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Response in Growth Geronggang (*Cratoxylon arborescens* Vahl. Blume) Seddling by Giving Chicken Manure

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Abstract

One potential plant species for restoration in peat swamp forests is Cratoxylon arborescens. A well-managed nursery includes the application of chicken manure. This study aims to determine the effect and best dose of chicken manure fertilizer on the growth of C. arborescens seedlings on peat planting media. This research used RAL (Completely Randomized Design) experimental method, which consisted of 4 treatments (P0 = control, P1 = 10% chicken manure + 90% peat, P2 = 30% chicken manure + 70% peat and P3 = 50% chicken manure + 50% peat) with 5 replications. The data obtained were analyzed statistically using variance analysis, followed by Duncan's New Multiple Range Test (DNMRT) at the 5% level. The results showed that chicken manure had a significant effect on the growth of C. arborescens seedlings, because it was able to increase fertility and nutrient availability, improve the physical, chemical and biological properties of peat. The most effective and best treatment for four-month-old C. arborescens seedlings was P2 (30% chicken manure + 70% peat) with 100% survival percentage, average height increase of 14.39 cm, average diameter increase of 1.56 mm, dry weight of 7.41 g and seedling robustness of 8.35

Keywords: *Chicken manure, Cratoxylon arborescens, Growth, Peat, Seedlings*

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INTRODUCTION

Indonesia has the fourth largest peatland area in the world, with 24.14 million hectares (Astika et al., 2022), peatlands are currently degraded, but still have the potential to be restored through peatland restoration. The successful implementation of peatland restoration can be determined by the selection of plant species (Rochmayanto et al., 2021). One potential plant species in peat swamp forests is geronggang (*Cratoxylon arborescens* Vahl. Blume).

Geronggang is native to peat swamp forests and as a pioneer species that attracts other species to peatlands (Istomo et al., 2022). Geronggang has the potential to be used as a candidate for the initial phase of peat restoration (Abdi et al., 2020). The results of research Junaedi (2018), geronggang has a good survival rate with a survival percentage of up to 80% at five years and six months after planting. The results of research by Yanne et al. (2022), geronggang can be used as a firebreak plant because it has fire-resistant properties and after peatland fires occur this type of plant can still grow.

The quality of geronggang seedlings will be good if the nursery is managed properly, such as applying chicken manure manure to the planting media. Setiawan et al. (2020), stated that the results of his research on the growth of cocoa plants with parameters of height, diameter, and dry weight of plants increased after being given chicken manure. In addition, the peat maturity process can be accelerated by adding chicken manure manure to the planting media because fertilization accelerates the decomposition process of organic matter in peat (Setiawan et al., 2020). The results of research by Susilo et al. (2022), stated that peat planting media can be better after adding chicken manure manure so that it benefits edamame plants to grow and develop.

The application of chicken manure to several agricultural crops or other forest plants in peat media has been carried out, but it is not yet known what composition of chicken manure in peat planting media is optimal for the growth of geronggang seedlings. Therefore, this study was conducted to determine the effect and best dose of chicken manure on the growth of geronggang seedlings on peat planting media.

METHOD

This research was conducted at the Experimental Garden of the Faculty of Agriculture and Forestry Laboratory of the Faculty of Agriculture, Riau University, Pekanbaru City in April-June 2023. The materials used were geronggang seedlings, chicken manure, water and sapric peat. The tools used were stationery, ruler, analytical scales, hoe, machete, paranet net, bucket, scissors, calipers, label paper, polybag, oven, cellphone camera and laptop.

This study used the experimental method of complete randomized design (CRD) with four treatments namely P0 (without application of chicken manure (control), P1 (10% chicken manure + 90% peat), P2 (30% chicken manure + 70% peat) and P3 (50% chicken manure + 50% peat) with five replications. Each experimental unit consisted of five plants, therefore a total of 100 plants. Research parameters, namely:

Research Parameters

Survival Percentage (%)

The percentage of seedlings alive is the ratio between the number of seedlings that are able to live and the total number of seedlings planted at the beginning of the study. The percentage of seedlings alive was calculated at the end of the observation with the formula:

$$\text{Survival Percentage} = \frac{\text{Number of seedlings alive}}{\text{Number of seedlings planted}} \text{ x } 100\% \quad (1)$$

Height Increase (cm)

Seedling height increase was determined by calculating the final seedling height minus the initial seedling height (from the base of the stem to the terminal end of the shoot). Seedling height measurements were taken once a week for eight weeks.

Diameter Increase (mm)

Diameter increase was determined based on the calculation of the difference between the final diameter of the seedlings and the initial diameter of the seedlings. Seedling diameter measurements were taken once a week after transplanting for eight weeks.

Plant Dry Weight (g)

At the end of the study, the plant dry weight parameter was measured by taking 3 samples of seedling plants from each treatment. After washing, the samples were air dried for two hours. Each sample was divided into two parts (crown and roots) by cutting at the base of the stem. Each part that has been cut is put into a different envelope and then an oven is carried out at a temperature of 103 ± 2 ^{o}C for 1 day or 24 hours until it reaches a constant weight. After that, weigh the dry weight using the formula:

$$\text{Dry weight} = \text{Crown dry weight} + \text{Root dry weight} \quad (2)$$

Seedling Robustness

Seedling robustness is a measure of the balance of height growth with seedling diameter growth where the calculation is carried out at the end of the study. The formula (Deselina, 2014) for the value of seedling sturdiness, namely:

$$\text{Seedling sturdiness} = \frac{\text{Height}}{\text{Diameter}} \quad (3)$$

Data Analysis

If the data has been obtained, then statistical analysis using variance analysis with the SPSS version 17.0 application. was conducted. After that, Duncan's New Multiple Range Test (DNMRT) at the 5% level was carried out with the aim of proving the difference between all treatment pairs and being able to maintain the real level set.

RESULT AND DISCUSSION

Seedling Survival Percentage (%)

The results of the analysis conducted on the parameter of the percentage of live geronggang seedlings showed no significant effect. The average observation results of the percentage of survival for eight weeks are presented in Table 1.

Table 1. Percentage of Living *Cratoxylon arborescens* Seedlings

Treatment	Seedling Survival Percentage (%)
P0 (100% peat)	100
P1 (10% chicken manure + 90% peat)	100
P2 (30% chicken manure + 70% peat)	100
P3 (50% chicken manure + 50% peat)	96

Table 1 shows that of the four treatments given to geronggang seedlings, there was no significant effect on the percentage of live geronggang seedlings observed. This happened because of all the seedlings planted in this research, only one seedling was unable to adapt so that the seedlings died, namely in the P3 treatment. This is thought to be the result of excessive application of chicken manure, which according to the results of research by Nuryani et al. (2019), plants will experience poisoning if the availability of nutrients in the planting media is available in excess. It also shows that the application of chicken manure has reached the optimum point in the P2 treatment, if it has reached the optimum point, the additional dose of chicken manure can interfere with plant survival.

The live percentage of 96% and 100% shows that geronggang seedlings are able to adapt well to the environment. Fitriani et al. (2019), stated that the key to success in determining the adaptability of plants to their environment is based on the percentage of life. According Wahyuningsih & Rahmayanti (2021), geronggang plants are native to peat swamps and adaptive in peat swamps. Selaras et al. (2023), also stated that geronggang plants successfully adapt to environmental factors such as peatlands that have been burned. Therefore, whether or not chicken manure was applied to the peat medium did not affect the survival of geronggang seedlings.

Height Increase

Based on the results of statistical analysis conducted on the parameter of height gain of geronggang seedlings, it shows a real effect. The average observation of geronggang seedling height gain is shown in Table 2.

Table 2. Average height increase of *Cratoxylon arborescens* seedlings at four months after treatment

Treatment	Height increase (cm)
P2 (30% chicken manure + 70% peat)	14,39[a]
P1 (10% chicken manure + 90% peat)	13,55[a]
P3 (50% chicken manure + 50% peat)	11,74[a]
P0 (100% peat)	7,48[b]

Notes: Numbers containing letters with different small sizes according to the DNMRT test at the 5% level are significantly different.

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Based on the average height of geronggang seedlings in Table 2, it proves that the application of manure significantly affects the increase in plant height and gives the highest average in geronggang seedlings. If chicken manure is applied properly, it can increase the macro and micro nutrients of the planting media. Napitupulu et al. (2021), the element that plays a role in plant vegetative growth, especially the stem and can spur plant height growth is the nutrient N.

The results showed that P2 was not significantly different from P1 and P3, presumably because manure derived from chicken manure can add nutrients to increase the fertility of peat media. Plants in the P2 treatment experienced changes where the plant height increased significantly due to the increased growth of terminal buds on plants as a result of the addition of chicken manure. According to Hidayah et al. (2022), the addition of chicken manure can loosen the soil which causes plant roots to grow well so as to increase the ability of the roots to retain water and nutrients can be effectively absorbed by plant roots. Plant height growth in P2 is the highest growth compared to other treatments, but in Table 2 it is known that the average plant height in the P1, P2 and P3 treatments is not too far away.

The P0 treatment showed a slow increase in geronggang seedling height and a low level of height gain compared to the other treatments (P1, P2 and P3), presumably because the nutrient content in peat is relatively low. Geronggang seedlings in the peat medium that were not given chicken manure were still able to grow, this happened because geronggang has the ability to adapt to the peat environment.

Susilo et al. (2022), stated that after chicken manure is applied, peat can be a good planting medium. Silalahi et al. (2018), proved that the addition of manure derived from chicken feces can have a good effect on acidic soil and is low in organic matter because organic fertilizers can increase the content of available P, K, Mg and Ca elements. The graph of geronggang seedling height growth in each treatment can be seen in Figure 1.

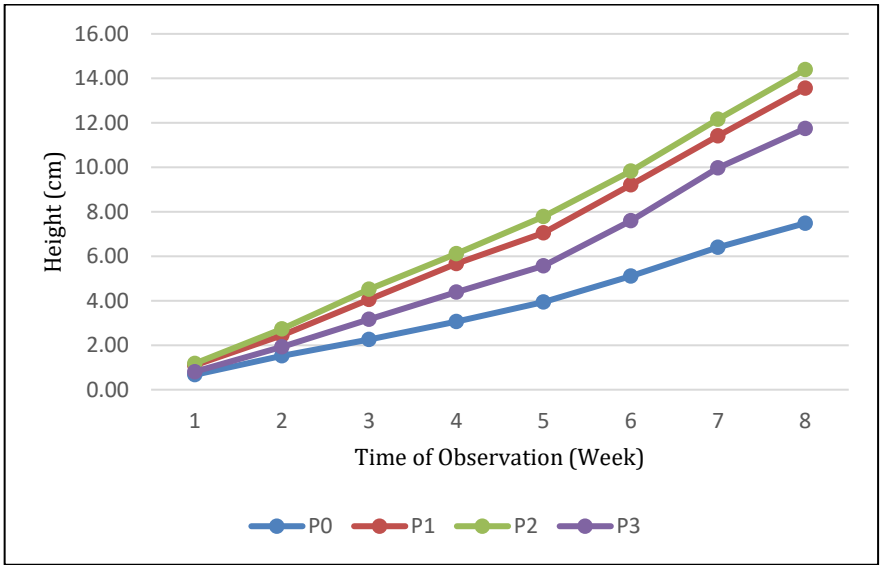

Figure 1. Four-month-old *Cratoxylon arborescens* seedling height observation graph.

Figure 1 shows that the P2 treatment shows a high growth rate, presumably because chicken manure fertilizer with an amount of 300 grams/polybag is a dose that is able to increase the height growth of geronggang seedlings the highest compared to other treatments. The nutrient N has a closely related influence on plant height increase (Napitupulu et al., 2021), so the N contained in chicken manure has a positive impact on the height increase of geronggang seedlings.

The graph in Figure 1 shows that P3 has a lower height gain than P2, even though the application of chicken manure in P3 is more than P2. It is suspected that excessive chicken manure fertilizer is not better for the growth of geronggang seedlings. According to Nuryani et al. (2019), if the concentration of chicken manure fertilizer is not right, it causes the results to be not optimal and if there is an excess of nutrients, it will result in the risk of nutrients being lost or unavailable.

Diameter Increase

Based on the results of statistical analysis conducted on the parameter of diameter increase of geronggang seedlings, it shows a real effect. The average observation results of diameter increase of seedlings are presented in Table 3.

Table 3. Mean diameter increase of *Cratoxylon arborescens* seedlings aged four months after treatment

Treatment	Diameter increase (mm)
P2 (30% chicken manure + 70% peat)	1,56[a]
P1 (10% chicken manure + 90% peat)	1,22[ab]
P3 (50% chicken manure + 50% peat)	1,07[b]
P0 (100% peat)	0,56[c]

Notes: Numbers containing letters with different small sizes according to the DNMRT test at the 5% level are significantly different.

Table 3 shows that the 100% peat treatment did not show significant growth in the diameter of geronggang seedlings, due to insufficient nutrient content. According to Armita et al. (2022), nutrients in the planting media if the availability is less or excessive, it can affect plant growth. According to Shafira et la. (2022), chicken manure plays a role in maintaining the balance of nutrients in the planting medium and provides nutrients for plants and has an effect for a long time. The element K (potassium) is a nutrient that affects diameter increase.\

Thamrin & Hama (2022), nutrient K has a function to increase sclerenchyma levels in plant stems. Thamrin & Hama (2022), the addition of sclerenchyma causes the diameter of the plant stem to increase. Based on this, the application of chicken manure can increase the K element and sclerenchyma levels which cause the diameter of geronggang seedlings to increase. A comparison of the diameter increase of geronggang seedlings for each treatment can be seen in Figure 2.

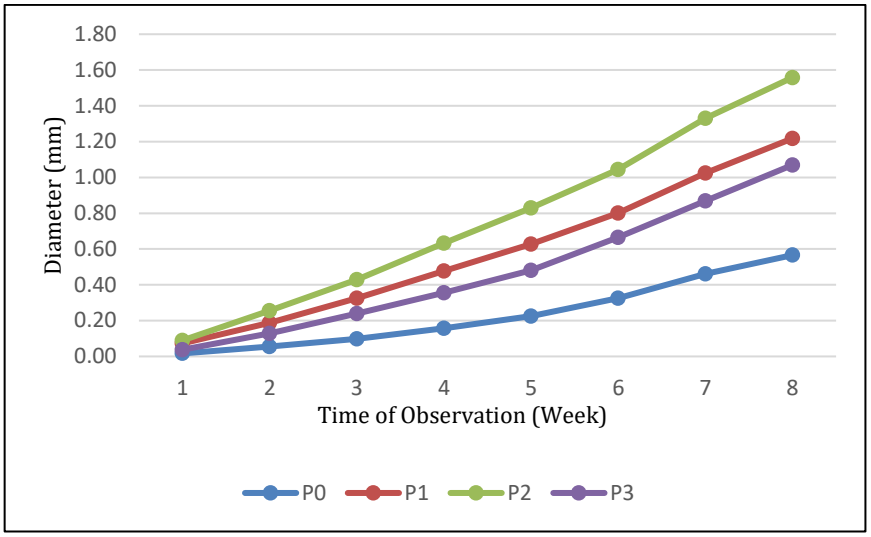

Figure 2. Observation graph of diameter increase of *Cratoxylon arborescens* seedlings at the age of four months.

Figure 2 showed that the P2 treatment experienced a rapid increase in diameter. This is thought to be because the amount of 300 grams/polybag is a dose of chicken manure that is able to increase the diameter of geronggang seedlings the most compared to other treatments. According to Minangsih et al. (2022), organic matter in chicken manure has a role for soil microorganisms for their energy source which can increase their activity in the soil. The stem diameter graph in the P3 treatment is smaller than P2 even though the dose in P3 is higher than P2. According to Simatupang (2019), increasing the dose of fertilizer can increase plant vegetative growth and if the dose is excessive it will reduce plant vegetative growth.

Plant Dry Weight

Based on the results of statistical analysis conducted on the dry weight parameter of geronggang seedlings, it shows a significant effect. The observation results of the dry weight of geronggang seedlings are presented in Table 4.

Table 4. Average dry weight of *Cratoxylon arborescens* seedlings aged four months after treatment

Treatment	Dry weight (g)
P2 (30% chicken manure + 70% peat)	7,41[a]
P1 (10% chicken manure + 90% peat)	5,11[b]
P3 (50% chicken manure + 50% peat)	4,40[b]
P0 (100% peat)	2,22[c]

Notes: Numbers containing letters with different small sizes according to the DNMRT test at the 5% level are significantly different.

Based on the results of dry weight data that have been analyzed in Table 4, it shows that the response of plants treated with chicken manure shows a significant effect on the dry weight of geronggang seedlings. The dry weight of geronggang seedlings is the highest compared to other treatments, namely P2, because it is thought

that the available nutrient content is able to support the photosynthesis and transpiration processes of geronggang seedlings. Hidayah et al. (2022), stated that after the addition of chicken manure manure can provide benefits in helping plants to carry out the photosynthesis process.

The high dry weight of plants indicates that the vegetative growth of plants is good. In accordance with the statement of Hidayat et al. (2010), stated that plant dry weight has a strong correspondence with height and diameter as well as leaf area and number, where plant dry weight will increase if height, diameter, leaf area and number of leaves also increase. In accordance with the results of observations on the increase in height and diameter of geronggang seedlings, where the increasing height and diameter of geronggang seedlings causes the dry weight of geronggang seedlings to also increase.

Seedling Robustness

Based on the results of statistical analysis conducted on the parameter of the robustness of geronggang seedlings, it shows a real effect. The mean of the observation of the sturdiness value of geronggang seedlings is presented in Table 5. Data on the sturdiness value of geronggang seedlings (Table 5) shows that the application of chicken manure to geronggang seedlings proves a significant effect on the root crown ratio value of geronggang seedlings, where the results of treatment P2 are significantly different when compared to other treatments. The P2 treatment has a low seedling robustness value and the P0 treatment has a high seedling robustness value. Plants will have a high chance of survival if they have a low robustness value (Sanusi et al., 2022) and vice versa, plants will have a low chance of survival if they have a high robustness value (Irmayanti et al., 2019).

Table 5. Mean sturdiness value of *Cratoxylon arborescens* seedlings aged four months after treatment

Treatment	Robustness value
P0 (100% peat)	10,38[a]
P3 (50% chicken manure + 50% peat)	10,04[a]
P1 (10% chicken manure + 90% peat)	9,96[a]
P2 (30% chicken manure + 70% peat)	8,35[b]

Notes: Numbers containing letters with different small sizes according to the DNMRT test at the 5% level are significantly different.

The results of the analysis carried out as a whole in each treatment show that the robustness value is still categorized as good and optimal. In accordance with SNI 01-5006.1-1999, if it is at 6.3-10.8, it shows that the seedling robustness value is classified as a good category and is further explained based on the type and quality of seedlings, if it is at 5.1-12, it shows the optimal seedling robustness value (Sukendro et al., 2023).

CONCLUSION

The application of chicken manure on peat planting media has a significant effect on the growth of geronggang (*Cratoxylon arborescens* (Vahl.) Blume) seedlings, because the application of chicken manure can increase the fertility and availability of peat nutrients, improve the physical, chemical and biological properties of peat. Chicken manure manure in the P2 treatment (30% chicken manure + 70% peat) provides the best treatment in increasing the growth of geronggang seedlings at the age of four months after being given the treatment with a live percentage of 100%, average height gain of 14.39 cm, average diameter gain of 1.56 mm, dry weight of 7.41 grams and seedling robustness value of 8.35.

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