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Aplikasi Micro-organisme Lokal Terhadap Pertumbuhan dan Produksi Tanaman Cabai Di Bawah Tegakan Kelapa

Local Micro-organism Application to the growth and Production of chili plants under coconut stands.

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ABSTRACT

The coconut plantations in Maffa village are spaced approximately 7 x 9 meters apart, providing enough room for the chili plants to grow. The shading from the coconut plants, at about 45 percent, is suitable for the growth of chili plants. An experiment was conducted to observe the application of local micro-organisms on chili and its influence on the phenotype of chilies in coconut-sheltered conditions also the resistance to anthracnose attacks.. The experiment was held in the Mafa village coconut plantation from November 2022 to March 2023. The research was implemented using factorial treatment based on Randomized Block Design with 30 percent and 45 percent coconut shelter respectively, and the concentration of local micro-organisms is 5ml and 10ml per liter of water, respectively. The observational data was analyzed using the F-test and a treatment difference test at a five percent significance level. The research findings indicated that shade level and local microorganism concentration significantly impacted, the number of brunches, and the fruit weight. The highest chili production was 476.39 g tree^{-1} harvest^{-1}.

Keywords: Chili, micro-organism, coconut plantation.

I. INTRODUCTION

Chili (*Capsicum frutescens* L.) is a horticultural plant from the Solanaceae family. Chili is commonly used for various household and industrial needs and has a year-round market. Chili cultivation patterns are also widely known by farmers. The chili plant's growth is influenced by climatic factors such as sunlight intensity, rainfall, humidity, and air temperature (Alhidayah, *et al*., 2024). Chili cultivation must be adapted to environmental conditions to produce quality fruit.

Ulinnuha *et al*. (2022) stated that high temperatures and intense light impact the growth and yield of plants in dry conditions. Excessive light and temperature can significantly limit plant productivity. In dry conditions, the effect of shade on coconut plants is considered a potential model for adjusting the environment for cultivating Chili, making it more conducive for growth and development. Chili plants can adapt to shade conditions because the mechanism path for capturing and using light is efficient under light capture and toleration by reducing the light compensation point and respiration rate. The ability of plants to overcome low light-intensity stress depends on their ability to continue photosynthesis under low light conditions, which can be achieved by increasing leaf area and reducing the amount of light transmitted and reflected (Franklin and Philip, 2013; Orcutt and Nilsen, 2000; Levitt, 1980).

Chili cultivation is often hindered by anthracnose disease, caused by the *Colletotrichum* sp. fungus. This disease leads to decreased yields and economic losses for farmers due to the formation of black spots and fruit decay. Infected chilies show symptoms of shriveling, rot, and falling off. On a severe attack, chili spotting be united and evenly distributed throughout the fruit skin surface. The

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disease is characterized by small, circular black spots on the fruit's skin, which expand to form more or less elliptical shapes (Prihatiningsih *et al*., 2020).

Healthy soil is important in cultivating chili plants. Healthy soil will function optimally to maintain a variety of soil organisms which will help prevent, and control plant diseases, and protect plants from insects, pests, and weeds by forming beneficial symbiotic associations between soil organisms and plant roots, recycling plant nutrients such as Ca2+ base cations, Mg2+, K+, and Na+. Soil health gives rise to the idea that soil is a living ecosystem and it needs to be managed carefully to restore and maintain the soil's ability to function optimally (Sonia and Setiawati, 2022: Moebius-Clune et al, (2017).

Dikr (2023) and Krasilnikov et al., (2022) state that emphasize the importance of balancing long-term fertilizer use with an understanding of the complex interactions in soil, plants, climate, and management practices. Farmers must grasp the impact of continuous intensive planting and fertilization on soil properties.

II. RESEARCH METHODS

The research was conducted from September 2023 to March 2024 in the coconut plantation of Maffa village. The chili seeds used were the Kaliber variety. The research location was determined based on survey results on coconut plantations owned by farmers in Maffa village. The research location was determined based on the survey of coconut plantations in Maffa village, by measuring the amount of light interception under the coconut plant canopies. The amount of solar radiation that reaches the bottom of the plant is recorded and used as a treatment in the research. Light interception through the coconut shelter was measured using a lux meter.

The research was implemented using factorial treatment based on Randomized Block Design with 30 percent and 45 percent coconut shelter respectively, and the concentration of local micro-organisms is 5ml and 10ml per liter of water, respectively. The treatment was repeated five times. The ingredients for the local micro-organisms consisted of leaf humus, bamboo roots, potatoes, and salt, which were made into a solution on a 10-liter scale. The application of the local microorganisms to the chili plants was scheduled once a week according to the experiment arrangement.

Observation data were analyzed using analysis of variance (F test) at a significance level of 5%. If there is a real effect, testing between treatments uses the BNT test at the 5% level.

Portable LAI-2000 Plant Canopy Analyzer (LI-3000A LICOR, USA) for measuring Leaf Area Index (ILD); Minolta SPAD-502 leaf chlorophyll meter and Spectrophotometer for measuring leaf chlorophyll content.

The chili plant variables observed are plant height (cm), Header Width (cm), leaf chlorophyll index, number of branches, number of fruits, and weight of fresh fruit (Tjokrodiningrat *et al*., 2023).

III. RESULTS AND DISCUSSION

The research showed an interaction between shade and the concentration of micro-organisms when observing the number of branches, and fresh fruit weight (Table 1).

Table 1. Summary of Varians Analysis on Applications of Local Micro-Organisms (LM-O) under Coconut Stands (CS) to the Components of Plant Height (cm), Header Width (cm), Leaf Chlorophyll Index, Number of Branches (units), and Fresh Fruit Weight (g) of Chilli.

No.	Variable	Coeff. of Variation	P > F
1.	Plant Height (PH) (cm)	6.2449	0.0013 ^{ns}
2.	Number of Branches (NB) (units)	2.6840	0.0901*
3.	Header Width (HW) (cm^2)	6.4261	0.5135^{ns}
4.	Fruit Weight (FW) $plant^{-1}$ (g)	5.9100	0.0014*
5.	Total Leaf Cholorphyl (TLC)	1.9372	0.3921^{ns}

*= significant; ns= non-significant.

The results showed that the combination of shade percentages of 30 percent and 45 percent respectively and microorganism concentrations of 5ml and 10ml did not significantly differ in plant height, canopy width and total chlorophyll of chili plant leaves, but was very significantly different in the components of number of branches and fresh weight of chili fruit per plant. This indicates that production is closely related to various combinations of production factors such as soil health which determines the availability of nutrients and plant performance in response to the environment. According to Sonia and Setiawati (2022), Moebius-Clune *et al*, (2017), Healthy soil is important in functioning to optimally a variety of soil organisms to prevent, and control plant diseases, and protect plants from disease, and pests by forming beneficial symbiotic associations between soil organisms and plant roots, also recycling plant nutrients such as Ca2+ base cations, Mg2+, K+, and Na+.

The mean difference test for the influence of shading and micro-organism concentration on these variables is presented in Table 2.

Table 2. Average Growth Character Value of Chilli on Applications of Local Micro-Organisms (LM-O) under Coconut Stands (CS).

Shelter and Concentration of Micro-organism	Chilli Plant Components				
	PH (cm)	NB (Unit)	HW (cm^2)	FW	TLC
$CS_{30}LM\text{-}O_5$	117.39a	37.47a	83.06a	392.10a	19.52a

Shelter and Concentration of Micro-organism	Chilli Plant Components				
	PH (cm)	NB (Unit)	HW (cm^2)	FW	TLC
$CS_{45}LM\text{-}O_5$	102.75a	43.56b	72.00a	308.50a	17.69a
$CS_{30}LM\text{-}O_{10}$	119.81a	47.78c	79.91a	476.39b	20.83a
$CS_{45}LM\text{-}O_{10}$	110.92a	44.10b	85.12a	410.74a	19.42a
BNT	17.43	4.09	11.07	81.57	3.16

Note: The values followed by the same letter are not significantly different from each other (α = 0.05) of the BNT test.
Plant Height (PH); Number of Branches (NB); Header Width (HW); Fruit Weight (FW); Total Leaf Cholorphyl (TLC).

The different tests showed that the number of branches and weight of chili fruit were influenced by shade and the concentration of micro-organisms. The highest number of branches was shown up in the treatment $CS_{30}LM\text{-}O_{10}$ (47.78), followed by the $CS_{45}LM\text{-}O_{10}$ (44.10) and the lowest number of branches was in treatment $CS_{30}LM\text{-}O_{05}$ (37.47). Meanwhile, the highest number of chilies was obtained from the treatment $CS_{30}LM\text{-}O_{10}$ (476.39) and the lowest yield was obtained from the treatment $CS_{45}LM\text{-}O_5$. The width of the crown can also affect the branching towards the side of the chili plant. The results of the study showed that the number of plant branches correlated with the yield of the chili plant.

Table 3. Difference Test Effect of micro-organisms and shade of coconut plants on temperature, relative humidity, and radiation transmission.

Shelter and Concentration of Micro-organism	Environment Component		
	Temperature (T)	Relative Humidity (RH)	Transmission radiation (TR)
$CS_{30}LM\text{-}O_5$	30.87b	68.96a	333.41b
$CS_{45}LM\text{-}O_5$	30.25a	79.60c	156.89a
$CS_{30}LM\text{-}O_{10}$	30.60b	73.63b	358.91b
$CS_{45}LM\text{-}O_{10}$	30.17a	79.10c	217.56a
BNT	0,33	4.68	110.10

The incident radiation intercepted in both coconut plantation conditions is explained by the amount of light reaching the surface of the chili plants. The greater the coconut shade, the smaller the incident radiation that is intercepted or can reach the bottom of the canopy, and conversely, the smaller the shade, the greater the incidence of solar radiation that reaches the plantation floor. However, the number of plant branches and fruit weight seem to be correlated with temperature and humidity on the plantation soil surface. Microclimate components contribute to the morphological characteristics of chili plants, especially the number of branches and weight of chili (Table 3).

Table 4. Correlation Coefficient between Average Fruit Weight (FW), Incident Temperature (T), and Air Humidity (RH), Intercept Radiation (IR), in chili plants.

Variable	FW	NB	T (°C)	RH (%)	R_intercept (Wm^{-2})
FW	1.0000		−0.7904**	0.8875**	0.2732**
NB	–	1.0000	0.9304**	0.8556**	0.2404^{tn}
T (°C)	–	–	1.0000	-0.7099**	-0.0295^{tn}
RH (%)	–	–	–	1.0000	0.1844^{tn}
R intercept (Wm^{-2})	–	–	–	–	1.0000

The correlation coefficient between average fruit weight per plant and negative temperature was very significant (r=−79.04**), and had a very significant positive correlation with humidity (r=0.71**), intercept radiation (retained by plant canopy) (r=0.27 **). The amount of sunlight that reaches the bottom of coconut plantations is affected by the shade created by the coconut plants. More shade (45 percent) results in less sunlight reaching the bottom of the coconut plantation. Additionally, the number of branches and the weight of fresh fruit appear to be influenced by the temperature and humidity on the surface of the plantation soil. The transmission of solar radiation to the plant canopy impacts the micro-climate and affects the availability of nutrients for plant growth (Cheng-Jin Chu et al., 2009).

Chili plants are a type of C3 plant, where C3 plants have the characteristic that the rate of photosynthesis increases with low leaf temperatures. However, chilies can adapt to environments that have high atmospheric CO_2 content. Therefore, in shaded conditions, chili plants can carry out optimal metabolism. Soil health is the capacity of soil to function as an important living system, sustaining plant health and productivity while maintaining or improving water and air quality. Chili adaptation is influenced by genetic factors and environmental factors. Environmental factors that influence the fenotipe of chili plants are altitude, climate, cultivation patterns, soil type, humidity, temperature and rainfall. Based on environmental treatment research, the differences in light interception under coconut plants are relatively diverse. This diversity can be seen from the quantitative character of Chile. The challenge for agricultural sustainability is to balance increasing yields with preserving soil and environmental health for the sustainable intensification of the agricultural sector.

IV. CONCLUSION

The application of microorganisms can improve the performance of chili plants under coconut plants as measured through vegetative components and plant production components. Based on observations during the research, the chili performance improved during the

cultivation process indicating that these microbes have a role in the shading of coconut plants.

The tolerance of chili plants to coconut canopy shade of 30 percent and a micro-organism concentration of 10 ml gave the best results. The coconut canopy shade of up to 45 percent at the same concentration of micro-organisms can produce the second-best number of branches and production. This shows the opportunity for practical and effective application of chili cultivation in land use under coconut plantations.

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