



The effect of growth regulator on growth rate of *amorphopallus titanium*



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ABSTRACT

The *Amorphophallus* flower is one of the Endangered species, so there needs to be an effort to preserve breeding with a fast time, namely artificial vegetative. In addition, there is a need for a growth hormone to accelerate the growth process so that the number is not extinct, namely growth regulators (ZPT). The purpose of this study was to breed *A. titanium* vegetatively supported with growth regulators (ZPT) to improve quality and growth rates. The method used is a completely randomized design (CRD), which is divided into 4 treatments namely A (coconut water), B (shallots), C (bamboo shoots), and D (control) with a total of 4 replications so that in this study there were 16 plants (polybags). The results showed that the natural growth regulator treatment of shallot extract gave the best results in the parameter of the number of shoots, while coconut water extract gave the best results in the parameters of shoot length and growth time. Based on the results, it can be concluded that the use of natural growth regulators from coconut water, shallots, and bamboo shoots affects the growth rate of *Amorphophallus titanium*.

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INTRODUCTION

Sumatra Island has a diverse range of plants that naturally grow along the Bukit Barisan, and most are found near or on the western slopes of, for example, Bengkulu. Geographical conditions and suitable abiotic environmental factors support the Bengkulu region's high diversity of flora. One of Bengkulu's prides that has become a regional icon is the presence of a large flower, *Amorphophallus*. This *Amorphophallus* flower is a plant from the taro-talasan tribe endemic to Sumatra, Indonesia, which is known as the plant with the largest flower in the world. *Amorphophallus* has 176 species spread across the globe, 25 of which, or about 14.2%, are found in Indonesia. At the same time, 7 out of 11 *Amorphophallus* species are found in Sumatra, which

are endemic to Sumatra (Handayani et al., 2020). *Amorphophallus titanum* is a species of major concern because it is the largest of the other *Amorphophallus* species.

The growth of *Amorphophallus titanum* flowers is influenced by abiotic factors and associations between plant levels as shade, so that plants can grow optimally (Wahidah et al., 2022). Shady habitat conditions can make *Amorphophallus titanum* thrive, such as under the forest canopy in the rainforests of Sumatra (Arianto et al., 2018). The growth of this plant requires certain conditions to be able to grow optimally, including altitude factors, soil texture, shade intensity, and soil moisture (Wahyu et al., 2021).

Based on a search of the IUCN Red List of Endangered Species website in 2018, *A. titanum* was listed as endangered under criteria A2ac; C2a (I); and D (Yuzammi & Hadiyah, 2018). The presence of this species in its natural habitat is threatened due to land conversion, which is the main cause, as well as local myths related to the appearance of snake-like petioles that can harm humans. Meanwhile, vulture flower breeding has 3 phases of its life cycle, namely vegetative, dormancy, and generative phases in a long period and generally irregular season (Patty, J et al., 2022). Therefore, this species is considered Endangered due to its small population size in nature and its decline.

Preservation efforts by breeding individual *A. titanum* have been the concern of researchers and the rare wildlife community. However, efforts are still limited to generative breeding from seeds that take a long time to grow. Vegetative breeding is still a study in central research circles such as LIPI, with the breeding of tuberous organs, bulbils, and raccoons. Vegetative breeding through other plant organs is an alternative breeding technique that can be chosen because it can be done easily (Dule & Murdaningsih, 2019).

Vegetative breeding of *A. titanum* can be supported by giving growth regulators so that the growth process can run quickly. As the results of research conducted by Tustiyani (2017) showed that giving ZPT in the form of shallots and coconut water to coffee cuttings proved to accelerate the growth process. This result is also supported by research conducted by (Tanjung & Darmansyah, (2021), by giving coconut water ZPT to pomegranate cuttings, which has a very good effect on the length and number of roots. The results of other studies also prove that vegetative breeding given natural growth regulators, can accelerate the growth process, such as shallot extract zpt on pepper plant cuttings (Abdullah et al., 2019), coconut water zpt and shallots on vanilla plant cuttings (Nugroho et al., 2023), and coconut water zpt on pepper plant cuttings (Muslimah et al., 2016).

Based on the above statement, vegetative plant breeding with the cuttings technique and given natural zpt has been widely done and proven to accelerate the growth process. In response to this, the use of vegetative breeding with natural zpt is one of the solutions for *A. titanum* conservation efforts. This is also the latest breakthrough considering there is no research study on vegetative breeding of *A. titanum* cuttings with natural zpt to improve quality and growth rate. Generally, ZPT materials contain auxin hormones IAA, IBA, NAA, IAN, and POA, which can be obtained from natural materials including onions (Gusti et al., 2022), bamboo shoots (Novianti et al., 2022), and coconut water (Saputri et al., 2022). The use of shallot extract can optimally grow root length in tin fruit cuttings because it contains allithiamin compounds (Emilda, 2020). Meanwhile, the use of coconut water ZPT shows the growth of apple seedlings and the number of leaves (Kasi et al., 2021). The results of other ZPT research show that the treatment of *Bambusa vulgaris* var extract gives a good response to the number of growths, number of shoots, growth time, and number of leaves (Novianti et al., 2022). Therefore, this research will breed *Amorphophallus titanum* vegetatively and add ZPT in the form of shallot extract, bamboo, and coconut water to see the growth rate.

RESEARCH METHODS

Research Design

This research was conducted in the conservation zone of Bengkulu University from December 2023 to February 2024. This vegetative breeding research was conducted using the Randomised Design Design (CRD) method which was divided into 4 treatments namely A (coconut water), B (onions), C (bamboo shoots), and D (control) with a total of 4 replications so that in this study there were 16 plants (polybags). The plants used were the stem tubers of *A. titanum*. This breeding was carried out using the stem cuttings technique.

Population and Samples

The sample in this study is the stem tuber of the *A. titanum* plant. These tubers will be bred using the stem cuttings technique. The total tubers produced later will be 16.

Instruments

The tools used for this study were polybags as growing media, labels and markers to identify the experiments in polybags, scales to weigh the weight of the bulbs, ruler to measure the length of the shoots, caliper to measure the diameter of the stem, blender to make zpt extract, and sieve to filter the zpt extract after blending. The materials used in this study were *Amorphophallus titanum* tubers, zpt materials (onions, bamboo shoots, coconut water) and soil and husks as growing media.

Procedures

Vegetative propagation research was carried out using the Completely Randomised Design (CRD) method which was divided into 4 treatments namely A (coconut water), B (onions), C (bamboo shoots), and D (control) with a total of 4 replications so that in this study there were 16 plants (polybags). Observations were carried out for 20 observations (10 weeks), in the bioconservation zone of Bengkulu University.

The stages of the vegetative propagation research *Amorphophallus titanum* cuttings technique include: 1) Preparation of planting media by combining soil with compost, after which it is put into polybags; 2) Preparation of fresh extracts of coconut water, onions, and bamboo shoots in a ratio of 1:1, namely mixing 500 grams of ingredients with 500 ml of water and mashed with a blender. Furthermore, the solution is filtered and fresh extracts are ready for use; 3) Administration of extracts by soaking the tubers for 5 minutes, after soaking, planting is carried out on planting media; 4) Observation and treatment were scheduled every Monday and Friday for 10 weeks. Observation activities by monitoring the parameters of growth time, number of shoots, shoot length, and shoot diameter.

Data Analysis

The data obtained were analysed with the ANOVA test to see significant differences in each variable tested. If between the factors tried there are real differences then the analysis is continued with the BNT test. The observed variables include: (1) shoot length, (2) shoot diameter, (3) growth time, and (4) number of shoots.

RESULTS

Length of Shoots

The results of the measurement of the average growth rate of *Amorphophallus titanum* shoot length using growth regulators can be seen in the Figure 1.

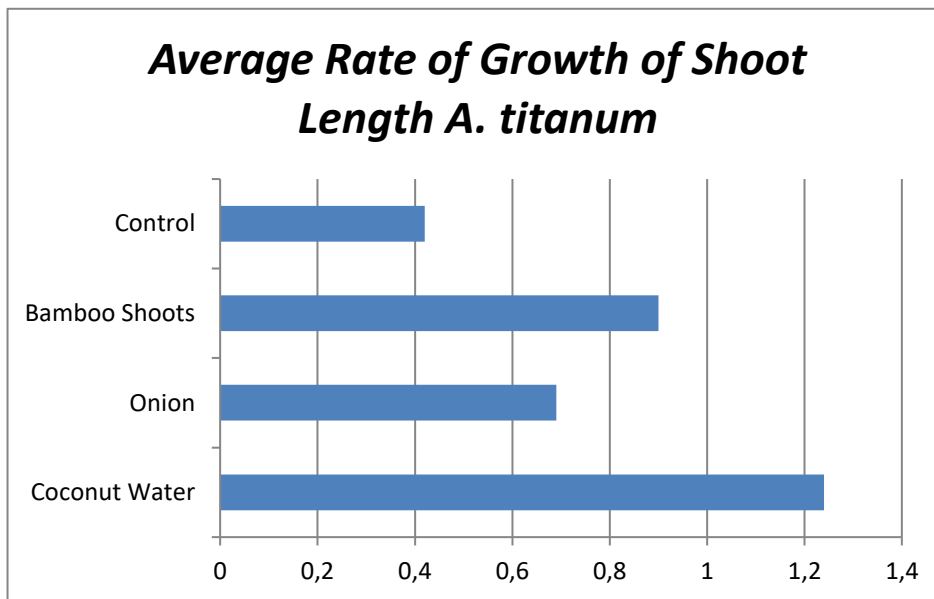


Figure I. Measurement results of the average growth rate of *A. titanum* shoot length using growth regulators (in mm)

Based on Figure I, it can be seen that the order of shoot length growth rate in *A. titanum* is higher when given growth regulators in the form of coconut water, bamboo shoots, onions, and control. These results prove that the use of coconut water is better in increasing the growth rate of shoot length. Then, to see the difference in growth results from each treatment, the BNT (smallest real difference) test was conducted. Before conducting the BNT test, the ANOVA analysis was conducted. It can be seen that the calculated *F* value is more than the *F* crit value (critical value) is $7,69 > 2,81$. This indicates that there is a significant difference between the averages of all treatments. This means that the average growth regulator substance in the form of onions, bamboo shoots, and coconut water, and control has a real difference. Then the BNT follow-up test was carried out to see the difference between the treatment of one growth regulator and the treatment of other growth regulators. The results can be seen in Table I.

Table I. BNT Test Measurement Results Shoot Length

Treatment	Average \pm SD	Symbol
Coconut water	$1,24 \pm 0,60$	c
Onion	$0,69 \pm 0,30$	ab
Bamboo shoots	$0,90 \pm 0,49$	bc
Controls	$0,42 \pm 0,17$	a

Based on Table I, it can be seen that the treatments using growth regulators that are significantly different are between coconut water with onions, coconut water with control, and bamboo shoots with control. The treatments using growth regulators that are not significantly different are coconut water with bamboo shoots, onions and bamboo shoots, and onions with control.

Diameter of shoots

The results of measuring the average growth rate of *Amorphophallus titanum* shoot diameter using growth regulators can be seen in Figure 2.

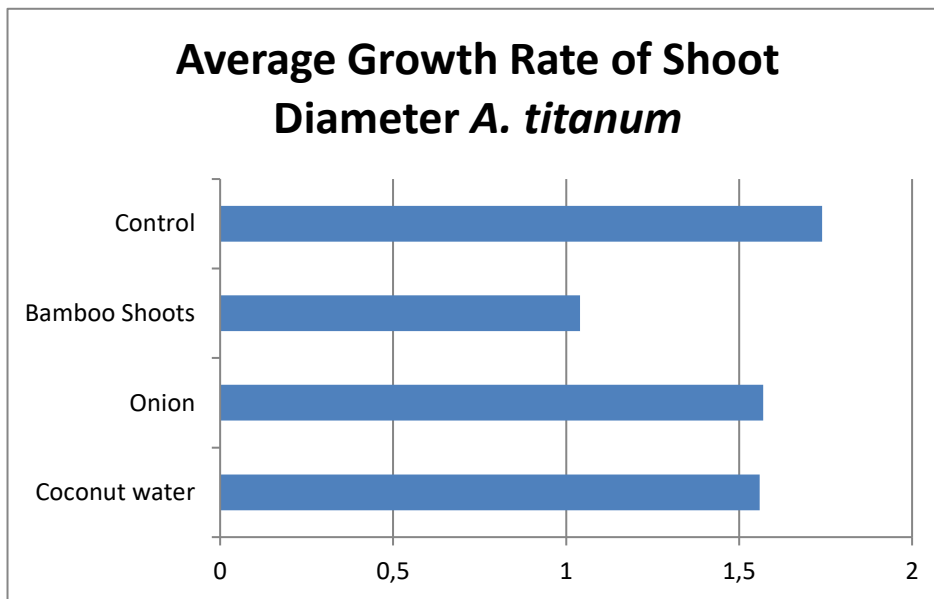


Figure 2. Measurement results of the average growth rate of the shoot diameter of *A. titanum* using growth regulators (in mm)

Based on Figure 2, it can be seen that the order of shoot diameter growth rate in *Amorphophallus titanum* is higher when no provision of growth regulators (control). Among the three growth regulators given the highest order is in onions, coconut water, and bamboo shoots. This result proves that the growth rate of the shoot diameter is best without using growth regulators.

Then, the ANOVA analysis test was conducted to see the real differences in the treatment averages. It can be seen that the calculated f value is less than the F crit value (critical value) is $0,09 < 2,81$. This indicates that there is no significant difference between the averages of all treatments. This means that the average growth regulator substance in the form of onions, bamboo shoots, and coconut water, and control has no significant difference. This result indicates that there is no need for further tests in the form of BNT.

Number of Shoots

The results of measuring the average growth rate of *Amorphophallus titanum* shoot diameter using growth regulators can be seen in Figure 3. Based on Figure 3, it can be seen that the order of the growth rate of the number of shoots in *Amorphophallus titanum* is higher when given a growth regulator in the form of onions, coconut water, bamboo shoots, and control. These results prove that the use of onions is better in increasing the growth rate of the number of shoots while the least number of shoots is in the control variable (without ZPT).

Then the ANOVA analysis test was conducted to see the real differences in the treatment averages. It can be seen that the calculated f value is less than the F crit value (critical value) is $0,34 < 2,81$. This indicates that there is no significant difference between the averages of all treatments. This means that the average growth regulator substance in the form of onions, bamboo shoots, coconut water, and control has no significant difference. This result indicates that there is no need for further tests in the form of BNT

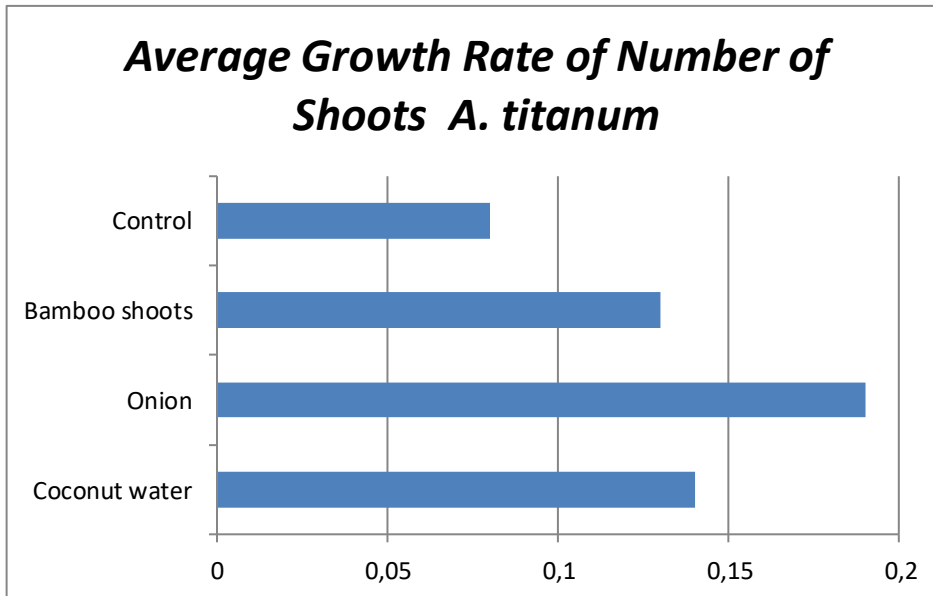


Figure 3. The results of measuring the average growth rate of the number of *A. titanum* shoots using growth regulators

Growing Time

The results of measuring the average growth rate of *Amorphophallus titanum* shoot diameter using growth regulators can be seen in Figure 4. Based on Figure 4, it can be seen under the order of the fastest growing time in *Amorphophallus titanum* is coconut water followed by onions, bamboo shoots, and control. These results prove that to accelerate the growth time for *Amorphophallus titanum*, it is very good to add a growth regulator in the form of coconut water rather than not adding anything.

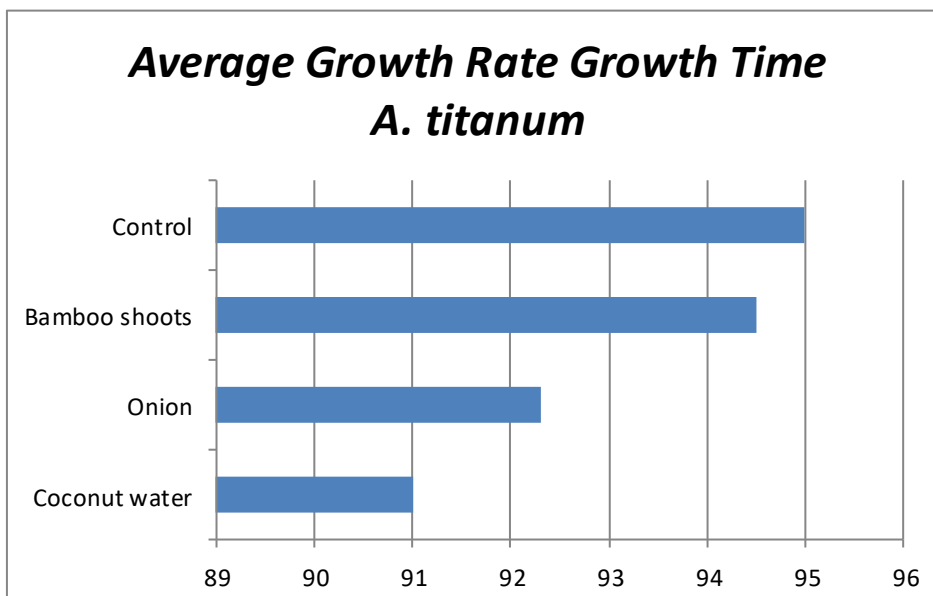


Figure 4. Measurement results of the average growth rate of *A. titanum* growth time using growth regulators (in days)

DISCUSSION

This study shows that one of the conservation efforts of *Amorphophallus titanum* can be done by breeding it vegetatively in the form of cuttings. Supporters to accelerate growth for

Amorphophallus titanum is by adding growth regulators (ZPT). ZPT is an organic compound that is not a nutrient and in small amounts can support, inhibit and can change the physiology of plants (Sitinjak et al., 2018). ZPT can be made from natural or synthetic materials (Mulyanti et al., 2023). ZPT in this study was made from natural ingredients, namely extract onions, coconut water, and bamboo shoots.

Based on Figure 1, it can be seen that the order of shoot length growth rate in *A. titanum* is higher when given growth regulators in the form of coconut water, bamboo shoots, onions, and control. These results prove that the use of coconut water is better in increasing the growth rate of shoot length. In line with the results of research which states that coconut water contains nutrients such as nutrients, vitamins, amino acids, nucleic acids, and growth regulators such as auxins and gibberellins needed by plants to increase plant growth (Maula et al., 2019). These results are reinforced by findings stating that the development of shoot length on cuttings treated with coconut water is faster and synchronous due to the presence of cytokinin content which allows the formation of shoots immediately and synchronously, more active cell division and enlargement (Azmi & Handriatni, 2019).

Based on Figure 2, it can be seen that the order of shoot diameter growth rate in *Amorphophallus titanum* is higher when without the provision of growth regulators (control). While from the three growth regulators given the highest order is in onions, coconut water, and bamboo shoots. This result proves that the growth rate of shoot diameter is best without using growth regulators. This can be caused by several factors such as the placement of *A. titanum* (control) in a place with high concentrations of temperature and light. Research reveals that planting at high temperatures and more light exposure affects enlarging the diameter of the stem so that the stem tends to be short and stumpy followed by less stem length (Parnidi & Setyo-Budi, 2016). This is consistent with the results in the control variable with the smallest shoot length.

Based on Figure 3, it can be seen that the order of the growth rate of the number of shoots in *Amorphophallus titanum* is higher when given a growth regulator in the form of onions, coconut water, bamboo shoots, and control. These results prove that the use of onions is better in increasing the growth rate of the number of shoots while the least number of shoots is in the control variable (without ZPT). This is because the process of soaking *Amorphophallus titanum* bulbs with ZPT can stimulate the formation of callus which will induce the growth of roots so that the cells will continue to divide and will form root primordia. With the formation of root primordia, the origins of chrysanthemum shoot cuttings can already absorb nutrients from the media to stimulate the number of shoots (Fadhil et al., 2018).

Based on Figure 4, it can be seen under the order of the fastest growing time in *Amorphophallus titanum* is coconut water, followed by onions, bamboo shoots, and control. These results prove that to accelerate the growth time for *Amorphophallus titanum*, it is very good to add a growth regulator in the form of coconut water rather than adding anything. This is supported by the results of research which states that the provision of water and coconut containing auxins and cytokinins can cause metabolic changes in the stum tissue to be more stimulated, thus causing faster growth time (Muazzinah & Nurbaiti, 2017).

Therefore, giving zpt to *Amorphophallus titanum* is one of the efforts in accelerating its growth. this is in accordance with the results obtained where when *Amorphophallus titanum* is given ZPT it experiences faster growth than without ZPT. This is certainly very good to do considering that the plant has a rare status and needs to be preserved.

CONCLUSION

Based on the study's results, using natural ZPT from coconut water, shallots, and bamboo shoots affects the growth rate of *Amorphophallus titanum* tubers. This is evidenced by the faster



growth in length, shoot diameter, number of shoots, and growth time when given zpt compared to without being given zpt. Therefore, it is hoped that the results of this study can be used as a reference for the government, conservationists, or the community in maintaining and preserving plants, especially *Amorphopallus titanum*.

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