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Selected Growth Characteristics of Stripped Bamboo (Bambusa Vulgaris) Variety Striata under Vegetative Propagation of Cuttings and Layering

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ABSTRACT

Bamboo resources exist in many species, some indigenous to Kenya while other exotic species were introduced in 1980s from China. The species is a fast-growing member of grass family and has been put in many uses. It is regarded a multi-purpose tree species which can substitute timber. Currently, the coverage of the species is low especially in indigenous forests where the government of Kenya has imposed harvesting moratorium on the species. Bamboo seed acquisition is expensive and has low germination rates thus vegetative methods remain most economical and rapid method of raising the species. Although various vegetative propagation methods have been applied on bamboo including direct potting of cuttings and layering knowledge on days taken to produce first shoot, growth rates and number of shoots they can produce per node under environmental conditions is poorly known. This study was done with the following objectives; (1) to establish number of days taken by culms subjected to direct potting and layering to produce first shoot under environmental conditions of the site of study, (2) to determine the growth rates of shoots under direct potting and layering and (3) to determine the number of shoots produced per node when propagated by either direct potting or by layering. Experiments were conducted at Narasha forest station tree nursery greenhouse located in Baringo County to compare growth by direct cuttings and layered culms. Regeneration of shoots and growth of seedlings were done as described by KEFRI (2019) methods. The study generated the following important findings; the number of days taken by direct cuttings to produce shoots was shorter compared to that taken by layered culms, the growth rates and number of shoots per node were however, higher when layered culms were used as compared to when direct cuttings were used. This study generated important knowledge for propagation of this variety of bamboo.

Keywords: Direct cuttings, Layered culms, Days to first shoot, Growth rate, Number of shoots per node.

1. INTRODUCTION

Bamboo is a member of grass family Poaceae and sub-family Bambusidae. There are over 90 genera and 1000 species of bamboo. The plant is perennial and appears green throughout the year. Like grass, bamboo is characterized by a long stem called a culm which is disjointed by nodes and internodes. Typically, culms are hollow, but some bamboo species have solid culms (Kumar et al, 2021).

Bamboo resources exist in many species, Yushania alpina is indigenous to Kenya and the entire East Africa while Bambusa vulgaris is native to China; other exotic species include Dendrocalamus asper, Dendrocalamus brandisii, Dendrocalamus giganteus; these three being different species of Giant Bamboo. In Kenya most exotic Bamboo resources including Bambusa vulgaris were introduced in 1980s (KEFRI, 2008).

Bamboo has many uses the notable one being its resilient and tenacious root system for adaptation and reclamation on degraded landscapes (Agriculture & gardening, 2023). The plant is excellent in preventing soil erosion, stabilizing substratum of riverbanks, excellent for mitigation of climate change effects, versatile for adoption in wide range of soils and amenable for rapid growth in marginal areas (Kinyili, 2020). The plant is a raw material in making baskets, toothpicks, also used to support horticulture plants in greenhouse, fencing and construction (Ongugo et al, 2020). Varmah and Bahadur (1980) put the number of uses of bamboo at 1500; this shows the great potential of the species.

Bamboo is a multi-purpose tree species which can substitute timber. Currently, the coverage of the species is low especially in indigenous forests where the government of Kenya has imposed harvesting moratorium on the species. Despite this, bamboo raw material remains required and is therefore sourced from farmer fields. Farmers must then produce them in sufficient quantities and thus require suitable germplasm for its cultivation.

Bamboo is propagated through seed, wildings, cuttings, offsets and plantlets from tissue culture obtained from mother plants. Bamboo seed are poorly viable and vegetative propagation is recommended (KEFRI, 2019). The cost of Bamboo seeds in Kenya is always high, currently at approximately Ksh.100,000/kg. One kilogram (1 kg) contains approximately 25,000 seeds. Given that the seed germination rate is 60% then only 15,000 plantlets will be raised from this quantity of seed (Kigomo, 2019). Thus, many organizations, individual farmers and private nursery operators incur a lot of expenses in the process. There is therefore need for a cheap and reliable source of germplasm of this material for industrialization and alleviation of poverty among Kenyan rural communities.

Bambusa vulgaris variety striata is a monocarpic plant that flowers and produces seed once in its lifetime, hence acquisition of its seed is always difficult and almost impossible. In Kenya, bamboo seed is usually imported from Asian countries particularly China. This source further incurs the challenge of low germination hence little value for money (Geetika et al, 2017). Although vegetative propagation of the species is advocated over seed; comparisons of vegetative methods of layering and cuttings is little known. This study was done with the following specific objectives; (1) to establish number of days taken by culms subjected to direct potting and layering to produce first shoot under environmental conditions of the site of study, (2) to determine the growth rates of shoots under direct potting and layering and (3) to determine the number of shoots produced per node when propagated by either direct potting or by layering.

2. MATERIALS AND METHODS

2.1 Study Site

The study was conducted in an open greenhouse at Narasha forest station tree nursery located N9955565 and E270756 in Baringo County. The site has an altitude of 1750m above sea level, with an annual rainfall of between 1600mm to 2000 mm per year. The mean annual temperatures range from 15 to 28 oC with the months of June, July, and August experiencing the lowest temperatures of between 12 and 20oC. The experiments were however, carried out between December 2022 and March 2023, these being the driest and warmest seasons of the year. Water was supplied to experiment by irrigation. Soils of the place are those developed from basement rock system and are fertile and rich in minerals. Soils developed on volcanic materials consist mainly of well-drained, very deep, red, friable clays (NITISOLS, ANDOSOLS, and ACRISOLS). The open greenhouse method mimic field conditions as much as possible except for the supply of water by irrigation.

Bamboo culms with no deformations were used in the experiment (Plate 1a). Each culm had at least 4 nodes with dormant buds. The source of the culms were aged between 2 – 3 years to avoid tissues which easily rot during propagation and too old tissues with hardened parts which hardly produce shoots or take abnormally long to produce shoots as described by KEFRI (2019).

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was sieved to remove stones and other non-soil material including sticks and stones.

2.2 Layering Experimental Set up

The growth media was spread on plots of 6 m by 3 m with a soil depth of about 10 cm. Twenty one (21) culms were layered horizontally on the growth media (Plate 2a) with a spacing distance of 30 cm in each replication as described by KEFRI (2019). Each experiment was replicated 3 times for generation of sufficient data. Watering and application of hormones was done immediately the culms were layered on the media. Watering was done on holes made at each internode (Plate 1b). The rooting hormone was sourced from Azatone ‘x’® and prepared by being mixed with water at a rate of 3 gms/20 lts. This rooting hormone source contains auxins and nitrogen; auxin is one of growth promoters and functions in induction of roots in stem cuttings besides other functions. Nitrogen is a major ingredient in synthesis of protein for promotion of growth. Watering was done once in a day for a period of 8 weeks.

2.3 Direct Cuttings Experimental Set up

Twenty one (21) bamboo cuttings with at least one node and a dormant bud were inserted in the tubes containing about 3 kgs of growth media (Plate 2b). Each cutting for potting was vertically inserted into the growth media such that the nodes containing dormant buds appeared 2 cm above the growth media surface. Source of rooting hormone, its application and watering was done as described for the layering experiment. The experiment was also replicated 3 times.

Plate 2a: Placement of Layered Culms on Growth Media

Plate 2b: Placement of direct cuttings on Growth Media

2.4 Data Collection

The layered culms and the vertical cuttings were observed at internodes on a daily basis for emergence of first shoot; the number of days taken for emergence of first shoot on each culm in every replicate was noted and recorded. The number of shoots per node and length of each shoot was determined at 28th and 56th day after set up of the experiments.

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entered in MS-excel spreadsheet checked for outliers and analyzed for means. Results were in figures.

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significant variation on the number of days taken nce of first shoot when vertical cuttings and ayering of culms were used ($P \leq 0.05$). Direct k an average of 17 days while culms regenerated took an average of 20 days from the onset of the (Fig 1)..

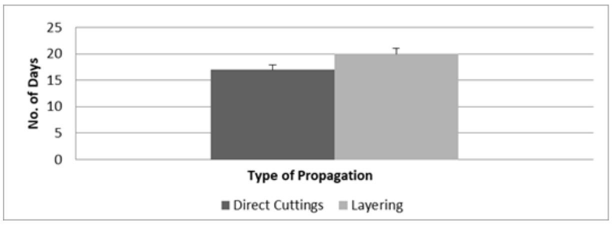

Figure 1: Comparison of the number of days taken for shoots to develop

The results are comparable to the findings of Solikin (2018), where the position of nodes had significant effect on regeneration and growth in Sambiloto (Andrographis paniculata). In his findings, young nodes had the highest regeneration life compared to nodes on older cuttings. The earliest rooting of direct cuttings compared to those regenerated by layering could be attributed to gravitropic movement of rooting hormone (Philosoph–Hadas et al, 2005). The direct cuttings were oriented vertically thus causing rooting hormone to move and concentrate on nodes towards the soil surface. High concentration of this exogenous hormone on these sites may have caused the earliest initiation of shoots. The layered culms on the other hand were horizontally oriented causing even distribution of rooting hormone along the culms. The low concentration of rooting hormone in these materials resulted in late initiation of shoots.

3.2 Comparison of Seedling Growth Rates

It was observed that initial average growth rate of shoots from direct cuttings was slightly higher than the average growth of shoots of layered culms at 28th day. Direct cuttings had an average growth rate of 0.08 cm/day while layered culms had an average growth rate of 0.07cm/day (Fig 2a).

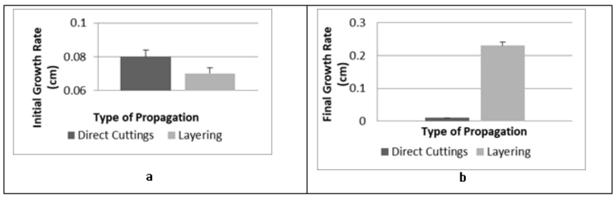

Figure 2: Growth Rates of Seedlings at (a) 28 and (b) 56 Days

A huge difference was however, observed with the average growth rate at 56th day between the two propagation methods. An average growth rate of 0.01cm/day and 0.23cm/day was recorded for shoots regenerated from direct cuttings and from layered culms respectively (Fig 2b).

This indicates a huge variation in the average growth rates of Bambusa vulgaris var. striata when subjected to the two methods of propagation. Shoots regenerated by direct cuttings have initial fast growth compared to shoots regenerated by layering. This could be attributed to the fact that material regenerated by direct cuttings developed roots and shoots earlier which enabled them to acquire growth nutrients (water, minerals and food) earlier resulting in fast growth. As growth progressed, space in potted direct cuttings became limiting thus reduced growth rate. On the other hand, layered culms developed roots and shoots late resulting low initial growth. As growth progressed, shoots developed by layered culms were exposed to unlimited space for acquisition of growth nutrients including synthesis of higher quantities of endogenous growth hormone compared to the potted cuttings, hence later fast growth. The results are similar to the findings of Digdem and Mehmet, (2008) on growth rate of triticale. Ahmed et al, (2022) lists some of the factors which limit seedling growth among them being space which is implicated in this study.

3.3 Comparison of number of shoots per node

At 14 days, the number of shoots/node observed from both methods of propagation was not varied. Both methods of propagation produced an average of 2 shoots/node. This thus shows that there is no significant difference in the average number of shoots/node produced at 14 days (Fig 3a). There was however, a noticeable difference on the number of shoots/node produced at 58 days from both methods of propagation. Direct cuttings method reported an average of 2 shoots/node while layered culms reported an average of 4 shoots/node which is double the number produced by direct cuttings. This shows that layered culms produced more shoots with time while direct cuttings remained fairly constant (Fig. 3b).

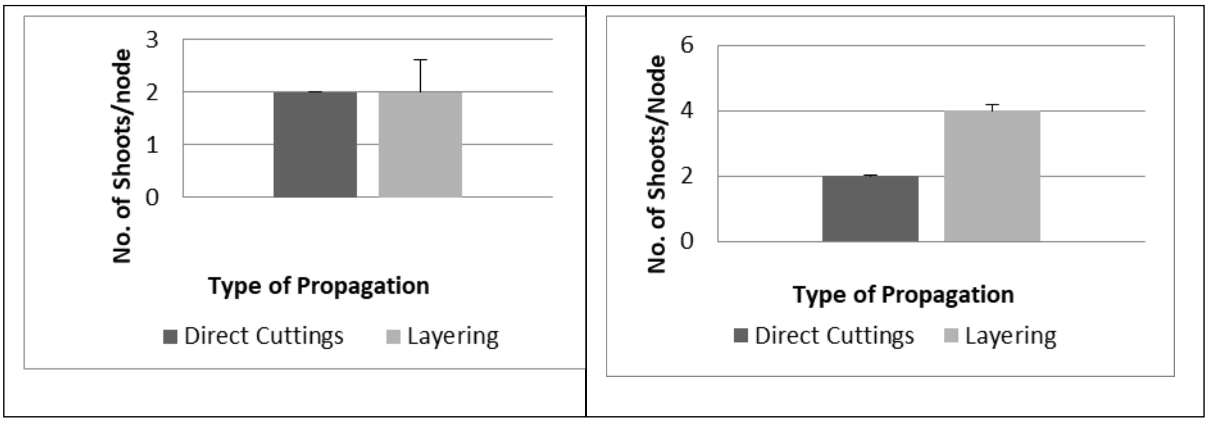

Figure 3: Number of shoots produced by culms at (a) 28 and (b) 56 Days

Increased sprouting of shoots among layered culms may be due to favourable conditions of layered media compared to potted media. In the layered media nutrient volume is spread over a large area compared to the potted media. The large area of space in the layered media may have presented growth nutrients such as air, water, minerals and light in more relative abundance compared to the potted media of direct cuttings thereby influencing increased sprouting of shoots. The results are similar to the findings of Franklin and Hogarth (2008) who investigated factors influencing shoot production in Semelparous bamboo.

4. CONCLUSION

The layering propagation method produces more shoots which have relatively fast growth unlike when cuttings are used. This method is therefore recommended for rapid production of seedlings to increase bamboo growing for industry and for mitigation of climate change.

5. ACKNOWLEDGMENTS

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