commercial planting of bamboo in Malaysia is the supply of planting material. Although it can be propagated by cuttings, the success rate was still considered low and dependent on species. So mass propagation by tissue culture method would be another option to be looked into.

In this paper, the early assessment of growth of *Gigantochloa levis* at 5 years after field planting raised by tissue culture plantlets compared with branch cuttings propagules is presented.

MATERIAL AND METHOD

Plantlets of *Gigantochloa levis* obtained through the multiple shoot formation method using nodal segments from lateral branches of mature plants were used [1]. The flow chart of micro propagation for obtaining the plantlets is shown below:



Tissue culture plantlets of *G. levis* were established in the nursery for six months. and were then planted in a one hectare trial plot in Mata Ayer Forest Reserve, Perlis. The initial planting density was 400 plantlets with a planting spacing of 5 m × 5 m open planting. The soil of the planting site is shallow with a laterite layer at 30 cm onwards mixed with fine sandy clay. The soil pH is between 4.3–5.2. The average annual rainfall, temperature and humidity of the site are 1500 mm, 30°C, and 89%, respectively, with dry season between December to March.

For this preliminary growth performance assessment, the *G. levis* propagated by branch cuttings of the same age planted in FRIM, Kepong was compared. Although both plots were located in different sites, in terms of the climatic conditions in Peninsular Malaysia there was not much difference. For this observation, there was no treatment applied to either trial plot. Growth parameters such as percentage of survival, mean number of culms per clump and also culm height and diameter were measured.

Twenty bamboo clumps were selected randomly to assess the growth performance at 5 years after field planting. Bamboo culms were then felled for the determination of the green weight of the culms, branches and leaves. Small samples were oven dried at $103 + 2°C$ to constant weight. Conversion to total dry-weight was based on the method used for moisture content determination.

RESULTS AND DISCUSSION

Percentage survival and culms production

Results on the percentage of survival and mean number of culms per clump after five years of planting are given in Table 1. The results showed that there is not much difference in the percentage of survival and mean number of culms produced between tissue culture plantlets and branch cuttings propagules. It is interesting to note that the percentage of survival (93–95%) in field planting is considered high without any treatments being given to the bamboo stands.

Further t-test analysis comparing growth performance of bamboo plantlets raised by tissue culture and branch cuttings is presented in Table 2. The analysis indicated that the mean number of culms produced per clump is not significant ($p < 0.05$) between tissue culture and branch cuttings plantlets. However, the mean height and mean diameter of the bamboo culms produced according to age gave significantly different values at $p < 0.05$.

Comparatively, branch cuttings gave higher mean number of culms per clump (28.3) compared to tissue culture plantlets (25.7); Table 3 gives the detailed breakdown according to age group. Table 3 also shows that bamboo which grew from branch cuttings produced better mean culm height and diameter than the tissue culture plantlets.

Table 1.
Percentage of survival and mean number of culms per clump at 5 years after field planting

Planting materials	Percentage of survival (%)	Mean number of culms/clump
Tissue culture	93	25.7
Branch cuttings	95	28.3

Table 2.
t-test comparing growth parameters between tissue culture plantlets and branch cuttings planting material 2 to 5 years after field planting

Source	Mean no. of culms/clump	Mean height	Mean diameter
Planting materials	1.23 ns	5.371*	5.234*

Remark: ns — not significant at $p < 0.05$. * — significant at $p < 0.05$.

Table 3.
Culm composition of *G. levis* at 2 to 5 years after field planting (per clump basis)

Age after field planting (year)	Mean no. of culms/clump		Mean DBH (cm)		Mean height (m)	
	TC	BC	TC	BC	TC	BC
Composition by age:						
2	8.5	9.7	1.8	4.0	2.0	5.7
3	5.9	7.3	3.2	5.3	4.3	7.4
4	5.4	6.3	4.2	5.8	6.4	9.3
5	5.9	5.0	6.8	7.6	10.8	12.1

Note: TC — Tissue culture. BC — Branch cuttings.

Table 4.
t-test comparing culm height and diameter at 5 years after planting between tissue culture and branch cuttings plantlets

Source	Mean height	Mean diameter
Planting materials	0.861 ns	0.94 ns

Remark: ns — not significant at $p < 0.05$.

Initially the culm size (height and diameter) produced by tissue culture plantlets at age 2 to 4 years after field planting is smaller compared to culms produced by branch cuttings. However, at age five years, the culms produced both by tissue culture and branch cuttings plantlets attain the size needed by the industry for producing bamboo flooring. The minimum size of bamboo culm that can be used to produce flooring must have dimensions of 1 cm, 6 cm and 10 m in thickness, diameter at breast height (DBH) and height, respectively.

However, the culms that produced 5 years after field planting showed characteristics that were quite similar. The t-test analysis in Table 4 comparing culm height and diameter showed that there is no significant difference between tissue culture and branch cuttings planting material.

Biomass production

On a mean per clump above ground dry weight basis, the total yield produced by branch cuttings and tissue culture plantlets was 362.4 kg and 204.1 kg, respectively

Table 5.
Mean above-ground biomass of *G. levis* in a 5-year-old plantation (per clump basis)

Planting material	Fresh weight (kg)				Dry weight (kg)			
	Culms	Branch	Leaves	Total	Culms	Branch	Leaves	Total
Tissue culture								
Composition by age:								
5 years after planting	187.8	18.8	22.3	228.9	114.7	11.3	10.7	136.7
4 years after planting	49.7	23.2	9.9	82.8	28.6	12.5	4.8	45.9
3 years after planting	14.9	12.5	3.6	31.0	8.1	6.5	1.6	16.2
years after planting	5.2	4.1	1.2	10.5	2.7	2.1	0.5	5.3
Total	257.6	58.6	37.0	353.2	154.1	32.4	17.6	204.1
Branch cuttings								
Composition by age:								
5 years after planting	196.9	20.3	23.8	241.0	120.1	12.2	11.4	143.7
4 years after planting	135.1	34.1	26.4	195.6	77.2	18.4	12.7	108.3
3 years after planting	72.1	43.9	13.6	129.6	38.9	22.8	5.8	67.5
2 years after planting	42.3	32.4	9.8	84.5	21.9	16.8	4.2	42.9
Total	446.4	130.7	73.6	650.7	258.1	70.2	34.1	362.4

(Table 5). The above-ground mass accumulation directly showed that branch cuttings plantlets grew better and more vigorously compared with tissue culture plantlets in this initial stage of establishment.

Results also showed that the tissue culture plantlets aged between 2 and 4 years produced much less total dry weight per clump compared to the same age range for branch cuttings plantlets. However, the total dry weight increased significantly after 5 years of field planting. At this stage, the culm size produced was quite similar to that of branch cuttings.

CONCLUSION

Although this was a preliminary observation, results showed that both the tissue culture and branch cuttings plantlets gave a high percentage of survival in field plantings for a tropical bamboo species. These initial observations indicate that tissue culture needed a longer time to establish sizeable bamboo culms compared to branch cutting plantlets. For the first 4 years after field planting, the growth of *Gigantochloa levis* plantlets propagated by tissue culture is poorer than that of branch cuttings. This could be due to the establishment period of the bamboo clumps; but by the fifth year onward, the culms produced by tissue culture plantlets can reach the size needed as with culms produced by branch cuttings plantlets.

These initial findings need more trials for a better assessment before tissue culture plantlets can be potentially used for mass production of planting material for commercial plantings.

Acknowledgement

The author is grateful to the Forestry Director of FRIM, Dr. Shamsudin Ibrahim for critical comments in preparation of this note. Special thanks to Pn. Aziah Yusof and the staff of tissue culture laboratory for producing the plantlets and the planting done in Mata Ayer Forest Reserved.

REFERENCE

1. A. M. Yusof and D. Aahmad, Production of bamboo propagules via tissue culture for large scale planting programmes, in: *National Bamboo Seminar I*, FRIM, Selangor (1992).