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# Survivability of three bamboo species (Giant Bamboo: *Dendrocalamus giganteus*, Machiku Bamboo: *Dendrocalamus latiflorus* and Spiny Bamboo: *Bambusa blumeana)* on different potting media

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**Key words:** Giant bamboo, Spiny bamboo, Machiku bamboo, Soil media, Survival of bamboo

**Abstract**

At the Cagayan State University Gonzaga Campus, the study was carried out between July 2021 and October 2021 in a bamboo nursery-protected setting. Three species of bamboo (Giant Bamboo- *Dendrocalamus giganteus*, Machiku - *Dendrocalamus latiflorus,* and Spiny Bamboo- *Bambusa blumeana)* were the subject of the investigation to ascertain their survival rates as influenced by different soil media. It aimed to determine the following parameters after three months: average number of shoots, average length (cm) of shoots, average number of roots, average length (cm) of roots, and the percentage (%) of survival. The study used a Completely Randomized Design (CRD) with a single factor experiment. There are three treatments in the study which are $T_1$-control, soil media composed of one-part vermicompost, one-part alluvial soil and one-part Raw Rice Hull (RRH); T2-soil media composed of one-part vermicompost, one-part alluvial soil and one-part carbonized rice hull (CRH); T3- soil media composed of one-part vermicompost, one-part alluvial soil and two parts carbonized rice hull (CRH). On the percentage of survival, giant bamboo is the only species significantly affected by the soil media composed of one-part vermicompost, one-part alluvial soil and one-part carbonized rice hull (CRH). It is concluded that the combination of alluvial soil, vermicompost and Carbonized Rice Hull (1:1:1) was the best combination of media results on all variables measured. This treatment leads in all the parameters gathered followed by Treatment 3, the combination of alluvial soil, vermicompost and Carbonized Rice Hull (1:1:2). As a result of the research's findings and conclusions, it is advised that using carbonized rice hull as part of the media will greatly improve the soil's ability to support the growth of the three kinds of bamboo propagules.

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## Introduction

All bamboo species are collectively referred to as "kawayan" in the Philippines. Only a short time after planting, the plant begins to grow quickly and regenerate. Another plant with numerous uses is this one. Profit is produced without harming the environment. Despite other advantages as a source of food, biofuel, and environmental preservation, it has emerged as the finest wood alternative in the furniture, handicraft, and building industries. (Revilleza, 2022)

Riverbanks are often vulnerable to soil erosion due to lack of vegetative cover. Threats to riverbanks are further aggravated by massive upland deforestation and unsustainable land use practices. The erratic weather conditions bringing heavy rains also add to the possibility of rivers overflowing. Hence, unstable riverbanks can take lives and damage properties of the communities living nearby. The exposed parts of riverbanks must be covered with vegetation to maintain the stability of the soil. The roots of bamboo plants hold the soil in place and lessen the effects of water flow, which is a method of stabilization. Due to its vegetative features and widespread distribution throughout the nation, bamboo is one of the best plants to prevent further degradation of the land and to alleviate natural disasters (Canavan, Susan, 2017).

Bamboo is currently in high demand both domestically and internationally, but supply is become tight. Nowadays, bamboo is not regarded as inferior timber. As an alternative for timber and for a range of designed product uses, it has now demonstrated its commercial usefulness. This opened the door for Executive Order No. 879, which created the Philippine Bamboo Industry Development Council (PBIDC) to promote the growth of the bamboo industry, direct the use of bamboo for at least 25% of the desk and other furniture needs of public elementary and secondary schools, and give preference to the use of bamboo in the construction of fixtures and furniture for government buildings. It is a plant that was additionally chosen for the National Greening.

Twenty-one (21) of the 62 bamboo species found in the Philippines are local or unique to the country. There are eight (8) upright and thirteen (13) climbers. The remaining ones are introduced, some of them in prehistoric times (Roxas, 2012).

Determining the best variety and importance will depend on a lot of factors. Most of the best bamboos are indigenous to tropical and sub-tropical climates. Among these species, three are identified for propagation in the locality because of their difficulty to survive when propagated because of the lack of technical know-how.

*Bambusa blumeana, Schultes*

Locally known as Pallutan/Siitan in Ilocano, Kawayan Tinik in Tagalog and Spiny Bamboo in English. Construction, parquets, basketry, furniture, concrete reinforcements, kitchen utensils, handicrafts, chopsticks, headgear, and toys are just a few of the many uses for it. In the absence of wood, it can also be used as fuel, and its edible shoots are eaten as vegetables. It has densely thick foliage, strongly upright clumps having thick stems reaching four inches in diameter. Well behaved, clumping habit is non-invasive (Roxas, 2016).

*Giant bamboo*

It is one of the fastest-growing plants in the world with an average growth rate of 3 to 10 cm each day. Depending on the local soil and temperature, it can even reach a height of 100 cm in roughly 24 hours (Yap, 2017).

Bamboo is viewed as an alternative crop with potential soil-trapping properties, in addition to being a source of new materials for house construction, the creation of handicrafts and furniture, and the foundation for livelihood programs. In instance, giant bamboo's roots effectively absorb extra water and bind the soil, preventing soil erosion. The enormous bamboo, which emits more oxygen than trees, can support riverbank stability, control watersheds, prevent soil erosion, and recycle nutrients from the water.

*Machiku bamboo*

Machiku bamboo scientifically known as *Dendrocalamus latiflorus,* Munro originated in China. It is a rhizome type, clump forming or sympodial bamboo. Machiku plantation inside the campus was established and reaches 12-16 meters in height having a culm of 8-25cm. It is regarded as a species of large-sized bamboo.

It is the best shoot-producing specie. It can also be made into baskets and hats. The culms are used for structural timber (of medium quality) for house and temporary construction, agricultural implements, water pipes (Sharma *et al.,* 2015).

Attempts have been made to propagate these species, but survival is quite low when compared to other species. There could be possible factors that can improve the percentage survival and one of which is the soil medium. It is for this reason that the study was conceived.

*Soil Media*

The choice of desirable potting material is one of the most important aspects of bamboo propagation. Banik (2008) employed a three-layered, seven- to ten-centimeter-deep sand propagation bed. He used large-sized sand and gravel at the bottom, Sand with medium size in the center and small stones at the top. The pre-rooted and pre-rhizomed branch cuttings all developed live roots in the propagation bed after 30 days. The cuttings are placed in polyethylene bags and stored in the nursery after becoming deeply established.

Battulayan (2012) used a well pulverized sandy loam mixed with compost with the ratio of 70:30 by volume as required for the propagation of giant bamboo.

Growing crops in greenhouses requires a variety of cultural inputs. Among these, the kind of growth media employed may be the most crucial. Growing media must be altered to give the proper physical and chemical qualities required for plant growth due to the relatively shallow depth and constrained volume of a container. In general, field soils are unsuitable for growing plants in containers.

This is mostly due to the fact that soils lack the necessary aeration, drainage, and water-holding capacity.

Generally, the purpose of this study was to evaluate how changing soil media affected the survival rates of three varieties of bamboo.

Specifically, it aimed to determine the average length (cm) of shoots after three months; average length of roots after three months; average number of shoots after three months; and percentage of survival after three months.

## Materials and methods

*Research Design*

The experiment was conducted in a single factor experiment in a Completely Randomized Design (CRD). This design is suited for experiments where the condition in the experiment area is the same or can be controlled. Each bamboo species was treated separately because they have different physiological characteristics. The treatments that were used are as follows:

$T_1$ – Control, 1-part organic fertilizer + 1-part alluvial soil + 1-part Raw Rice Hull (RRH)

$T_2$ – 1-part organic matter + 1-part alluvial soil + 1-part carbonized rice hull

$T_3$ – 2 parts carbonized rice hull + 1-part alluvial soil +1-part organic fertilizer

Total enumeration was made in the collection of data except on the number and length of roots. There were 15 cuttings propagated per treatment and were replicated three times making a total of 45 cuttings planted per treatment. The total number of cuttings propagated per species was 135.

*Locale of the Study*

The study was conducted at Cagayan State University Gonzaga Campus in the month of October to December 2021.

*Selection of Planting Stock*

Branches from a more or less two years culm was selected as planting stock.

To estimate the age of such culm, the leaf sheath should have been detached with fully developed branches. Such branches have fully expanded leaves. Too young planting stocks have a very low chance of survival and so with matured ones.

Not all branches are suitable for propagation at one time. Only those branches with pronounced root initials at the bases were used. However, the presence of roots is not enough to guarantee that the planting stock will survive. The presence of prominent bud was also considered because it is in the bud where the sprout will come out. These branches can be easily separated from the culm with the use of a sharp bolo, chisel, hacksaw or crosscut saw, reduce to a two-node cutting. Proper care was observed to preserve live buds. Once the branch is detached it was soaked in clean water to prevent dehydration. All collected cuttings were soaked in clean water within 24 hours or overnight to allow them to rehydrate.

*Potting*

The different composition of soil media was prepared by mixing alluvial soil, vermicompost, with carbonized rice hull and media with raw rice hull. The soil media was mixed thoroughly and put in a polyethylene bag.

*Planting*

The prepared cuttings were inserted into a potting mix that had already been prepared. With the middle of the polyethylene bags, the cuttings were vertically planted so that the lower node would be buried and covered in soil. After planting, the cuttings' bases were gently pressed, and the soil was wetted right away to help the soil settle.

*Care and Maintenance*

Bamboo cuttings have a better chance of survival if the soil where it is propagated is kept moist all the time. Watering was carried out twice daily—early in the morning and late in the afternoon—or more frequently as needed—to maintain a sufficient level of moisture. Weeds are alternate host of pests and diseases and act as competitor with the propagated bamboo. They were removed whenever they grow.

*Data Analysis*

The statistical method of Analysis of Variance (ANOVA) on Completely Randomized Design (CRD) in single factor experiment was used to examine the tabulated data.

## Results and discussions

*Average Survival Rate (%)*

The result (Table 1) showed that the highest percentage of survival of spiny bamboo was obtained by $T_3$, cuttings propagated in one part alluvial soil, one part vermi-compost and two parts of Carbonized Rice Hull (CRH) and $T_2$, cuttings propagated in one part alluvial soil, one part vermi-compost and one part of Carbonized Rice Hull (CRH) with a mean of 66.67% while $T_1$, one part alluvial soil, one part vermi-compost and one part of Raw Rice Hull (RRH) garnered the lowest survival rate.

On the other hand, giant bamboo as shown in Table 2, $T_2$ garnered the highest percentage of survival having a mean of 66.67%. This was followed by T3 with a mean of 53.33%, $T_1$ obtained the lowest percentage of survival having a mean of 28.89%. The performance of machiku bamboo's survivability is shown in Table 3. T2 and T3 both had the highest machiku bamboo survival rates, with a mean of 88.89% and 75.56%, respectively. $T_1$ has the lowest survival rate with a mean of 28.89%. On the survival rate of giant bamboo, the treatment variation is sufficiently larger than the experimental error and it yielded a significant difference. Higher percentage of survival means more propagules to plant. Spiny bamboo and machiku bamboo performed insignificant effect of the said treatments.

High survival of $T_2$ and $T_3$ may be because of Carbonized Rice Hull (CRH) as combination of the media that was used. Compared to un-carbonized rice hull, CRH is more porous because of its loose composition which improves aeration. Good aeration of the soil means higher survival of seedlings and propagules to be raised. Too densely compacted will not allow enough oxygen to reach the root system.

*Average number of shoots*

Spiny bamboo produced the greatest number of shoots in $T_2$, a soil medium composed of one-part alluvial soil, one-part organic fertilizer and on- part carbonized rice hull with a mean of 3.20. This was followed by $T_3$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and two parts of Carbonized Rice Hull (CRH) that produced a mean of 2.97 shoots while $T_1$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Raw Rice Hull (RRH) obtained the least number of shoots produced with a mean of 2.33 (Table 1).

Table 2 shows the performance of giant bamboo. An equal number of shoots was observed on $T_1$ and $T_2$ with a mean of 2.61 while $T_3$ produced the lowest number of shoots with a mean of 2.52.

On the other hand, treatment 2 of machiku bamboo propagation yields the most shoots, with a mean of 2.64, followed by treatment 3 with a mean of 2.56. With a mean of 2.53, Treatment 1 produced the fewest shoots. The experiment failed to detect any difference among the treatments tested which could be due a very small treatment difference (Table 3).

Based on the findings of Paembonan, et.al, (2020) a ratio of topsoil+ compost (1:2) it shows the highest average number of shoots compared to other compositions {only topsoil and soil+ compost (2:1)}. Topsoil+ compost (1:2) represents porous type of growing media. This finding gives support to the study that the soil media incorporated with raw rice hull will serve as only topsoil that also garnered the lowest number of shoots as the rice hull is in the process of decomposition.

*Average length (cm) of shoots*

Spiny bamboo obtained the longest length of shoots after three months in $T_3$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and two parts of Carbonized Rice Hull (CRH) with a mean of 100.10cm. This was followed by $T_2$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Carbonized Rice Hull (CRH) with a mean of 89.91cm while $T_1$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Raw Rice Hull (RRH) obtained the shortest length of shoots after three months with a mean of 83.08cm (Table 1).

**Table 1.** Parameters obtain of spiny bamboo as influenced by different potting media after three (3) months).

| Treatments | Parameters | | | | |
|---|---|---|---|---|---|
| | Average Survival rate (%) | Average number of shoots | Average length (cm) of shoots | Average number of roots | Average root length (cm) |
| T1-1:1:1 RRH | 57.78 | 2.33 | 83.08 | 27.58 | 39.99 |
| T2-1:1:1 CRH | 66.67 | 3.20 | 89.91 | 23.42 | 50.49 |
| T3-1:1:2 CRH | 66.67 | 2.97 | 100.10 | 27.92 | 48.85 |
| ANOVA RESULTS | ns | ns | ns | ns | ns |
| C.V. (%) | 9.23 | 25.01 | 15.41 | 20.65 | 17.98 |

According to Table 2, T2 produced the longest shoots for giant bamboo, averaging 81.60cmcm, followed by T3 at 65.43cm. $T_1$ garnered the shortest shoots with a mean of 63.38cm. According to Table 3, Machiku bamboo in T2 likewise had the longest shoots, with a mean of 85.15cm, followed by T3 and 83.93cm, while T1 had the smallest shoots, with a mean of 79.70cm. In all the treatments observed, $T_2$, a soil media composed of one-part alluvial soil, one-part vermi-compost and one part of Carbonized Rice Hull (CRH) shows as the best soil media to use in giant and machiku bamboo while $T_3$, a soil media composed of one-part alluvial soil, one-part vermi-compost and two parts of Carbonized Rice Hull (CRH). There was insignificant difference among treatment means but it does not in any way prove that all treatments are the same.

*Average number of roots*

Table 1 shows that spiny bamboo in $T_3$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and two parts of Carbonized Rice Hull (CRH) obtained the greatest number of roots with a mean of 27.92. $T_1$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Raw Rice Hull (RRH) follows with a mean of 27.58. $T_2$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Carbonized Rice Hull (CRH) had the least average number of roots with a mean of 23.42. Table 2 reveals, on the other hand, that T2's big bamboo had the most roots overall, with a mean of 50.58, followed by T1's mean of 36. 50. T3 produced the fewest roots overall, with a mean of 35.67. The machiku bamboo, with a mean of 48.83, grows the most roots in T2. Following T3 is T3, with a mean of 42.08. T1 generates the fewest roots, with a mean of 27.50.

**Table 2.** Parameters obtain of giant bamboo as influenced by different potting media after three (3) months).

| Treatments | Parameters | | | | |
|---|---|---|---|---|---|
| | Average Survival rate (%) | Average number of shoots | Average length (cm) of shoots | Average number of roots | Average root length(cm) |
| T1-1:1:1 RRH | 28.89 | 2.61 | 63.38 | 36.50 | 25.74 |
| T2-1:1:1 CRH | 66.67 | 2.61 | 81.60 | 50.58 | 57.21 |
| T3-1:1:2 CRH | 53.33 | 2.52 | 65.43 | 35.67 | 28.15 |
| ANOVA RESULTS | T2* | ns | ns | ns | T2** |
| C.V. (%) | 22.39 | 21.33 | 15.74 | 50.14 | 17.98 |

*Average length of roots*

It can be gleaned from Table 1 that spiny bamboo obtained the longest length of roots in T2, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Carbonized Rice Hull (CRH) with a mean 50.49. This was followed by $T_3$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and two parts of Carbonized Rice Hull (CRH) with a mean of 48.85 while $T_1$, cuttings propagated in one-part alluvial soil, one-part vermi-compost and one part of Raw Rice Hull (RRH) obtained the shortest length of roots after three months with a mean of 39.99.

According to Table 2, T2 yielded the longest roots for giant bamboo, averaging 81.60cm, followed by T3 at 65.43cm. The root length for T1 was the smallest, with a mean of 63.38. According to Table 3, machiku bamboo in T2 also had the longest roots, which were on average 57.21cm long. T3 was next, with a mean of 28.15cm, while T1 had the lowest roots, on average 25.74cm long.

In all the treatments observed, $T_2$, a soil media composed of one-part alluvial soil, one-part vermi-compost and one part of Carbonized Rice Hull (CRH) shows as the best soil media to use in giant and spiny bamboo in producing longer roots while $T_1$, a soil media composed of one-part alluvial soil, one-part vermi-compost and two parts of Carbonized Rice Hull (CRH) performed in machiku bamboo. There was insignificant difference among treatment means but it does not in any way prove that all treatments are the same.

Plants absorb water and nutrients more efficiently when the soil is aerated. This will give a high contribution in its growth parameters. According to the results obtained by Kappler, *et al.* (2018), adding Carbonized Rice Hull (CRH) is far better than adding Raw Rice Hull (RRH). Even both residues could slightly contribute to the soil pH regulation maybe acting as a soil correction agent; CRH is finer than RRH which means it is more porous.

**Table 3.** Parameters obtain of machiku bamboo as influenced by different potting media after three (3) months).

| Treatments | Parameters | | | | |
|---|---|---|---|---|---|
| | Average Survival rate (%) | Average number of shoots | Average length (cm) of shoots | Average number of roots | Average root length (cm) |
| T1-1:1:1 RRH | 68.71 | 2.53 | 79.70 | 27.50 | 43.50 |
| T2-1:1:1 CRH | 88.89 | 2.64 | 85.15 | 48.83 | 35.59 |
| T3-1:1:2 CRH | 75.56 | 2.57 | 83.93 | 42.08 | 33.73 |
| ANOVA RESULTS | ns | ns | ns | ns | ns |
| C.V. (%) | 13.28 | 21.07 | 17.29 | 42.11 | 19.88 |

## Conclusions and recommendations

The result showed that the combination of alluvial soil, vermin-compost and Carbonized Rice Hull (1:1:1) was the best combination of media results on all variables measured. This treatment leads in all the parameter gathered followed by Treatment 3, the combination of alluvial soil, vermin-compost and Carbonized Rice Hull (1:1:2). It can be concluded that administering Carbonized Rice Hull as part of the media is very effective in improving the soil that helps in growth of the three species of bamboo propagules.

Based upon the findings and conclusion of the study, $T_2$-soil media composed of alluvial soil, vermin-compost and Carbonized Rice Hull (1:1:1) is recommended to use in propagating the three species of bamboo because of its capability to improve survival rate. It is further recommended that rice hull must be carbonized before mixing to the soil medium to give more advantages to our bamboo propagules.

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