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Effectiveness of Coconut Water and Atonics on the Growth of Eggplant (*Solanum melongena*) Seedlings of the Laguna F1 Variety

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Abstract

Eggplant (*Solanum melongena* L.) is an authentic plant native to tropical climates, widely favored by the community, and available at an affordable price. The demand for eggplant in Indonesia reached 69,963 tons in 2015 and has continued to increase to 74,081 tons. Based on FAO data in 2016, Indonesia is one of the eggplant-producing countries, ranking sixth in the world after China, India, Egypt, and Turkey. The Laguna F1 eggplant variety is known for its quality and resistance to bacteria-causing wilting. To minimize the cultivation time of eggplants, it is necessary to use readily available natural fertilizers, one of which is coconut water. The utilization of coconut water as fertilizer is due to its content of various hormones that play a crucial role in plant growth, namely auxin, cytokinin, and gibberellin. The purpose of this research is to investigate the effects of coconut water and atonic, determine the optimum concentrations, and understand the interaction between coconut water and atonic in the growth of eggplant plants. The research was conducted in the Botany Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Lampung, in October-November 2019, using a 2x3 factorial design. The first factor involved coconut water at concentration levels of 25%, and 50%, and compared with a control group (0%). The second factor was the atonic solution with a concentration of 10 ml/l, compared with a control. The treatments were repeated in five replications, resulting in 30 experimental units. Observed variables included plant height, fresh weight, dry weight, relative water content, and chlorophyll content. The results of this research can be summarized as follows: the application of coconut water and atonic has a positive effect on the growth of eggplant plants. Additionally, the combined induction of coconut water at a concentration level of 25% and atonic at 0% demonstrated superior outcomes in terms of plant height, fresh weight, dry weight, relative water content, and chlorophyll content in eggplant plants.

Keywords: atonic, coconut water, eggplant *(Solanum melongena L.).*

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INTRODUCTION

Eggplant (*Solanum melongena* L.) is an authentic plant native to tropical regions, highly sought after in Indonesia, and easily accessible in traditional markets at affordable prices [1]. Eggplants also have a delicious taste and numerous benefits, making them popular in the market, as evidenced by data from the Central Statistics Agency of Indonesia [2] indicating an increasing demand for eggplants each year. In every 100g of eggplant, there are various beneficial components for the body, including 24.9 calories, 1g of protein, 3g of fiber, 25 IU of vitamins K and C, folate, and potassium [3].

The eggplant of the Laguna F1 variety is known for its high quality, delicious taste, and proven resistance to bacteria that can cause wilting. The eggplant plants of the Laguna F1 variety also have the potential for a harvest yield of approximately 50 tons per hectare [4]. Eggplants contain chlorogenic acid, a compound found in several plants, which can reduce fat levels and act as an antimicrobial and antivirus agent. Additionally, it may prevent cancer due to its high antioxidant content [5].

In the cultivation of eggplant (*Solanum melongena*), it typically takes about one month for the eggplant to grow to a stage ready for transplantation to a larger growing medium, such as a larger polybag or a field. Eggplants are usually considered suitable for transplantation when they have developed 4-5 leaves [6]. Due to these factors, efforts to enhance eggplant cultivation yield can involve the use of fertilizers, and one readily available natural fertilizer is coconut water. Indonesia is among the world's largest coconut producers, with production reaching 18.3 million tons in 2016 [7]. The contents of coconut water are essential for many plants as it contains various essential hormones. In a study, coconut water was found to contain 5.8 mg/l of cytokinin and 0.07 mg/l of auxin [8], and plant growth can be enhanced through the application of coconut water. According to the research conducted by Darlina et al. [9], which discusses the application of coconut water, it has been found to bring significant changes to the growth of black pepper (*Piper nigrum* L.) with varying concentrations, namely 100ml/L, 150ml/L, 200ml/L, 250ml/L, 300ml/L.

In addition to using natural fertilizers for plant cultivation, plant growth regulators (ZPT) available in the market can also be utilized, such as Atonic. Atonic is a growth regulator that influences various stages of plant development. It enhances seed germination and root growth, and can even mitigate plant damage due to stress. Atonic is known to improve the quality and quantity of the harvest [10].

MATERIALS AND METHODS

This research was conducted in the Botany Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Lampung, in October-November 2019.

The tools used in this research included an oven, spectrophotometer, petri dishes, erlenmeyer flask, polybags, stirring rod, analytical balance, ruler, and sprayer. Meanwhile, the materials used were soil, eggplant seeds, distilled water (aquadest), young coconut water, and atonic.

Data collection was conducted every 7 days with parameters of plant height, fresh weight, dry weight, relative water content, and chlorophyll content.

Data Analysis

The observation data obtained were analyzed quantitatively through statistical testing using Analysis of Variance (ANOVA) with a significance level of α=5%. If the results were found to be significant, further testing was conducted using the Tukey test

to determine the extent of the research's impact on the growth of eggplant plants. Regression analysis was performed to establish the regression equation and determine the R (multiple correlation coefficient) and r (coefficient of determination) values.

RESULTS AND DISCUSSION

Plant Height

The Levene test at α=5% indicates that the sample distribution of eggplant plant height 4 weeks after planting is proven to be homogenous. The analysis of variance (ANOVA) at α=5% demonstrates a significant effect after 4 weeks of coconut water and atonic application. In the interaction between coconut water and atonic, a significant effect on the height of eggplant plants is also observed ($p<0.05$). Therefore, the Tukey test was conducted based on the ANOVA analysis of the interaction between atonic and coconut water. This is shown in Table 1

Table 1. Tukey Test of Coconut Water and Atonic on Eggplant Plant Height Four Weeks After Planting

Factor		Atonic	
	Level	0	10
Coconut water	0	7,02 ± 0,38 a	12,21 ± 0,83 b
(% v/v)	25	13,76 ± 0,68 b	11,49 ± 0,70 b
	50	11,01 ± 0,59 b	11,94 ± 0,97 b

Notes: HDS Cell [0.05] = 3.13. Values followed by the same lowercase letter are not significantly different at the 5% level.

Analysis of the simple effect of atonic based on the Tukey test at α=5% yielded results. The combination treatment of coconut water and 0% atonic v/v showed the lowest results compared to other treatment combinations. While, other treatment combinations produced the same results in terms of plant height, which were higher than the results obtained with 0% coconut water and 0% atonic. The combination treatment of 25% coconut water and 0% atonic showed the highest plant height. This is supported by the curve of eggplant plant height in the interaction between coconut water and atonic, as shown in Figure 1.

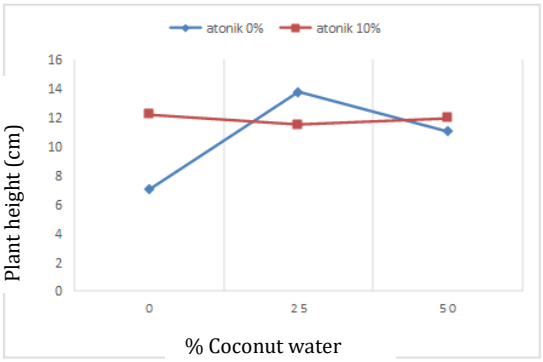

Figure 1. Interaction curve for 4 MSP.

In this study, the height of eggplant plants showed a positive response to the induction from the combination of coconut water and atonic solution. Atonic at a concentration of 0% and 25% v/v coconut water exhibited a significantly different effect, producing the best results among the other concentrations for plant height. This aligns with Seswita's research [11], which suggests that plant growth regulators and nutrients present in young coconut water are essential for supporting plant growth and development.

Fresh Weight

The Levene test at α=5% indicates homogeneity of the samples ($p>0.05$). The analysis of variance at a significance level of α=5% confirms a significant effect of coconut water treatment on fresh weight in atonic induction. Moreover, the application of atonic and coconut water significantly influences the fresh weight of eggplant plants ($p<0.05$). Therefore, the interaction between coconut water and atonic was further examined with the Tukey test and is

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presented in Table 2

Table 2. Effects of Coconut Water and Atonic on Fresh Weight of Eggplant Plants after Treatment

Factor	Atonic		
	Level	0	10
Coconut water (% v/v)	0	3,37 ± 0,29 a	7,12 ± 0,54 b
	25	12,10 ± 0,97 c	6,19 ± 0,54 b
	50	5,66 ± 0,41 ab	5,06 ± 0,38 ab

Notes: HDS cell [0.05] = 2.48. Values followed by the same lowercase letter are not significantly different at the 5% level

Analysis of the simple effect of atonic at α=5% through the Tukey test proves that the treatment combination of 0% atonic with 0% and 50% v/v coconut water has no significant effect on the fresh weight of the plants. However, the treatment combination of 0% atonic with 25% v/v coconut water shows a positive effect, indicated by the highest fresh weight compared to other concentration treatments. This is supported by the interaction curve between coconut water and atonic on the fresh weight of eggplant plants, as presented in Figure 2.

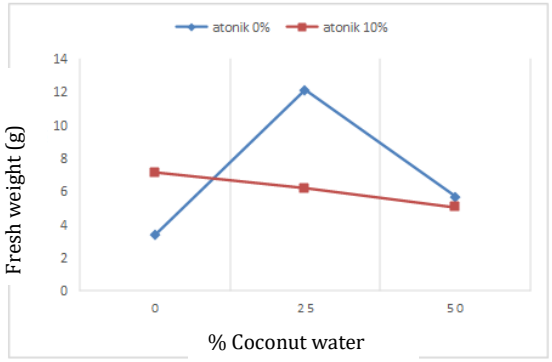

Figure 2. Interaction curve between coconut water and atonic on plant wet weight after treatment.

The application of coconut water and atonic shows a significant difference in the fresh weight of eggplant plants. However, plants treated with 10% atonic tend to have a smaller fresh weight. This is suspected to occur because atonic is quickly absorbed by the plants and can stimulate root growth. However, excessive concentration may inhibit growth, resulting in a smaller fresh weight of eggplant plants treated with 10% atonic compared to others. The fresh weight with the treatment combination of 25% coconut water and 0% atonic shows a larger result compared to other plants. This is attributed to the richness of the content in coconut water, which can enhance plant growth. However, similar to atonic, excessive concentration of coconut water can still hinder plant development. This is in line with the research conducted by Seswita [11].

Dry Weight

The Levene test at α=5% indicates sample homogeneity (p>0.05). The analysis of variance at α=5% shows that the treatment of coconut water and atonic has a significant effect on the dry weight of plants. The interaction between coconut water and atonic also yields the same result (p<0.05). Therefore, further testing was conducted on the interaction between coconut water and atonic, as shown in Table 3.

Table 3. Effects of coconut water and atonic on dry weight of eggplant after treatment

Factor	Atonic		
	Level	0	10
Coconut water (% v/v)	0	0,96 ± 0,03 a	1,29 ± 0,11 a
	25	1,84 ± 0,12 b	1,23 ± 0,10 a
	50	1,19 ± 0,10 a	1,25 ± 0,10 a

Notes: HSD cell [0.05] = 0.44. Values followed by the same lowercase letter are not significantly different at the 5% level.

Analysis of simple effect of atonic based on the Tukey test at α=5% shows that the interaction of 0% atonic and 25% v/v coconut water has a positive effect on the dry weight of plants, yielding larger results compared to plants subjected to the combination treatment of 10% atonic with 25% coconut water and 0% atonic with 50% coconut water. This is supported by the curve shown in Figure 3.

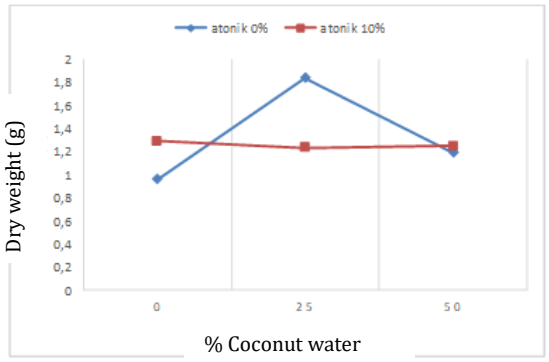

Figure 3. Interaction curve between coconut water and atonic on plant dry weight after treatment.

Relative Water Content

The simple effect analysis of atonic based on the Tukey test at α=5% indicates that the treatment combination of atonic with 10% and 50% v/v coconut water has no significant effect on the water content of plants. However, the treatment combination of 0% atonic with 0% coconut water has the lowest water content compared to the water content in plants subjected to other treatment combinations. This is supported by Figure 4.

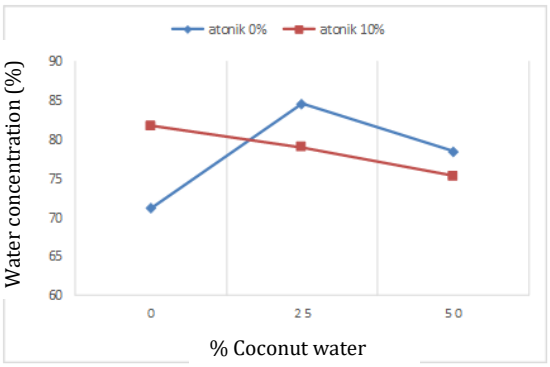

Figure 4. Interaction curve between coconut water and atonic on plant water content after treatment.

Chlorophyll a Content

The Levene test at α=5% indicates that the sample variance is homogeneous (p>0.05). The analysis of variance at α=5% shows that atonic, coconut water and their interaction significantly affect the chlorophyll A content of eggplant plants (p<0.05). Therefore, further testing with the Tukey test, based on the analysis of variance, is conducted on the interaction between atonic and coconut water, as presented in Table 4.

Table 4. Effects of coconut water and atonic on chlorophyll a of eggplant after treatment

Factor	Atonic		
	Level	0	10
Coconut water	0	0,16 ± 0,01 a	0,26 ± 0,02 c
(% v/v)	25	0,27 ± 0,01 c	0,23 ± 0,02 bc
	50	0,18 ± 0,01 ab	0,16 ± 0,01 a

Notes: HSD cell [0.05] = 0.06. Values followed by the same lowercase letter are not significantly different at the 5% level.

Analysis of the simple effect of atonic based on Tukey's test at α = 5% showed that the combination of atonic treatment with 10% and 50% coconut water v/v did not significantly affect the chlorophyll A content. However, atonic 00% with 25% coconut water v/v had a positive effect that caused greater chlorophyll A content compared to the results of the treatment combination of 0% atonic treatment with

0% coconut water, 0% atonic and 50% coconut water, 10% atonic and 0% coconut water and 10% atonic and 25% coconut water. This is reinforced by the graph in Figure 5.

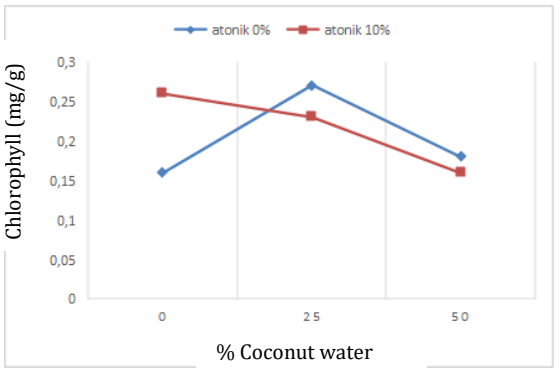

Figure 5. Interaction curve between coconut water and atonic on chlorophyll a in plants after treatment.

Chlorophyll b Content

The Levene test at α=5% indicates that the sample variance is homogeneous (p>0.05). The analysis of variance at α=5% shows that atonic, coconut water, and their interaction significantly affect the chlorophyll b content of eggplant plants (p<0.05). Therefore, further testing with the Tukey test, based on the analysis of variance, is conducted on the interaction between atonic and coconut water (Table 5).

Table 5. Effects of Coconut Water and Atonicon Chlorophyll b of Eggplant Plants after Treatment

Factor	Atonic		
	Level	0	10
Coconut water	0	0,17 ± 0,01 a	0,29 ± 0,02 b
(% v/v)	25	0,25 ± 0,02 b	0,13 ± 0,01 a
	50	0,13 ± 0,01 a	0,17 ± 0,01 a

Notes: HSD cell [0.05] = 0.06. Values followed by the same lowercase letter are not significantly different at the 5% level.

The simple effect analysis of atonic based on the Tukey test at α=5% shows that the treatment combinations of atonics with 0% and 50% v/v coconut water, as well as 10% atonics with 25% v/v coconut water, have no significant effect on the chlorophyll b content and exhibit the smallest results. However, the combination of 10% atonics with 0% v/v coconut water and the interaction of 0% atonic with 25% v/v coconut water have a positive effect, resulting in a higher chlorophyll b content compared to other treatment combinations. This is supported by the graph in Figure 6.

Total chlorophyll content

The Levene test at α=5% indicates that the sample variance is homogeneous (p>0.05). The analysis of variance at α=5% shows that atonic, coconut water and their interaction significantly affect the total chlorophyll content of eggplant plants (p>0.05). Therefore, further testing with the Tukey test, based on the analysis of variance, is conducted on the interaction between atonic and coconut water (Table 6).

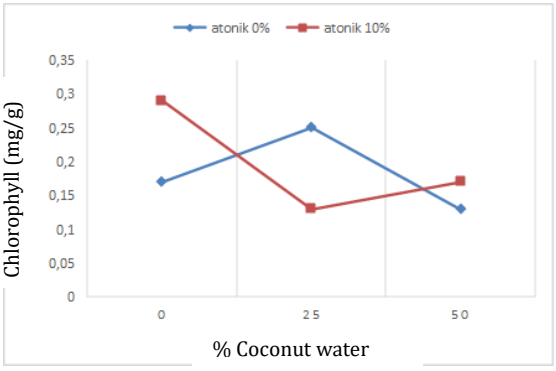

Figure 6. Interaction curve between coconut water and atony on chlorophyll b in plants after treatment.

Table 6. Effects of Coconut Water and Atonic after Treatment

Factor	Atonic		
	Level	0	10
Coconut water (% v/v)	0	0,32 ± 0,01 a	0,56 ± 0,03 b
	25	0,52 ± 0,03 b	0,36 ± 0,02 a
	50	0,31 ± 0,01 a	0,33 ± 0,02 a

Notes: HSD cell [0.05] = 0.07. Values followed by the same lowercase letter are not significantly different at the 5% level.

The simple effect analysis of atonic based on the Tukey test at α=5% shows that the treatment combinations of atonic with 0% and 50% v/v coconut water have no significant effect on the total chlorophyll content. However, the treatment combination of 10% atonic with 0% v/v coconut water and the combination of 0% atonic with 25% v/v coconut water have a positive effect, resulting in a higher total chlorophyll content compared to the total chlorophyll content in eggplant plants with the combination treatment of 0% atonic with 0% coconut water and 25% coconut water with 10% atonic. This is supported by the graph in Figure 7.

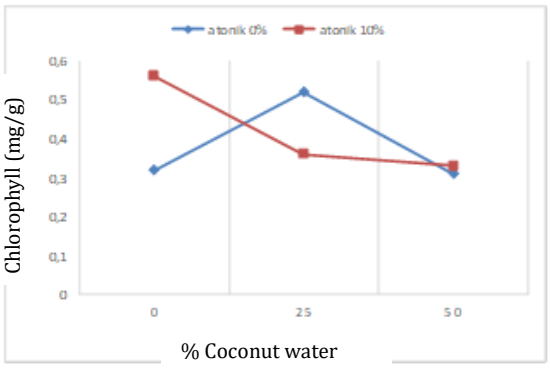

Figure 7. Interaction curve between coconut water and atonic on chlorophyll b in plants after treatment.

CONCLUSION

The conclusion from the research results indicates that the administration of coconut water and atonic has a positive impact on the growth of eggplant plants. Furthermore, the induction of a combination of coconut water at a concentration of 25% and atonic at 0% level demonstrates superior outcomes in terms of plant height, wet weight, dry weight, relative water content, and chlorophyll content in eggplant plants.

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