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Branch Cutting Propagation of Different Bamboo Species Through Varying Levels of Alpha Naphthalene Acetic Acid Supplementation

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ABSTRACT

A study was conducted to determine the survivability and growth performance of different bamboo species supplemented with varying levels of Alpha Naphthalene Acetic Acid (ANAA). The study is a two-factor experiment arranged in a Randomized Complete Block Design (RCBD) with three replications. The study revealed that the different bamboo species had influenced the growth characteristics of bamboo cuttings in terms of number of shoots developed, height of shoots, number of leaves developed, length of leaves, number of roots, and survival rate. Supplementation of ANAA to different species of bamboo had a positive effect on the growth performance of bamboo cuttings in terms of length of leaves, width of leaves, number of roots, and survival rate. There was a significant interaction effect observed between the different species of bamboo and the level of ANAA supplementation on the survivability of bamboo cuttings. For higher survivability of bamboo cuttings, supplementation of 2 parts per million ANAA is recommended to obtain better growth performance in propagating bamboo and faster multiplication of planting materials.

Keywords: Bolo, Kawayang Kiling, Kawayang Tinik, ANAA, Propagation

INTRODUCTION

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 assist in carbon sequestration (Ntirugulirwa et al., 2013). Seeing the potential of Panay Island to grow healthy bamboos, Department of Environment and Natural Resources (DENR) Secretary Roy A. Cimatu proposed the possibility of making Panay Island the country's bamboo capital (Panay News, 2020). The province of Aklan had established a bamboo plantation from 2013 to 2018 with a total area of 640 ha (Tamayo, 2019). Bamboos belong to the family of grasses, Gramineae or Poaceae. This plant can be characterized as having woody and usually hollow culms, complex rhizome and branch systems, petiolate leaf blades, and prominent sheathing organs. Moreover, all the members of this plant possess similar anatomical features in the leaf blades (i.e., fusoid cells and arm cells), which set the bamboos apart from grasses (Roxas, 2012).

Naphthalene Acetic Acid, also named as α-naphthalene acetic acid (ANAA), belongs to a class of organic compounds of naphthalene that contain a naphthalene moiety of two fused benzene rings. NAA is a synthetic auxin plant hormone. It is used as a rooting agent and for the vegetative propagation of plants from stem and leaf cuttings (Shibin et al., 2014).

Conventional methods of bamboo propagation are based on seeds and vegetative methods. However, the availability of seeds is limited to a specific period. Many bamboo plants develop flowers and seeds only two to three times in a century, and the viability period of the seeds is very short. There is a growing shortage in the supply of bamboo raw

materials. Many bamboo enterprises have closed operations for this reason. Although research and development programs on bamboo have continued, the infusion of new technologies and products into the industry has been inadequate and slow. Many enterprises still utilize woodworking machines, which are not appropriate tools for processing bamboo. This results in increased processing time and, consequently, low productivity, which is reflected in the high cost of production.

In view of these concerns, this study would lead to finding a cost-effective method for large-scale propagation of bamboo for planting to reduce the existing gap between demand and supply; hence, this study is pursued.

MATERIALS & METHODS

A two-factor experiment arranged in a Randomized Complete Block Design (RCBD) was used in the study. Factor A was designated as the species of bamboo like A1: Kawayang tinik (Bambusa blumeana), A2: Kawayang kiling (Bambusa vulgaris), and A3: Bolo (Gigantochloa levis). Factor B involved the varying levels of ANAA with the following treatments: B1 (control), B2 (2 ppm), B3 (4 ppm), and B4 (6 ppm). There were three replications involved, for a total of 36 experimental units; each unit consists of 15 pots (6 inches by 6 inches in size). The layout of the experimental study is shown in Figure 1. The layout and randomization employed are by the drawing of lots method to randomly distribute the different treatment combinations separately for each block; there were three independent randomizations for the two-factor experiment in RCBD.

Preparation and potting of soil media. Before the gathering of cuttings, soil media was prepared one week before planting. A total of 540 pots were prepared using a 1:1:1 ratio, composed of garden soil, vermicompost, and carbonized rice hulls placed in a 6" x 6" black polyethylene bag.

Collection of planting materials. The cuttings were collected from different municipalities of Aklan which were obtained from 1 – 2 years old, healthy and disease-free bamboos using sharp tools to cut the cuttings based on the Ecosystem Research Development Bureau (ERDB) Technical Bulletin no. 2016-01. A total of five hundred forty (540) bamboo cuttings were prepared.

I	II	III
A_1B_1	A_2B_3	A_1B_3
A_2B_1	A_3B_1	A_3B_4
A_2B_4	A_1B_1	A_2B_2
A_3B_2	A_1B_2	A_3B_1
A_1B_2	A_2B_1	A_2B_4
A_3B_1	A_3B_3	A_1B_1
A_2B_2	A_1B_3	A_3B_2
A_3B_4	A_1B_4	A_3B_3
A_1B_3	A_2B_2	A_2B_1
A_3B_3	A_3B_2	A_1B_4
A_2B_3	A_2B_4	A_2B_3
A_1B_4	A_3B_4	A_1B_2

Figure 1. Experimental layout of a two factor experiments with treatments arranged in Randomized Complete Block Design (RCBD).

A_1 – *Kawayang tinik*
A_2 – *Kawayang kiling*
A_3 – *Bolo*

B_1 – Control
B_2 – 2
B_3 – 4
B_4 – 6

Legend: Factor A – Bamboo Species Factor B – Level of ANAA (ppm)

ANAA application. ANAA application was done by soaking the cuttings for 1 hour before planting based on the manufacturer's instructions indicated on the label of the product. The ANAA was mixed according to the levels indicated in the treatment and was dissolved in 1 liter of water per treatment.

Planting. The cuttings were planted directly into the pots at a depth of 2–4 cm and covered with soil media on the corresponding pots for each treatment and replication.

STATISTICAL ANALYSIS

All data gathered was consolidated and tabulated using Microsoft Excel 2013. The Analysis of Variance (ANOVA) for a two-factor experiment arranged in a randomized complete block design (RCBD) was utilized. Further tests for significant differences were computed using the Least Significant Difference (LSD) interpreted at 5% level of significance.

RESULT

Number of Shoots

The mean number of shoots developed by the different bamboo species are reflected in Table 1. As for the bamboo species, Kawayang kiling obtained the highest mean number of 3.19 shoots per node per plant. Fewer number of shoots formed by Kawayang tinik (0.87) and from Bolo (0.75), respectively. LSD further revealed that Kawayang kiling developed a greater number of shoots as to the supplementation of ANAA, regardless of concentration applied. The formation of bamboo shoots 105 days after planting (DAP) was not affected by ANAA supplementation. Hence, each factor was independent in its effect on the attainment of number of shoots of the bamboo species being studied.

Table 1. Mean number of shoots developed by the bamboo cuttings at 105 DAP as influenced by different species and varying levels of ANAA supplementation.

Bamboo Species	Levels of ANAA (ppm)				Mean*
	0	2	4	6	
Kawayang Tinik	0.63	1.33	0.97	0.53	**0.87^{b}**
Kawayang Kiling	3.10	3.63	3.17	2.87	**3.19^{a}**
Bolo	0.53	1.13	1.20	0.13	**0.75^{b}**
Mean^{ns}	**1.42**	**2.03**	**1.78**	**1.18**	**1.60**

CV = 47.34 %; Marginal means having a common letter are not significantly different at 5% level by LSD. Significant; ^{ns} Not Significant; DAP – days after planting.*

Height of Shoots

On the height of shoot, it was observed that Kawayang kiling obtained the tallest shoot of 86.98 cm. On the other hand, Bolo attained the shortest height with a mean of 20.27 cm but was comparable to Kawayang tinik at 20.79 cm. F-test further revealed that shoot height was significantly affected by the different species of bamboo. On the other hand, the mean shoot height of bamboo supplemented with varying level of ANAA ranged from 31.23 cm (6 ppm of ANAA) to 55.59 cm (2 ppm of ANAA). F-test, however, indicated that the level of ANAA supplementation did not affect the shoot height of different bamboo species. There was no significant interaction effect observed between the two factor on this particular growth measurement of bamboo species.

Table 2. Mean height (cm) of shoots of bamboo cuttings at 105 DAP as influenced by different species and varying level of ANAA supplementation.

Bamboo Species	Levels of ANAA (ppm)				Mean**
	0	2	4	6	
Kawayang Tinik	14.70	42.67	19.90	5.89	**20.79^{b}**
Kawayang Kiling	85.50	95.13	84.13	83.13	**86.98^{a}**
Bolo	12.20	28.97	35.23	4.67	**20.27^{b}**
Mean^{ns}	**37.47**	**55.59**	**46.42**	**31.23**	**42.68**

*CV = 43.87 %; Marginal means having a common letter are not significantly different at 5% level by LSD. ** Highly significant; ^{ns} Not significant; DAP - days after planting.*

Number of Leaves

The data show that Kawayang kiling obtained the greatest number of leaves developed with a mean of 24.18 (Table 3). Kawayang tinik and Bolo produced comparable number of leaves developed with a mean of 7.97 and 4. 86 respectively. F-test further revealed that the number of leaves was significantly affected by the different species of bamboo tested in the study (Appendix Table 6). As can be noted, the mean number of leaves of bamboo species supplemented with varying level of ANAA ranged from 9.26 (6 ppm of ANAA) to 15.59 (2 ppm of ANAA). F-test, further showed that the number of leaves developed by bamboo species was not significantly affected by the varying level of ANAA supplemented. No significant interaction effect was observed between these two factors, indicating independent effect of each factor on the number of leaves developed by different bamboo species.

Length of Leaves

On the length of leaves developed, it was observed from the data reflected in Table 4 that Kawayang kiling emerged to have the longest leaves with a mean of 25.76 cm. Whereas, Kawayang tinik and Bolo comparatively developed the shortest leaves with a mean of 5.58 and 6.83 cm, respectively. On the other hand, bamboo species supplemented with 2 ppm of ANAA produced the longest leaves with a mean of 18.57 cm. Those applied with 6 ppm ANAA produced the shortest with a mean of 9.14 cm. LSD test further showed that the different bamboo species supplemented with 2 ppm of ANAA significantly had the longest leaves compared to 4, 0 and 6 ppm supplementation. This suggests that the effect of different species of bamboo was not dependent on the level of ANAA supplementation and vice versa.

Number of Roots

As indicated by the results shown the bamboo cuttings from different species was significantly affected by ANAA supplementation. Kawayang tinik developed the greatest number of roots with a mean of 35.32. Whereas, Kawayang tinik and Bolo comparatively produced shorter roots with a mean of 16.45 and 16.80, respectively. In terms of ANAA supplementation, the greatest number of roots counted was from 2 ppm supplementation. The 4-ppm level was also comparable with the 2 ppm supplementation. Fewer roots were noted from 6 ppm (14.98) and 0 ppm (22.00) supplementation. F-test, however, revealed significant difference at 1% level among treatment means indicating that the number of roots per plant vary with the different species of bamboo. On the other hand, interaction effect between the different bamboo species and ANAA supplementation on the number of roots was neither significant. It was observed that rooting is comparatively quick and maximum in a sand medium compared to the conventional soil medium. Sand is chemically inert, has high porosity, provides aeration and well drained condition, and maintains temperature in the rooting medium (Banik, 2008) which favors the rooting of propagated cuttings like bamboo.

Survivability Rate

Figure 2 presents the survival rate of bamboo cuttings as effected by different bamboo species and ANAA supplementation. As can be noted Kawayang kiling had a mean highest survival rate of 96.11 % while Bolo obtained the lowest survival rate of 36.11 %. F-test, however, showed that the survival rate of bamboo cuttings was significantly affected by the different species at 1 % level on the effect of ANAA supplementation, bamboo species supplemented with 2 ppm had the highest percentage of survival with a mean of 73.33 % while the 6 ppm supplementation had only 46.67 % survival rate. F-test further showed that the survival rate was affected by the supplementation of different level of ANAA. Further a significant interaction effect was noted between the two factors on the survival rate

of bamboo species at 5% level. The result of the present experiment is similar to the findings of Ansari et al. (2017) who reported that the survival rate of Bambusa balcooa was 90 % recorded from developed rooted cuttings of bamboo.

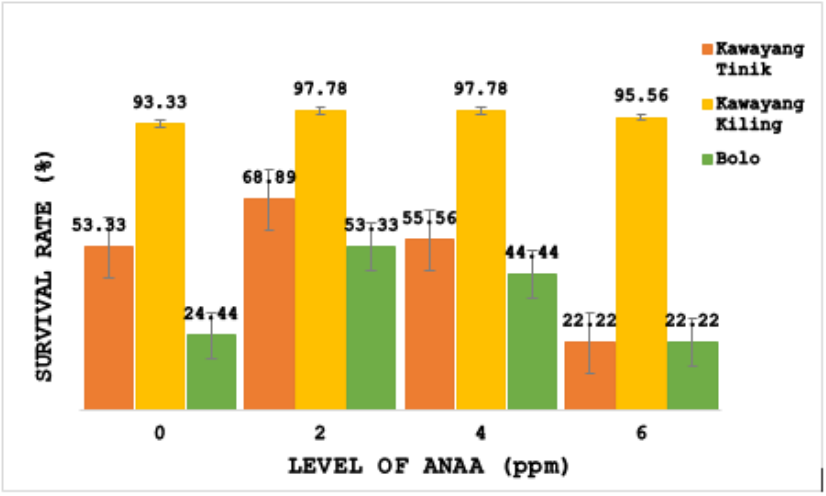

Figure 2. Mean survival rate (%) of different bamboo species as influenced by varying level of ANAA supplementation.

DISCUSSION

Kawayang kiling obtained the highest mean number of 3.19 shoots per node per plant. The same is pointed out by Ray and Ali (2017), who argue that cuttings from the basal position contain more carbohydrates due to their larger diameter, which equally enhances root formation and bud sprouting. Fewer shoots were formed by Kawayang tinik (0.87) and Bolo (0.75), respectively. On the height of the shoot, it was observed that Kawayang kiling obtained the tallest shoot at 86.98 cm. On the other hand, Bolo attained the shortest height with a mean of 20.27 cm but was comparable to Kawayang tinik at 20.79 cm. The data show that Kawayang kiling obtained the greatest number of leaves developed, with a mean of 24.18. Kawayang tinik and Bolo produced comparable numbers of leaves, with a mean of 7.97 and 4. 86 respectively. The F-test further revealed that the number of leaves was significantly affected by the different species of bamboo tested in the study. On the length of leaves developed, it was observed from the data reflected that Kawayang kiling emerged to have the longest leaves with a mean of 25.76 cm. Whereas Kawayang tinik and Bolo comparatively developed the shortest leaves with a mean of 5.58 and 6.83 cm, respectively. Kawayang tinik developed the most roots, with a mean of 35.32. Whereas, Kawayang tinik and Bolo comparatively produced shorter roots with a mean of 16.45 and 16.80.

The survival rate of bamboo cuttings as affected by different bamboo species and ANAA supplementation. As can be noted, Kawayang kiling had a mean highest survival rate of 96.11 %, while Bolo obtained the lowest survival rate of 36.11 %. The F-test showed that the survival rate of bamboo cuttings was significantly affected by the different species at the 1% level on the effect of ANAA supplementation; bamboo species supplemented with 2 ppm had the highest percentage of survival with a mean of 73.33%, while the 6-ppm supplementation had only 46.67% survival rate. However, previous studies conducted by El-Keltawi and Abdel-Rahman (2010) as well as Singh et al. (2004) demonstrate that culm cuttings exhibit superior performance compared to branch cuttings. Furthermore, Gulabrao et al. (2012) and Shirin et al. (2021) found that cuttings obtained from the basal position of bamboo culms demonstrate enhanced performance. The F-test further showed that the survival rate was affected by the supplementation of different levels of

ANAA. Further, a significant interaction effect was noted between the two factors on the survival rate of bamboo species at the 5% level. The result of the present experiment is similar to the findings of Ansari et al. (2017), who reported that the survival rate of Bambusa balcooa was 90% recorded from developed rooted cuttings of bamboo. In addition, cuttings treated with plant growth regulators perform better than those untreated (Saffari and Saffari, 2012; Topacoglu et al., 2016). Plant growth regulators such as indole-3-butyric acid, and alpha-naphthalene acetic acid are commonly used to promote root development and bud sprouting in cuttings (Choudhary et al., 2022; Kamis et al., 2016; Mustafa et al., 2021; Shirin et al., 2021; Suwal et al., 2020). The success of rooting and sprouting varies according to species (Hamalton et al., 2022) and growth regulator doses (Dolor et al., 2011; Topacoglu et al., 2016).

CONCLUSION

The propagation of different bamboo species has influenced the growth performance of bamboo cuttings in terms of the number of shoots developed, shoot height, the number of leaves developed, length of leaves, width of leaves, number of roots, length of roots, and survival rate.

The supplementation of ANAA at varying levels to different bamboo species has significantly affected the growth performance of bamboo in terms of the length of leaves, width of leaves, number of roots, and survival rate.

Declaration by Authors

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REFERENCES

1. Choudhary, A.K., Kumari, P. and Kumari, S. (2022) Academic journals - african journal of biotechnology - in vitro propagation of two commercially important bamboo species (Bambusa Tulda Roxb. and Dendrocalamus stocksii Munro.), African Journal of Biotechnology.
2. E.M. El-Keltawi, N. and S.A. Abdel-Rahman, S. (2010) 'Propagation of bamboo (Dendrocalamus giganteus, Munro) through culm-branch cuttings in Egypt', Assiut Journal of Agricultural Sciences, 41(1), pp. 1–22. doi:10.21608/ajas.2010.267818.
3. Dolor, D. (2011). Effect of fruit fermentation on the germination and growth of Irvingia Wombolu (Vermoesen) seedlings. American Journal of Biotechnology and Molecular Sciences, 1(2), 45–50. https://doi.org/10.5251/ajbms.2011.1.2.45.50
4. Gulabrao, Y.A. et al. (2012) 'Seasonal effect on rooting behaviour of important bamboo species by culm cuttings', Journal of Forestry Research, 23(3), pp. 441–445. doi:10.1007/s11676-012-0282-0.
5. Hamalton, T. (2022) '"vegetative propagation techniques for Bamboo Species: A review"', International Journal of Agriculture Environment and Biotechnology, 15(1). doi:10.30954/0974-1712.01.2022.13.
6. Kalanzi, F. and Mwanja, C.K. (2023a) 'Effect of nodal cutting position and plant growth regulator on bud sprouting of Dendrocalamus giganteus wall. ex munro in Uganda', Advances in Bamboo Science, 2, p. 100016. doi: 10.1016/j.bamboo.2023.100016.
7. Kalanzi, F. and Mwanja, C.K. (2023b) 'Effect of nodal cutting position and plant growth regulator on bud sprouting of Dendrocalamus giganteus wall. ex munro in Uganda', Advances in Bamboo Science, 2, p. 100016. doi: 10.1016/j.bamboo.2023.100016.
8. Mustafa, A.A. et al. (2021) 'A concise review of dendrocalamus asper and related bamboos: Germplasm conservation, propagation and Molecular Biology', Plants, 10(9), p. 1897. doi:10.3390/plants10091897.
9. Ntirugulirwa, B. et al. (2013) 'Influence of bud position on Mother Stem and soaking duration on sprouting of bamboo cuttings', Rwanda Journal, 28(1). doi:10.4314/rj.v28i1.1.
10. Ray, S.S. and Ali, Md.N. (2017) 'Factors affecting macropropagation of bamboo with special reference to culm cuttings: A review update', New Zealand Journal of Forestry

Science, 47(1). doi:10.1186/s40490-017-0097-z.
11. Roxas, C.A. (2012) Handbook on erect bamboo species found in the Philippines. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources.
12. Saffari, M. and Saffari, V.R. (no date) Effects of media and indole butyric acid (IBA) concentrations on Hopbush (Dodoneae viscosa L.) cuttings in Green House, Annals of Forest Research. Available at: https://www.afrjournal.org/index.php/afr/article/view/76 (Accessed: 13 July 2023).
13. Shirin, F. et al. (2021) 'Seasonal and hormonal variation during adventitious rhizogenesis in five commercially important bamboo species for production of quality planting material', Journal of Forest Research, 26(5), pp. 377–385. doi:10.1080/13416979.2021.1935548.
14. Singh, S., Kumar, P. and Ansari, S.A. (2004) 'A simple method for large-scale propagation of Dendrocalamus Asper', Scientia Horticulturae, 100(1–4), pp. 251–255. doi: 10.1016/j.scienta.2003.08.006.
15. Suwal, M.M., Lamichhane, J. and Gauchan, D.P. (2020) 'Regeneration technique of bamboo species through nodal segments: A Review', Nepal Journal of Biotechnology, 8(1), pp. 54–68. doi:10.3126/njb.v8i1.30209.
16. Topacoglu, O. et al. (2016) 'Utjecaj Fitohormona na Sposobnost Zakorjenjivanja Reznica Vrste ficus benjamina L.', Šumarski list, 140(1–2), pp. 44–44. doi:10.31298/sl.140.1-2.4.

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