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Shoot production of Machiku Bamboo (*Dendrocalamus latiflorus*) as affected by different management practices

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Abstract

The study was conducted along the Tabungao Farmers Irrigation Sytem machiku Bamboo plantation of Cagayan State University- Gonzaga Campus, Philippines from May until December 2022. The study sought to determine the shoot production of machiku Bamboo (*Dendrocalamus latiflorus)* as affected by different management practices. It aimed to determine the following parameters: average number of culms per clump; average number of days from treatment application to the first day of bearing shoot in each treatment; average number of shoots per clump; average length (inch) of shoots; and average weight of shoot (kg) four weeks after emergence. The study was conducted in a single factor experiment under Randomized Complete Block Design (RCBD). There were four (4) treatments replicated three (3) times. T1- motolite technology (control), T2- pruning of clumps and culms, T3- pruning of clumps and culms + fertilizing and T4- pruning of clumps and culms + fertilizing + watering + mulching. To do it, 48 clumps of bamboo with three (3) blocks were applied with different management practices. In each block there were 16 bamboo clumps planted. The growth and survival of shoots were observed for a period of 8 months. All parameters determined were significantly observed in T4. It is concluded and recommended that pruning of clumps and culms, watering, fertilizing and mulching was the best management practice in Bamboo shoot production although any of the treatments can still be used because they still produced Bamboo shoots.

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Introduction

Bamboo, also known as kawayan, is a woody perennial plant that is a member of the Gramineae (Poaceae) family of grasses. It has special characteristics and a variety of uses. One of the fastest-growing plants in the world is Bamboo, according to popular belief. The Bamboo culm or pole is perfect as a low-cost material source for housing and construction, scaffolding, furniture, handicraft, banana props, fish pens, agricultural implements and carts, musical instruments, boat outriggers, pulp and paper manufacturing, toys, industrial products like bamboo tiles and plyboo, and many other things. To keep the soil in place and reduce soil erosion, it is frequently planted along river banks and rivers. Young shoots (rabong or tambo) of some species are excellent for food, whether they are consumed fresh or tinned. Culm harvesting can begin in three to five years. Due to the early return on investment, there is a clear benefit over trees that grow quickly.

In the Philippines, Bamboo is gaining popularity due to its many uses and advantages for both people and the environment. Formerly referred to as "poor man's lumber," it is now praised as "climate change grass" and still bears the famous epithet "the tallest grass of life." Because the Philippines is home to numerous native (including endemic) Bamboo species that naturally thrive in a variety of settings, stands of Bamboo may be found all across the nation. Several species that were introduced are now habituated to or well adapted to the environment in the area.

Bamboo is currently a new and very promising commodity as a result of the recent recognition of the value to the environment. The government's flagship program for reforestation of Bamboo, which seeks to reforest 500,000 hectares as part of ASEAN's promise to create 20 million hectares of new forest by 2020, serves as an example of this. When it comes to commercial production, community livelihood, and environmental protection measures, bamboo can serve as the foundational renewable resource.

Machiku *(Dendrocalamus latiflorus)*, an invasive species, is well-known around the world for producing vegetables (shoots). It was discovered that this species produced the tastiest Bamboo shoots and was regarded as having the sweetest Bamboo shoots of all the bamboo species. Pruning and fertilization are two of the finest ways to maintain, safeguard, and save the genetic diversity of the plant while also increasing the output of Bamboo shoots on campus.

East Asia, notably southern China, Myanmar, and Vietnam, is home to *Dendrocalamus latiflorus,* also referred to as Sweet Bamboo. It is sympodial, thickly tufted, and evergreen. Its culm is upright with a pendulous tip and can grow up to 25 m tall and 20 cm in diameter.

Young shoots can be eaten fresh or cooked. Mature culms can be used to build houses, make paper pulp, tiny rafts, baskets, or water pipes. It is occasionally grown for decorative purposes. Bamboo can be produced from seed or by taking rhizome and culm cuttings.

Pruning, as used in horticulture, is the removal or reduction of parts of a plant, tree, or vine that are not required for its growth or production, are no longer aesthetically pleasing, or are detrimental to the plant's health or growth.

Bamboo is a grass that behaves differently from a tree or a shrub, thus pruning requires a specific technique. It isn't particularly challenging, but like anything else in the garden, it does require some effort to keep up its ideal health and appearance lower branches must be pruned, as well as older culms. To prevent the plant from spreading too quickly, it is also necessary to trim the Bamboo roots. The Bamboo canes' tops may occasionally also need to be trimmed.

Fertilizing can accelerate growth by a year or more. It is the best way to increase growth. Bamboo can benefit from extra energy provided by additional fertilization.

Mulching is an operation that involves spreading or depositing any substance, organic or inorganic, natural or synthetic, on the ground with the primary goals of reducing soil water loss through evaporation,inhibiting weed development, preventing erosion and controlling soil temperature. In order to begin growing Bamboo as soon as possible after planting, chopped weed leaves, straws, or foliage should be gathered from the farm and piled at the bases of the seedlings as tightly as possible. Better results come from thickness. They will breakdown and turn into organic fertilizers.

The plants should receive enough water, especially while they are young, on sandy soils, and during dry or droughty periods.

Bamboo sprouts are available year round but in Gonzaga, its peak season is during the month of May to October depending upon the occurrence of rainy days. Since Bamboo is one of the flagship commodity of Cagayan State University- Gonzaga campus, this study was conducted to give an opportunity to step up Bamboo shoot production not only to address local demand but also to explore other uses of Bamboo shoots.This claims the study of (Thounaojam *et al.*, 2017) with their study entitled: In vitro Propagation of an Edible Bamboo *Dendrocalamus latiflorus* Munro using nodal explants. According to them, young shoots of bamboo are said to be rich in proteins, carbohydrates, vitamins, fiber, and bioactive compounds like phenols and phytosterols, which have many nutraceutical properties. Demand for Bamboo is also increasing because of its many applications.

Materials and methods

Research design

The study was conducted in Randomized Complete Block Design (RCBD) with four treatments and three replications.

The experimental treatments were as follows:

T1- no technology (control)

T2- pruning of clumps and culms

T3-pruning of clumps and culms + fertilizing

T4-pruning of clumps and culms + fertilizing + watering + mulching

Locale of the study

The study was conducted at Machiku Bamboo plantation along the Tabungao Farmers Irrigation Sytem of Cagayan State University- Gonzaga Campus, Philippines from May until December 2022.

Data collection instruments and procedures

Site selection

Researchers conducted site selection and prepared the experimental area along the Tabungao Farmers Irrigation System where machiku bamboo plantation is located.

Counting number of culms per clump

Researchers counted the number of culms per clump in each treatment.

Treatment applications

Pruning and cleaning around the bamboo culms and clumps

Pruning was done using the accurate pruning tools like bolo, hacksaw and pruning shear of chosen plant corresponding to their treatments. Pruning and cleaning around the Bamboo culms and clumps was also done to remove unwanted hazards.

Fertilizer application

Fertilizer was applied at a rate of 500 grams (14-14-14) in the chosen treatments and weighed separately using clock type weighing scale for accurate distribution of fertilizer more than the application of Mr. Bareja which he uses 200-300 grams per clump and recommend to increase application when he clumps get thicker.

Mulching

Mulching was done using the Bamboo fallen leaves to suppress weeds, enrich the soil with nutrients and improve soil retention. Three things are accomplished by utilizing dried leaves to cover the soil surrounding the bamboo, reducing moisture loss, feeding the plant with organic material (which breaks down and feeds the bamboo), and controlling weed development. (Bamboo Plus).

Watering

Watering was done after the application of fertilizer in T4 only to make sure that the fertilizer applied was dissolved to prevent the loss of nutrients. The volume of water was 16 liters per hill.

Data gathering

Counting number of shoots

The number of shoots in each sample plant was counted after their emergence and the average was computed.

Harvesting

This was 30 days after the emergence of each shoot. The shoots were cut at ground level using hack saw and bolo.

Measuring

The length of shoots was measured using a meter stick from the base of the shoot up to the tip after one month from emergence.

Weighing

The harvested shoots were weighed. All the shoots from each treatment were weighed using digital weighing scale and the average was computed.

Statistical analysis

The tabulated data were analyzed in a single factor experiment using the statistical procedure of Analysis of Variance (ANOVA) on Randomized Completely Block Design (RCBD). Comparisons of means among treatments were carried out using Least Significant Difference (LSD) Test.

Results and discussion

Average number of culms per clump

Personal observations revealed that when the number of culms per clump has a wide gap more culms produced more shoots as compared to culms having lesser culms. It was also based on the data gathered on different parameters that the number of culms does not have effect on the shoot performance of machiku Bamboo.

Table 1. Parameters obtained by the Machiku bamboo using different treatments

Treatmets	Parameters						
	Average number of shoots per clump	Average weight (kg) gained per clump	Average number of culms per clump	Average number of days from treatment application to the first day of bearing shoot in each treatment	Average number of shoots per clump	Average length (cm) of shoot	Average weight of shoot (kg) four weeks after emergence
T1-motolite technology (control)	19.25	56.02	11.19	13.83	6.42 [b]	14.70 [a]	0.73 [ab]
T2- pruning of clumps and culms	21	70.40	12.64	10.75	11.00 [b]	11.70 [b]	0.53 [c]
T3- pruning of clumps and culms + fertilizing	41	90.47	12.88	12.33	13.83 [b]	11.90 [b]	0.56 [bc]
T4- pruning of clumps and culms + fertilizing + watering + mulching	73	204.30	13.47	14.08	24.42 [a]	14.77 [a]	0.70 [a]
ANOVA results	-	-	ns	ns	**	*	*
C.V. (%)	-	-	6.10	26.26	30.72	8.21	11.86

The number of culms per clump is presented in Table 1. Data disclosed that T4, clumps pruned, fertilized, mulched and watered when needed had the most number of culms per clump with a mean of 13.47 followed by T3, clumps pruned and fertilized with a mean of 12.88 and next is T2, clumps pruned with a mean of 12.64. The untreated clumps had the lowest number of culms with a mean of 11.19. Analysis of variance proved that there were no significant differences among the different treatments tested.

Average number of shoots per clump

Table 1 shows that T4 reach the highest number of shoots produced per clump that reaches 73.25 pcs followed by T3 with an average of 41.5 pcs. T2 also reached 21 pcs of shoots per clump and the T1, the

control was the lowest with an average of 19.25 pcs of shoots in a clump. T1 has a total of 77 pcs, T2 has a total of 84 pcs, T3, has a total of 166 pcs and T4 has 293 pcs of shoots produced the whole duration of the study.

Average weight (kg) of shoots per clump

Table 1 shows that T4 reach the heaviest shoots produced per clump that reaches 204.30kg followed by T3 with an average of 90.47. T2 also reached 70.40kg of shoots per clump and the T1, the control was the lowest with an average of 56.02kg of shoots in a clump. T1 has a total of 224.10kg, T2 has a total of 281.59kg, T3, has a total of 361.86kg and T4 has 817.20kg of shoots produced the whole duration of the study.

Average number of days from treatment application to the first day of bearing shoot in each treatment

Table 1 presents the average number of days for the clumps to produce new shoots. The lesser number of days for the clumps to produce new shoots is better. T2, pruning of clumps and culms had the least number of days to bearing new shoots with a mean of 10.75 follwed by T3, pruning of clumps and culms+ fertilizing with a mean of 12.33, then T1 with a mean of 13.83. Pruning of clumps and culms + fertilizing+ watering + mulching, T4 had the most number of days before it produce shoots with a mean of 14.08. The analysis of variance disclosed that there were no significant differences among the treatments tested.

Average number of shoots per clump

Table 1 show the average number of shoots per clump. The table disclosed that T4, machiku Bamboo clumps pruned, fertilized, mulched and watered when needed produce the most number of shoots with a mean of 24.42. This was followed by T3, machiku bamboo clumps pruned and fertilized with a mean of 13.83 and T2, machiku bamboo clumps pruned with amean of 11.00. T1, the control plants had the lowest number of shoots with a mean of 6.42.

The analysis of variance revealed that there were highly significant differences among treatments tested. T4, Bamboo clumps pruned, fertilized, mulched and watered when needed was found to have significantly differed overall the other treatments tested. T3, T2 and T1 are comparable with each other though they vary in numerical values.

In the study, pruning promote and create space for new development of bamboo shoots. Cutting branches up to two meters high reduce competition for space, sunlight, moisture, and nutrients. It also allows good air circulation, as Brent Wilson, 2022 stated also in his study.

Using dried bamboo leaves was considered as organic fertilizer as mulch during the conduct of the study and helps to maintain the moisture of the bamboo clumps. It also supplements the study of Fan *et al.* (2021) that addition of organic fertilizer to the Bamboo stands can meet the nutrient requirements of a large number of shoots during the shooting period and improve bamboo shoot quality. The emergence of shoot, as well as the number of shoots sped up with the help of fertilizers (Kleinhenz and Midmore, 2002).

Average length (inch) of shoot

Table 1 presents the average height of Bamboo shoots after 30 days. T4, pruned, clumps and culms, fertilized, watered when needed had the tallest shoots with a mean of 14.77 inches. It was followed by T1, the control with a mean of 14.70 T3, pruned clumps and culms and fertilized came after with a mean of 11.90 while T2, pruned clumps and culms had the shortest shoots with a mean of 11.70.

The analysis of variance manifested a significant relationship among the treatments tested. T4 and T1 are similar with each other and they were found to have significantly taller shoots within 30 days than T3 and T2. T3 and T2 were also found approximately the same with each other.

T4 had the most number of culms that made it shady and for the shoots to receive sunlight they had to grow fast, faster than those with lesser culms.

The study of Kleinhenz and Midmore, 2002 was same with the result of this research which presents fertilizer application can boost growth rate of bamboo shoots in terms of centimeters. Same to their results fertilizer application allow clumps to achieve large shoot yields. The study caused by the effect of fertilizer applied in soaking the clumps that made the faster growth of the shoots.

Average weight of shoot (kg) four weeks after emergence

Table 1 shows that T1, control, with a mean of 0.73, has the heaviest weight, while T4, pruned clumps and culms, fertilized, watered as needed, and mulched, is next, with a mean of 0.70. T3, pruned clumps and culms, and fertilization with a mean of 0.56. The lightest weight, with a mean of 0.53, was found in T2 trimmed clumps and culms.

The analysis of variance proved that there are significant differences among the different treatments tested. T1 is comparable to T4 although only T1 is significantly heavier over T3 and T2 while T4 is statistically the same with T3. T3 is comparable to T2.

The result is caused by the number of shoots produced. T1 had the least number of shoots and definitely there are lesser nutrients required to nourish them and lesser competition resulting in heavier weight of shoots. This supplements the information of (Bamboo Sourcery Nursery & Gardens, 2019), watering bamboo clumps during a protracted dry spell necessitates soaking to address the curling of its leaves and prevent dehydration. As a result, this will create the right conditions for the production of shoots.

On the other hand, T4 was pruned, fertilized, mulched, and watered as needed to meet the needs to generate heavier weight of shoots despite having the most shoots. T4 had the most shoots overall.

Bamboo's leaves will curl into a "V" form as a sign of water stress. Immediately water the plant if this is seen. First and foremost, make sure your bamboo is well-watered (7 Arrows Farm) (2014).

Conclusion

As disclosed in the study, the implementation of the different management practices contributed to the production of Bamboo shoots. Among these practices there is one practice that transcends over the other. It is therefore concluded that pruning of clumps and culms coupled with fertilizer application, mulching and watering when needed is the best management practice that contributes to the production of Bamboo shoots as a source of food.

Recommandations

It is divulged on the findings of the study that the implementation of different management practices enhanced the production of Bamboo shoots. It is therefore recommended that management practices such as the pruning of clumps and culms, fertilizing, mulching and watering the clumps when necessary should be done to enhance the production of bamboo shoots. It is further recommended that the implementation of the different management practices on the production of Bamboo shoots should be done before the season of the production of shoots in order to attain a more conclusive result. It is also recommended that shoots harvested should undergo heavy metal analysis for general safety when exploring different uses of Bamboo shoots for utility model and patenting purposes. Cost and return analysis on the management practices should also be included on the output of the research in case a similar study will be conducted along this line.

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