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IDENTIFICATION OF *PERONOSCLEROSPORA SPP.* MORPHOLOGICAL CAUSES OF DOWNY MILDEW DISEASE IN CORN PLANTS (*ZEA MAYS* L.) IN DELI SERDANG, NORTH SUMATRA, INDONESIA

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I. ABSTRACT

Downy mildew on corn plants in Deli Serdang was originally identified as being caused by one species. In recent years, reports have stated that downy mildew on corn plants is caused by several species of *Peronosclerospora*. This study aims to identify *Peronosclerospora spp.* causes of downy mildew in corn plants and determines the diversity of *Peronosclerospora spp.* Morphological causes of downy mildew disease in corn plants in four sub-districts in Deli Serdang Regency. The research was carried out from February to April 2024 on farmers' corn plantations and in the laboratory of the North Sumatra Animal, Fish and Plant Quarantine Center, Kualanamu Service Unit. Field observations were carried out by counting downy mildew attacks in four sub-districts in Deli Serdang district. Observations in each sub-district were carried out in two villages which are corn planting centers so there were eight different locations. The results of the research show that the identification of the causes of downy mildew disease on corn plants in four sub-districts of Deli Serdang Regency has been described based on cell wall thickness, shape and size of conidia, and has been outlined in an identification key. The results showed that the cause of downy mildew was *P. maydis*. This shows that downy mildew caused by *P. sorghi* and *P. philippinensis* has not spread in Namorambe, Pancur Batu, Kutalimbaru and Sunggal subdistricts. The highest intensity of downy mildew attacks was found in the villages of Tanjung Anom and Tuntungan in Pancur Batu District, namely 14.91% and 10.54% respectively, while the lowest intensity of downy mildew attacks was found in the villages of Central Kuta and Namorambe in Namorambe District, namely respectively 2.5% and 3.5%.

KEYWORDS: Corn, Productivity, Identification, *Peronosclerospora* spp.

I. INTRODUCTION

Corn is a plant that is quite popular in Indonesia because it is the second source of carbohydrates after rice. Corn also has an important meaning in industrial development in Indonesia because it is a raw material for the food and animal feed industry. Demand for corn continues to increase from year to year along with the development of livestock businesses and the food industry. However, the development of domestic corn production has not been able to keep pace with developments in demand (Prasetyo et al., 2019; Iswari et al., 2021).

In corn cultivation, many obstacles are found that can reduce corn production. One of the obstacles faced by farmers is the low resistance of corn plants to pests and diseases. One of the diseases that is a limiting factor in corn production is downy mildew (*Peronosclerospora spp.*) (Iswari et al., 2021; Nasehi et al., 2023; Djaenuddin et al., 2024). Corn downy mildew is a disease caused by *Peronosclerospora spp.* and is the main disease of corn plants in Indonesia. Yield losses due to this disease can reach 50-80% (Janruang & Unartngam, 2018; Salgado-Salazar et al., 2018; Sukto et al., 2021). Even in certain corn varieties, yield losses can reach 100% (Pradhipta et al. 2019). Corn plants that are infected at a very young age usually cannot bear fruit, causing puso or crop failure (Ginting et al., 2023).

This disease has become important, especially with the expansion and efforts to increase corn production. Recently, downy mildew has also been reported to infect new superior varieties in the early growth phase and has the potential to significantly reduce corn yields on a national scale. The existence of an initial inoculum source, due to the planting of susceptible corn varieties, and unsynchronized planting patterns in each corn planting center area means that downy mildew is always present, is latent and remains a threat to efforts to meet

corn production targets in Indonesia (Hendrayana et al., 2020; Chaithra et al., 2022).

According to Van Hoof (1953) in Hikmahwati et al. (2011), in Indonesia downy mildew is caused by three species, namely *Peronosclerospora maydis, P. philippinensis* and *P. sorghi*. Of the three species that cause downy mildew, two of them still have OPTK A2 status, namely *P. philippinensis* and *P. sorghi* (Rustiani et al., 2015). Until now there is no information regarding the identification and diversity of *Peronosclerospora spp*. spread across Deli Serdang Regency. Identification needs to be done. to obtain information on the morphological and morphometric characteristics of *Peronosclerospora spp*. Therefore, this research was conducted to obtain information about the diversity of *Peronosclerospora spp.* to find out the cause of downy mildew that spread in Deli Serdang Regency.

Based on that, the aim of this research is to identify *Peronosclerospora spp.* causes of downy mildew in corn plants and determines the diversity of *Peronosclerospora spp*. Morphological causes of downy mildew disease in corn plants in four sub-districts in Deli Serdang Regency.

MATERIALS AND METHODS

The research was carried out in February-April 2024 by conducting a corn planting survey in four sub-districts and two villages in each sub-district in Deli Serdang Regency, namely Namorambe District (Central Kuta and Namorambe Villages), Pancur Batu District (Tanjung Anom Village and Tuntungan Village), Kutalimbaru District (Market identification of Peronosclerospora spp. conventionally (morphology) is carried out at the North Sumatra Animal, Fish and Plant Quarantine Center Laboratory, Kualanamu Service Unit.

OBSERVATION PARAMETERS

The parameters observed were: Symptoms of attack and cross-section of the roots causing downy mildew disease on corn plants (Zea mays L.), conventional identification of the causes of downy mildew disease on corn plants (Zea mays L.) (morphology), Morphological observations of Peronosclerospora spp. by observing the shape of the conidia, counting the number of conidiophore branches, measuring the length of the conidiophores, measuring the conidia, and the thickness of the conidia walls.

Data taken from the Deli Serdang Regency Agriculture Service is the intensity of downy mildew attacks on corn plants in the four sub-districts which are the research locations. Plant damage by downy mildew in the field is calculated based on observations of absolute damage. Determination of absolute damage disease intensity was calculated using the equation formulated by Foda et al. (2021) as follows:

IS = (n÷N) X 100%

IS = attack intensity (%);

n = number of examples of plants or certain parts of plants that are absolutely damaged or considered absolutely damaged;

N = the number of plant samples or specific parts of plants observed

RESULTS AND DISCUSSION

The results of research in four sub-districts of Deli Serdang Regency based on symptoms of attacks in the field showed that the cause of downy mildew in the research location was symptoms of attacks caused by *P. maydis* where the initial symptoms were spots and chlorosis. extends parallel to the leaf veins with clear boundaries between healthy leaves and whitish yellow leaves. The corn varieties attacked by downy mildew in the field are Pioneer P-32, Exotic Pertiwi and BISI 18. An overview of the symptoms of *P. maydis* attack in the field can be seen in the picture below:

Figure 1: Attack symptoms *P. maydis* in the field; Image caption: 1. Chlorosis extends parallel to the leaf veins, the leaves are whitish yellow (Private document Tarigan, 2024).

Figure 1 clearly shows the symptoms of attack on corn plants: *P. maydis*. This is in accordance with Pakki & Jainuddin (2019); Ulhaq & Masnilah (2019) stated that the typical symptoms of *P. maydis* downy mildew on corn plants are chlorosis, extending parallel to the leaf veins, the growth of affected plants is stunted, and in the morning. a layer of white powder is visible beneath the surface of the leaves. Based on field observations, the source of the inoculum for the *P. maydis* pathogen was obtained from corn plants that were attacked by downy mildew, which caused a white powdery layer under the surface of the leaves and caused chlorosis. Chlorosis is characterized by pale stripes running parallel to the leaf veins.

Based on observations in the field, downy mildew disease can also be seen attacking corn plants in the

vegetative phase, namely 0-60 HST. Kalqutny et al. (2020); Puspita et al. (2023) stated that the vegetative phase (0-14 days after planting) is the risk period for corn plants to be attacked by downy mildew. The affected plants are still very young, usually the plants have not yet produced fruit.

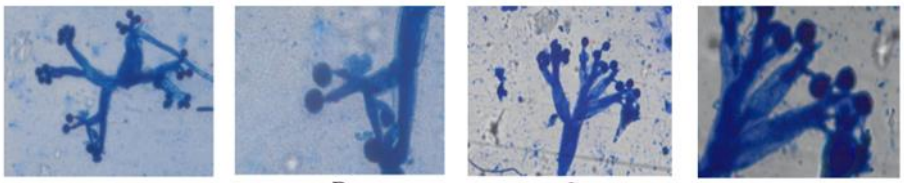
The results of identifying the cause of downy mildew disease on corn plants in four sub-districts of Deli Serdang Regency conventionally (morphologically) found the species *P. maydis*. The morphological characteristics of *P. maydis* have 2 branched conidiophores, namely hyaline conidiophores. Conidia are round or ovoid. Average conidia size 15.12 µm x 13.56 µm, conidiophore length 62.77 µm at 40 x magnification, conidia wall thickness 3.43 µm at 100 x magnification.

Tanzil & Purnomo (2021) stated that the onidium mushroom *P. maydis* is round when young, whereas when it is ripe it can become oval. Conidium size 12-19 x 10-23 µm only averages 19.2-17.0 µm. Hyaline conidiophores, 2 times branched, 2-4 times branched, conidiophore length 150-550 µm, conidia walls thin. Septian et al. (2020); Wardani et al. (2023) stated that the morphological identification of downy mildew species is weak because there are only a few morphological characters that can be used as distinguishing characters. In addition, characters such as conidia dimensions have been used as one of the main differentiating characters in *Peronosclerospora spp*. is greatly influenced by various factors such as weather conditions and host plants.

A B

Figure 2: Symptoms of downy mildew disease on corn plants in the villages of Kuta Tengah (A), and Namorambe (B) in Namorambe District, Deli Serdang (Personal Documentation, Tarigan, (2004)).

Figure 2 shows that the attack of downy mildew on corn plants in the villages of Kuta Tengah and Namorambe, Namorambe District, is caused by *P. maydis*, which can be seen from the initial symptoms of the attack in the form of spots and chlorosis extending parallel to the veins of the leaves with clear boundaries between healthy leaves and colored leaves. whitish yellow. Chlorosis occurs due to a decrease in chlorophyll due to the closure of leaf stomata by fungi.



A B C D

Figure 3: The fungus P. Maydis causes downy mildew on corn plants in the villages of Kuta Tengah (A, B) and Namorambe (C, D) in Namorambe District, Deli Serdang with an altitude of 65.6 m above sea level (A, B) and 103 m above sea level. (C, D). A, C 40x magnification, and B, D 100x magnification (Tarigan's personal documentation, 2024).

Figure 3 shows that morphologically, the fungus *P. maydis* which causes downy mildew disease on corn plants in Kuta Tengah village (Figures 3A, 3B) has a number of branching conidiophores of 2, hyaline conidiophores. Conidia are round or ovoid. The average conidia size was 12.45 µm x 10.99 µm, the conidiophore length was 81.64 µm at 40x magnification, and the conidia wall thickness was 2.88 µm at 100x magnification. Meanwhile, *P. maydis* which causes downy mildew on corn plants in Namorambe village

(Figure 3C, 3D) has a larger conidia wall size and thickness, namely the average conidia size is 15.86 µm x 12.27 µm, conidiophore length is 78.53 µm at 40x magnification, and conidia wall thickness 6.71 µm at 100 x magnification.

The intensity of downy mildew attacks in Kuta Tengah and Namorambe villages is also different, namely the intensity of downy mildew attacks in Namorambe village compared to Kuta Tengah, namely 3.5% and 2.5% respectively.

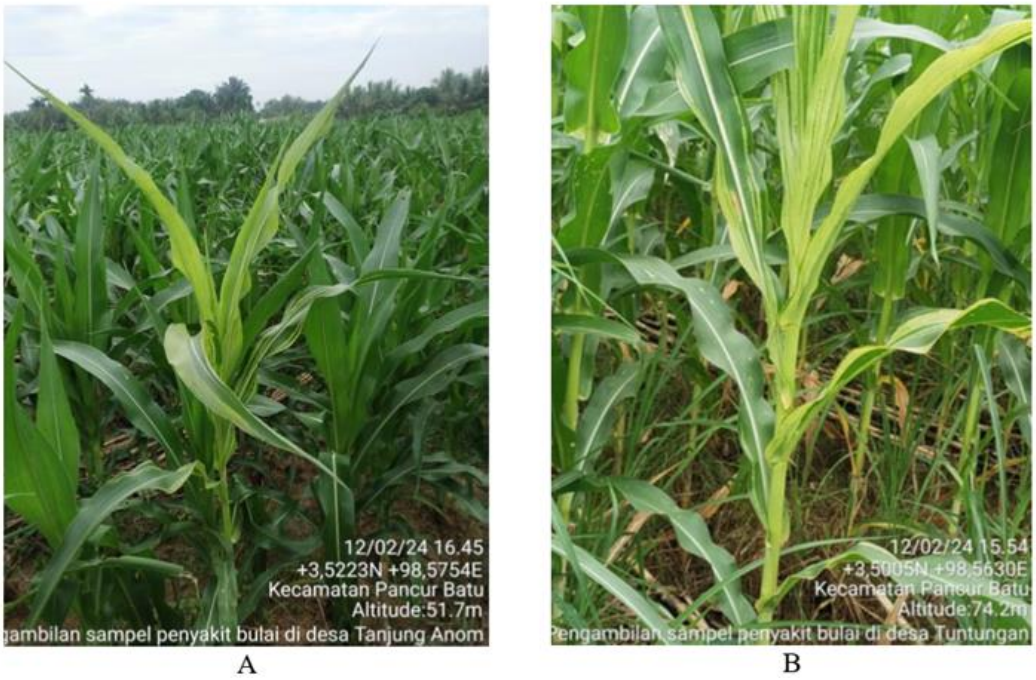
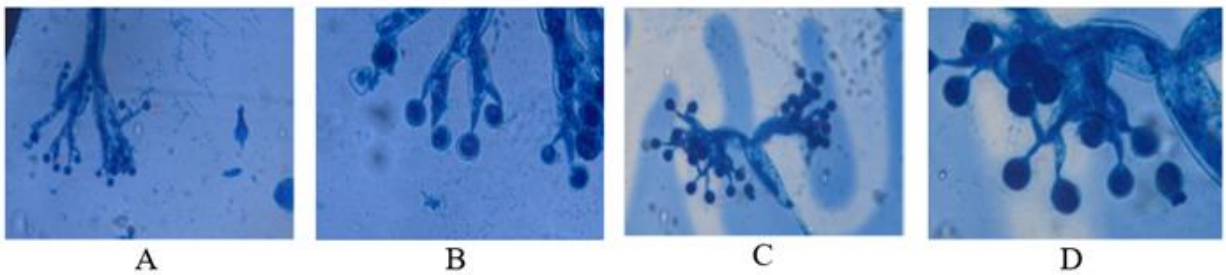


Figure 4: Symptoms of downy mildew attack on corn plants in the villages of Tanjung Anom (A), and Tuntungan (B) in Pancur Batu District, Deli Serdang (Personal Documentation, Tarigan, (2004)).

Figure 4 shows that downy mildew on corn plants in Tanjung Anom and Tuntungan villages, Pancur Batu District is also caused by *P. maydis* which also shows the same initial symptoms of attack as the two villages in Pancur Batu District, namely initial attack symptoms in the form of spots and elongated chlorosis. parallel to the leaf veins with clear boundaries between healthy leaves and whitish yellow leaves.



Gambar 5: Cendawan P. Maydis penyebab penyakit bulai pada tanaman jagung di desa Tanjung Anom (A, B) dan Tuntungan (C, D) di Kecamatan Pancur Batu, Deli Serdang dengan ketinggian tempat 51.7 m dpl (A, B) dan 74.2 m dpl (C, D). A,C perbesaran 40x, dan B,D perbesaran 100x (Sumber: Tarigan, 2024).

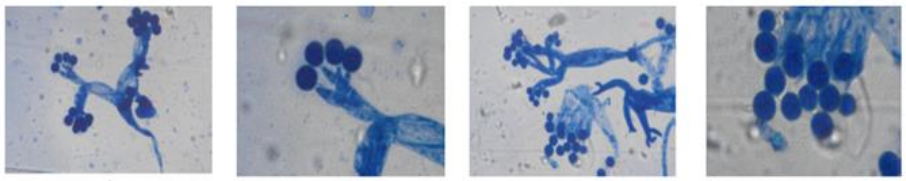
Figure 5 shows that morphologically, the fungus *P. maydis* which causes downy mildew on corn plants in Tanjung Anom village (Figures 5A, 5B) has a conidia size of 10.04 µm x 10.02 µm, conidiophore length of 87.95 µm at 40x magnification, and conidia wall thickness. 6.71 µm at 100 x magnification. Meanwhile, *P. maydis* which causes downy mildew on corn plants in Tuntungan village (Figure 5C, 5D) has a larger conidia wall size and thickness, namely the average conidia size is 15.12 µm x 13.56 µm, conidiophore length is 62.77 µm at 40x magnification, and conidia wall thickness 3.43 µm at 100 x magnification.

The intensity of downy mildew attacks in the villages of Tanjung Anom and Pancur Batu is also different, namely the intensity of downy mildew attacks is greater in Tanjung Anom village compared to Tuntungan, namely 14.91% and 10.54% respectively.

A B

Figure 6: Symptoms of downy mildew disease on corn plants in Pasar X (A) and Sawit Rejo (B) villages in Kutalimbaru District, Deli Serdang (Personal Documentation, Tarigan, (2004)).

Downy mildew attacks on corn plants in Pasar X and Sawit Rejo villages, Kutalimbaru District are also caused by *P. maydis* (Figure 6) with initial symptoms of attack in the form of spots and chlorosis extending parallel to the veins of the leaves with clear boundaries between healthy leaves and colored leaves. whitish yellow. Chlorosis occurs due to a decrease in chlorophyll due to the closure of leaf stomata by fungi.



A B C D

Figure 7: *P. Maydis* fungus causes downy mildew on corn plants in Pasar X (A, B) and Sawit Rejo (C, D) villages in Kutalimbaru District, Deli Serdang with an altitude of 171.8 m above sea level (A, B) and 47.0 m above sea level. (C, D). A, C 40x magnification, and B, D 100x magnification (Source: Tarigan, 2024).

Figure 7 shows that morphologically, the fungus *P. maydis* which causes downy mildew disease on corn plants in Pasar X conidia are round or ovoid. The average conidia size was 14.77 µm x 13.53 µm, the conidiophore length was 46.35 µm at 40x magnification, and the conidia wall thickness was 2.04 µm at 100x magnification. Meanwhile, *P. maydis* which causes downy mildew on corn plants in Sawit Rejo village (Figure 7C, 7D) has a smaller conidia size, namely 14.42 µm x 13.19 µm, but has a longer conidiophore length, namely 107.21 µm at 40x magnification. and also a thicker conidia wall thickness, namely 4.14 µm at 100 x magnification.

The intensity of downy mildew attacks in Pasar X and Sawit Rejo villages is also different, namely the intensity of downy mildew attacks in Pasar X village compared to Sawit Rejo, namely 9.75% and 7.0% respectively.

A B

Figure 8: Symptoms of downy mildew disease on corn plants in the villages of Sei Beras (A), and Suka Maju (B) in Sunggal District, Deli Serdang (Personal Documentation, Tarigan, (2004)).

Downy mildew attacks on corn plants in Sei Beras and Suka Maju villages, Sunggal District are also caused by *P. maydis* (Figure 8) with initial symptoms of attack in the form of spots and chlorosis extending parallel to the veins of the leaves with clear boundaries between healthy leaves and leaves. Whitish yellow in color. Chlorosis occurs due to a decrease in chlorophyll due to the closure of leaf stomata by fungi.

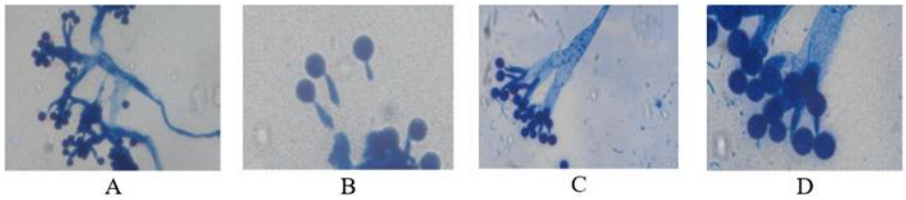


Figure 9: The fungus *P. Maydis* causes downy mildew on corn plants in the villages of Sei Beras (A, B) and Suka Maju (C, D) in Sunggal District, Deli Serdang with an altitude of 31.6 m above sea level (A, B, C, D). A, C 40x magnification, and B, D 100x magnification (Source: Tarigan, 2024).

Figure 9 shows that morphologically, the fungus *P. maydis* which causes downy mildew disease on corn plants in the villages of Sei Beras (Figures 9A, 9B) and Suka Maju (Figures 9C, 9D) has a number of branching conidiophores of 2, hyaline conidiophores and conidia are round or ovate. The average conidia size in Sei Beras village was 16.36 µm x 12.14 µm, conidiophore length was 139.42 µm at 40x magnification, and conidia wall thickness was 3.53 µm at 100x magnification. Meanwhile, *P. maydis* which causes downy mildew on corn plants in Suka Maju village (Figure 9C, 9D) has a larger conidia size, namely 20.04 µm x 18.00 µm, but has a shorter conidiophore length, namely 64.98 µm at 40x magnification, and also the conidia wall thickness is thinner, namely 2.16 µm at 100 x magnification.

The intensity of downy mildew attacks in Sei Beras and Suka Maju villages is also different, namely the intensity of downy mildew attacks in Sei Beras village compared to Suka Maju, namely 5.07% and 4.25% respectively.

The P. maydis species is known as a native species to Indonesia, because it is reported to have existed in Indonesia since 100 years ago (Semangun 2008, CABI 2014). Therefore it is known by the common name Java Downy Mildew. This native species in several countries such as the USA and China, is included in the list of Quarantine Pests and potentially invasive species (Huber et al., 2002; Xu et al., 2012).

The other two *Peronosclerospor*a species, namely *P. sorghi* and *P. philippinensis*, in Indonesia included in the list of Quarantine Plant Pest Organisms (OPTK) category A2, which needs to be prevented from spreading widely in Indonesia. These two pest species are reported only occurs in limited areas and has the potential to cause very severe epidemic events in corn plantations, as in a recent report by Kim et al. (2007). The distribution area of *P. sorghi* is recorded in South Sulawesi, North Sumatra, West Java, and East Java. However, *P. philippinensis* is only spread in the Sulawesi area (BKP, 2013). Therefore, it is necessary to regulate plant quarantine between areas to prevent the spread of the two species into areas free from these two OPTKs by limiting the traffic of corn seeds.

CONCLUSION

Identification of the causes of downy mildew disease on corn plants in four sub-districts of Deli Serdang Regency has been described based on cell wall thickness, shape and size of conidia, and has been outlined in an identification key. The results showed that the cause of downy mildew was *P. maydis*. This shows that downy mildew caused by *P. sorghi* and *P. philippinensis* has not spread in Namorambe, Pancur Batu, Kutalimbaru and Sunggal subdistricts.

The highest intensity of downy mildew attacks was found in the villages of Tanjung Anpm and Tuntungan in Pancur Batu District, namely 14.91% and 10.54% respectively, while the lowest intensity of downy mildew attacks was found in the villages of Kuta Tengah and Namorambe in Namorambe District, namely respectively 2.5% and 3.5%.

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