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Identification Of Diseases On Coffee Plant In Cangkringan, Sleman, Yogyakarta

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ABSTRACT

Many different kinds of plants, including coffee plants, are susceptible to disease. In Cangkringan, Sleman, Yogyakarta, this study aims to discover diseases. Compute the percentage of disease attacks, and determine the causes of diseases that affect coffee plants. The Central Laboratory of the Yogyakarta Institute campus is located in the Sleman Regency's Maguwoharjo District. The sample took place in the hamlets of Kopeng, Petung, and Gondang Pusung in the Cangkringan District, D.I. Yogyakarta. The research was done between March and September of 2021. Survey, collection, and identification of fungi that cause coffee plant diseases in the field and laboratory were the research techniques used. Additionally, farmers who work on coffee plantations were interviewed. Descriptive analysis was done on observational data related to diseases symptoms. According to data on environmental conditions in the three coffee plantations, Petung Hamlet had the highest elevation (875.7 masl), Kopeng Hamlet and Gondang Pusung Hamlet had the highest air temperature (27.9 °C), Gondang Pusung Hamlet had the highest air humidity (75%), Kopeng Hamlet had the highest irradiation intensity (1,947 Lux), and the three hamlets' soil pH ranged from 5.5 - 7. A quantitative analysis of the diseases attack rate was performed. On the macro- and micro-morphological characteristics of fungi, qualitative analysis was conducted. The findings revealed that fungi were to cause for four different types of coffee plant diseases. These diseases include leaf rust (caused by the fungus *H. vastatrix*), leaf spot *(C. coffeicola),* pink disease *(U. salmonicolor),* and black mildew *(Capnodium sp.).* Kopeng Hamlet had the highest incidence of disease attacks, including 9.7% for leaf rust, 11.8% for leaf spot, 4.8% for pink disease, and 2.9% for black mildew.

Keywords*:* *leaf spot, leaf rust, pink disease, black mildew, coffee plant*

1. INTRODUCTION

One of the products from plantations that is significant to Indonesian economic activity is coffee. Along with oil and gas, coffee is a major export for Indonesia and a significant source of foreign cash. The domestic coffee market is still pretty big, and export options are becoming more and more accessible (BPS, 2021).

In Indonesia, there are two types of coffee plantations: large plantations (PB) and smallholder plantations (PR). Huge plantations are made up of both large private (PBS) and large state plantations (PBN). Data about coffee PR in Indonesia was gathered from the Ministry of Agriculture's Director General of Plantations. From 1.210 million hectares of coffee cultivation in 2018 to 1.221 million hectares in 2019, there was a rise of 0.87 percent. The size of the PR coffee plantation expanded by 0.50 percent, or 1.227 million hectares, in 2020 (BPS, 2021).

Compared to PBN settings, the farming management conditions for people's coffee are still quite subpar. Disease is one of the causes of the low yield of coffee plants. Coffee plants frequently suffer severe losses as a result of diseases. Per hectare of coffee plants, losses might amount to millions of rupiah annually. Fungi are the primary disease-causing agents in coffee plants, as bacteria and viruses are uncommon and do not significantly harm the plants (Semangun, 2000).

Plant diseases can result in losses in agricultural yields' quantity and quality. With the correct aims and techniques, efforts to reduce losses brought on by plant disease infections can be controlled. Early monitoring and accurate disease diagnosis will guarantee effective control (Sutarman, 2017). Utilizing endophytic fungus is one of the control strategies (Yuliana et al., 2022).

Leaf rust is a disease that frequently affects coffee plants (Amaria & Harni, 2012). According to Harni et al. (2015), leaf rust, leaf spot, split canker, root fungus, and dieback are the diseases that affect coffee plants.

Central Java's Pagilaran coffee farms have been the subject of research on the fungus disease (Tjokrosoedarmo, 1996). Mulyani & Nildayanti have reported diseases in organic coffee plants in Bolokan Lembang Tiroan Village, Bittuang District, Tana Toraja Regency (2018). The growth of organic coffee is a result of people's growing understanding of how crucial it is to preserve the sustainability of natural resources. Compared to conventional farming systems, which have a tendency to be exploitative, it is considered that organic farming systems will ensure the sustainability of natural resource functions (Hadi, 2014). In the North Toraja region, the coffee leaf rust disease has been researched by Alimuddin (2021). In Bujang Village, Bale, Batin Wih Pongas, Tingkem, Kutetanyung, Bukit District, and Bener Meriah Regency, coffee leaf rust was recorded (Irma, 2022).

In the Cangkringan area of Sleman, Yogyakarta Special Region, there are several smallholder plantations. The issue is that no diseases affecting coffee plants in the region have been reported. As a result, it's important to identify diseases in Cangkringan, Sleman, DIY coffee plants. Identifying coffee plant diseases and their causes in Cangkringan, Sleman, DIY was the goal of this study.

2. MATERIALS AND METHODS

The study was carried out at the Yogyakarta Instiper campus' Central Laboratory, located at sub-district Maguwoharjo, district Sleman. Kopeng Hamlet, Petung Hamlet, and Gondang Pusung Hamlet, Cangkringan District, Sleman Regency, Yogyakarta, were the sampling locations for disease coffee plant components. The study was carried out between March and

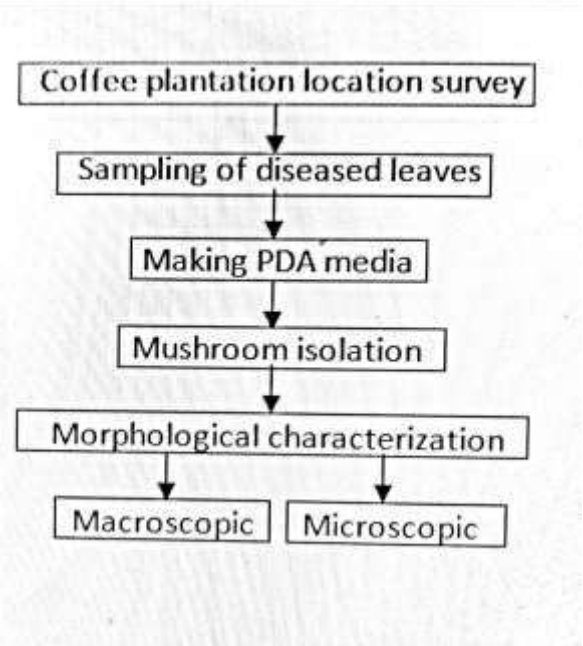

Figure 1. A flowchart for research

Before choosing a place for the investigation, preparations were made by assessing potential sites and obtaining permission. Owners of coffee plantations were directly interviewed with the purpose of gathering data. The chosen small plantations were situated in three separate places: Kopeng hamlet, Petung hamlet, and Gondang Pusung hamlet, Cangkringan, Sleman, DIY. The diagonal method of sampling was used to select 5 plant sites at random. Based on the disease's symptoms and signs, the disease was identified in each sample. The number of plants infected by the pathogen is counted, divided by the total number of plants, and multiplied by 100% to estimate the severity of the attack. The portion of each plant's leaf or fruit that the disease has affected is taken. The sample pieces are placed in a plastic clip before being transported to the lab.

In an Erlenmeyer tube, 39 g of instant PDA powder and 1,000 ml of sterile distilled water were combined to create PDA medium. Slowly stirring is done while the Erlenmeyer tube is heated on an electric heater until it boils. After that, the homogeneous medium was autoclave sterilized for 90 minutes at 121 °C. After waiting until the medium is heated, the pH is tested on the sterilized medium. The acidity level is adjusted to pH 7. After that, the medium is added to a petri dish. The medium in each petri dish is 15 ml.

A moist chamber technique was used to isolate disease-causing (fungi) from coffee plant parts (Defitri, 2016). The sample is first cleaned with distilled water and running water. The afflicted area was sliced with a scalpel into a roughly 3x3 cm square, laid out on filter paper in a petri dish, and then delivered to LAF. The item was then surface sterilized three times with sterile distilled water and 70% alcohol for one minute. Using a sterile scalpel and a petri dish, each surface-sterilized material is then sliced into squares of 1 x 1 cm. The parts were then put on the PDA media after that. Three 24-hour incubations of Petri dishes were performed. Following that, a mobile phone camera was used to observe and capture images of the fungi colonies as they grew. Additionally, the fungus was examined under a light microscope and captured on video by the Optic Lab.

The following observational metrics are:

1. The percentage of various disease attacks.
2. The macro- and microscopic morphology of fungal colonies.

A quantitative analysis of data on the percentage of various diseases' attacks was done. Qualitative analysis of fungi morphology was conducted. Macroscopic observations were qualitatively analyzed, including colony diameter, colony color, and colony morphology. The morphology of the hyphae and the presence or absence of spores were among the microscopic observations.

3. RESULTS AND DISCUSSION

The same four forms of coffee plant diseases, including leaf rust, leaf spot, pink disease, and black mildew, were present in the three small plantations that were examined (Kopeng Hamlet, Petung Hamlet, and Gondang Pusung Hamlet). Diseased leaves on coffee plants with leaf rust produce yellow patches before turning brown. There are urediospores, which resemble orange powder, on the surface of the spots on the underside of the leaves. When under heavy attack, the tree becomes yellow, its leaves drop, and eventually it is left bare. Coffee plants with leaf spot grow sick leaves with yellow spots and a yellow halo (circle).

Pink fungus attacks coffee plants, and the first sign of an infestation is the appearance of thin, silky cobweb-like fungal threads. Additionally, there is necrosis in that area, which leads to degradation and a dark brown or black hue. Attacks by soot dew on coffee plants are initially identified by the presence of white patches on the lower leaves. Rapidly growing white dots eventually cover the leaf's surface with a sticky black coating. Kopeng Hamlet's portrayal of the appearance of the coffee plant portions impacted by the disease's symptoms is seen in Figure 2.

Figure 2. Coffee plant diseases at Kopeng Hamlet. a. leaf rust, b. leaf spot, c. pink disease, d. black mildew

Table 1 provides information on the percentage of fungi-caused disease attacks on coffee plants at three different locations.

Table 1. Percentage of disease attacks on coffee plants

Location	Disease (%)			
	leaf rust	leaf spot	pink disease	black mildew
Kopeng hamlet	9,7	11,8	4,8	2,9
Petung Hamlet	10,3	8,6	4,0	2,6
Gondang Pusung Hamlet	8,0	9,6	3,6	2,3

The percentage of disease attacks in Kopeng Hamlet with the highest percentage is shown in Table 1 and includes leaf rust (9.7%), leaf spot (11.8%), pink disease (4.8%), and black mildew (2.9%). There are well-maintained and only partially managed small plantations, according to the findings of field surveys and in-person interviews with coffee producers. While the small plantations in Kopeng and Petung hamlets are only partially managed, the gardens in Gondang Pusung hamlet are well-maintained. Lack of care for coffee plants, including weeding, fertilizing, pruning, and shade control, leaves them vulnerable to disease, which is the root of the disease attack's high severity.

Environmental factors of the coffee farms were studied in addition to the percentage of disease attacks. The findings of the observation are shown in table 2.

Table 2. Data on environmental conditions of coffee plantations

Location	Place altitude (m asl)	Air temperature (^{0}C)	Humidity (%)	Sunlight intensity (Lux)	soil pH
Kopeng hamlet	763	27,9	71	19.470	6,5 - 7
Petung Hamlet	875	27,4	71	18.770	5,5 - 7
Gondang Pusung Hamlet	554	27,9	75	19.120	6 - 7

The disease triangle is a theory on how diseases develop in plants, especially coffee plants. The host plant, the pathogen, and the environmental factors make up the disease triangle. Whenever a plant is weak and fragile, it can become ill. Plant-attacking pathogens are aggressive or malignant. High humidity and an acidic soil pH are two environmental factors that hinder the growth and development of host plants and promote the growth and development of diseases, respectively (Sopialena, 2017).

Fungi on coffee plants can be recognized macroscopically and microscopically based on the findings of observations made in relation to study by Masnilah and Pradana (2019). Figure 3 depicts the fungus's macroscopic and microscopic appearances, which cause coffee plants to develop leaf rust disease.

Figure 4 depicts the fungus that causes the leaf spot disease. Figure 5 displays the fungus that produces pink disease, and Figure 6 displays the fungus that causes black mildew.

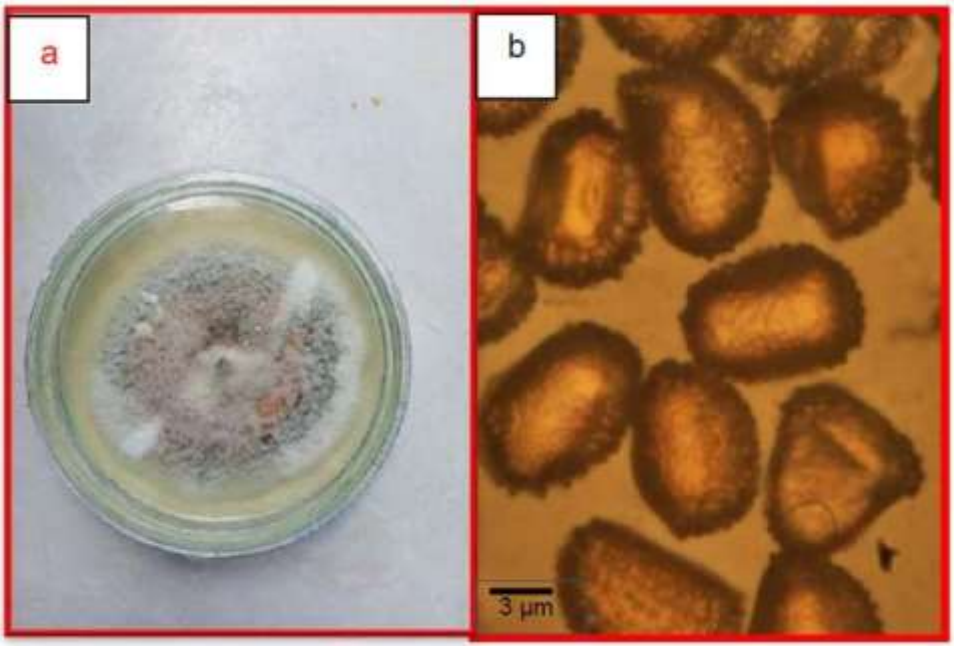

Figure 3. Appearance of the fungus *H. vastatrix* macroscopically and microscopically.
Description: a. Fungal colony, b. Urediospora

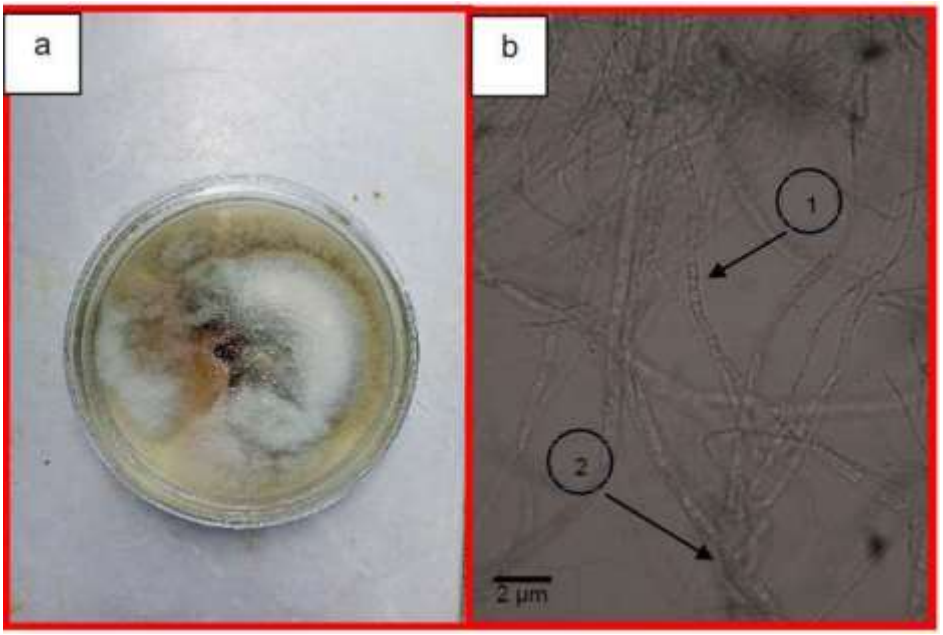

Figure 4. Appearance of fungus *C. coffeicola* macroscopically and microscopically.

Description: (1) Conidiophores, (2) Fungal hyphae, (3) Fungal colony (2)

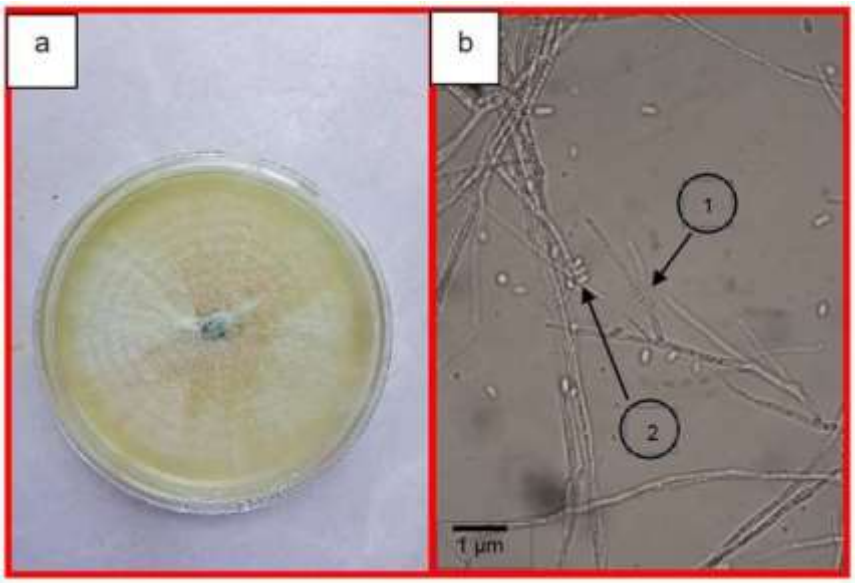

Figure 5. Appearance of fungus *U. salmonicolor* macroscopically and microscopically. Description: a. Fungal colony, b. Fungal hyphae, hyphae (1), conidiophore (2)

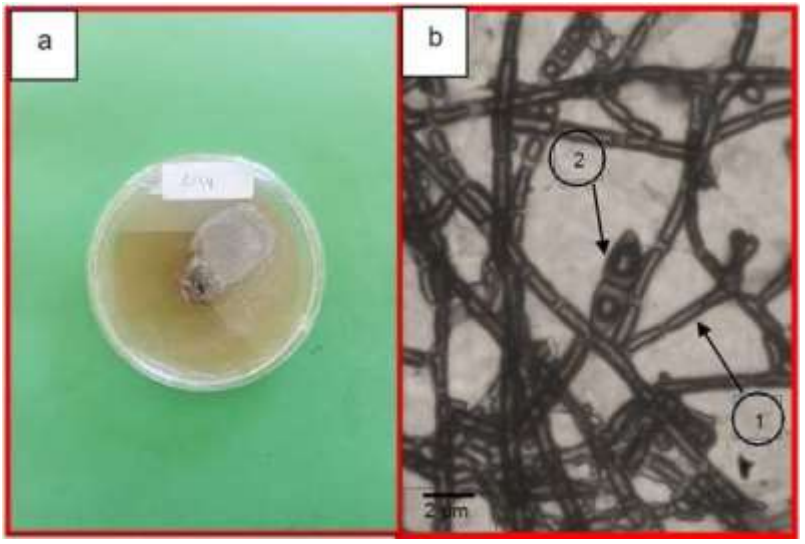

Figure 6. Appearance of *Capnodium* sp. macroscopically and microscopically. Description: a. Fungal colony, b. Fungal hyphae, hyphae (1), conidium (2)

Based on the results of the observations above, a summary is made presented in Table 3.

Table 3. Macroscopic and microscopic characteristics of fungi on coffee plants

Fungus Name	Characteristics	
	macroscopic	Microscopy
Hemileia vastatrix	Orange color, wedge-shaped shape, and colorless walls make up this object.	The convex's outside side features a barb, but its inside side is smooth.
Cercospora coffeicola	Colonies are white on the third day, turn grayish white on the fifth day, and finally turn black on the seventh day.	branching, insulated conidiophores on the hyphae
Upasia salmonicolor	Colonies are white on the third day, dull white on the fifth day, and grayish white on the seventh day.	branching, insulated conidiophores on the hyphae
Capnodium sp.	Colonies are white on the third day, turn blackish brown on the fifth day, then turn completely black on the seventh day (dark)	Conidia that are round and have rounded corners on the hyphae (oval)

Fungal spores, wind, the use of organic fertilizers, cultivation tools, and seeds that have been infected with the fungus are all common ways that it spreads on coffee plants. Because of improper plant spacing, poor air circulation, and excessive humidity in the environment, the leaf rust disease spreads swiftly and targets weak or highly sensitive plants (Amaria & Harni, 2012; Talhinhas et al., 2017). High humidity, for instance, during the rainy season, in too-dark nurseries, with too-dense shadowing, and with poor air exchange all contribute to the spread of leaf spot (Phengsintham et al., 2013). A lot of factors contribute to the development of pink disease, including wet environments, lack of sunlight, and the spread of fungi by wind or splashing water. The spores that are carried by the wind can help black mildew spread (Chomnunti et al., 2014). The black mildew coating can separate when the air is sufficiently dry, when it can be dispersed by the wind or rains. Insects that carry disease are capable of dispersing black mildew (vectors).

4. CONCLUSION

Kopeng hamlet had the highest incidence of disease attacks, including leaf rust (9.7%), leaf spot (11.8%), pink disease (4.8%), and black mildew (2.9%). There were discovered to be four different forms of coffee diseases: *H. vastatrix* caused leaf rust, *C. coffeicola* caused leaf spot, *U. salmonicolor* caused pink disease, and *Capnodium* sp. caused black mildew.

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