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Effect of Young Coconut Water Concentration on The Growth of Dendrobium Orchid Seedlings

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Abstract: *This study aims to assess the effect of young coconut water concentration on the growth of Dendrobium orchids. The research was conducted for 4 months at Candi Orchid Production House, Semarang, with a one-factor completely randomized design (CRD) and four treatments of young coconut water concentration (0 mL/L, 100 mL/L, 150 mL/L, 200 mL/L), each with five replications. Parameters observed included number of shoots, root length, and plant height. Data were analyzed using ANOVA and Duncan's further test at the 5% level. The results showed that the application of young coconut water had no significant effect on the number of shoots and root length ($p > 0.05$), but had a significant effect on plant height ($p = 0.003$), especially at a concentration of 100 mL/L. The predominance of cytokinin hormones in coconut water likely plays a role in stimulating stem growth, while its effects on shoots and roots require interactions with other hormones. Although coconut water contains essential nutrients, its composition may not be fully suitable for the physiological needs of orchids in the seedling phase.*
Keywords*: young coconut water; dendrobium orchid; organic fertilizer; plant growth*

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INTRODUCTION

The use of fertilizers in plants is one of the needs for plants. This need is influenced by plants that always require adequate nutrition. Adequate and balanced nutrition will support optimal growth and good yields for plants. Fertilizers provide micro and macro nutrients that are intended for plant growth and development. In general, plants have the same nutrient needs, namely vitamins, carbohydrates, amino acids, growth regulators, and macro and micro nutrients (Hasanah et al., 2014).

Fertilization is very important during the seedling phase (Nurahmi et al., 2024). There are 2 types of fertilizers, namely organic and inorganic fertilizers. Inorganic fertilizers are made by the fertilizer industry through chemical, physical, and biological processes (Hartati et al., 2023). Organic fertilizers come from the remains of living things, such as plant, animal and human remains. Inorganic fertilizers are generally preferred by orchid farmers and entrepreneurs because of their easy availability, high nutritional content and time effectiveness in optimizing plant growth and production. However, if chemical fertilizers are used in excess, it can make the soil or other growing medium harder, which prevents the plant from absorbing nutrients. The nature of chemicals is more difficult to break down or destroy compared to the nature of organic matter (Bandang et al., 2021). The presence of organic fertilizers will make the media less acidic. This makes farmers need to increase awareness in using organic fertilizers so that the fertility of the planting media is maintained (Fitri et al., 2020). Not only that, in terms of economics inorganic fertilizers are more expensive. Therefore, other

alternatives are needed as an effort to utilize the potential of organic materials to replace inorganic fertilizers. Especially for hobbyists or home orchid collectors who need affordable fertilizer.

Indonesia is an archipelago that has tremendus potential in the development of young coconut (*Cocos nucifera* L.). Indonesia has a coconut area of rearching 3.300.894 hectares with the total production of around 2.861.856 ton (Ditjenbun, 2023). This figure is also influenced by coconut trees that can grow well in the tropics, especially in the lowlands (Hartawan & Sarjono, 2016). Coconut trees grow best between latitudes 15° north latitude and 15° south latitude (Arifin, 2020). Places close to the equator get plenty of sunlight throughout the year making young coconuts easier to grow in Indonesia . The coconut plant is known as a plant that has many benefits. Almost all of its parts can be utilized for other living things. One part that can be utilized is certainly found in the fruit. In the coconut fruit there is meat and also coconut water which also contains many benefits. Some important parts of coconut water (*Cocos nucifera*) include organic ions such as Cl, Mg, Cu, phosphate, K, Na, and S; nitrogen components; amino acids; enzymes (catalase, dehydrogenase, diastase, peroxidase, and RNA polymerase); phosphoric acid; vitamins (biotin, folic acid, niacin, pentothenic acid, riboflavin, pyridoxine, and thiamine); and sugars (fructose, glucose, and sucrose) and growth hormones (auxin, cytokinin, and gibberellin) (Arditti, 2008).

The growth and development of a plant is strongly influenced by auxin and cytokinin type ZPT, plant cell division is also carried out by the work of auxin and cytokinin simultaneously (Ghani et al., 2023). Auxin increases callus formation, especially roots, somatic embryogenesis, and shoot bud growth. Cytokinin hormones play a role in the formation of new leaves and roots. (Dewi et al., 2021). The provision of gibberellin causes additional height in plants this is because gibberellin can trigger cell division and lengthening. (Swandari & Faisal, 2023). This is in line with the opinion that says that gibberellins can accelerate cell division and growth, which results in more stems and more plant internodes (Asra et al., 2020).

One of the largest genus of the Orchidaceae family is the Dendrobium orchid (Nandariyah et al., 2022). With more than 2,000 species, Dendrobium is one of the largest orchid genus in the Orchidaceae family (Apriliyani & Wahidah, 2021). Dendrobium orchid is one of the orchids that can adapt to various growing environment conditions. Indonesia has tropical environmental conditions, the adaptability of dendrobium orchids is very suitable to be able to grow in Indonesia.

A proper approach is needed to use organic fertilizers, which includes selecting the right organic fertilizer for the circumstances and needs of the plant. The selection of young coconut water as organic fertilizer for orchid plants is appropriate. Coconut water has great potential as a natural ingredient for promoting the growth of ornamental plants, especially orchids and other ornamental plants that require growth stimulants for roots and shoots (Irmayanti & Dewi, 2025). This is because the essential needs for the growth and development of orchids are already contained in young coconut water. Coconut water contains growth hormones such as cytokinin, auxin, and a small amount of gibberellin, along with essential minerals like potassium, calcium, magnesium, and phosphorus, which play a crucial role in stimulating the growth of stems, shoots, and roots in orchids. With these rich nutrients, coconut water serves as a natural solution to enhance the optimal growth and development of orchid plants. Therefore, his study aims to assess the effect of young coconut water concentration on the growth of Dendrobium orchids.

METHOD

This research was conducted at Candi Orchid Production House located in Candisari, Jangli Karanganyar Street, Candisari District, Semarang City, Central Java, at an altitude of 86 meters above sea level, for four months. The research used various tools such as pots, planting media, sprayer, measuring cup, ruler, camera, and stationery. Materials used included orchid seeds and young coconut water. The variables in this study consisted of independent variables, namely the concentration of young coconut water with treatments K0 (0 ml/l), K1 (100 ml/l), K2 (150 ml/l), and K3 (200 ml/l); dependent variables such as the number of new shoots, plantlet height, number of leaves, number of roots, and root length; and control variables such as orchid type, young coconut type, growing media, sunlight intensity, and fertilization time.

This study used a completely randomized design (CRD) experimental design with 1 factor and 5 repetitions. Observations were made every 15 days for 16 weeks. The data collected included primary data, obtained directly from field observations, and secondary data obtained through literature studies from books, journals, and scientific articles to support research analysis. Data analysis and processing in this study used the ANOVA (Analysis of Variance) test on the SPSS program. Furthermore, if significant differences are indicated, then further tests will be carried out using the Duncan test at the 5% level. Quantitative data processing is used to describe the data numerically analyzing differences by comparing the growth of Dendrobium orchid seedlings at various concentrations of young coconut water to see if there are significant differences.

RESULTS AND DISCUSSION

Based on observations of the parameters observed, namely, the number of shoots, number of roots, number of leaves, root length, and plant height. Then the results of these observations can be presented as follows.

Number of Buds

Table 1 shows that the growth of the number of buds of young coconut water treatment has no significant effect on the number of orchid buds at the 0.05 significance level, which is 0.613.

Table 1. ANOVA results of number of buds

	Sum of Square	df	Mean Square	F	Sig.
Between Groups	0.034	3	0.011	0.612	**0.613**
Within Groups	0.515	28	0.018		
Total	0.549	31			

Young coconut water contains a number of bioactive substances that can contribute to the growth of Dendrobium orchid buds, mainly through the content of growth hormones such as auxins and cytokinins (Alfriyadi & Wijayanto, 2024). Cytokinin plays an important role in triggering cell division and bud differentiation, which can directly increase the number of buds on orchid plants. In addition, a balanced amount of auxin can also help coordinate shoot growth with the root system. The content of minerals such as potassium, phosphorus, and calcium in young coconut water also supports bud development by accelerating cell metabolism and strengthening plant tissues. In addition, the presence of amino acids and natural

sugars in young coconut water can act as an energy source that accelerates protein synthesis, thereby increasing shoot growth (George et al., 2008).

Although young coconut water contains bioactive substances that are expected to increase the number of buds, the results showed that the effect was not significant. This could be caused by several factors, such as the interaction between auxin and cytokinin in young coconut water may be unbalanced, so the effect on cell division and bud formation is not optimal. In addition, although auxin and cytokinin can stimulate shoot growth, they require the right environmental conditions to work optimally. For example, temperature, humidity, and light intensity can affect the effectiveness of these hormones in stimulating shoot growth. Hormone concentrations that are too high or too low can inhibit shoot growth (Khair et al., 2013). Therefore, although young coconut water contains components that support growth, perhaps the concentration used in this study was not optimal enough to show a significant difference in the number of shoots.

Root Length

Table 2 shows that the significance value is greater than 0.05, so there is no significant difference between the treatment groups at the 95% confidence level. This means that statistically, the young coconut water treatment did not show a significant effect on the root length of Dendrobium orchids.

Table 2. ANOVA results of root lenght

	Sum of Square	df	Mean Square	F	Sig.
Between Groups	3.383	3	1.128	2.286	**0.101**
Within Groups	13.816	28	0.493		
Total	17.200	31			

Although statistically insignificant, young coconut water can extend the roots of Dendrobium orchids because it contains natural growth hormones such as auxins and cytokinins that play a role in root cell differentiation and elongation. Auxins, particularly in the form of indole-3-acetic acid (IAA), stimulate cell elongation and promote lateral root formation, thereby accelerating orchid root growth (Asra et al., 2020). In addition, young coconut water contains essential minerals such as potassium (K) and phosphorus (P) that contribute to the development of a strong and healthy root system. The natural sugar content in young coconut water also serves as an energy source for root growth, while vitamins and amino acids support root cell metabolism and increase plant resistance to sub-optimal environmental conditions (Silva et al., 2015).

Plant Height

Table 3 shows that the significant value or p-value of 0.003 is less than 0.05. This indicates that there is a significant difference between the treatment groups at the 95% confidence level.

Table 3 ANOVA results plant height

	Sum of Square	df	Mean Square	F	Sig.
Between Groups	2.152	3	0.717	5.826	**0.003**
Within Groups	3.448	28	0.123		
Total	5.600	31			

After the results in the ANOVA table indicated a significant difference, namely, 0.003 which is less than 0.05, a further test (Duncan) with a 95% confidence level is needed to understand the differences between each treatment.

Table 4 Duncan test results plant height

Perlakuan		N	Subset for alpha = 0.05	
			1	2
Duncan[a]	K2	8	2.1825	
	K3	8		2.5700
	K0	8		2.7088
	K1	8		2.8875
	Sig.		1.000	0.097

Table 4 shows that the significance value in subset 1 is 1.000, which means there is no significant difference in the subset. Subset 2 shows a value of 0.097, which is close to 0.05. This indicates that between the groups in subset 2 there is a trend of significant differences but not strong enough. This could be due to the fact that each treatment only has 8 samples, which can lead to low statistical power in post-hoc tests, making it difficult to detect differences between pairs.

The results of subset grouping showed that treatment K2 (150 ml/L) had the lowest average plant height, which was 2.1825, and was included in its own subset (subset 1). Meanwhile, treatments K3 (200 ml/L), K0 (control), and K1 (100 ml/L) had higher averages of 2.5700, 2.7088, and 2.8875, respectively, which belonged to the same subset, subset 2. This shows that the K2 treatment consistently had lower yields than the other treatments, although the difference was not statistically significant.

Based on the results of the one-factor analysis of variance, it showed that of the three parameters observed, plant height was the only parameter that showed little significant difference between the treatment groups. This indicates that young coconut water can have a positive effect on orchid height growth, especially at concentration K1 (100 ml/L). Other parameters (number of buds, number of roots, root length, and number of leaves) did not show significant differences due to young coconut water treatment. This could be due to the physiological tolerance of the plant or the incompatibility of the concentration with the specific needs of the orchid plant. There are internal factors that affect plant growth such as the seed or the plant itself (Tatik Maryani et al., 2022). In addition, it can be estimated that the content of young coconut water is not specific enough to meet the physiological needs of Dendrobium orchids, especially in the seedling phase.

According to Morel (1974), coconut water contains the hormones cytokinin (concentration 5.8 mg/l), auxin (concentration 0.07 mg/l), and a little gibberellin which can help stimulate cell division and organ formation Coconut water also contains a special chemical pool that greatly affects plant growth. This chemical pool consists of minerals, vitamins, sugars, amino acids, and phytohormones (Winarto & da Silva, 2015). In line with this opinion, there are components in young coconut water, namely, fatty acids, amino acids, organic acids, enzymes, phenolic compounds, vitamins, and minerals (Gómez-Tah et al., 2023). These minerals include potassium (potassium) up to 17%. Not only that, young coconut water also contains sugar between 1.7 to 2.6% and protein between 0.07 and 0.55%. Other minerals include sodium (Na), calcium (Ca), magnesium (Mg), ferum (Fe), cuprum (Cu), phosphorus (P), and sulfur (S)

(Jonas, 2021). Although coconut water contains natural growth hormones such as cytokinins and auxins as well as certain minerals, they are not specific enough, not at the optimal dose, or not relevant to affect these growth parameters significantly.

The more dominant cytokinin hormone content in young coconut water encourages cell division and cell expansion in certain parts such as stems and buds. In the stem, cytokinin stimulates cell division in the apical meristem area, so that the stem can grow longer, in other words, cytokinin hormones contribute to an increase in plant height. However, in shoots and roots, the effect of cytokinin tends to be more complex, cytokinin hormones must work together with auxin hormones. This can be the reason only the plant height parameter shows a significant value. The concentration that showed significant results was in the K1 treatment, namely, 100 ml/L. This is in line with the statement that the optimal concentration of coconut water for the growth of Dendrobium orchids, especially in *Dendrobium sp. var* Kumala and *Dendrobium anosmum*, is 100 ml/L (Amalia et al., 2021; Tuhuteru et al., 2012). Research shows that the use of coconut water at this concentration can significantly increase the growth and propagation of orchids, both in terms of the number of buds, leaf length, and number of roots.

Orchids enter the young growth phase or seedling phase, when they reach the age of 8 to 9 months with a size of 5 to 8 cm (Rahayu, 2024). The seedling phase takes place when the plant has been removed from the compote and lasts up to 6 months (Sari et al., 2024). The seedling phase generally focuses on the growth and development of vegetative organs in plants, such as roots, stems, and leaves. In this phase, orchids have a high need for Nitrogen (N) compared to Phosphorus (P) and Potassium (K) (Sari et al., 2024). The high nitrogen is used to support vegetative growth and as a fertilizer for seedling size orchids. Therefore, although young coconut water contains beneficial minerals and hormones, it may not be sufficient to meet the needs of plants in the seedling phase.

CONCLUSION

Based on the research results, it can be concluded that (1) Young coconut water has a significant effect on the growth of orchid plant height, especially at a concentration of 100 ml/L; (2) Other growth parameters, such as the number of shoots and root length, did not show significant differences; (3) The dominance of cytokinin in young coconut water plays a key role in stimulating cell division and expansion in the stem; (4) The effect of young coconut water on shoots and roots requires interaction with other hormones, such as auxin; (5) Although young coconut water contains beneficial minerals and hormones, it may not be sufficient to meet the complete nutritional needs of orchids in the seedling phase.

RECOMMENDATION

The use of young coconut water (100 ml/L) has the potential to increase the height of orchid plants but does not significantly affect other growth parameters. Therefore, it is recommended to combine it with additional nutrient sources and conduct further research on the composition of young coconut water and its effects on the growth phases of orchids.

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