

MORPHOLOGICAL CHARACTERIZATION AND PATHOGENICITY OF *Colletotrichum* sp. AND *Lasiodiplodia* sp. FROM ANTHRACNOSE AND BLIGHT INFECTED LONGAN LEAVES FROM MERANGINJuanita Hibatullah^{1*} and Mutia Safitri²¹Biology, Faculty of Science and Technology, Universitas Merangin, Merangin.²Chemical Engineering, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta.*Email: juanitahibatullah13@gmail.com**Abstract**

Longan is an economically important fruit crop widely cultivated in Indonesia, particularly in Merangin Regency, Jambi Province. However, longan production is frequently constrained by foliar diseases, notably anthracnose and blight, which significantly reduce both yield and fruit quality. This study aimed to isolate and identify the fungal pathogens associated with anthracnose and blight symptoms on longan leaves collected from Pulau Rengas, West Merangin. Symptomatic leaf samples were subjected to fungal isolation, followed by macroscopic and microscopic characterization. Pathogenicity assays were conducted in vitro to confirm the disease-causing potential of the isolates. Two distinct fungal species were identified: *Colletotrichum* sp., exhibiting gray, cottony colonies with septate hyphae and cylindrical conidia, and *Lasiodiplodia* sp., characterized by dark gray to black, fluffy colonies and ellipsoid to obovoid conidia. In vitro, inoculation of healthy longan leaves with these isolates resulted in the development of characteristic lesions: brownish-gray spots for *Colletotrichum* sp. and dark necrotic lesions for *Lasiodiplodia* sp., confirming their pathogenicity. These findings are consistent with previous reports implicating these genera as causal agents of anthracnose and blight in longan and other tropical crops. This study represents the first report of *Lasiodiplodia* sp. associated with blight spot disease in longan leaves.

Keywords: Anthracnose; Blight Spot; *Colletotrichum*; *Lasiodiplodia*; Longan**Abstrak**

Longan merupakan tanaman buah penting secara ekonomi yang banyak dibudidayakan di Indonesia, khususnya di Kabupaten Merangin, Provinsi Jambi. Namun, produksi longan seringkali terhambat oleh penyakit daun, terutama antraknosa dan hawar, yang secara signifikan mengurangi hasil panen dan kualitas buah. Penelitian ini bertujuan untuk mengisolasi dan mengidentifikasi patogen jamur yang terkait dengan gejala antraknosa dan hawar pada daun longan yang dikumpulkan dari Pulau Rengas, Merangin Barat. Sampel daun yang menunjukkan gejala diisolasi dari jamur, kemudian dikarakterisasi secara makroskopis dan mikroskopis. Uji patogenitas dilakukan secara in vitro untuk mengkonfirmasi potensi penyebab penyakit dari isolat tersebut. Dua spesies jamur yang berbeda diidentifikasi: *Colletotrichum* sp., yang menunjukkan koloni berwarna abu-abu seperti kapas dengan hifa bersepta dan konidia silindris, dan *Lasiodiplodia* sp., yang dicirikan oleh koloni berbulu berwarna abu-abu gelap hingga hitam dan konidia elips hingga obovoid. Secara in vitro, inokulasi daun longan yang sehat dengan isolat ini menghasilkan perkembangan lesi karakteristik: bintik-bintik abu-abu kecoklatan untuk *Colletotrichum* sp. dan lesi nekrotik gelap untuk *Lasiodiplodia* sp., yang mengkonfirmasi patogenitasnya. Temuan ini konsisten dengan laporan sebelumnya yang mengaitkan genus ini sebagai penyebab antraknosa dan hawar pada longan dan tanaman tropis lainnya. Studi ini merupakan laporan pertama tentang *Lasiodiplodia* sp. yang terkait dengan penyakit bercak hawar pada daun longan.

Kata Kunci: Antraknosa; Bercak Hawar; *Colletotrichum*; *Lasiodiplodia*; Longan

INTRODUCTION

Longan is a fruit commodity known for its high qualities and economic value. Its sweet taste, distinctive aroma, and richness in vitamins and fiber make it highly popular. Several longan varieties introduced from Thailand and Vietnam have been developed in Indonesia (Direktorat Hortikultura, 2021). According to the Merangin Regency Government (2023), Merangin Regency, located in Jambi Province, is known for its extensive longan cultivation, especially in Pulau Rengas Village, West Bangko District. Longan farming contributes to improving the economic well-being of local farming communities, promotes agricultural development, and serves as a catalyst for local tourism.

Despite the numerous benefits associated with longan cultivation, the plants face significant challenges from diseases, primarily caused by pathogenic microorganisms, particularly fungi. According to Huyen *et al.* (2021), anthracnose and blight spot are the most prevalent diseases affecting longan, predominantly targeting the fruits and leaves, compromising its quality. The symptoms of anthracnose include the development of sunken lesions with blackened spots on flowers and immature fruits, resulting in discoloration. Additionally, blight spot disease begins with the appearance of small dots on the leaf surface, which gradually expand and merge to form larger affected areas. (Serrato-Diaz *et al.*, 2020). This disease is primarily caused by fungal pathogens that proliferate rapidly under conditions of high humidity, especially during the rainy season.

The elevation of Pulau Rengas is approximately 96 meters above sea level and receives annual rainfall of 2,200 to 3,600 mm, which is relatively high precipitation (Merangin Regency Government, 2023). Rainfall increases caused humidity levels to increase, creating a conducive environment for fungi to disseminate pathogenic spores on longan plants. For managing diseases affecting longan, farmers commonly use two strategies, which are physical and chemical. Physical management involves the removal of infected branches and subsequently burning them to prevent the spread of contamination. Chemical treatment of anthracnose often utilizes fungicides with active ingredients such as propineb. Moreover, Bordeaux is also widely applied as a preventive and curative agent against longan diseases. According to Ahmad Dhiyaul Dhaifulloh *et al.* (2024), the chemical fungicides have significant environmental risks. A concern is the runoff of these chemicals, which can lead to contamination of adjacent ecosystems and water bodies. One major concern is pesticide runoff, which can contaminate surrounding ecosystems. For example, mercury residues in pesticides can generate heavy metal waste that may accumulate in plants and subsequently be carried into the environment through agricultural runoff. Biological control methods are proposed as the best solution for managing longan diseases, more specifically. This involves identifying the fungal pathogens, followed by conducting *in vivo* and plant tests.

Previous studies have identified the fungal species responsible for anthracnose and blight spot in Vietnam and Thailand based on rDNA sequences as *Colletotrichum capsica* and *Lasiodiplodia chonburiensis*. The microscopic character was septate hyphae and cylindrical, colorless conidia with crescent-shaped tips characterize this fungus. Anthracnose disease affects various plants, including longan, chili peppers, papaya, coffee, mango, and strawberries, and is caused by different species within the *Colletotrichum* genus (Huyen *et al.*, 2021; Phoulivong, 2012). However, there have been no reports in Merangin regarding the specific isolates infecting longan plants affected by anthracnose and leaf blight. Therefore, preliminary research is essential to identify the fungal species involved, which will enable the development of targeted and effective disease management using biological strategies.

The objective of this study is to identify fungal strains responsible for anthracnose and blight spots on longan leaves in Merangin, which represents a critical initial step for selecting effective biocontrol agents. The isolation process involves collecting samples from plants exhibiting symptoms of anthracnose and leaf blight in longan, isolating the fungal pathogens, and identifying the fungi based on morphological characteristics, which include both macroscopic observations of colony features and microscopic examination of fungal structures.

METHODS

This study presents an exploration of fungal isolates obtained from a longan plantation in Pulau Rengas, West Merangin. The isolates were cultured and subjected to pathogenicity assays at the Biology Laboratory of Universitas Merangin. Comprehensive observations encompassed the macroscopic and microscopic characterization of fungal cultures, as well as pathogenicity tests conducted on leaf samples. The data were analyzed descriptively using a qualitative approach.

Sampling Collection

Samples were collected from a longan farm in Pulau Rengas, Merangin, at coordinates -2.11611 °S and 102.21639 °E. The sampling occurred in January 2025 and the sampling site location showed in Figure 1. Pulau Rengas is situated at an elevation of approximately 96 meters above sea level. The area has an annual rainfall ranging from 2200 mm to 3600 mm and has an average temperature between 24 °C and 30 °C. The soil in this region is alluvial, known for its fertility and suitability for plantation crops. Leaves exhibiting anthracnose and blight symptoms were gathered into plastic sampling bags, and the collection was replicated three times. The samples were subsequently subjected to further analysis at the Biology Laboratory of Universitas Merangin.



Figure 1. Sampling Site Location at Pulau Rengas, Merangin Regency, Jambi Province, Indonesia

Fungi Isolation

Longan leaves with disease symptoms were initially rinsed with water to eliminate any surface soil and debris. Diseased tissue was then excised into small sections at the interface between infected and healthy areas using a sterile scalpel. These sections were surface sterilized by immersion in a 1% sodium hypochlorite solution for 3 minutes, followed by rinse in sterile distilled water for 1 minute. The sterilized leaf pieces were then placed onto the surface of Potato Dextrose Agar (PDA) in Petri dishes (Huyen *et al.*, 2021; Suksakol *et al.*, 2024). The dishes were inverted and incubated at 30 °C until fungal colonies appeared. Mycelia with differing morphologies were then aseptically transferred to fresh PDA plates and incubated for 5 days to obtain pure cultures (Hibatullah & Kasiamdari, 2024).

Morphology of Fungi

Morphological observations of fungal colonies were conducted by cultivating pure cultures on PDA to examine characteristics such as colony surface texture, radial lines, concentric rings, colony growth rate, colony surface color, reverse colony color, and colony margin. Microscopic observations were performed using a microscope. The microscopic examination employed the slide culture technique with Lactophenol Cotton Blue staining to observe fungal microscopic morphology, including hyphal type, conidia or spore type, conidiophore branching pattern, conidiophore wall structure, and phialide

characteristics, followed by detailed observation under the microscope (Gajera *et al.*, 2015). The characteristics of the obtained isolates were then compared using a fungal identification key.

In Vitro Fungal Infections

Leaves were initially rinsed with sterile distilled water, and both leaves axis were trimmed. The remaining leaf sections were sterilized by immersion in 70% ethanol for 30 seconds, followed by treatment with 0.4% sodium hypochlorite solution for 10 minutes. Subsequently, the leaves were thoroughly rinsed with sterile distilled water for 10 minutes to remove any residual disinfectants. Inoculation was performed by pricking multiple points on the leaf surface using a sterile needle. The wounded leaves were placed on the surface of petri dishes and inoculated with fungal spores. Infected leaves were incubated at 30 °C for five days to accelerate the hyphal growth and sporulation process of fungal pathogens (Huyen *et al.*, 2021 and Fu *et al.*, 2023).

RESULTS AND DISCUSSION

Results

The results presented describe the macroscopic and microscopic characteristics of fungi isolated from longan leaves exhibiting symptoms of anthracnose disease and leaf blight. The Healthy leaves of longan, anthracnose, and blight spot symptoms on longan leaves shown in Figure 2.

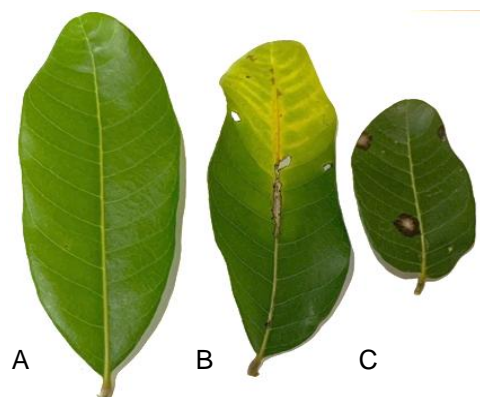


Figure 2. Comparative Morphological Analysis of *Dimocarpus longan* Leaves: (A) Healthy Leaf Tissue, (B) Leaf Exhibiting Anthracnose Symptoms, and (C) Leaf with Blight Spot Symptoms.

Fungal Isolation

Two fungal species were successfully isolated and purified from longan leaf samples, each exhibiting unique colony morphologies. These fungal isolates were labeled as P1 and P2. Identification was conducted through a detailed examination of both colony morphology and cellular characteristics. Isolate P1 produced colonies with a gray coloration and cottony mycelium. The colony reverse exhibited a central black pigmentation surrounded by gray (Figure 3A–B). Microscopic analysis revealed septate hyphae, round appressoria, and cylindrical conidia with rounded apices (Figure 3C). Based on these macroscopic and microscopic features, isolate P1 was identified as belonging to the *Colletotrichum* sp.

In contrast, isolated P2 formed dark gray to black colonies with a characteristic fluffy mycelium on the surface, while the reverse side of the culture displayed black pigmentation (Figure 3D–E). Microscopic observations of P2 showed hyaline and septate hyphae. The conidia were initially hyaline, aseptate, ellipsoid to obovoid in shape, unicellular, and exhibited a color progression from brown to sepia (Figure 3F). These morphological characteristics are the *Lasiodiplodia* sp.

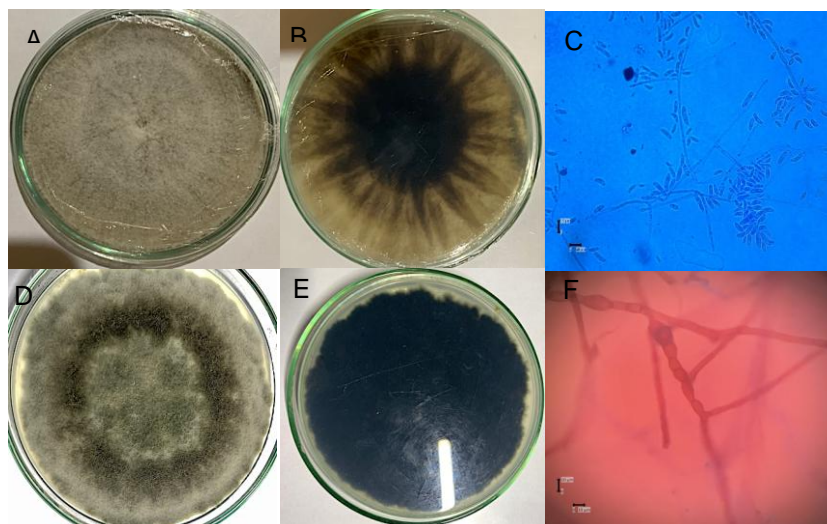


Figure 3. Macroscopic and Microscopic Morphology of Fungal Isolates Obtained from Longan Leaves Exhibiting Anthracnose Symptoms at Pulau Rengas, Merangin. Cultures Were Grown on PDA and Incubated for Seven Days. (A–B) The Colony Surface and Reverse Morphology of Isolate P1, (C) The Microscopic Morphology of Isolate P1 at 40× Magnification and Scale Bar 10 µm, (D–E) Surface and Reverse Colony Morphology of Isolate P2, and (F) The Morphology Under Microscope of Isolate P2 at 40× Magnification and Scale Bar 10 µm.

In Vitro Pathogenicity

The in vitro pathogenicity assay revealed mycelial growth on wounded longan leaves within two days of incubation. By day three, clear signs of tissue degradation were observed, indicating that longan leaves provide a favorable environment for the growth of both *Colletotrichum* sp. and *Lasiodiplodia* sp. The symptoms differed between the two fungi: leaves inoculated with *Colletotrichum* sp. developed brownish-gray lesions, whereas those inoculated with *Lasiodiplodia* sp. exhibited distinct dark black necrotic spots. In contrast, control leaves showed only minor discoloration confined to the sites of mechanical injury. The differences in symptom development among the control, *Colletotrichum* sp., and *Lasiodiplodia* sp. treatments are illustrated in Figure 4.

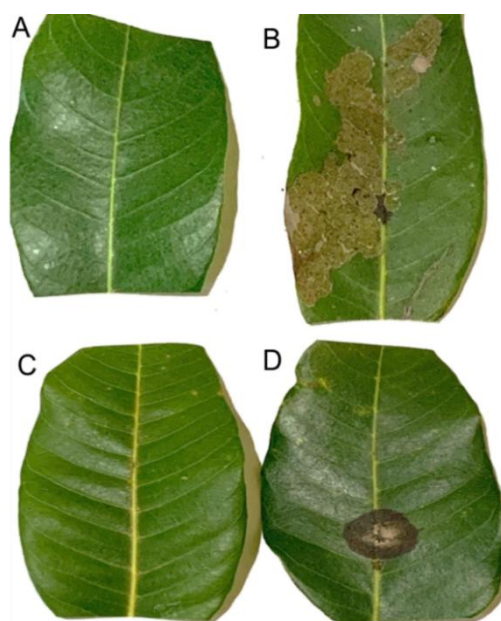


Figure 4. Morphological Features of *Dimocarpus Longan* Leaves Under Healthy and Fungal-Infected Conditions. (A) Healthy Leaf, (B) Leaf Showing Characteristic Anthracnose Lesions Five Days Post-Spore Inoculation of *Colletotrichum* sp., (C) Healthy Control Leaf, (D) Leaf Exhibiting Blight Spot Symptoms Five Days Following *Lasiodiplodia* sp. Inoculation.

DISCUSSIONS

Two fungal isolates were successfully identified, each exhibiting morphological and cultural characteristics consistent with those of the genera *Colletotrichum* and *Lasiodiplodia*. Identifications were supported by microscopic examination and colony morphology assessments. Notably, previous investigations have extensively documented members of *Colletotrichum* and *Lasiodiplodia* as primary phytopathogens responsible for the development of anthracnose and blight spot diseases, respectively. According to studies by Huyen *et al.* (2021) and Pornsuriya *et al.* (2023), the involvement of these genera in disease outbreaks affecting longan and coffee leaves, highlighting their significant impact on plant health and crop productivity.

Anthracnose symptoms are characterized by shoot necrosis, brown blight, and blistering, which cause chlorotic to light green lesions on foliar and fruit tissues. The genus *Colletotrichum* represents one of the most globally significant groups of phytopathogenic fungi, with profound implications for both agricultural productivity and ecosystem health. Members of this genus are predominantly implicated in the etiology of anthracnose disease across a diverse array of economically important crops. (Lu *et al.*, 2025).

Isolates P1 obtained from symptomatic longan from Pulau Rengas, West Merangin, displayed similar microscopic characteristics, including septate hyphae, round appressoria, and cylindrical conidia, which are typical morphological features of *Colletotrichum* Species. These observations support the identification of the isolates as members of the genus *Colletotrichum* and confirm their role in causing anthracnose disease in longan. In comparison to the *Colletotrichum* strain BKHCM reported by Huyen *et al.* (2021), the isolate in this study exhibited differences in colony morphology, notably in coloration, presenting white and black colonies, respectively. Nevertheless, their morphological traits closely resembled those of *Colletotrichum brevisporum*, a known pathogen causing anthracnose on coffee leaves in China with microscopic characteristics. Vegetative hyphae are hyaline to medium brown, typically smooth-walled, septate, and branched. Conidiophores arise either directly from the hyphae or from clusters of spherical, hyaline cells; they are septate and occasionally branched. Conidia are initially hyaline and may develop 1–2 septa as they mature. They are smooth-walled and vary in shape from ovoid to cylindrical or clavate, with rounded ends or one end rounded and the other acute (Lu *et al.*, 2025). Microscopic examination further confirmed that the isolates recovered from longan belong to the *Colletotrichum* genus. Moreover, *in vitro* pathogenicity assays revealed lesion development consistent with anthracnose symptoms, thereby validating the pathogenic potential of these isolates on longan leaves.

Furthermore, this research will be the first report that the fungi isolate caused blight spots in longan leaves identified as *Lasiodiplodia* sp. Based on previous reports, Genus *Lasiodiplodia* is commonly implicated in leaf spot diseases affecting various tropical crops, such as rambutan and rubber (Serrato-Diaz *et al.*, 2020). This pathogen is typically associated with the development of dark necrotic lesions that progress to leaf necrosis and defoliation. According to Pornsuriya *et al.* (2023), *Lasiodiplodia* is a confirmed causal agent of leaf spot disease in rubber trees, resulting in substantial leaf loss.

The isolate designated P2 exhibited phenotypic traits aligned with *Lasiodiplodia* sp., including the formation of dark gray to black colonies with a fluffy mycelial texture, as well as hyaline, septate hyphae and conidia that were ellipsoid to obovoid in shape, transitioning in color from hyaline to sepia. Based on Gnanesh *et al.* (2022), *Lasiodiplodia theobromae* is characterized by conidia that are initially hyaline and aseptate, exhibiting an ellipsoid to obovoid morphology. These unicellular conidia possess thick walls with fine longitudinal striations and display a coloration ranging from hyaline to sepia as they mature. With development, the conidia typically form one to two septa. These observations report the expanding host range of *Lasiodiplodia* and highlight the necessity for effective management strategies to mitigate its impact on longan cultivation.

In vitro, pathogenicity assays revealed the same in lesion development caused by the two fungal species identified. According to Azizi *et al.* (2018), fungal isolates recovered from oil palm (*Elaeis guineensis*) have been identified as *Colletotrichum* sp., *Curvularia* sp., and *Pestalotiopsis* sp., all of which are commonly associated with the occurrence of central leaf spot and anthracnose diseases. These fungi

are well-established as significant plant pathogens responsible for the development of leaf lesions, which subsequently impair photosynthetic capacity and result in decreased crop yields. This finding is aligned with the present study, which identified two fungal species, *Colletotrichum* sp. and *Lasiodiplodia* sp. Infection assays demonstrated that both pathogens induce symptoms, including leaf spots and anthracnose, confirming their association as causal agents of disease in longan plants.

The symptoms caused by *Lasiodiplodia* sp. on longan leaves in this study initially presented as blackish-brown necrotic spots, which progressively enlarged and ultimately led to premature leaf abscission. Microscopic examination revealed the presence of black fungal structures, comprising setae and conidia, localized at the center of the lesions. In contrast, pathogenicity assays involving *Colletotrichum* sp. inoculation resulted in the development of characteristic grey lesions on the longan leaves. According to the research Pornsuriya *et al.* (2023), pathogenicity tests demonstrated that *L. chonburiensis* and *L. theobromae* initiate infection and colonization in plant tissues through wounding. The wounding method appeared to be more effective in inoculating inoculum (mycelia or conidia) into plant tissues earlier compared to the non-wounding method. This may be attributed to the wounded tissue facilitating fungal mycelia penetration into the plant, leading to colonization and infection (Fukada *et al.*, 2019). Several fungal pathogens utilize appressoria to form penetration pegs on host plants to cause infection (Xia *et al.*, 2022). The healthy leaves can undergo rapid decay without displaying disease symptoms after five days. According to Huyen *et al.* (2021), leaves isolated from the parent tree in experimental conditions are more susceptible to decay, whereas leaves that remain attached benefit from the tree's immune responses, which effectively inhibit or delay the progression of infection and decay.

This study provides essential baseline data regarding the pathogenic fungi associated with longan leaves and provides concern for future research aimed at biological control strategies in Merangin. A limitation of this study is that fungal identification was based only on morphological features. While useful, morphology alone can be unreliable for accurately identifying species in genera like *Colletotrichum* and *Lasiodiplodia*, which look very similar across species. Therefore, molecular methods, such as DNA sequencing of specific regions (ITS, TEF1- α , TUB2), are necessary to confirm species identity accurately. Future research should combine molecular identification with morphological analysis to ensure precise diagnosis and support effective disease management.

CONCLUSION

This study successfully isolated and identified two species of fungal pathogens caused by anthracnose and leaf spots in longan, namely, *Colletotrichum* sp. and *Lasiodiplodia* sp. Based on detailed macroscopic and microscopic analyses. In vitro pathogenicity assays confirmed that both fungi are capable of infecting wounded longan leaves, with *Colletotrichum* sp. causing brownish-gray lesions and *Lasiodiplodia* sp. inducing dark black necrotic spots. In contrast, control leaves showed minor discoloration. This research represents the first report of *Lasiodiplodia* sp. as a fungi pathogen caused black leaf spot disease on longan, expanding its known host range and underscoring the need for vigilant monitoring and effective disease management strategies to protect longan crops from these emerging pathogens.

REFERENCES

- Dhaifulloh, A. D., Khayumi, B. I., Legawa, D. T., Ansya, M. K. A., & Radianto, D. O. (2024). Dampak penggunaan pestisida kimia terhadap kualitas tanah dan air sungai di daerah pertanian. *Venus: Jurnal Publikasi Rumpun Ilmu Teknik*, 2(2), 197–208.
- Azlan, A. M. N., Ahmad, Z. A. M., Idris, A. S., & Vadamalai, G. (2018). Assessment of leaf spot and anthracnose diseases in nurseries and its relationship with oil palm seedling ages. *IJAMR*, 5(1), 19–26.
- Direktorat Hortikultura. (2021). *Buku lapang budidaya lengkeng*. Direktorat Jendral Hortikultura Kementerian Pertanian.
- Fu, J., Wu, Y., Yan, X., Wang, L., Zhang, S., & Luo, Y. (2023). Isolation and identification of the endophytic fungus J2-3 and its disease-preventive and growth-promoting effects on cucumber. *Brazilian Journal of Microbiology*, 54(2), 1115–1125.

- Fukada, F., Kodama, S., Nishiuchi, T., Kajikawa, N., & Kubo, Y. (2019). Plant pathogenic fungi *Colletotrichum* and *Magnaporthe* share a common G 1 phase monitoring strategy for proper appressorium development. *New Phytologist*, 222(4), 1909–1923.
- Gajera, H. P., Bambharolia, R. P., Hirpara, D. G., Patel, S. V., & Golakiya, B. A. (2015). Molecular identification and characterization of novel *Hypocrea koningii* associated with azo dyes decolorization and biodegradation of textile dye effluents. *Process Safety and Environmental Protection*, 98, 406–416.
- Gnanesh, B. N., Arunakumar, G. S., Tejaswi, A., Supriya, M., Manojkumar, H. B., & Devi, S. S. (2022). Characterization and Pathogenicity of *Lasiodiplodia theobromae* Causing black root rot and identification of novel sources of resistance in mulberry collections. *Plant Pathology Journal*, 38(4), 272–286.
- Hibatullah, J., & Kasiamdari, R. S. (2024). Indigenous fungi from batik wastewater exhibit decolorization potential for Remazol Red Dye. *International Journal of Life Science and Agriculture Research*, 03(10), 793–799.
- Huyen, P. T., Thi Xuan Huong, V., & Thanh Nhan, D. (2021). Isolation and potential biocontrol of the fungus causing anthracnose in longan in Vietnam. *Science and Technology Development Journal*, 24(1), 1889–1896.
- Lu, Y., Zhang, W., Hu, X., He, C., Liang, Y., Huang, X., Yi, K., & Wu, W. (2025). Diversity and pathogenicity of *colletotrichum* species causing coffee anthracnose in China. *Microorganisms*, 13(3), 1–19.
- Merangin Regency Government (2023). Laporan penyelenggaraan pemerintah daerah Kabupaten Merangin Tahun 2023. <https://meranginkab.go.id/files/LPPD-Merangin-2023.pdf> [Accessed Juli 2025].
- Phoulivong, S. (2012). Cross infection of *colletotrichum* species; a case study with tropical fruits. *Current Research in Environmental & Applied Mycology*, 2(2), 99–111.
- Pornsuriya, C., Thaochan, N., Chairin, T., & Sunpapao, A. (2023). Morphological and phylogenetic evidences reveal *Lasiodiplodia chonburiensis* and *L. theobromae* associated with leaf blight in *hevea brasiliensis* in southern Thailand. *Diversity*, 15(9), 1–12.
- Serrato-Diaz, L. M., Aviles-Noriega, A., Soto-Bauz6, A., Rivera-Vargas, L. I., Goenaga, R., & Bayman, P. (2020). Botryosphaeriaceae fungi as causal agents of dieback and corky bark in Rambutan and Longan. *Plant Disease*, 104(1), 105–115.
- Suksakol, S., Liamkraituan, J., Teeraarunsiri, W., Chiangmai, P. N., & Mahadtanapuk, S. (2024). Biocontrol of fruit discoloring and fruit rot disease in Longan (*Dimocarpus longan*) by using antagonistic *Bacillus* spp. *Trends in Sciences*, 21(5), 2–10.
- Xia, G. Y., Manawasinghe, I. S., Phillips, A. J. L., You, C. P., Jayawardena, R. S., Luo, M., & Hyde, K. D. (2022). *Lasiodiplodia fici* sp. nov., Causing leaf spot on *Ficus altissima* in China. *Pathogens*, 11(8), 1–13.