Study on the amount of chlorophyll content and leaf area of Robusta coffee plants with shade trees and fertilizer application in Hanakau Sukau West Lampung

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Abstract. Coffee is one of the most important plantation crops in Indonesia. Coffee has high economic value, significantly increasing income, especially in West Lampung district, Lampung province. Coffee production in this area reaches 954 kg ha^{-1} year^{-1}. Some subdistricts can produce more than 1,000 kg ha^{-1} year^{-1}, and some have only reached 500 kg ha-^{1} year^{-1}. This research was conducted from June to November 2020, to get the effect of shade plants and the effect of types of fertilizers on the productivity of robusta coffee and their interaction on robusta coffee production. The results showed that the amount of chlorophyll content of robusta coffee leaves was not influenced by shade and fertilization, and the interaction between fertilization and shade trees had an effect on leaf surface area.

1. Introduction

Lampung Province is the second Robusta coffee producer in Indonesia. West Lampung Regency is the main center of coffee production in Lampung Province. The average productivity of coffee plantations in this area reaches 954 kg ha^{-1} year^{-1}, but these results are not evenly distributed in areas that are the production base. Some Districts can produce productivity of more than 1,000 kg ha^{-1} year^{-1}, but some are only producing 500 kg ha^{-1} year^{-1}. The difference in productivity from one region to another is thought to be due to some plants being cultivated using shade plants and some not using shade plants. On the other hand, some plants are fertilized using inorganic fertilizers and some are using organic fertilizers enriched with microbes.

This research is field research designed using a factorial pattern. The first factor is shade plants (A) consisting of A1 coffee plants without shade and A2 coffee plants with shade. The second factor is fertilizer (B) which consists of B1 plants given inorganic fertilizers and B2 plants given organic fertilizers enriched with microbes.

This study aims to determine the effect of shade plants on the productivity of robusta coffee, get the effect of the type of fertilizer on the productivity of robusta coffee, and get the interaction between shade plants and types of fertilizer robusta coffee production. This research is field research and designed using a factorial pattern. The first factor is shade plants (A) consisting of A1 coffee plants without shade and A2 coffee plants with shade. The second factor is the use of fertilizer (B) which consists of B1 plants given inorganic fertilizers and B2 plants given organic fertilizers enriched with microbes. This research will be carried out on a coffee plantation located in Pekon Hanakau, Sukau District, West Lampung Regency from June to November 2020.

2. Methods

This research was conducted in coffee plantations in the West Lampung district, namely Pekon Hanakau, Sukau by observing the terrain and local people's coffee plantations. The tools used in this study were stationery, clipboards, cameras, sample labels, paint, cable ties, meters, thermometers, hygrometers, lux meters, and hand counters. The material used is the robusta coffee plant. In normal plant conditions, plants are trees from productive gardens with treatment using and not using shade plants, fertilized either by using inorganic fertilizers (Urea, SP36, KCl) or organic fertilizers enriched with microbes (Organic Ghaly (GO)). Retrieval of data on research samples (coffee plants).

3. Result and Discussion

The results of variance analysis (Table 1), showed that the use of shade and fertilizer treatment on Robusta coffee plants in Hanakau (West Lampung) gardens on the amount of chlorophyll content in the upper, middle, and lower leaves had not shown a significant effect.

Table 1. Recapitulation analysis of the various chlorophyll content of the upper, middle, and lower leaves of the Robusta coffee plant.

SS	DF	F Top Leaf	F Middle Leaf	F Lower Leaf	F table	
					5%	1%
Group	1	ns	ns	ns	5.12	10.56
Treatment	3	ns	ns	ns	3.86	6.99
A	1	ns	ns	ns	5.12	10.56
B	1	ns	ns	ns	5.12	10.56
AB	1	ns	ns	ns	5.12	10.56
Error	9	ns	ns	ns		
Total	15	ns	ns	ns		

Note: ns = non-significant

The Concern about leaves in plant cultivation is of primary importance to plant growth. The benefits of the leaves are so many for plants and other living things. The chlorophyll content strongly influences fruit production due to the photosynthesis process that occurs in coffee leaves in leaves. Chlorophyll serves as a light catcher needed for photosynthesis to take place. The high chlorophyll content is an indicator of high photosynthetic yield [1]. The light factor plays an essential role in the formation of chlorophyll. Shade plants affect the intensity of light received by coffee plants.

Table 2. Recapitulation analysis of the variety of upper, middle, and lower leaf areas on Robusta coffee (cm^2).

SS	DF	F Top Leaf	F Middle Leaf	F Lower Leaf	F table	
					5%	1%
Group	1	ns	ns	*	5.12	10.56
Treatment	3	ns	ns	**	3.86	6.99
A	1	ns	ns	**	5.12	10.56
B	1	ns	ns	**	5.12	10.56
AB	1	ns	ns	*	5.12	10.56
Error	9	ns	ns			
Total	15					

Note: ns = non-significant

[2] stated that the difference in leaf chlorophyll content in robusta coffee would differ in light intensity by 50% and 100%. The amount of chlorophyll in one plant leaf can represent an indicator of the plant's overall condition. In general, healthy plants contain more chlorophyll than less healthy ones. Likewise, with the leaf color, the greener the leaf color, the more chlorophyll is in the leaf. The SPAD value displayed in the chlorophyll meter indicates the relative amount of chlorophyll in a single plant leaf.

External and internal factors influence plant growth and development. The main external factors are soil, moisture, light, and water. Internal factors can include genes, hormones, anatomical structure, and morphology of plant organs, and chlorophyll content [3]. Based on the analysis of variance (Table 2) the use of shade and fertilizer treatment on robusta coffee plants in Hanakau gardens has not shown a significant effect on the upper and middle leaf area. However, the lower leaves show a real interaction.

Table 3. The results of the mean follow-up test for the interaction of shade treatment and fertilizer application on lower leaf area (cm2)

Treatment	Average	Notation
A2 B2 (a coffee plant with shade and organic fertilizer enriched with microbes)	212.87	a
A1 B2 (coffee plants without shade and organic fertilizer enriched with microbes)	202.66	b
A2 B1 (a coffee plant with shade and inorganic fertilizer)	200.03	c
A1 B1 (a coffee plants without shade and inorganic fertilizers)	195.41	d

Note: the numbers followed by different letter notations are significantly different based on the Least Real Test at the 5% level

The application of organic fertilizers enriched with microbes (Table 3) showed the highest mean value of 212.87. As an essential plant organ, leaves play a role in photosynthesis, respiration, and transpiration. The leaves are the place of formation of primary or secondary compounds. Leaf surface area has a role in photosynthesis. The larger leaf surface area allows it to capture better light to have a higher value of photosynthesis. Photosynthesis yield per plant unit is determined by leaf area. [4] stated that the surface area of the leaves greatly influences production. Leaves are the primary organ for photosynthesis. Number of leaves, leaf area,
[5] stated that shade that provides a light intensity of not more than 60% can allow optimum environmental conditions and high and sustainable coffee production. [6] show that differences in the shade in coffee will affect photosynthesis results. Light intensity that is too high or low will cause photosynthesis to be not optimal.

4. Conclusion

Based on the research results, it can be concluded that the amount of chlorophyll content of robusta coffee leaves in Hanakau, West Lampung is not influenced by shade and fertilization. The results of the interaction between fertilization and shade trees affect the leaf surface area.

References

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