

## ECO-FRIENDLY PEST CONTROL FOR THE CONTROL OF BROWN RUST DISEASE (HEMILEIA VASTARIX) ON DUKU LEAVES

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### Abstract

Rust disease is a group of plant diseases caused by fungi belonging to the race (order) Pucciniales. This disease is most clearly visible symptoms on the leaves, so it is called leaf rust. Symptoms are characterized by the appearance of reddish-brown spots on the leaves that get bigger and bigger. These spots are usually surrounded by yellow tissue due to chlorosis of leaves. Several studies have proven that brown rust disease in plants, especially leaves, has a very bad impact on fruit yield. The purpose of this study is to study; (1) How does brown rust disease occur on duku leaves? (2) What is the environmentally friendly pest control model for the control of brown rust disease on duku leaves? Type of literature research with a qualitative descriptive approach and analysis with an inductive approach. The results showed that brown rust disease on duku leaves is a disease caused by *Hemileia vastatrix* fungi, fungi, bacteria and viruses. Environmentally friendly pest control for the control of brown rust disease on duku fruit leaves include; 1) Organic Pesticides, 2) Vegetable pesticides, 3) Integrated pest control, 4) Routine land use. With several environmentally friendly pest control models, pest control against all types of plant diseases, including spots or rust on plants and fruits, including brown rust on duku leaves, will be resolved in the long term without side effects or damage to plants and the environment

**Keywords:** Pest Control, Leaf Rust, Duku Leaf,

## INTRODUCTION

### Background

Indonesia is one of the three countries that have high biodiversity. Plants in Indonesia are part of the Indo-Malayan plant geography. IndoMalayan flora includes plants that live in India, Vietnam, Thailand, Malaysia, Indonesia, and the Philippines. The flora that grows in Malaysia, Indonesia, and the Philippines is often referred to as the Malesiana flora group. Biodiversity owned by Indonesia is very useful and has certain values that can be utilized for the welfare of the Indonesian people. (Hariss 2017)

Indonesia is rich in germplasm resources, especially horticultural crops that can be designed as superior commodities in order to increase household and state economic resources. The potential of tropical fruits as a source of income for household economic income of farming communities and foreign exchange of the State. One type of potential fruit that is expected to become a national flagship fruit is duku. Supporting potentials for the development of duku agribusiness include the availability of adequate human and land resources, as well as suitable agroecological conditions for duku growth and production. (Nurhidayat, Rochdiani, and Sudrajat 2019) (Hariyanto et al. 2020)

Duku (*Lansium domesticum* Corr) is an important fruit in Indonesia and has a wide market ranging from traditional markets to modern supermarkets. Duku production centers in Indonesia are in South Sumatra (Ogan Komering, Gunung Megang, Muara Enim, and Prabumulih), West Sumatra (Sijunjung and Air Haji), North Sumatra (Rantau, Prapat, and Padang Sidempuan), Riau (Bangkinang), Jambi (Jambi), DKI Jakarta (Pasaringgu), Central Java (Lebaksiu, Branti, Kaligondang, Mrebet, Kejombang, Kutosari, Sigaluh, Salaman, Kaligesing, Matesih), East Java (Singosari), and North Sulawesi (Aermadidi, Tondano, Pinaleng, Bolaang Mongondow). The most famous duku in Indonesia is the Palembang duku, especially those from the Komering Watershed, this is due to differences in fruit characteristics related to taste. (Ratna Puri, Paiman, and pada Faculty Agriculture Department Forestry Jambi University 2022) (Nuranisa, Sudiana, and Yani 2020) (Subakti et al. 2003)

Duku trees are widely spread in the countries of Malaysia, Indonesia and Thailand. Duku plants have been known and planted by the inhabitants of Indonesia since hundreds of years ago. Duku trees are found in almost all provinces in Indonesia. (Deroes and Andi Vijaya 2010)

Duku fruit is included in the category of fruit plants that are grown and cultivated by several fruit farmers in Indonesia, which certainly cannot be separated from the interference of pest and disease attacks on these plants. Among the many examples that occur, pests or diseases found in duku fruit, one of which is leaf rust caused by fungal diseases and fungi. (Asra, Miranti, and Adriadi 2022)

Brown Leaf Rust (BLS) is one of the most important and most common fungal diseases in plants. *Cercospora henningsii* Allesch is a pathogen that causes brown leaf spot disease, spread throughout the world and can be found in most lowland plantations. (Ika Rochdjatun 2014)

One of the plant nuisance organisms that attack organs on duku leaves is leaf rust disease. As a result of this leaf rust plant disease, it causes damage and death to plants. This will have an impact on decreasing production yields, this decrease in production will cause losses. Losses that occur can be in the form of direct and indirect losses. Direct losses are losses experienced by farmers due to the attack of the disease. (Aditya, Hasanuddi, and Pinem 2013)

Based on the background above shows that the spread of brown leaf rust disease on duku leaves is caused by fungi. This study aims to find out how brown rust disease occurs on duku leaves and how environmentally friendly pest control to control brown rust on duku fruit leaves so that the harvest from duku fruit can be maximized and also does not have a bad impact on environmental damage due to pest control that is not environmentally friendly.

## Problems

1. How is the cause of brown rust disease on duku leaves?
2. What is the eco-friendly pest control model for the control of brown rust disease on duku leaves?

## LITERATURE REVIEW

In Indonesia, leaf rust disease is not only found on duku fruit leaves, but also on several vegetables and fruits, including;

- a) Research by Reymas M.R Ruimassa shows that the results of the conclusion that leaf rust disease found in corn leaves in Copti Village in SP III Prafi, Aimasi District, Manokwari Regency, the cause is Climate factors such as rainfall, temperature and air humidity greatly support the increase in the intensity of *P. polysora* disease attacks on corn leaves.
- b) Research by Syahri, Renny Utami, et al showed the conclusion that there are two types of diseases in soybean plants, namely rust disease and leaf spot. Leaf rust disease is an important disease that causes damage to soybean crops. Besides being caused by the influence of treatment, long dry conditions with high temperatures are thought to also cause low intensity of rust disease attacks. Long moist conditions and cold periods required the fungus to infect the leaves and sporulate. The spread of urediniospores is aided by gusts of wind in rainy times
- c) The results of Wa Nurjana Mustafa's research showed the conclusion that leaf rust disease on teak leaves caused by the fungus *Olivia tectonae* which showed 3 types of symptoms, namely the presence of small spots and large spots, brown leaf spots with curled leaf margins and brownish-yellow spots resulting in hollow leaves. The intensity of attacks due to leaf rust disease has an average value of 36.43% included in the category of moderate damage attacks.

From some of the studies above, the cause of leaf rust disease is caused by various factors and leaf rust disease is not only found in the leaves of duku fruit, but in several types of plants.

Some of the research above, there is also no discussion about how to overcome and solve the problem of leaf rust pests on some plants. In this study, it will be discussed how the model of skin rust disease pest control on plants, especially on duku fruit leaves, which of course the control is environmentally friendly, so as not to have a bad effect on plants, fruits, and the environment.

## RESEARCH METHODOLOGY

This type of research is literature research with secondary data. The approach used in this study is a qualitative approach with a descriptive method. The data analysis that researchers use is qualitative data analysis in an interactive way and takes place continuously at every stage of research. Analysis is the process of sequencing data, arranging data into patterns, categories, and basic descriptive units to obtain the similarity of a method to draw conclusions. (Lubis 2018) (Maleong 2013a) (Maleong 2013b)

## RESEARCH RESULTS

### Factors causing brown rust disease on duku leaves and their effects

Leaf rust disease is one of the diseases that often attacks some fruit plants, caused by the fungus *Hemileia vastatrix*. *Hemileia vastatrix* is an obligate parasite without other components that reproduces using light spores so it is very easily carried by the wind. The spread of this fungus is very fast through spores either with the help of wind or rain splashes, so that when one of the plants is attacked, the surrounding plants will easily be infected by this fungus. (Mustafa, Wattimena, and Latumahina 2019)

Infestation generally occurs on the undersurface of leaves. It begins with symptoms of yellow lesions covered with powder or stains that appear on the underside surface of leaves. On young lesions, pale yellow stains appear with obvious sporulation so that the leaves will dry out and fall which eventually results in the plant becoming bare. This has an impact on the decline in duku fruit production which causes losses to duku farmers. (Hadi et al. 1998)

The terms pest and disease are often considered synonymous, as they can both be detrimental to plants and humans. But actually the two are different. Pests are animals that damage crops and generally harm humans economically. These losses are associated with economic value, because if there is no decrease in economic value, then the presence of these pests on plants does not need to be controlled or eradicated. Meanwhile, plant diseases can be bacteria, fungi, algae and viruses. (Indriyanto, Asmarahman, and Tsani 2020)

The form of tree damage to stands varies, depending on the type of causative factor. The cause of tree damage is due to biotic factors and abiotic factors that affect tree growth. Tree damage caused by biotic factors and abiotic factors can be seen directly characterized by tree organs that look abnormalized or there are disturbing organisms. Biotic factors that usually attack trees, namely pests, fungi, and pathogens while abiotic factors that affect tree growth, namely wind and sunlight. (Saputra, Wirianata, and Crystallization 2018) (Surachman, Indriyanto, and Asmarahman 2023)

Some diseases on leaves are caused by fungi, bacteria and viruses, such as leaf rust, anthracnose, leaf spot, bacterial ulcers, bacterial wilt, mosaic and others. The most commonly encountered diseases are those caused by fungi. Leaf rust disease occupies the first level of various diseases caused by fungi. (Rusae, Metboki, and Atini 2018)

Symptoms of leaf spot vacuuming are influenced by the host plant genotype and environmental factors the initial symptoms of both diseases are small chlorotic spots on the leaves 10 days after infection. The spots then grow larger and brown or black in color because the leaf tissue undergoes necrosis. Early and late leaf spot vagues have almost the same symptoms, namely in the form of dark brown to black spots on the leaves. Early leaf spot symptoms are generally characterized by dark brown round spots surrounded by a yellowish halo on the upper surface of leaves. While the final leaf spot spots are rounder, smaller in size and darker in color black) on the lower surface of the leaves. The early leaf spot (*C. erachidicolo*) is influenced by the host and environment. Similar whorls can be found on late leaf spot (*P. personala*). Oieh

therefore circles cannot be used as a proper diagnostic character. Both fungi also cause slightly oval spots on petioles and stems. When the transmission rate is high, the tanarnan leaves turn yellow, dry and fall off. (Susanto et al. 2020)

Early leaf spot disease attacks can occur earlier than late leaf spot disease, but both generally affect plants from 3-5 weeks after planting. Late leaf spot disease is considered more dangerous and detrimental than early leaf spot. Symptoms of rust fungal infection are characterized by small orange spots on the lower surface of leaves which are actually fungal uredinia containing spores (uredinia). Advanced symptoms of infestation are characterized by the formation of spores on the upper surface of leaves. In addition, rust fungi can also infect plant stalks and stems. In contrast to leaf spot disease that can shed leaves. Rust disease causes leaves to dry but remain attached to the trunk and branches. (Prihatiningrum et al. 2021) (Sari et al. 2022)

The growth and development of duku leaf rust disease is influenced by climatic conditions that take place during the growth process. Suitable climate, affects the overall process of interaction of pathogenic hosts of a plant disease. Increased rainfall results in an increase in the intensity of disease attacks. The existence of rainfall causes garden conditions to become moist and ultimately affects various processes of growth and development of pathogens such as spore germination, infection rate, and pathogen development. (Sugiarto, Cape, and Primary 2023) (Heriyanto 2015)

The rate of disease progression also increases along with the increasing intensity of attacks and is categorized as severe. Rainfall greatly supports the development of the disease. An increase in the amount of precipitation can lead to an increased development of rust disease. Rainfall causes the planting land to become wet and causes evapotranspiration which causes the garden to become moist and facilitates the distribution of disease from one corn plant to another in the same garden or between gardens. The increased conditions of development of the disease are also due to the sensitivity of the plant to highly virulent pathogenic races to duku fruit crops. (Ruimassa, Sari, and Martanto 2023)

Leaf diseases of the fruit are very important, serious leaf diseases not only cause the leaves to dry out, affect the delay in fruit development and bud formation, but also lead to the weakening of the tree, thereby aggravating other diseases.(Pani and Sari 2023)

Leaf spot disease or leaf rust on plants, including on duku fruit leaves has an effect or effect on trees and even fruits. Not a few even plants affected by the disease cannot bear fruit and can even die. The following are the effects or consequences of leaf spot or leaf spot disease on trees and fruits; (Risky et al. 2022)

1. Stunted growth: Plants infected with the disease usually grow slower than healthy plants, and can look less lush or even stunted.
2. Scab or deformity on fruit: The fruit of a plant infected with the disease may develop scab or deformity, such as a deformity or size that does not fit as it should.
3. Flowers do not develop: Plants infected with the disease can experience problems in flower formation and fruit production.

4. Plant stem and root rot: Disease can cause rotting of the stem and roots of the plant, which can result in the plant wilting and death.
5. Decreased production: Plants infected with the disease may experience a decrease in the quantity and quality of production.
6. Plant death: Severe disease can result in the overall death of the plant.

Fruit leaf disease in addition to causing a decrease in the quantity and quality of the fruit itself, if the prevention and control are not timely, resulting in other plants easily infected, causing serious economic losses, and having a major impact on environmental health. (Andriani et al. 2023)

### **Eco-friendly pest control model for brown rust disease control on duku leaves**

The occurrence of a disease or the presence of a disease in a type of plant is determined by three main factors, namely susceptible or sensitive host plants, the cause of the disease or virulent pathogens and a supportive environment. (Hidayati, Nurrohmah, and Ardhany 2020)

Healthy plants are better able to withstand attacks by various pathogens or disease-causing plants. Conversely, plants are unable to withstand the attack of various pathogens when conditions are poor. (Agustini and Manohara 2009)

The development of pathogens is not only influenced by the condition of the plant/host, but by its environment. For example, high relative humidity, and suitable temperatures are good conditions for the development of pathogenic species. On the other hand, the role of humans is also a very important factor in determining the occurrence of disease attacks. Thus it can be argued that other diseases that are not found are as a result of one of the components that cause the disease that does not support. (Santoso and - 2013)

In Indonesia, the use of household pesticides to overcome the problem of settlement pests began to increase after the 1970s. Since then pesticides have become an inseparable part of domestic life due to fears of contracting diseases spread by pests, physical losses, comfort disturbances, and aesthetic problems. However, intensive use of household pesticides can also cause negative impacts such as acute and chronic poisoning for humans, environmental pollution, and can cause pest resistance to pesticides. (Prayogi Saiful Anwar et al. 2021) (Wahyuningsih 2007)

Various negative impacts caused by the use of pesticides further encourage the development of active ingredients to replace pesticides that are safe and environmentally friendly. Therefore, natural raw materials obtained from plants are becoming one of the pesticide alternatives that are increasingly considered. (Made et al. 2023)

One of the problems often faced by farmers, especially vegetable and fruit farmers is pest attacks, both in the form of nematodes, fungi, caterpillars, fruit flies and anthracnoses. This pest attack often thwarts the harvest, causing huge losses. Farmers generally use chemical pesticides to eradicate these pests because chemical pesticides are widely sold in the market and are very effective in eradicating pests. They do not understand if the consequences caused

by the use of chemical pesticides, especially in the long and continuous period of time are very dangerous. This chemical pesticide cannot decompose in nature so the residue will accumulate in the soil, besides that it will also stick to plants. (Budhi, Prayitno, and Elvina 2019) (Masriyani et al. 2020)

Below are some environmentally friendly pest control models for the control of brown leaf rust disease on plants, one of which is on duku fruit leaves. (Shahri et al. 2023)

### **Organic Pesticides**

Alternative use of organic pesticides that are much more environmentally friendly and non-toxic is a better solution to replace the role of chemical pesticides. When compared to chemical pesticides, organic pesticides have several advantages. First, it is more friendly to nature, because the nature of organic material is easily decomposed into other forms so that the impact of toxins does not stay for a long time in the wild. Second, organic pesticide residues do not last long on plants, so sprayed plants are safer for consumption. Third, from an economic point of view, the use of organic pesticides provides added value to the products produced. Non-pesticide food products cost better than conventional products. In addition, making organic pesticides can be done by farmers themselves, thus saving production costs. Fourth, the use of organic pesticides integrated with the concept of integrated pest control will not cause resistance to pests. However, based on field surveys that have been conducted, it was revealed that not many farmers are aware of the dangers posed by the use of chemical pesticides for a long time. They also do not know the existence of organic pesticides that are much cheaper and harmless where the manufacturing process is very easy. Thus, it is necessary to socialize and provide skills in making environmentally friendly organic pesticides to overcome pest attacks on vegetable and fruit crops. (Erari et al. 2021)

### **Vegetable Pesticides**

Lately the attention to vegetable pesticides is getting bigger, various kinds of plants and medicinal plants can be used as vegetable pesticides, one of the medicinal plants that has anti-fungal substances is the leaves of siri (*Piper aduncum* L). Siri leaf extract (*Piper aduncum* L) functions as an anti-fungus that can affect the growth and formation of fungal conidia. The chemical components of siri leaves (*Piper aduncum* L) are essential oils, sesquiterpenes, triterpenes, terpenoids, sitosterol neolignans and crotepoksids. The activity of fungi is thought to come from the essential oils of siri-siri leaves, namely socugenol, limonene, and kariesifilena. (Inayati and Yusnawan 2016)

To face various challenges of agricultural development, the government together with the community must be able to make breakthroughs with various alternatives that can provide a way out of the problem by not forgetting concern for the environment and prioritizing partiality for farmers. An alternative pest and disease control that is cheap, practical and relatively safe for the environment is needed by developing countries such as Indonesia with the condition of farmers who have limited capital to buy synthetic pesticides. (Rabuanasyah et al. 2014)

### **Integrated Pest Control (IPM)**

One way out to overcome this problem is to apply the conception of Integrated Pest Control (IPM). Integrated Pest Control is an environmentally friendly conception of pest control, which seeks to encourage the role of natural enemies and is another non-chemical means of control. In its implementation, pesticides are only used when necessary and their use is done selectively. Therefore, the quality of vegetable and fruit production can increase because it is free from pesticide residues. (Anto and Yudi 2013) (Pasetriyani 2010)

Integrated Pest Control (IPM) provides space and life rights for all components of ecological biota without causing damage to cultivated plants. The goal of integrated pest control is to reduce the use of chemical pesticides by combining various components of biological control techniques and chemical applications if other control techniques are unable to suppress pest populations. (Indiati and Marwoto 2017)

### **Routine Land Use**

Pest problems arise due to a combination of environmental factors that favor the growth of its population. Monitoring of the development of pest populations, the role of natural enemies, climate and environment must be carried out to determine the state of land ecosystems that are always changing and developing. The state of planting from season to season shows that not every time the plant is attacked by pests. In the state of unattacked plants, nature can maintain a balance so that the pest population is not high and does not cause losses. Such a state of equilibrium is called biological equilibrium. (Siregar, Siahaan, and Siahaan 2022)

Control factors such as weather/climate, food and biodiversity (parasites, predators and pathogens) can change at any time and the balance will change as well. Therefore, biological balance is not static but dynamic and always in motion. The balance of pest populations can also change with human intervention in managing plants. The use of chemical pesticides as a means of pest control, if not selective and inappropriate, the dose can kill natural enemies and cause resurgence and pests to increase the population. This results in bio-modifying factors cannot work optimally. Integrated pest control deliberately utilizes and strengthens the role of natural enemies that guarantee the control of pest population explosions. Management of overlapping planting times throughout the year will lead to the availability of food for pests throughout the year. Such a situation will accelerate the growth and development of pest populations. (Arifianto, Koesmaryono, and Impron 2016) (Saputra, Wirianata, and Crystallization 2018)

The influence of climate and humidity can support the growth and development of pest populations. In an environment with optimum temperature, the speed of insect metabolic processes is directly proportional to the increase in ambient temperature. The faster metabolic process causes the time needed to complete its development is shorter and the pest population is growing faster. Each field has an ecosystem with its own characteristics, so every farmer needs to have the skills to monitor the development of pest populations and the environment and take appropriate, practical and beneficial pest control measures. (Manengkey et al. 2011)



With some of the environmentally friendly pest control models above, pest control against all types of plant diseases, including spots or rust on leaves on plants and fruits, will be resolved in the long term without side effects or damage to plants and the environment.

## CONCLUSION

The results showed that brown rust disease on duku leaves is a disease caused by the fungus *Hemileia vastatrix*. *Hemileia vastatrix* is an obligate parasite without other components that reproduces using light spores so it is very easily carried by the wind. The spread of this fungus is very fast through spores either with the help of wind or rain splashes, so that when one of the plants is attacked, the surrounding plants will easily be infected by this fungus.

Another cause of brown rust disease on duku leaves is caused by fungi, bacteria and viruses. The most commonly encountered diseases are those caused by fungi. Leaf rust disease occupies the first level of various diseases caused by fungi.

Environmentally friendly pest control for the control of brown rust disease on duku fruit leaves include;

1. Organic Pesticides
2. Vegetable pesticides
3. Integrated pest control
4. Regular land use.

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