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The Effect of Dead-end Trench on Disease Attacks on Robusta Coffee Plants (*Coffea robusta* L.)

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ABSTRACT
Indonesian is the fourth largest coffee producer in the world. Increased coffee production is subject to proper land control. The use of dead-end trench is useful for accommodating organic matter and biological elements. This study aims to explore the effect of dead-end trench and without dead-end trench application on the attack of leaf rust and leaf spot disease. This research was conducted using qualitative methods by collecting data through observation and weekly observation. The results showed that the use of dead-end trench and without dead-end trench had an effect on the intensity of attacks including: (1) Leaf rust attacks on plants using dead-end trench (R1) of 40.11 and leaf spot of 50.11. The without dead-end trench coffee growing culture (R2) received 35.39 leaf rust attacks and 53.11 leaf spot attacks, (2) leaf rust attacks in the second week reached 40.56 and leaf spot by 51.61. Planting without dead-end trench reached an intensity of leaf rust attacks reaching 37.28 and leaf spot of 53.88, (3) the third week of attacks on planting with a dead-end trench of 40.67 and leaf spot reaching 50.67. Meanwhile, planting without dead-end trench leaf rust attack reached 42.22 and leaf spot by 53.33, (4) the fourth week of planting without dead-end trench increased by 42.56 and leaf spot by 52.61. Plant with dead-end trench reaches 42.50 and leaf spot infestation reaches 50.22. This research makes an important contribution to coffee farmers regarding the use of dead-end trench as an effective minimizing tool in reducing the spread of leaf rust and leaf spot.

***Keywords**: Coffe Robusta; Dead-end Trench; Leaf Rust; Leaf Spot.*

INTRODUCTION
Indonesia is an agrarian country where many agricultural sectors. The agricultural sector has an important role in plantations in Indonesia. The diversity of plant species in Indonesia has a lot of potential that can be utilized in human life and help the economy of country, namely coffee plants. Coffee commodities play an important role in the Indonesian economy. Coffee is an important commodity as an important contributor to the country's foreign exchange resources but as a source of income for half a million coffee farmers throughout Indonesia (Setiawan, 2018). Indonesian coffee began to be known since 1696, which was brought by the VOC (Dahang, 2020). Marketing average of coffee 14.96, 15.88 and 6.71%.

The development of coffee in Jombang, especially Wonosalam, has been marked by the increase in the number of coffee production developed over the years. In 2017, the Wonosalam region produced coffee with a total of 490.80 tons with a coffee plantation area of 924.00 ha and in 2019 the Wonosalam region produced 887.03 tons with an area of 1,500.4 ha (BPS Jombang, 2019). There are two types of ungulan coffee developed in the Wonosalam area, among others Robust coffee.

Robusta coffee (*Coffea robusta* L.) was introduced to Indonesia in 1900 to replace Arabica coffee damaged by leaf rust. Robusta coffee is more resistant to pests and diseases, so it is considered a suitable alternative (Puspitawati, *et al.*, 2020). The increasing production of coffee in the area of Wonosalam there is proper land control so as not to happen things like disease attacks that gives impact on declining production and quality of coffee. The use of dead-end trench, for decomposition processes and root rejuvenation.

Dead-end trench is a small hole measuring about 50 cm long, 50 cm wide and 50 cm high or a dead-end trench. Dead-end trench is a treatment of gardening cultural practices with the aim of managing land, organic matter and soil and water conservation measures in plantations (Satibi, 2019; Romadoni, *et al.*, 2022). Dead-end trench serves to trap or capture the flow of eroded surfaces. According to the research that had conducted by Maghfiroh (2020), the result show that dead-end trench definitely improves the physical and chemical condition of the soil. Dead-end trench is also effective as a repository medium for organic matter and various other nutrients. Coffee plantations are usually dead-end trench excavation form beside to the plant aims to bring fertilizer and drainage flow. This study aims to explore the effect of the application of dead-end trench and without dead-end trench on leaf rust and leaf spot disease in Robusta coffee plants.

MATERIALS AND METHODS

Research Locations

This research was conducted in February-December 2022 at farm coffee plantations in Segunung Village, Wonosalam Subdistrict, Jombang District, East Java, Indonesia.

Research Tools and Materials

The tools used in the study were meter, laptop, flash sample, HP camera, stationery. The material used is Robusta coffee plantation land.

Research Methods

The design used in the study was a complete randomized design (RAKL) consisting of 1 factor. The first factor was 1 variety of coffee that is Robusta coffee (K1) and the second factor was dead-end trench that used dead-end trench (R1) and without dead-end trench (R2). The experiment there are 2 combinations that are repeated 6 times, there were 12 combinations x 3 blocks obtaining, including 36 Robusta coffee plants that showed in the table below:

Table 1. The Research Layout Consists of 3 Blocks

	BLOCK 1	BLOCK 2	BLOCK 3
K1	K1R1	K1R1	K1R1
	K1R2	K1R2	K1R2

Table 2. Sample of Layout

BLOCK 1		
K1R1	K1R2	K1R1
K1R2	K1R1	K1R2
K1R1	K1R2	K1R1
K1R2	K1R1	K1R2

BLOCK 2		
K1R2	K1R1	K1R2
K1R1	K1R2	K1R1
K1R2	K1R1	K1R2
K1R1	K1R2	K1R1

BLOCK 3		
K1R1	K1R2	K1R1
K1R2	K1R1	K1R2
K1R1	K1R2	K1R1
K1R2	K1R1	K1R2

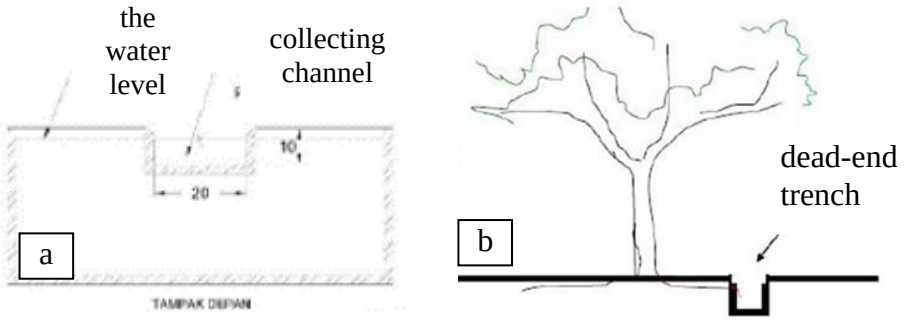

Figure 1. a) Dead-End Trench, b) Dead-End Trench Layout

Data Collection Techniques

Data collection conducted in this study using the following :

1. Observation was the collection of data by directly observing the place of research to obtain data related to dead-end trench on coffee plant land.
2. Documentation was data collection with data recording techniques required from the experimental design. Documentation was presented in the form of photos at the time of research.

Data Analysis

Data analysis of this study used test analysis of variant ANOVA. Subsequently the ANOVA test was done, the data that had a real effect continued with the Duncan advanced test (DMRT) at a real level of 5%.

RESULTS AND DISCUSSION

Results

Environmental conditions

Based on the results of the study known from environmental data taken in a period of 4 weeks there were four observation factors, particularly the light intensity, temperature, humidity, and wind speed. Light intensity showed in the figure below:

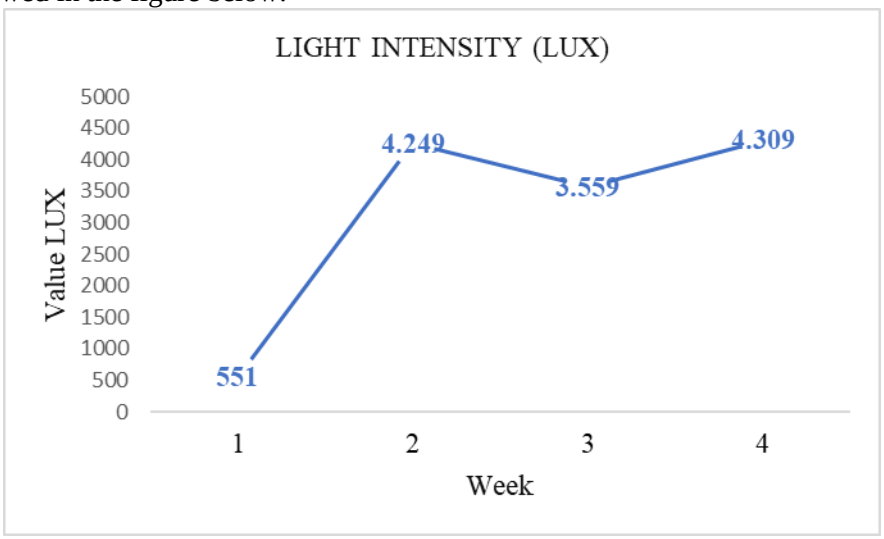

Figure 2. Light Intensity

From the figure 2 showed the intensity of light for 4 weeks the highest there in the fourth week reached 4.309 LUX, followed by the second week 4.249 LUX, in the third week 3.559 LUX while in the first week only amounted to 551 LUX. Light intensity greatly affects vegetative growth. While the second factor that is the influence of disease attacks was given in the following figure:

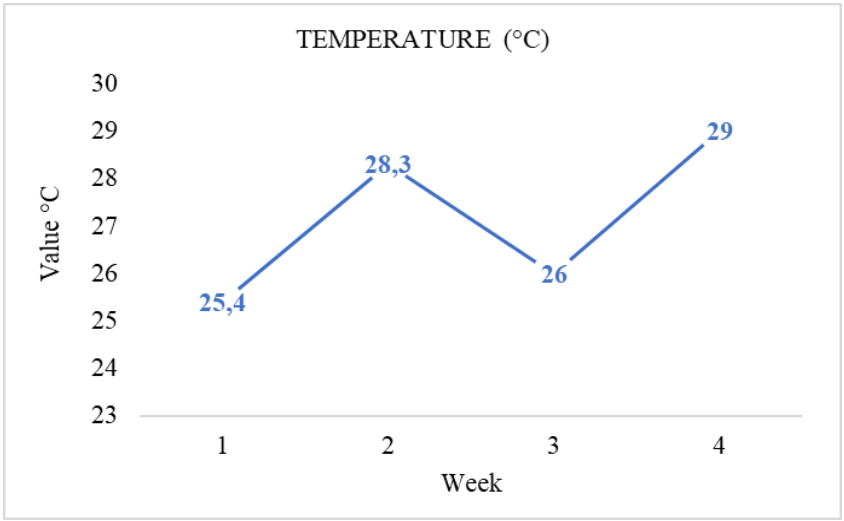

Figure 3. Temperature

Figure 3 illustrates the temperature for 4 weeks, the highest was the second week with 28.30 C. In the first week got 25.4 °C continued in the second week experienced gain in temperature rise 28.3 °C in the third week experienced a decline in temperature 26 °C and in the fourth week experienced an increase 29 °C. Robusta coffee disease attacks can be affected by temperature, because temperature can affect the growth rate and temperature related to light intensity. One of the causes of many coffee plants attacked by leaf rust disease as a result of current temperature ranges from 21 to 25 °C that the optimal temperature for the development of the disease (Harni et al, 2015). The third factor of the attack of the disease affects were showed in the following figure:

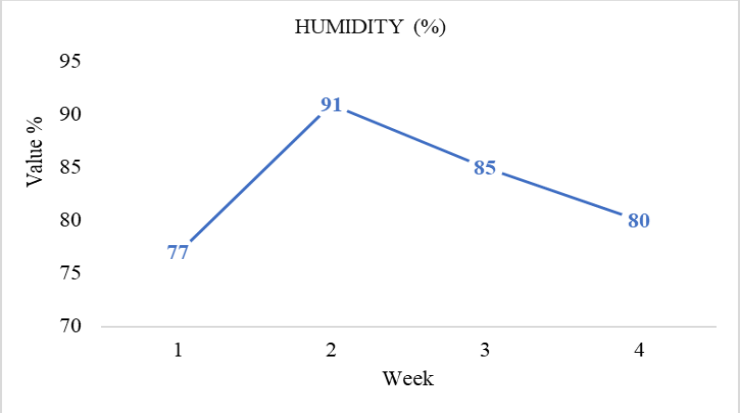

Figure 4. Humidity Observation

From the figure 4 above it can be seen that the highest humidity for 4 weeks found in the second week with an average humidity of 91%. The first week observations get 77%. In the second week increased humidity 91% further in the third week decreased humidity 85% and the fourth week decreased to 80%.

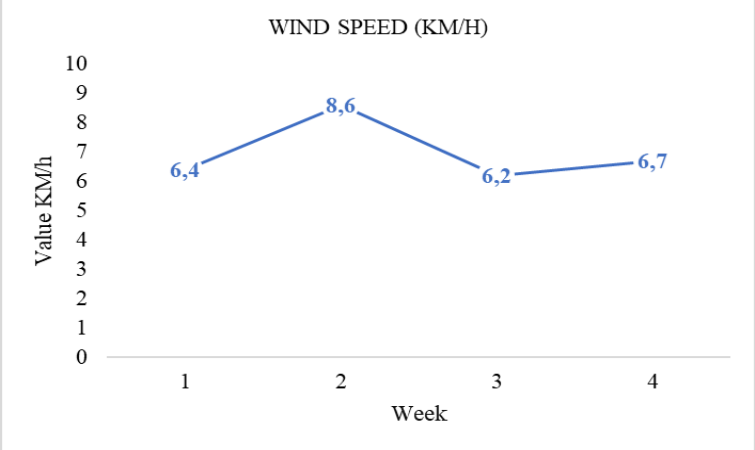

Figure 5. Wind Velocity

From the figure 5 above it was known that the highest wind velocity on the second weeks with a velocity of 8.6 km / h. Based on observations of wind speed observations in the first week got 6.4 km /H. In the second week to get 8.6 km/h, in the third week experienced a decline of 6.2 km/h and in the fourth week observations get 6.7 km / h. Wind velocity affects pollination in plants and wind velocity can also spread infectious diseases in plants and lead to infection from wounds or scratches on plants. Wind gusts help the spores escape from the inoculum source thus the spores spread and will eventually fall due to the force of gravity (Prakoso et al, 2020).

Disease Attacks

Cultivation techniques that are generally less environmentally friendly can reduce the kadunungan organic matter in the soil, in addition to biodiversity and soil fertility, reduce genetic diversity and plant species and increase the spread of pests and diseases (Winoyo, 2016). Based on the results of study for 4 weeks there are two diseases, namely leaf rust as shown below.

1. Leaf rust (*Hemileia vastatrix* B.et Br.)

Coffee leaf rust disease was a disease caused by the fungus Hemileia vastatrix. According to Alimudin (2021) this pathogen infection was characterized by the presence of yellow to orange spots on the lower surface of the leaves and then the spots merge together causing the photosynthesis area to decrease, causing plant growth to decrease. This causes the number of fallen leaves as a follow-up symptom of this disease attack continued with the number of flowers and coffee beans produced decreased (Harni et al, 2015).

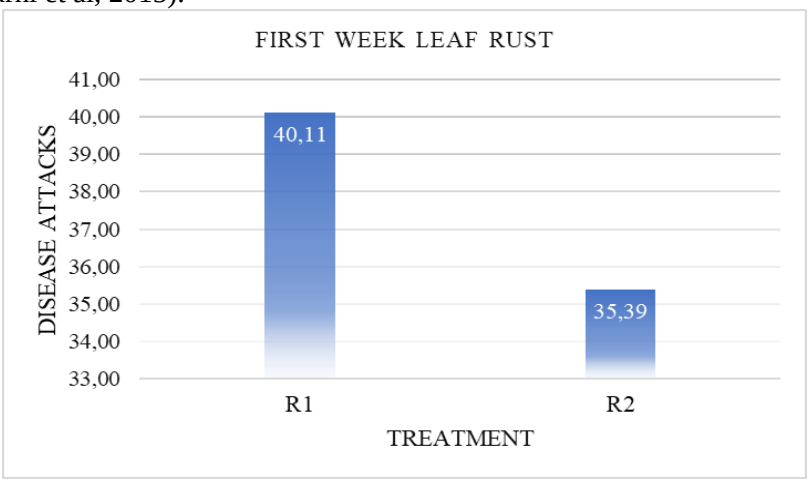

Figure 6. First Week Leaf Rust Disease Attack

The results of observations in the first week of planting with dead-end trench disease amounted to 40.11 while without dead-end trench reached 35.39. The observation in the second week as follows :

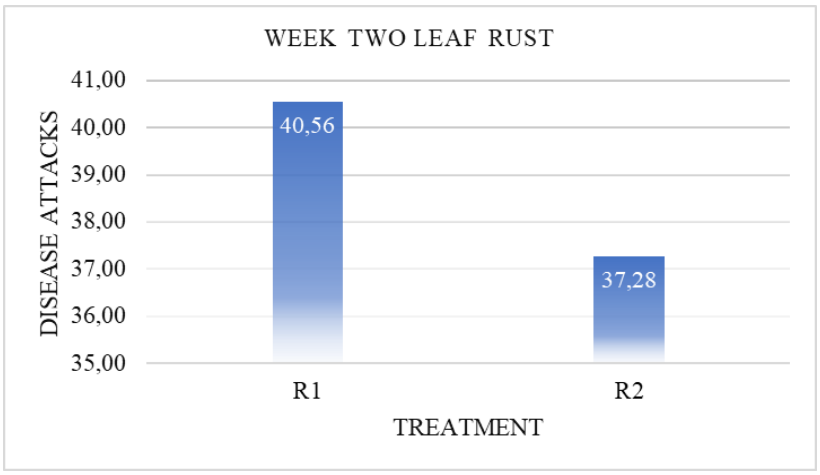

Figure 7. Second Week Leaf Rust Disease Attack

Based on the above results, the intensity of the attack on R1 is 40.56 and R2 with an attack of 37.28. The potential for disease attack occurs at altitudes below 1,000 m above sea level, while above 1,000 m above sea level the level of leaf rust disease attack was lower (Sugiarti, 2017).

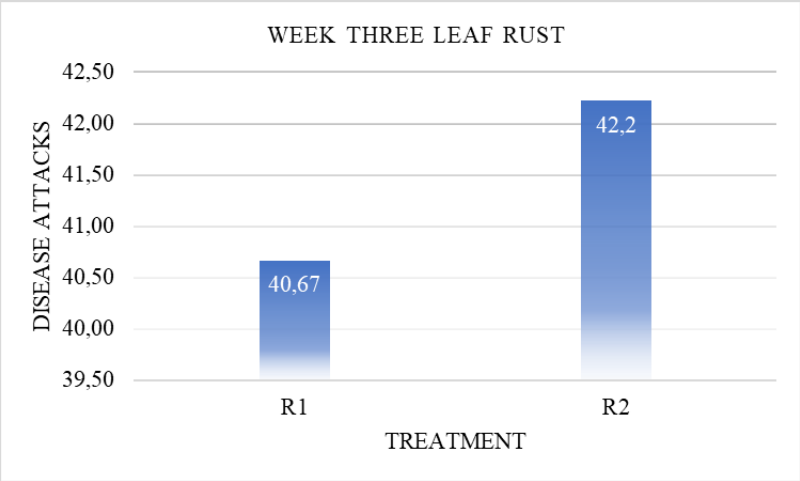

Figure 8. Third Week Leaf Rust Disease Attack

On the observation above, it was known that the disease attack on planting R1 is 40.67 and planting R2 is 42.2. The very dense conditions of the experimental garden also greatly affected the survival of the *Hemileia vastatrix* fungus. Coffee species, plant age, and leaf density affected the development of leaf rust disease (Sugiarti, 2017). As for the attacks in the fourth week as follows:

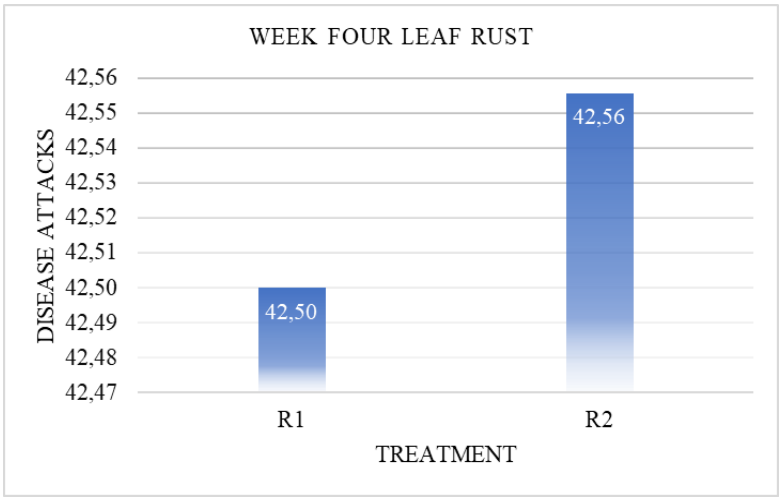

Figure 9. Fourth Week Leaf Rust Disease Attack

The results of the study above disease attack on R1 of 42.50 and R2 of 42.56. This occured inasmuch as there were environmental factors that good the development of leaf rust disease. According to Sugiarti (2017) Rain increases humidity, making it suitable for the germination of *uredospores* and the spread of *Hemileia vastatrix* fungi. Direct sunlight on the leaf surface prevents *uredospora* germination and prolongs the germination time of leaf rust. Meanwhile, in leaf spot disease, the intensity of the attack is as follows :

2. Leaf Spot (*Cercospora coffeicola* B. et Cke)

   Leaf spot disease is caused by *Cercospora caffeicola* B. et cetera. The attack on the leaves occurs because it has to do with a state of high humidity that generally occurs in the rainy season, when in the nursery it was quite dark and the provision of a too lush shelter or dense results in an not suitable air surface. Based on observations of leaf spot disease :

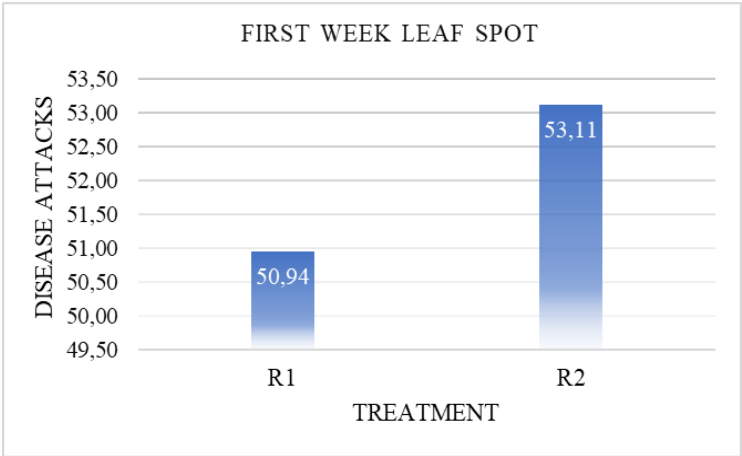

Figure 10. Attack of Leaf Spot Disease First Week

The observation of the first week of attack on dead-end trench amounted to 50.94 and not using dead-end trench leaf spot disease attack reached 53.11. The development of leaf spot disease was strongly supported by high humidity of 95% at a temperature of 12-33°C (Sumartini, 2019). In the second week, as follows:

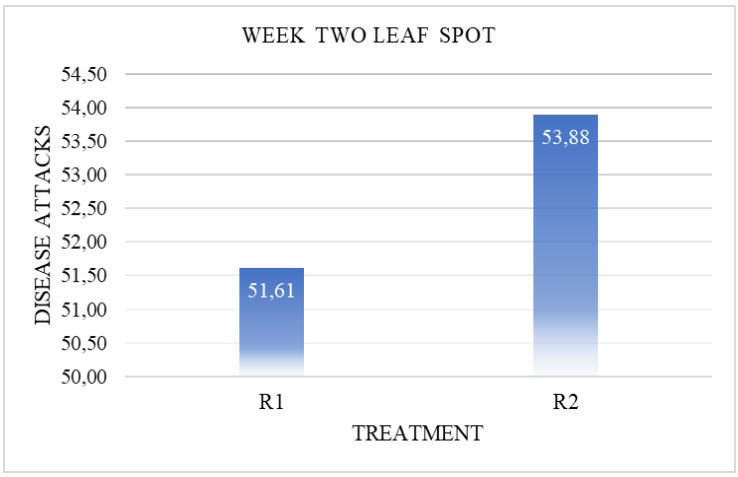

Figure 11. Second Week Leaf Spot Disease Attack

Based on the observation of the second week R1 51.61 leaf rust attack while R2 experienced the intensity of the disease attack 53.88. The three main factors that determine the occurrence of the disease are susceptible host plants, virulent pathogens, and suitable weather (Sumartini, 2019). As for the intensity of attacks of the disease in the third week, it is as follows :

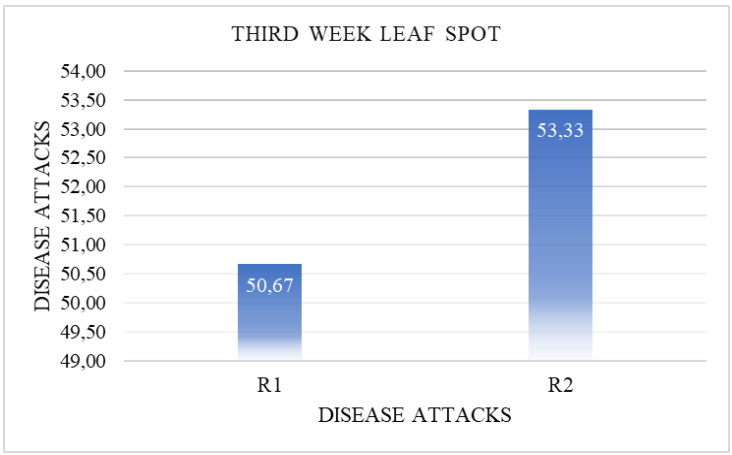

Figure 12. Third Week Leaf Spot Disease Attack

Based on the observation results in the third week of the intensity of disease attacks on R1 get 50.67 attacks while R2 get 53.33 disease attacks. There were also observations in the fourth week, as follows :

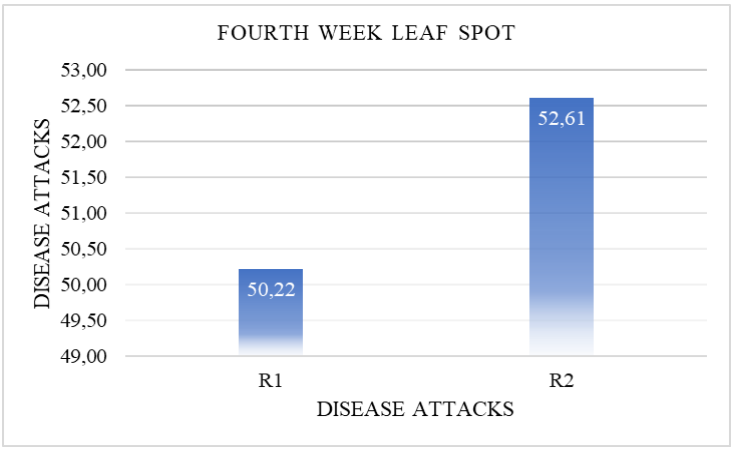

Figure 13. Fourth Week Leaf Spot Disease Attack

Based on the observation of the intensity of leaf rust disease attack on R1 50.22 and R2 earn disease attack of 52.61. Making dead-end trench on a plantation can affect the physiology and arrival of good microbes that function as natural nutria and also as natural enemies of diseases.

General Discussion

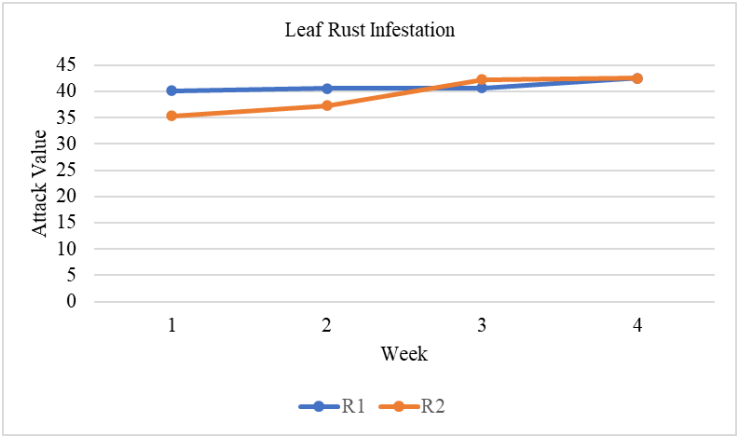

Figure 14. Observation of Leaf Rust Infestation for 4 Weeks

Figure 15. Leaf Rust Disease

The results of observations for four weeks showed that the treatment of dead-end trench and without dead-end trench had an influence on leaf rust disease, increased leaf rust disease occurred in Robusta coffee plants without dead-end trench, the most severe increase occurred in the fourth week, while Robusta coffee plants using dead-end trench had an increase in slow relalative disease it was influenced by the use of dead-end trench and environmental factors. Soil conversion using dead-end trench served to resist erosion and suppress nutrient loss. According to Haerul et al (2020) dead-end

trench served as a container for litter and shade and as a place for fertilizer application. The addition of organic matter to improve microganism that can serve as a defense from disease attacks or as a nutrient enhancer.

The environment affects the spread of the disease, one of the reasons leaf rust disease affects many coffee plants was the ambient temperature between 21°C to 25°C, the optimal temperature for the development of the disease.

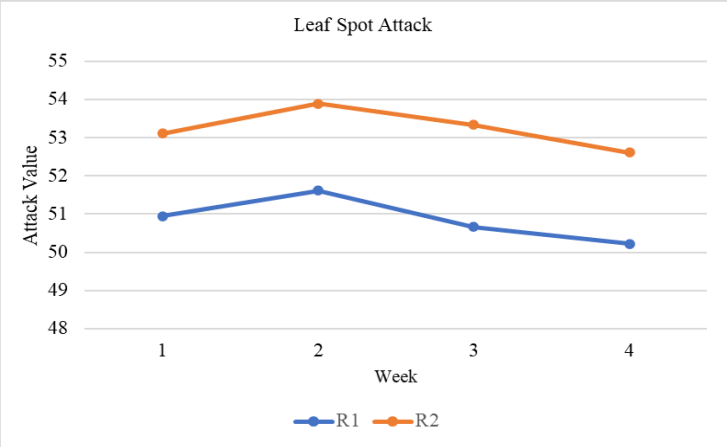

Figure 16. Observation of Leaf Spot Attacks for 4 Weeks

Based on observations for four weeks the level of leaf spot disease occurs in the application of Robusta coffee plants without dead-end trench in the second week while Robusta coffee plants with dead-end trench disease attack is low.

Figure 17. Leaf Spot Disease

Symptoms of leaf spot begins with the presence of brownish-yellow spots round ring. Leaf spot disease spreads through spores carried by wind, rainwater, and agricultural tools, assisted by moist environmental conditions and poor planting patterns (Rukmana, 2014; Hakim, *et al*., 2022). Inhibition of disease attacks can be influenced by biological agents (Sopialena, 2017). Using dead-end trench on a plantation can affect the physiology and arrival of good microbes that function as natural nutrients and also as natural enemies of diseases.

CONCLUSIONS

Disease attack on Robusta coffee is influenced by environmental conditions such as light intensity, temperature, humidity and wind speed the use of dead-end trench and not using dead-end trench on Robusta coffee plants gets different disease attack values. This indicates that the application of dead-end trench effect on disease attacks.

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