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Influence of Bud Position on Mother Stem And Soaking Duration on Sprouting of Bamboo Cuttings

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Abstract

*Bamboo is one of the fastest growing and highest yielding renewable natural resources with multiple uses in the world. It is used to make furniture, charcoal, food, control soil erosion and can assist in carbon sequestration. The increasing rate of tropical deforestation calls for search for alternative natural resources and the characteristics of bamboo make it a perfect choice. The major constraint in the use of bamboo is the lack of an efficient propagation method. The objective of this study wase to establish an efficient propagation method and to evaluate the adaptability of different bamboo varieties, to Nyungwe National Park (NNP) and the surrounding zones.The trial was conducted in Nyaruguru District, Ruheru Sector bordering Nyungwe National. Basal, middle and apical cuttings were harvested from three bamboo species (**Bambusa vulgaris, Arundinaria alpina** and an unknown native bamboo growing naturally in the Nyungwe forests).*

*Results of the trial indicated that the three species were not significantly different in terms of stem diameter. However, the number of sprouts that emerged from cuttings differed with species: **Bambusa vulgaris** producing 22.2 sprouts, **Arundinaria alpina** 18.1 and the native bamboo producing 15.0 sprouts. On the other hand, the native bamboo had a mean height of 54.0 cm, while **Bambusa vulgaris** 36.6 and **Arundinaria alpina** had 30.8 cm**..***The soaking treatments did not have significant difference on all the parameters evaluated. This reproducible protocol opens new prospects for propagation of bamboo and will go a long way in alleviating the shortage of planting materials and exploiting the enormous potential of bamboo in Rwanda.*

Key words: *Bamboo, propagation, mother stem, sprouts*

INTRODUCTION

Bamboo belongs to the family of Poaceae/ Gramineae. It is part of the true grass family, and makes up the largest and most productive member. There are approximately 1500 species of bamboo under 87 genera worldwide (Zhou et al., 2005). About 300 species are so far reported from China, 130 species from India, 55 species from the Philippines, 50 species from Thailand, 33 species from Bangladesh, 31 species from Indonesia, 26 species from Papua New Guinea and 12 species from Malaysia (Banik, 1987). The largest forest area under bamboo is in India with 9.57 million hectares of bamboo forests or 12.8% of the total forest area (Zhou et al., 2005). In China 3.4 million hectares are under bamboo (3% of total forest area), with a production of 5 million tons. Bamboo has the ability to grow in regions that range from the sub-Sarahan deserts of Africa, to the cold mountain terrain of the Himalayas (Jifan, 1987). It has a long and detailed history and is one of the most versatile plants in the world. The majority of species are native to the tropics of Asia, although one species, *Arundinaria gigantea*, is native to the United States.

It is one of the most unique and versatile groups of plants known to mankind; the bamboos occupy a special place in the lives of the rural poor, especially in Asia. For almost half the human race in the world, life would be quite hard without bamboo. It is used for food, as a weapon or as a tool, as a cooking instrument or a container, as a musical instrument or as an object of beauty, as shelter and even as medicine (Huang et al, 1988). It is also known to produce very high biomass. One of the most important contributions of bamboo to modern-day man is in the production of paper. Though once called poor man's timber it is no longer cheap. Its use as a long-fiber raw material in the pulp and paper industry is well known and it is one of the most sought-after raw materials in the tropics. (Huang et al, 1988).

Rwanda has the highest rate of deforestation (3.9% per annum) reported for African countries and, indeed, in the world (MINITERE and CGIS-NUR 2007). It is for this reason that the Rwandan government has decided to put particular effort in the afforestation program. However, this program is severely constrained by several factors including but not limited to lack of

good quality and adapted planting materials for some tree species like bamboo. There are also few indigenous species of which *Arundinaria alpina,* predominantly found in the north around Volcano National Park and *Bambusa vulgaris* in the forests of Crest-Zaire-Nile region of the country. For the country to exploit the potential of bamboo it is imperative to establish a propagation protocol to effectively multiply and supply the required amount of planting materials for large scale plantation.

Conventionally, bamboo is propagated through seed or by vegetative means. Propagation by seed has a number of challenges as some of the species do not produce seed (e.g., *Bambusa balcooa* and *Bambusa vulgaris*), and those which do so, often flower at long intervals varying from 30 to 70 years *(e.g. Bambusa bambos, B. polymorpha, Dendrocalamus strictus, Melocanna baccifea* and *Phyllostachys spp.)* (Nath et al., 2009).

Vegetative propagation is done by dividing up clumps and their underground stems or cutting up the underground stems (rhizomes) of non-clumping species. However, many species produce extremely large plants and it is not always easy to dig out pieces for propagation. The number of plants produced using the above methods are not adequate (Gupta, 2008) and it is important to make available suitable planting stocks in order to complement efforts to conserve shrinking forest habitats.

MATERIALS AND METHODS

The study was conducted at Ruheru, Nyaruguru District, in the buffer zone of Nyungwe National Park within the Congo-Nile basin. The area is recognized as a zone of two natural bamboo species, *Arundinaria alpina* and *Oxytenanthera abyssinica*. The mean altitude at the site is 2354 m above sea level. Temperatures at the site are generally cool with an average minimum of 10.9° C and an average maximum of 19.6° C. The mean annual rainfall is 1,744 mm. A major dry season occurs between July and August and a minor dry season takes place between December and January.

METHODOLOGY

Three bamboo species comprising *Arundinaria alpina, Bambusa vulgaris* and a native variety were used. Cuttings from three positions (basal, middle and apical) were subjected to soaking in water for 0, 6, 12, 18 and 24 hours and each treatment comprised of 48 cuttings.

The field was hand-cultivated and the trial was established in December 2007 in a 0.5 ha plot. The spacing between each cutting was 1.5 x 1.5 m. Organic manure (farm yard manure) was applied to all plots before planting at 10 t/ha. A Randomised Complete Block Design (RCBD) with 3 replicates of treatments.45

Analysis of variance (ANOVA) indicated no significant difference between various treatments. Data was subjected to normality test, which showed no uniform distribution. This necessitated using nonparametric tests. Thus, the nonparametric Kruskal-Wallis test was used to analyze the data.

RESULTS

Effect of soaking bamboo cuttings on growth and development parameters

The various soaking treatments did not have any significant effect on sprouting, collar diameter and plant height on all the three bamboo species evaluated (Table1)

Effect of original position of cuttings on the mother stem

The three cutting positions evaluated did not have a significant effect on sprouting, collar diameter and plant height in *Arandunaria alpina*. However, the cuttings harvested from the middle region had the highest number of sprouts while those harvested from the basal part had the lowest number of sprouts (Table 2).

The three cutting positions evaluated did not have a significant effect on sprouting, collar diameter and plant height in *Bambusa vulgaris.* However, the cuttings harvested from the middle position gave the highest number of sprouts while the cuttings harvested from the bottom canopy gave the lowest number of sprouts (Table 2).

The three cutting positions evaluated did not have a significant effect on sprouting, collar diameter and plant height in *Native bamboo* but the cuttings harvested from the bottom gave the highest number of sprouts while the cuttings harvested from the top gave the lowest number of sprouts (Table 2).

Table 1: Effect of soaking on growth characteristics of bamboo varieties

Duration of soaking (Hours)	Number of sprouts			Diameter (cm)			Plant height (cm)		
	Var1	Var2	Var3	Var1	Var2	Var3	Var1	Var2	Var3
0	18.67 a	20.39 a	13.61 a	2.89 a	2.31 a	1.43 a	31.54 a	30.06 a	38.11 a
6	12.28 a	23.40 a	10.67 a	3.66 a	2.43 a	1.50 a	36.83 a	32.68 a	40.63 a
12	24.56 a	23.89 a	20.83 b	2.12 a	2.97 a	2.70 a	25.86 a	36.91 a	65.51 b
18	16.06 a	17.28 a	20.89 b	3.60 a	2.42 a	2.26 a	34.79 a	52.59 a	57.73 b
24	18.89 a	26.22 a	8.83 a	2.55 a	2.36 a	2.30 a	27.99 a	30.75 a	67.94 b

* Ø- Diameter
Var1- *Arundinaria alpina*
Var2- *Bambusa vulgaris*
Var3- Native bamboo

Table 2: Effect of position of cuttings on growth characteristics of bamboo varieties

Position of cutting	Number of sprouts			Mean Ø* (cm)			Mean height (cm)		
	Var1	Var2	Var3	Var1	Var2	Var3	Var1	Var2	Var3
Top	18.70 a	23.63 a	10.10 b	2.64 a	7.71 a	2.46 a	23.38 a	45.69 a	59.89 a
Middle	21.73 a	25.70 a	13.83 ab	2.56 a	3.33 a	2.00 a	32.83 a	34.57 a	53.41 a
Bottom	13.83 a	17.37 a	20.97 a	3.43 a	2.43 a	1.85 a	35.31 a	29.81 a	51.05 a

* Ø- Diameter
Var1- *Arundinaria alpina*
Var2- *Bambusa vulgaris*
Var3- Native bamboo

Effect of variety on different growth and development parameters

The three varieties were significantly different in sprouting and plant height. *Bambusa vulgaris* had the highest number of sprouts, which was significantly (p=0.001) different from *Arundinaria alpine* and the native bamboo. On the other hand, the native bamboo had the highest height which was significantly (p=0.001) different from the other varieties (Table 3).

Table 3: Effect of variety on different growth characteristics in Bamboo

Variety	Number of sprouts	Mean Ø (cm)	Mean height (cm)
Arundinaria alpina	18.09 b	2.88 a	30.78 b
Bambusa vulgaris	22.23 a	4.46 a	36.57 b
Native bamboo	14.97 b	2.05 a	53.97 a

DISCUSSION AND CONCLUSION

Bamboos can be propagated either by seeds or vegetatively. Propagation by seed is seldom used because of the rare and irregular flowering of most bamboo species. Besides, most bamboos produce infertile seeds or they rarely develop seeds. Moreover, most bamboos generally die soon after flowering (Nath et al., 2009).

Among the vegetative parts, the one node cutting method is at present the most widely used because it is the most economical and easiest to handle. This method is recommended for raising planting stocks of the genera *Bambusa, Dendrocalamus* and *Gigantochloa* (Manipula et al*.,* 1990). Propagation of bamboo using cuttings has more benefits than the conventional methods. The three cutting positions evaluated did not have a significant effect on sprouting, collar diameter and plant height.

However, the cuttings harvested from the middle region had the highest number of sprouts while those harvested from the basal part had the lowest number of sprouts. This concurs with Malab et al. (1995) who made similar observations when working with *Bambusa vulgaris* and *Dendrocalamus* spp.

The soaking pre-treatment did not have a significant difference in the number of sprouts. However, *Bambusa vulgaris* had the highest number of sprouts. *Bambusa vulgaris* has been found to be more prolific than most of the bamboo species evaluated by Cariño (1990) and Ramoran et al. (1993). There are no publications on the use of cuttings to propagate *Arundinaria alpina* and for the first time, the current study showed that it is possible to use cuttings.

In this trial the native bamboo had the highest mean height in all the treatments. A possible explanation for this is the fact that the trial was conducted in Nyungwe forest which is its natural habitat.

In conclusion, it may be stated that the best part of bamboo to use when propagating the three bamboo varieties is the middle part and soaking cuttings in water has no added advantage. However, it is recommended that further work be replicated in other agro ecological zones and crucial parameters like rooting be evaluated.

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