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Development of Basal Stem Rot (*Ganoderma boninense*) of Oil Palm in Peatland and Minerals

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A B S T R A C T

Basal stem rot caused by *Ganoderma boninense* is the main disease of oil palm plantations. The disease decreases yield, causes plant death, shortens economic life, and accelerates replanting. The purpose of this study is to compare the development of this disease in third-generation oil palm plantations in peat soil and mineral soils. Observations were made to verify secondary census data for 4 years on affected (endemic) rotten stems. Observations were made on each of the 3 blocks for peat soil and mineral soil with palm oil planting year 2011-2012. The results showed that stem base rot develops faster with a higher severity in peat soil than yellow-red podsolic soil. The availability of organic matter in both soil and oil palm plant residues becomes an important source of nutrients for pathogenic fungi in completing the cycle of disease in plantations.

1. INTRODUCTION

1.1. *Research Background*

Palm oil is one of the important commodities in Indonesia in palm oil production and plays an important role in the social and environmental economy. One of the main problems in palm oil cultivation is the attack of several types of Ganoderma mushrooms that cause basal stem rot disease. This disease is the main disease in oil palm plantations, which can cause decreased production, crop death, shorten economic life, and accelerate replanting. The development and severity and pattern of spread of stem-base rot disease in oil palm plantations correlate with soil type, which is related to the availability of nutrients in supporting the resistance of plants to disease. This type of mineral soil is the mainland that is following the cultivation of oil palm, although currently there is also much cultivation of these plants in peatlands. Therefore, this study will be studied how the development of basal stem rot caused by Ganoderma in oil palm plants in peatlands and minerals.

1.2. *Literature Review*

Palm oil is the main plantation commodity in Southeast Indonesia, especially Indonesia and Malaysia. These two countries control 85% of the world's palm oil production and have an important economic, social and environmental role. The sustainability of production in the region is threatened by the onslaught of several types of Ganoderma mushrooms. Stem root rot is a very important disease caused by G. *boninense* that can reduce yield and shorten the economic life of palm oil [1], [2] Losses from this disease in Malaysia reach the US $ 500 million per year [3]. G. *boninense* causes both root and upper trunk rot, by a ratio of 10:1 to 1:1 and in some instances more upper stem rot than the base of the stem rot [4] and is the most detrimental disease in Southeast Asia due to lower yields, causing plant mortality, shortening economic life and early replanting [5]. The disease causes the death of young plants in 1-2 years and the death of adult plants 3 years after the appearance of symptoms [2]. This fungus can degrade lignin in woody tissues [6].

G. *boninense* infection affects xylem which further interferes with the distribution of water and nutrients to all parts of the plant, resulting in symptoms that look similar to water choking and nutrient deficiency in the canopy. These symptoms are followed by the appearance of the body of the fungus at the base of the stem, and internal tissues undergo necrosis [7]. This damage causes photosynthesis to be disrupted due to low chlorophyll content and water deficit [8].

The spread of Ganoderma in the soil through root contact and the air. As basidiomycetes, this fungus has two strategies: spores

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and mycelium. Studies on Ganoderma show that G. boninense in oil palm plantations has several genotypes of sexual recombination with spread through basidiospores [9]. The spread of basidiospores through wind, rainwater, and insects and the penetration of pathogens through pruning wounds although the chances of success are low [10]. In Peninsular Malaysia, basal stem rot is found in plantations located near the beach that was previously planted with coconuts. It was also reported that the same incident occurred in peat soil [11].

Oil palm cultivation in peat soil is very susceptible to nutrient deficiencies, especially macronutrients, although improvements in physical and chemical properties have been made [12]. The optimum level of essential nutrients in plants is essential for supporting physiological processes, including a role in plant resistance mechanisms against pests and diseases [13]. Field observations show that the development and severity and pattern of spread of stem-base rot disease in oil palm plantations have a correlation with the physical and chemical properties of soil [14]. The development of stem root rot control strategies in oil palm plantations is based on efforts to reduce initial inoculum production and inoculum production rate, so that the availability to reduce initial inoculum production and inoculum production rate, so that the availability

1.3. Research Objective

This study aimed to find out the development of basal stem rot disease in oil palm plantations in peat soil and mineral soil.

2. .MATERIALS AND METHODS

This research was conducted at PT. Smart Tbk Duke plantation for peat soil and Padang Halaban plantation for mineral soil. Each type of soil is represented by 3 garden blocks that show symptoms of the disease and are third-generation soils. The area per block is 30 hectares with a population of 134 trees per hectare. The attack and the development of the severity of the base of the rod are based on census data for 4 years (2017-2020). Progress is determined based on the score in Table 1.

Table 1. Determination of the development of stem rot disease in palm oil plants

Score	description
1 (light)	Young leaves are pale/dull, there is or is no fruiting body, the plant looks healthy but there is a fruiting body, the smelter is shorter and narrowed compared to healthy plants.
2 (medium)	Spear leaves/shoots that have not bloomed (3, young leaves or all leaves look pale there or no fruiting body, the plant looks healthy but the base of the stem begins to weather.
3 (weight)	Spear leaves/shoots that have not bloomed (3, the entire leaf appears pale, the lower leaves dry from the end of the leaf strands, old leaves begin to break, there is or is nobody of the fruit.
4 (very heavy)	The base of the trunk or upper stem begins to rot or weather, there is a fruiting body, the plant is uprooted or not uprooted.

Information about technical culture and satisfaction for sample blocks in the form of secondary data is adjusted to research recommendations.

3. RESULT AND DISCUSSION

The technical culture of garden maintenance is adapted to standards for peat soil and mineral soil. Fertilization is adjusted to technical recommendations based on tissue analysis and leaf analysis whose realization is presented in Table 2.

Table 2. Technical culture and fertilization of peat soil and yellow-red podsolic soil of oil palm plantations.

Technical Culture	Peatlands	Mineral land
Type of soil	Organic material	Podsolic red yellow.
soil pH	4.0 – 5.5	3.5 – 4.5
Seed type	D x P Damimas	D x P Damimas
Fertilization	Urea, RP, MOP, Dolomite, Kaptan, HGFB, CuSo4, dan ZnSo4	Urea, Rp, MOP, Dolomite, dan HGFB
Planting distance	8.5 m x 7.8 m	9 m x 7.8 m
dish	2 meter	2 meter

Table 2 shows that peat soil content as organic soil has different physical and chemical properties than yellow-red podsolic mineral soil. In addition, peat at the research site included mature types (saprik) shown by a pH of about 4.0-5.5 and higher than yellow-red podsolic soil, the variety of fertilizers given is the same, except for peat soils given Zn and Cu as a result of high pH. The population of oil palm on peat soil is tighter than the soil, this is following the recommendation that the infertile land class should be planted in a closer population (8.5m x 7.8m).

Characteristic peat as organic soil affects the development of basal stem rot disease and its spread between trees as shown in Figure 1. There is a firm difference in the development of the severity of the disease between the two soils. The progression of the disease from a score of 1 to a score of 3 is relatively stable and slow and experienced a sharp increase to a score of 4 on yellow-red podsolic soil. In contrast, the change in scores from mild to severe and severe categories once took place more quickly as demonstrated by visual symptoms observed during the census and research on peat soils. Furthermore, it followed the death of trees in greater numbers than palm oil in mineral soils.

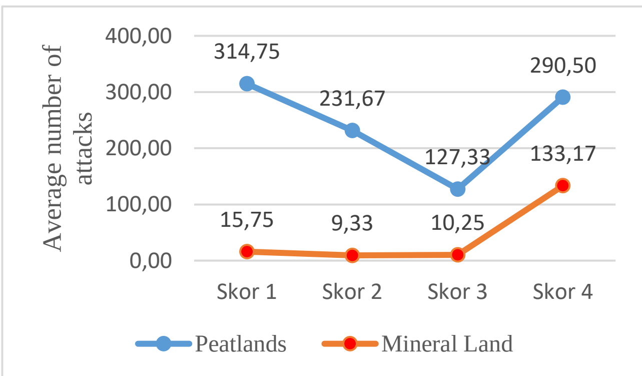

Fig 1. The development of symptoms of the foul disease of the base of the stem in peat soil and yellow-red podsolic soil.

The results of the study in Figure 1 revealed also that the plant deaths (score 4) increased sharply from a score of 3 (severe attacks). In heavy attacks, the internal colonization of G boninense is almost evenly distributed and spreads to root and stem tissues, thereby increasing the number of dead trees. It is also known that an increase in the number of sick trees ranging from scores 1 to 3 indicates a difference in external symptoms of each level of severity between peat soil and yellow-red podsolic soil. This difference is due to the rapid development of internal symptoms not offset by an increase in external symptoms, especially symptoms on the header (smelter) on the yellow-red podsolic soil. The expression of disease symptoms is the result of interactions between pathogens, host plants, and the environment [15]. The physical and chemical properties of peat soils have the potential to predispose to hosts and create conditions conducive to pathogenic development [16] and this supports that G. *boninense* is a weak pathogen [17].

G. *boninense* attacks on palm oil are heavier on peat soil than mineral soils (Table 3). Observations over 4 years (2017-2020) show that the intensity of this fungal attack reaches 54.37% per year and this is much higher than the attack on mineral soils (9.64%). Oil palm cultivation in peat soil and yellow-red podsolic is the third generation. The root rot epidemic is primarily determined by the availability of the G. *boninense* inoculum between the two rejuvenation cycles. As a necrotrophic fungus, stem residues at ground level and roots in the soil become food bases during the saprophytic development of these fungi before attacking new plants. In addition, peat is a food base that provides organic matter to support the life cycle of pathogens, especially as long as it does not interact directly with palm oil.

Table 3. The intensity of Ganoderma attacks on palm oil in peat and mineral soils

Year	The intensity of Ganoderma Attacks (%)	
	Peatlands	Mineral
2017	34,52	25,96
2018	46,85	4,69
2019	85,86	4,54
2020	50,25	3,35
Avarage	54,37	9,64

Table 3 also shows that the availability of organic matter as a food base for pathogens is critical in the root rot epidemic. The intensity of the disease showed a different pattern of development during the 4 years of observation, this parameter continued to increase in peat soil instead decreased in yellow-red podzolic soil. The death of many trees on peat soil (Figure 1) provides a food base (nutrients) rich in lignin and cellulose to support saprophytic growth (prepenetration) of G. *boninense* as white fungi [18] that contribute to the epidemic of basal stem rot in oil palm plantations, especially in peat soils.

4. CONCLUSION

G. boninense attacks on palm oil in peat soil are heavier than yellow-red podsolic soil. The development of disease severity from mild levels (score1) to heavy levels (score 3) is faster on peat soil instead of slowly in yellow-red podsolic soil. The existence and continuity of organic food bases in the soil is the main cause of this disease epidemic in oil palm plantations, especially in peat soils. All palm oil affected by this disease will experience death, so preventive efforts with sanitation of inoculum sources and spread limiting deserve priority in the management of this disease.

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