

***Ganoderma* spp. Basidioma Variation from Infected Oil Palm on Smallholder Peatland Plantation in Kampar Regency, Riau, Indonesia**

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ABSTRACT

A total of 15 types of *Ganoderma* diversity in the world have been identified. In Indonesia, information related to the variety of *Ganoderma* has not been widely reported. *Ganoderma* is the main cause of stem rot disease of oil palm plants, which has been reported to attack at various stages of plant growth. Information regarding the genetic diversity of *Ganoderma* needs to be known, considering that each pathogen has specificity in causing disease. This information is necessary to determine how the mechanism of infection, spread, and the response of plants to the presence of each type of *Ganoderma* in the physiological processes of oil palm plants. This research was conducted using survey methods in smallholder oil palm plantations in Kampar Regency and the Plant Disease Laboratory, Faculty of Agriculture, Riau University. The basidioma of *Ganoderma* spp. taken from the trunk of the infected oil palm tree. Basidioma of *Ganoderma* spp. then characterized based on its color. The data from these observations were then analyzed descriptively and presented in the form of tables and pictures. Field observations indicate that the presence of *Ganoderma* basidioma at the oil palm trunk is closely related to visual plant symptoms. Based on symptom observation results showed 62.07% severe symptoms, 10.34% dead plants, 20% had moderate symptoms and only 6.90% had mild symptoms. The plant condition in Deli Makmur Village shows severe symptoms with a severity index reaching 75%. There were 6 groups of *Ganoderma* based on the characteristic color variations of the basidioma found in the sample locations. The Gano-1 group is the group with the highest incidence found in the field. This study also found 48% of infections of more than one *Ganoderma* group in one oil palm plant. Further testing is needed to determine the diversity of this *Ganoderma* species based on its genetic characteristics.

Keywords: *basidioma, diversity, Ganoderma, oil palm, smallholder plantations*

1. INTRODUCTION

Basal Stem Rot disease is a significant disease that is still difficult to control in oil palm plantations, especially in Indonesia. This disease is caused by the pathogenic fungus *Ganoderma boninense* which has caused significant economic losses in the palm oil industry (Kresnawaty, et al., 2017; Yuliar and Suciati, 2018), because it can cause death by up to 50% resulting in a decrease in oil palm production [1].

Ganoderma spp. It is an important pathogen to control because it can attack oil palm plants from the nursery level to the field known as Basal Stem Rot (BSR) disease. Basal Stem Rot disease could kill more than 80% of oil palm trees that have half their economic life span [2]. *Ganoderma* sp. can also cause Upper Stem Rot symptoms, which are predominantly found on peatlands in Labuhan Batu, North Sumatra [3]. Previously Susanto et al. have reported that the incidence of scion rot reached more than 35% in Tanjung Selamat [3].

Turner has reported that there are 15 species of *Ganoderma* from various regions of the world that are associated with stem rot disease in oil palm plants. Some of them are *G. boninense*, *G. zonatum*, *G. miniatocinctum*, *G. tornatum*, *G. applanatum*, *G. chaliceum*, *G. lucidium* and *G. pseudoferreum* [4]. In a recent study in Malaysia, it was found that the species *G. tornatum* is a non-pathogenic species that only attacks the stems of dead oil palms [5].

In Indonesia, other types of information related to *Ganoderma* spp. which attacks oil palm plantations have not been widely reported. Information regarding the genetic diversity of *Ganoderma* needs to be known, considering that each pathogen has specificity in causing disease. This information is necessary to determine how the mechanism of infection, spread, and the response of plants to the presence of each type of *Ganoderma* in the physiological processes of oil palm plants.

2. MATERIALS AND METHODS

This research was conducted using survey methods in smallholder oil palm plantations in Kampar Regency and the Plant Disease Laboratory, Faculty of Agriculture, Riau University. The sampling location was determined using purposive random sampling with the criteria of smallholder oil palm plantations showing symptoms of basal stem rot disease. *Ganoderma* spp. taken from the infected oil palm plant in the form of a basidioma that has appeared at the base of the oil palm trunk. Basidioma of *Ganoderma* spp. obtained from the field then characterized based on its color. The data from these observations were then analyzed descriptively and presented in the form of tables and pictures.

3. RESULTS AND DISCUSSION

3.1. Morphology and Disease Severity in oil palm plants infected with *Ganoderma* spp.

Ganoderma basidioma samples were obtained from Deli Makmur Village, Kampa District. This village was chosen because it has a high *Ganoderma* attack. Based on the data obtained, the age of oil palm plants has been more than 17 years which is managed by the community. Oil palm is planted on peatland. In general, the plant samples were infected by *Ganoderma* sp. with different conditions which can be seen in Table 1.

Based on the results of the survey conducted, from the Deli Makmur villages that have been determined, it was

found that there was an attack by *Ganoderma* sp. accompanied by the formation of a basidioma. The details of the condition of the oil palm plantations in Deli Makmur village are detailed in Table 1.

Data in Table 1 shows that there are several variations of the attack symptoms of *Ganoderma* sp. According to Pilotti, oil palm plants that are attacked by stem rot disease in the field can be seen from the crown of the plant with the formation of more leaves than usual. Besides, the leaves are pale green, the old leaves wilt, break off the midrib, and hang around the tree. A typical symptom is the occurrence of rot at the base of the stem followed by the appearance of a mushroom basidioma [6].

Symptoms of attack and the presence of *Ganoderma* sp. in oil palm plantations vary widely. From the data in Table 4.1, the severity of the disease seen from the condition of the plants attacked by *Ganoderma* and the disease rating scale is not always determined by the number of fronds and spear leaves, but by the presence of the basidioma of *Ganoderma* sp.

Based on symptom observation results in Table 2 showed that 62.07% of severe symptoms, 10.34% dead plants, 20% had moderate symptoms and only 6.90% had mild symptoms. In general, the condition of the plants in the study location showed severe symptoms, with a disease severity index reaching 75%. This shows that the incidence of *Ganoderma* in smallholder oil palm plantations is very high. This can be caused by a lack of care and disease control techniques practiced by farmers in community gardens. Besides, the use of uncertified oil palm seeds is also an obstacle to the vulnerability of oil palm to being attacked by *Ganoderma* sp. [7].



Figure 1 Morphology of diseased plants infected by *Ganoderma* spp. with mild (a), moderate (b) and severe conditions Deli Makmur Village, Kampa District, Kampar Regency.

Table 1. Description of the condition of the oil palm trees attacked by *Ganoderma* sp.

Sample Location	Sample Code	Plant Infected Symptoms by <i>Ganoderma</i> sp.			Condition of plant severity	Disease Rating Scale
		Number of Spear Leaves	Number of Hanging Fronds	Number of Basidioma		
Deli Makmur, Dahlia Sari Village (DMDS)	DMDS01	0	0	6	Dead Plants	5
	DMDS02	0	0	5	Dead Plants	5
	DMDS03	3	15	5	Heavy	4
	DMDS04	3	13	4	Heavy	4
	DMDS05	1	2	5	Heavy	4
	DMDS06	2	1	1	Mild	2
	DMDS07	3	10	2	Heavy	4
	DMDS08	4	16	5	Heavy	4
	DMDS09	2	9	5	Moderate	3
	DMDS10	3	11	3	Heavy	4
	DMDS11	2	11	3	Heavy	4
	DMDS12	4	15	4	Heavy	4
	DMDS13	5	12	4	Heavy	4
	DMDS14	3	21	6	Heavy	4
Deli Makmur, Dahlia Makmur Village (DMDM)	DMDM01	3	7	3	Moderate	3
	DMDM02	2	5	5	Heavy	4
	DMDM03	3	11	5	Heavy	4
	DMDM04	2	2	4	Moderate	3
	DMDM05	3	2	5	Heavy	4
	DMDM06	4	2	7	Heavy	4
	DMDM07	2	0	1	Mild	2
	DMDM08	3	5	2	Moderate	3
	DMDM09	2	1	3	Moderate	3
	DMDM10	4	7	2	Heavy	4
	DMDM11	2	3	3	Moderate	3
	DMDM12	3	7	2	Heavy	4

3.2. Diversity of *Ganoderma* spp. Basidioma Morphology from Smallholder Palm Oil Plantation

Data from field observations, based on the morphology of *Ganoderma* basidioma found at the base of the oil palm plant stem, show that there are several variations. In this observation, variations in the diameter of the basidioma were not used as a differentiating parameter, due to different development stages and land conditions. This is based on the opinion of Ryvardeen (1955) in Bhosle et al., which states that the shape and size of the basidiocarp (basidioma) are doubtful in terms of morphological characteristics [8]. In this study, the diversity of *Ganoderma* sp. is seen from the color of the basidioma obtained. In general, based on field data, it was found that there were six groups of basidioma colors of *Ganoderma* sp. namely the Gano-1 group, Gano-2 group, Gano-3 group, Gano-4 group, Gano-5 group and Gano-6 group (Figure 2).

The basidioma characteristics in the Gano-1 group show wavy *pilleus* (surface), shiny light brown to dark color, white areas on the edges of the *pilleus* and the basidioma is not too thick. The basidioma morphology in

the Gano-2 group showed wavy *pilleus*, shiny yellowish brown with white areas on the edges of the *pilleus* and the basidioma was not too thick. The Gano-3 group showed characteristic basidioma with flat, brown, matte *pilleus* with white patches on the *pilleus* and thin basidioma.

The basidioma morphology of Gano-4 group shows wavy *pilleus*, shiny reddish to dark brown with basidioma not too thick. The Gano-5 group showed a characteristic light brown wavy *pilleus*, and the basidioma was not too thick. The characteristics of the Gano-6 group are different from other groups, namely wavy *pilleus*, purplish brown with thick basidioma. In general, the presence of basidioma in the six groups was different in each location and sample plants as shown in Table 2.

The data in Table 2 also shows the highest incidence of *Ganoderma* sp. those in the field were the Gano-1 group (79.31%) and the Gano-4 group (31.03%). The other four groups were found to be small in numbers at the study site.

Table 2 Description of the morphological diversity of the basidioma of *Ganoderma* sp. from the affected oil palm plant

<i>Ganoderma</i> spp. Group	<i>Ganoderma</i> sp. group Incident
Gano-1 Group	79.31%
Gano-2 Group	17.24%
Gano-3 Group	10.34%
Gano-4 Group	31.03%
Gano-5 Group	13.79%
Gano-6 Group	6.90%

Based on the color of the basidioma in the Gano-1 group, it is suspected that this is *Ganoderma boninense* Pat. This is consistent with the description by Markom *et.al.* statement that *G. boninense* is the main fungal pathogen that causes the stem rot disease in oil palm plants [9]. It is necessary to carry out further tests using molecular characteristics to determine the diversity of these 6 *Ganoderma* groups.



Figure 2 The color diversity of *Ganoderma* sp. a) Gano-1 Group, b) Gano-2 Group, c) Gano-3 Group, d) Gano-4 Group, e) Gano-5 Group dan f) Gano-6 Group

The results of observations in the field also found a double incidence, namely several types of *Ganoderma* sp. Based on the diversity of colors in one plant. There were also several types of *Ganoderma* in one plant. The data in Figure 3 shows that there is a 38% incidence of 2 groups of *Ganoderma* in one plant, 10% when 3 types of *Ganoderma* are found in one plant and 52% a single incidence.

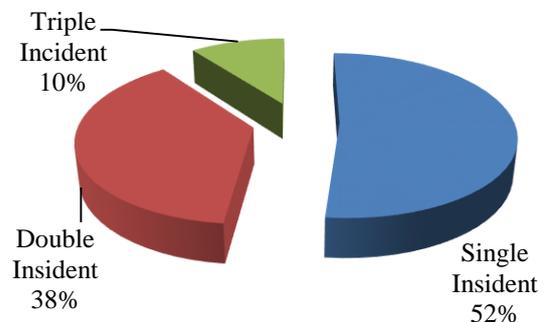


Figure 3 The occurrence of several *Ganoderma* groups in one plant

4. CONCLUSION

The plant condition in Deli Makmur Village shows severe symptoms with a severity index reaching 75%. There were 6 groups of *Ganoderma* based on the characteristic color variations of the basidioma found in the sample locations. The Gano-1 group is the group with the highest incidence found in the field. This study also found 48% of infections of more than 1 *Ganoderma* group in one oil palm plant. Further testing is needed to determine the diversity of this *Ganoderma* species based on its genetic characteristics.

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