



Original Article

Initial Diagnostic of Fungal Pathogens in Coconut Plantation Plot Area in Bukit Kor, Terengganu, Malaysia

Reza Ramadhan ¹, Efrida Lubis ^{1,*} and Siti Nordahliawate Mohammed Sidique ²

¹ Department of Agricultural Product Technology, Faculty of Agriculture, Universitas Muhammadiyah Sumatera Utara, Medan Timur, 20238 Kota Medan, Sumatera Utara, Indonesia. (R.R.)

² Department of Science Agrotechnology, Faculty of Fisheries and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia. (S.N.M.S.)

* Correspondence: efridalubis@umsu.ac.id (E.L.)

Citations: Ramadhan, R., Lubis, E., & Sidique, S.N.M. (2024). Initial Diagnostic of Fungal Pathogens in Coconut Plantation Plot Area in Bukit Kor, Terengganu, Malaysia. *Global Journal of Emerging Science, Engineering & Technology*, 2(1), 29-35.

Received: 17 January 2024

Revised: 16 April 2024

Accepted: 2 May 2024

Published: 31 May 2024

Abstract: Plant diseases are the diseases that most often harm cultivated plants. This attack will cause plants to be attacked by disease pathogens, especially leaves, which can cause a decrease in the plant's capacity to carry out the photosynthesis process so that during photosynthesis. This study was conducted at the Laboratory of Pests, Diseases and Microbial Biotechnology (LAPDIM) Bukit Kor Faculty of Fisheries and Food Science, Universiti Malaysia Terengganu, in September 2023. the research was conducted using a descriptive method by taking samples of plant leaves indicated to be attacked by pathogens, looking at signs on plant leaves, and identifying them under a microscope. This study aims to determine the causes of diseases that attack the leaves of mango, coconut, and papaya plants found in coconut, mango, and papaya plantations in Bukit Kor. The results showed from the sample leaves of coconut, mango and papaya plants, namely Mango (*Mangifera indica*), Coconut (*Cocos nucifera* L.), and Papaya (*Carica Papaya* L.) are *Capnodium* sp, *Colletotrichum* sp, *Culvularia* sp, *Hemileia* sp, *Fusarium Oxysporum* sp, *Cladosporium* sp, and *Cladosporium* sp.

Keywords: Leaf diseases; Coconut plantation; Fungal pathogens; Symptoms; Bukit Kor.



Copyright: © 2023-2024 by the authors. Submitted for possible open-access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Plant diseases are the diseases that most often harm cultivated plants. Similar plants have the same diseases, so they have the same names, for example, leaf rust. This attack will cause plants to be attacked by disease pathogens, especially leaves, which can cause a decrease in the plant's capacity to carry out the photosynthesis process so that during photosynthesis, there is a decrease of 20% -40% or even greater so that leaf rust makes farmers' efforts inefficient and even experience losses (Sutarman, 2017). Diseases on plant leaves are caused by various pathogens such as fungi, bacteria, viruses and nematodes. Anthracnose is a major disease of mango plants caused by the fungus *Colletotrichum gloeosporioides*, transmitted from the soil. This fungus can survive in seeds or plant remains that have fallen to the ground. In moderate temperatures (between 18-28°C), very high humidity (97% or more) and low pH (5.8 to 6.5) will cause the

fungus *Colletotrichum gloeosporioides* to spread to green fruit that is not yet ripe and is still in good condition, on plants through wind and raindrops. However, on the other hand, in dry weather, high solar radiation or extreme temperatures can inhibit its growth. Anthracnose disease can attack mango twigs, leaves, flowers and fruit. Usually, it attacks during flowering and fruiting. Anthracnose attacks can reduce the quantity and quality of fruit (Suryadi et al., 2020).

Pathogenic fungi from the genera *Culvularia*, *Alternaria*, *Helminthosporium*, *Cercospora*, and others are mainly caused by diseases grouped into leaf spots. The initial symptoms of leaf spot disease caused by *Culvularia* sp. In the form of yellow spots that infect the canopy and leaf blades, which over time become dry, brown-grey spots so that they shrivel and die (Parinthawong et al., 2010). Leaf rust disease caused by *Hemileia vastatrix* is a disease that often attacks coffee plants. *Hemileia vastatrix* is an obligate parasite, meaning the fungus cannot live in abiotic tissues. It causes the transmission of leaf rust disease to only infect plants around the disease host. Almost 20 -70% of losses are caused by loss of production due to leaf rust disease (Mahfud, 2012). The leaf rust disease in Indonesia has been around for more than a century and has significantly impacted reducing production yields. Still, until now, no practical way has been found to control it. Apart from being caused by climatic factors and cultivation methods, the presence of the *H. vastatrix* race is also thought to be one of the factors that caused a crisis in plantations in Colombia and Central America between 2008 and 2013 (Avelino et al., 2015).

The *Curvularia* fungus, which in its teleomorph form is *Cochliobolus* sp., is a pathogen for various plants in tropical and subtropical areas. *Curvularia*, consisting of nine species, can infect multiple plants (Watanabe, 2002). *Curvularia* has a wide host range and can be found in multiple parts of the world. This fungus also plays a role in causing disease in humans, namely keratitis (endophthalmitis) in the eyes after trauma to the eye (Alex et al., 2013). *Curvularia* is commonly found on coconut seedlings. The *curvularia* that attack asparagus are *Curvularia lunata* (85%), *C. pallescens* (32%), *C. eragrostidis* (18%), and *C. barchyspora* (11.5%) (Salleh et al. 1996). Many efforts have been made to control pathogens using resistant plants and synthetic pesticides. However, plants resistant to plant pathogens are rarely available, while synthetic pesticides, if used unwisely, will cause many problems for the environment, plant products and human health (Soesanto et al., 2013). Biological control agents are a promising option for controlling plant pathogens because they are cheap, easy to obtain, and safe for the environment. *Trichoderma* sp. is a species of antagonistic fungus commonly found in soil, especially in organic soil and is often used in biological control, both against soil-borne or rhizosphere pathogens and phyllosphere pathogens. The broad host range of plant pathogens is also one of the considerations why this fungus is widely used (Soesanto et al., 2013).

2. Materials and Methods

The observation sampling location was in a coconut, mango and papaya plantation area. It was carried out in Bukit Kor, Marang, Terengganu, Malaysia, at 35 meters above sea level at the Laboratory of Pests, Diseases and Microbial Biotechnology (LAPDIM), Faculty of Fisheries and Food Sciences, Universiti Malaysia Terengganu, in September 2023. The tools used in this research were a microscope, dropper pipette, slide sticker, microscope slide, tube rod, and writing tools. The materials used in this research were leaves that showed signs or symptoms on mango, coconut, and papaya plants, sterile tissue and sterile water. Samples of infected plant leaves were attached with slide stickers to leaf objects that had symptoms after they felt sticky. The stickers were to microscope slides, dripped sterile water using a loop stick, then observed with a microscope camera and followed the progress. The results of this study show that three types of leaf samples show disease symptoms on the leaves of mango plants (*Mangifera indica*), symptoms of sooty dew (*Capnodium* sp.) and anthracnose (*Colletotrichum* sp.) on the leaves of coconut plants (*Cocos nucifera* L.) disease symptoms. Brown spots (*Culvularia* sp.) and leaf rust (*Hemileia* sp.) and on the leaves of papaya plants (*Carica Papaya* L.) symptoms of fusarium wilt (*Oxysporum* sp.) and leaf curl (*Cladosporium* sp.).

3. Results

Table 1 indicates six plant leaf samples, each with two leaf samples attacked by disease, including mango, coconut and papaya plants. Where the six-leaf samples were attacked by plant leaf disease. In the sample, one mango leaf was affected by symptoms of sooty dew caused by the fungus *Capnodium* sp. Then, the fungus organism *Colletotrichum* sp. was found in the samples of two mango leaves. One sample of coconut leaves was affected by symptoms of leaf spot disease on the leaves caused by the fungus *Culvularia* sp. Then, the fungal organism *Hemileia* sp. was found in the samples of two coconut leaves. One sample of papaya leaves was affected by symptoms of fusarium wilt disease caused by the fungus *Fusarium Oxysporum* sp. The fungus organism *Cladosporium* sp. was in a sample of two papaya leaves.

Table 1. Observation of Diseases and Organisms in Several Plants

| No. | Plants | Syntific | Disease | Causative organism |
|-----|---------|--------------------------|---------------|-------------------------------|
| 1 | Mango | <i>Mangifera indica</i> | Sooty dew | <i>Capnodium sp.</i> |
| 2 | Mango | <i>Mangifera indica</i> | Anthracnose | <i>Colletotrichum sp.</i> |
| 3 | Coconut | <i>Cocos nucifera</i> L. | Brown spots | <i>Culvularia sp.</i> |
| 4 | Coconut | <i>Cocos nucifera</i> L. | Leaf rust | <i>Hemileia sp.</i> |
| 5 | Papaya | <i>Carica Papaya</i> L. | Fusarium wilt | <i>Fusarium Oxysporum sp.</i> |
| 6 | Papaya | <i>Carica Papaya</i> L. | Leaf curl | <i>Cladosporium sp.</i> |

This study aims to identify plant diseases caused by pathogenic fungi. Identification of the causes of disease in plants is essential to obtain basic information regarding the pathogen, especially information on the species of the pathogen. This is needed for proper disease control and to increase plant productivity. Figure 1 displays that a fungus was identified microscopically at 40 times magnification, namely *Capnodium sp.* This fungus attacks the entire surface of the leaves of mango plants, causing sooty mildew disease. Symptoms of fungal attacks (*Capnodium sp.*) on the surface of the leaves are a black layer that covers the entire surface of the leaves. This aligns with the statement by Fiani & Hadiyan (2017) that sooty dew disease is in the form of a thin black layer on the surface of the leaves, but the leaf tissue underneath remains green. The black layer is fungal mycelia, which expands and is easily peeled off by the wind. The fungus *Capnodium sp.* and *Meliola sp.* cause sooty mildew disease. Sooty dew is a fungal layer that only covers the surface of the leaves and is not a parasite, but it is still detrimental because it inhibits metabolism, especially photosynthesis.

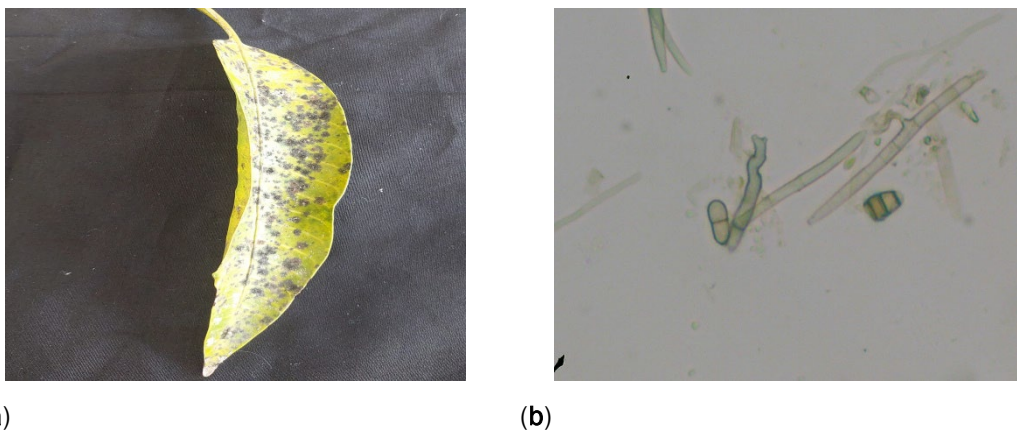


Figure 1. Mango leaves infected with sooty mildew caused by *Capnodium sp.* (a) typical sooty mildew with a black coating covering the entire leaf surface and (b) *Capnodium sp.* with (40X) Magnification.

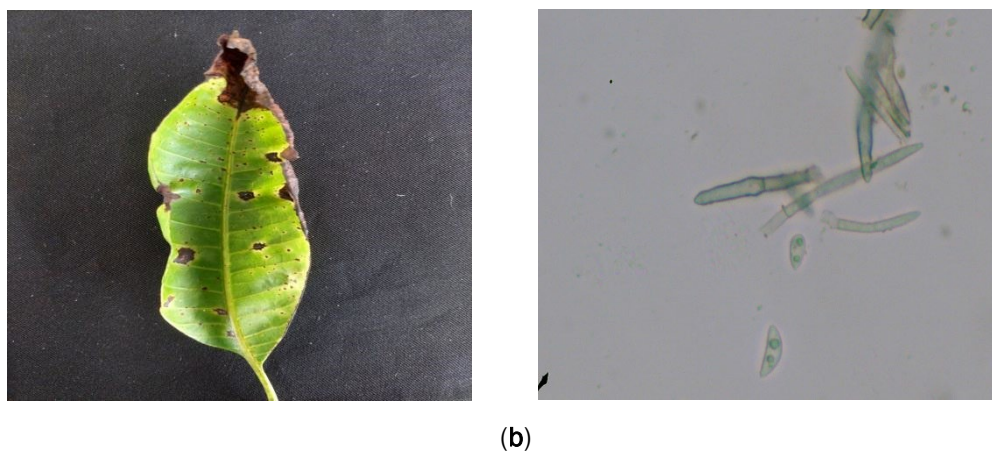


Figure 2. Mangoes infected with anthracnose caused by *Colletotrichum sp.* (a) Anthracnose with dry leaf tips and blackish brown spots in the middle of the leaves, (b) *Colletotrichum sp.* with (40X) Magnification.

According to Tarigan (2016), a layer of sooty dew will inhibit photosynthesis, disrupting plant growth and resulting in yellowing, wilting, and falling leaves. According to Costes et al. (2013), the disease attacks the surface and branches. A thin layer of black colour is on the leaves and twigs' surface. The black layer is

a fungus that gets food from the honey liquid released by pests such as mango leafhoppers, scale bugs, and mealybugs. Sooty dew usually strikes during the rainy season. Figure 2 captures a fungus identified microscopically at 40 times magnification, namely the fungus *Colletotrichum* sp. Mango leaves infected with anthracnose are caused by the fungus *Colletotrichum* sp. Symptoms of attack occur when the tips of the leaves dry out, and there are also blackish-brown spots in the middle of the leaves. This is reinforced by Alemu et al. (2014), who state that dark brown, concave and round-shaped spots on the surface of the skin characterize the symptoms of anthracnose attacks post-harvest. The spots will spread further and enter the fruit's flesh if the attack level becomes more severe (Mahneli, 2007). The fungus *Colletotrichum gloeosporioides* can attack unripe mangoes on the tree, and then the disease develops during storage. The germinated spores form an appressorium and do not develop until the fruit is harvested and ripe.

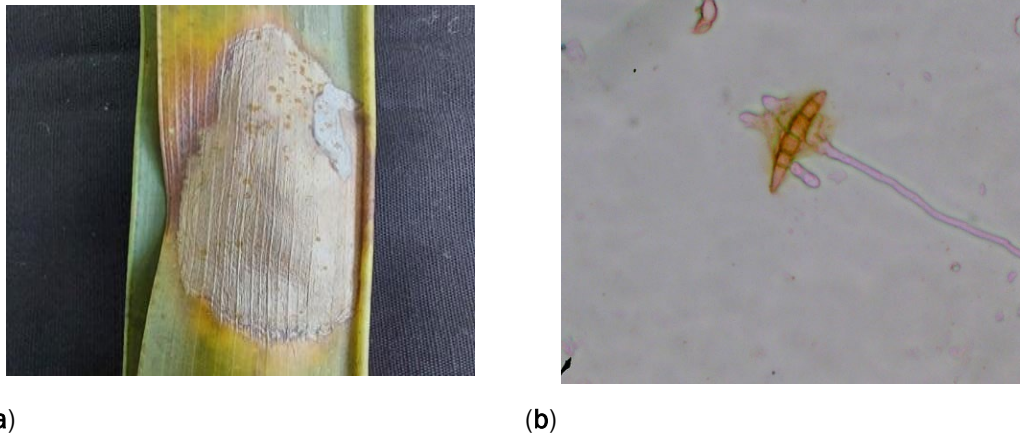


Figure 3. Coconut leaves infected with leaf spots caused by *Culvularia* sp. (a) Symptoms of leaf spots show the presence of brown spots with yellowish edges on the surface of the affected leaves and (b) *Culvularia* sp. with (40X) Magnification.

Figure 3 describes a fungus identified microscopically at 40 times magnification, namely the fungus *Culvularia* sp. Coconut leaves infected with leaf spot disease caused by the fungus *Culvularia* sp. result in symptoms of leaf spot attack, which shows the presence of brown spots with yellowish edges on the surface of the affected leaves. This aligns with the statement of Semangun (2007), namely that the initial symptoms of leaf spot disease are characterized by the appearance of yellow spots (symptoms of chlorosis), which over time turn grey-brown or yellowish, the spots become dry, fade and finally, the tissue dies. Leaf spot disease spreads either through fungus spores carried by the wind or splashed with rainwater and spray water and even carried by insects. According to Agrios (1996), pathogen interference with the photosynthesis process is seen from the chlorosis in infected plants and necrotic wounds produced by pathogens on green plant parts and from the reduced growth and number of fruits produced in infected plants. According to Kittimorak et al. (2013), the level of damage due to leaf spot disease can reach more than 50%, even if left unchecked, which can cause plant death.

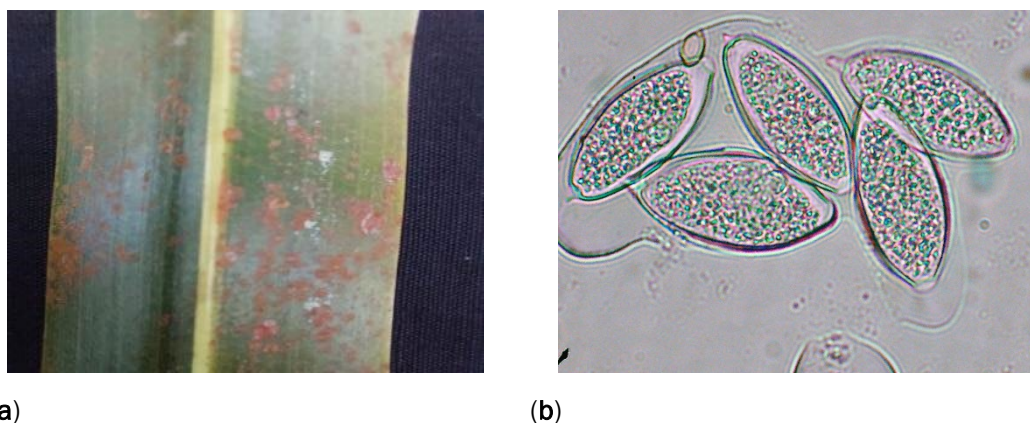


Figure 4 captures a fungus identified microscopically at 40 times magnification, namely *Hemileia* sp. Coconut leaves infected with leaf rust disease caused by the fungus *Hemileia* sp. cause symptoms of attack, namely leaf rust, resulting in small brownish spots on the surface of the leaves. It is reinforced by the

statement of Agrios (2007), who states that symptoms of leaf rust disease can be seen on the upper and lower surfaces of the leaves, marked by yellow-orange spots like powder. According to Harni et al. (2015), If you observe the underside of the leaves, you will see spots that are initially light yellow, then will change to dark yellow; on this part, you will see a powdery orange or orange colour. The orange or orange-coloured flour is the uredospores of the fungus *Hemileia vastatrix*. Further symptoms include brown spots on the leaves that join together, become larger, then dry out and fall so the plant becomes bald.

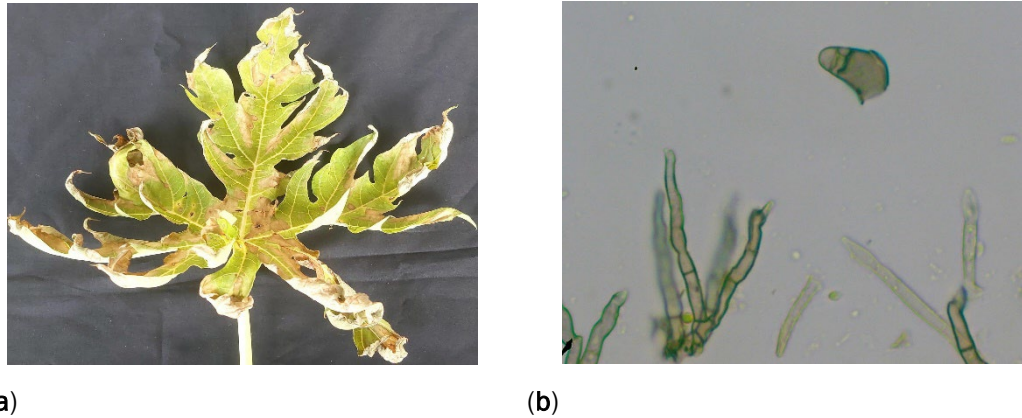


Figure 5. Papaya infected with Fusarium Wilt disease caused by *Fusarium Oxysporum* sp. (a) Typical fusarium wilt with the lower leaves turning yellow and drying out over time and (b) *Fusarium oxysporum* sp. with (40X) magnification.

Figure 5 indicates that a fungus was found that was identified microscopically at 40 times magnification; namely, *Fusarium oxysporum* sp. papaya leaves infected with fusarium wilt disease caused by *Fusarium oxysporum* sp., which causes symptoms of fusarium wilt attacks with the bottom of the leaves turning yellow and over time they wilt and dry out. It aligns with (Miller et al., 1986), namely that the symptoms produced are wilting and are first visible on the lower leaves. Wilting continues until all the leaves wilt and eventually die (Ambar, 2002). Sometimes, senescence is preceded by yellowing the leaves, stunted plants, and stunted growth. If the stems of diseased plants are split vertically, brown bundles will appear along the xylem network. According to Semangun (2001), the initial symptom of Fusarium wilt disease is pale leaf veins, especially the top leaves. It is followed by the rolling of the older leaves (epinasty) due to the drooping of the leaf stalks, and finally, the whole plant wilts. In very young plants, the disease can cause the plant to die suddenly because damage occurs at the base of the stem. Meanwhile, infected adult plants can often survive and form fruit, but the results are very few.

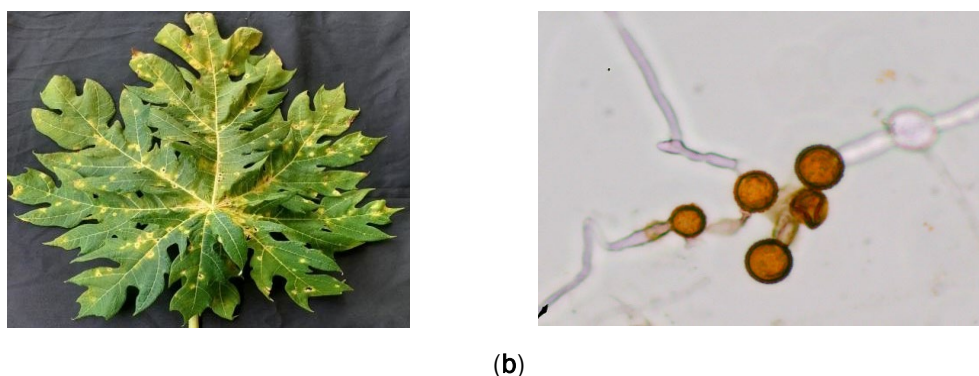


Figure 6. Papaya infected with leaf curl disease caused by *Cladosporium* sp. (a) Typical leaf curl with curled chlorotic yellow spots all over the leaf surface; (b) *Cladosporium* sp. with (40X) magnification.

Figure 6 shows that a fungus was found that was identified microscopically at 40 times magnification; namely, *Cladosporium* sp. papaya leaves infected with leaf curl disease caused by *Cladosporium* sp. with symptoms caused by leaf curl disease in the form of yellow chlorotic spots that curl all over the surface of the leaves. This is reinforced by Chen et al. (2009), namely that the symptoms of curly disease in papaya begin with the formation of small yellow spots on the leaves, followed by necrosis in the centre of the spots. The necrotic part will fall off, and holes will form. Symptoms of the disease are mainly visible on papaya leaves, but this disease can potentially result in yield loss. Heavy attacks on young leaves cause newly

formed leaves not to develop properly, so the photosynthesis process does not run optimally, and fruit is not produced optimally. According to Widodo & Wiyono (2012), Symptoms of this disease attack are mainly visible on young leaves in the form of yellow spots, which then undergo necrosis, resulting in holes in the leaves. If the attack is heavy, the young leaves will curl, and the plant canopy will not develop completely.

4. Conclusions

This study concludes that the fungal pathogen *Capnodium* sp. causes symptoms of sooty dew disease, and *anthracnose* disease is caused by the fungal pathogen *Colletotrichum* sp. Coconut plants are attacked by symptoms of leaf spot disease caused by the fungal pathogen *Cercospora* sp. and leaf rust disease caused by the fungal pathogen *Hemileia* sp. Papaya plants are attacked by symptoms of fusarium wilt disease caused by the fungal pathogen *Fusarium oxysporum* sp. and leaf curl disease caused by *Cladosporium* sp.

Author Contributions: Conceptualization, R.R., E.L. and S.N.M.S.; methodology, R.R.; software, R.R.; validation, E.L. and S.N.M.S., Y.Y. and Z.Z.; formal analysis, R.R.; investigation, R.R., E.L. and S.N.M.S.; resources, R.R.; data curation, E.L. and S.N.M.S.; writing—original draft preparation, R.R. and E.L.; writing—review and editing, R.R., E.L. and S.N.M.S.; visualization, R.R.; supervision, E.L. and S.N.M.S.; project administration, E.L.; funding acquisition, E.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to thank Universitas Muhammadiyah Sumatera Utara, Indonesia for supporting this research and publication. We would also like to thank the reviewers for their constructive comments and suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

References

- Agrios, G. (2007). *Plant Pathology*. Elsevier Academic Press.
- Agrios, G. N. (1996). *Ilmu penyakit tumbuhan [Science of plant diseases]*. Gadjah Mada University Press.
- Alemu, K., Ayalew, A., & Weldetsadik, K. (2014). Evaluation of Antifungal Activity of Botanicals for Postharvest Management of Mango Anthracnose (*Colletotrichum gloeosporioides*). *International Journal of Life Sciences*, 8(1), 1–6. <https://doi.org/10.3126/ijls.v8i1.9957>
- Alex, D., Li, D., Calderone, R., & Peters, S. M. (2013). Identification of *Curvularia lunata* by polymerase chain reaction in a case of fungal endophthalmitis. *Medical Mycology Case Reports*, 2(1), 137–140. <https://doi.org/10.1016/j.mmcr.2013.07.001>
- Ambar, A. A. (2002). *Karakterisasi Fusarium oxysporum penyebab penyakit layu pada tomat [Characterization of Fusarium oxysporum which causes wilt disease in tomatoes]*. Universitas Gadjah Mada.
- Avelino, J., Cristancho, M., Georgiou, S., Imbach, P., Aguilar, L., Bornemann, G., Läderach, P., Anzueto, F., Hruska, A. J., & Morales, C. (2015). The coffee rust crises in Colombia and Central America (2008–2013): impacts, plausible causes and proposed solutions. *Food Security*, 7(2), 303–321. <https://doi.org/10.1007/s12571-015-0446-9>
- Chen, R.-S., Wang, W.-L., Li, J.-C., Wang, Y.-Y., & Tsay, J.-G. (2009). First Report of Papaya Scab Caused by *Cladosporium cladosporioides* in Taiwan. *Plant Disease*, 93(4), 426–426. <https://doi.org/10.1094/PDIS-93-4-0426C>
- Costes, E., Lauri, P.-E., Simon, S., & Andrieu, B. (2013). Plant architecture, its diversity and manipulation in agronomic conditions, in relation with pest and pathogen attacks. *European Journal of Plant Pathology*, 135(3), 455–470.
- Fiani, A., & Hadiyan, Y. (2017). Respon Populasi Asal Cendana (*Santalum album* L) Terhadap Serangan Embun Jelaga [Population Response of Sandalwood Origin (*Santalum album* L) to Sooty Dew Attack]. *Proceeding Biology Education Conference: Biology, Science, Environmental, and Learning*, 14(1), 106–108.
- Harni, R., Taufiq, E., & Martono, B. (2015). Ketahanan pohon induk kopi liberika terhadap penyakit karat daun (*Hemileia vastatrix* B. et Br.) di Kepulauan Meranti [Resistance of Liberica coffee mother trees to leaf rust

- disease (*Hemileia vastatrix* B. et Br.) in the Meranti Islands]. *Jurnal Tanaman Industri Dan Penyegar*, 2(1), 35–42. <https://doi.org/10.21082/jtidp.v2n1.2015.p35-42>
- Kittimorak, J., Pornsuriya, C., Sunpapao, A., & Petcharat, V. (2013). Survey and Incidence of Leaf Blight and Leaf Spot Diseases of Oil Palm Seedlings in Southern Thailand. *Plant Pathology Journal*, 12(3), 149–153. <https://doi.org/10.3923/ppj.2013.149.153>
- Mahfud, M. C. (2012). Teknologi dan strategi pengendalian penyakit karat daun untuk meningkatkan produksi kopi nasional [Technology and strategies for controlling leaf rust disease to increase national coffee production]. *Pengembangan Inovasi Pertanian*, 5(1), 44–57.
- Mahneli, R. (2007). *Pengaruh Pupuk Organik Cair dan Agensia Hayati terhadap Pencegahan Penyakit Antraknosa (Colletotrichum gloeosporioides (Penz.) Sacc.) pada Pembibitan Tanaman Kakao (Theobroma cacao L.)* [The Effect of Liquid Organic Fertilizer and Biological Agents on the . Universitas Sumatera Utara.
- Miller, S. A., Rowe, R. C., & Riedel, R. M. (1986). Fusarium and Verticillium wilts of tomato, potato, pepper, and eggplant. In *Extention Factsheet. Hyg-3122-96*. (Vol. 3, pp. 1–4). The Ohio State University.
- Parinthawong, N., Tansian, P., & Youngnit, C. (2010). Effects of three plant crude extracts on fungal spore germination and hyphal growth of *Curvularia* sp. *Asian Agricultural Symposium and International Symposium on Agricultural Technology. Faculty of Agricultural Technology. King Mongkut's Institute of Technology Ladkrabang. Thailand*.
- Semangun, H. (2001). *Pengantar ilmu penyakit tumbuhan [Introduction to plant disease]*. Gajah Mada University.
- Semangun, H. (2007). *Penyakit-Penyakit Tanaman Hortikultura di Indonesia [Horticultural Plant Diseases in Indonesia]*. Penerbit Universitas Gajah Mada.
- Soesanto, L., Mugiastuti, E., Rahayuniati, R. F., & Dewi, R. S. (2013). Uji kesesuaian empat isolat *Trichoderma* spp. dan daya hambat in vitro terhadap beberapa patogen tanaman [Suitability test of four isolates of *Trichoderma* spp. and in vitro inhibition of several plant pathogens]. *Jurnal Hama Dan Penyakit Tumbuhan Tropika*, 13(2), 117–123.
- Suryadi, Y., Susilowati, D. N., & Samudra, I. M. (2020). Pengaruh Rasio Kitosan-Sodium Tripolifosfat Terhadap Pengendalian Antraknosa (*Colletotrichum gloeosporioides*) Pada Mangga Kultivar Manalagi [Effect of Chitosan-Sodium Tripolyphosphate Ratio on Control of Anthracnose (*Colletotrichum gloeosporioides*) on Man. *Jurnal Penelitian Sains*, 22(3), 144–152. <https://doi.org/10.56064/jps.v22i3.581>
- Sutarman, S. (2017). *Dasar-Dasar Ilmu Penyakit Tanaman [Introductory of Plant Disease Science]*. Umsida Press.
- Tarigan, E. B. R. (2016). *Fenomena Embun Jelaga Pada Tanaman Kopi [Sooty Dew Phenomenon on Coffee Plants]*. Balittri.
- Watanabe, T. (2002). *Pictorial atlas of soil and seed fungi: Morphologies of cultured fungi and key to species*. CRC Press. <https://doi.org/10.1201/9781420040821>
- Widodo, W., & Wiyono, S. (2012). Penyakit Keriting Daun Pepaya yang Disebabkan oleh *Cladosporium cladosporioides* [Papaya Leaf Curl Disease Caused by *Cladosporium cladosporioides*]. *Jurnal Fitopatologi Indonesia*, 8(1), 28–29. <https://doi.org/10.14692/jfi.8.1.28>