Survey of Basal Stem Rot Disease on Oil Palms (*Elaeis guineensis* Jacq.) in Kebun Bukit Kijang,North Sumatera, Indonesia

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Abstract. Basal stem rot disease caused by *Ganoderma* sp. is a significant disease on oil palm plantations in Indonesia, especially in North Sumatera. Currently, the pathogen does not only attack the plants that have produced (old plants) but also attacks the plants that have not produced in the first generation yet. A survey of the distribution of the basal stem rot disease in the plantation of the community has been completed in order to illustrate the distribution and the incidence of the basal stem rot disease in 5 locations of the oil palm plantation of the community in Desa Bukit Kijang, Region of Asahan, North Sumatera, Indonesia. From the research, it is revealed that the basal stem rot disease has spread to all of the observed locations with the level of disease incidence between 0.71% in Kebun Bukit Kijang 3 to 50% in the 17 years old oil palm in Kebun Bukit Kijang 4 and Bukit Kijang 5. The observable symptoms of the basal stem rot disease are chlorotic leaves, the appearance of fruiting body, collapsed plants, and the existence of holes on the basal stem. The incidence of basal stem rot disease is higher on land due to a high sand content (>50%).

1. Introduction

Palm oil (*Elaeis guineensis* Jacq.) is the most significant plantation commodity in Indonesia. At the current time, Indonesia is the biggest oil palm exporter and producer, as the width of the oil palm plantation area was 8.91 million hectares in 2011 [1], and the average production of crude palm oil is around 31 million ton per year [2]. The width of this oil palm plantation will continue to grow, and in 2020, it will be dominated by the plantation of the community and the large private plantation. One of the provinces that has the second largest oil palm plantation area in Indonesia is North Sumatera, where the total area is almost 1.2 million hectares [3]. From the width, more than 405 thousands hectares comprise the oil palm plantations of the people in the area [4].

Currently, a serious problem that emerges on the oil palm plantation, especially the community's plantation, is the basal stem rot disease that is caused by *Ganoderma* sp. Field research has shown that in the oil palms that are planted on the land that was previously a forest or held rubber plants, the symptoms of basal stem rot appear in the 10^{th} – 12^{th} year of the plants' lives with the level of disease incidence around 1 – 2%, and it increases to 25% when the plants reach 25 years of age [5]. On the replanted oil palms with underplanting as the technique, disease incidence can reach 33% on plants

that are 15 years of age [6]. Hence, the basal stem rot disease can reduce the oil palm production to 35%.

Though the information about the incidence and the loss of the result caused by the attack of the basal stem rot disease in Indonesia has been frequently reported, information on the distribution and the attack level of the basal stem rot disease has not been published yet. The lack of information in the farmer's knowledge about this disease means that there is no preventive action taken by the farmer.

The objective of this research was to determine the distribution and the incidence of the basal stem rot disease in 5 locations of the community's oil palm plantation in Desa Bukit Kijang, Region of Asahan, North Sumatera, Indonesia.

2. Materials and methods

2.1. Determination of the sampling location

A survey was done in 5 community's oil palm plantations in Desa Bukit Kijang, Gunung Melayu, in North Sumatera, Indonesia. The determination of the sampling location is based on the consideration toward the existence of the plant's age difference. From each chosen location, the plantation width, the total number of the plants, age of the plants, and GPS coordinates were recorded.

2.2. The Observation of the basal stem rot disease incidence

The observation of the basal stem rot disease incidence done for each location is based on the symptoms and a visual diagnostic that uses the scale 0 – 4. This scale is based on the method of Abdullah et al. [7] (table 1).

Table 1. The diagnostic and the symptom of the basal stem rot on the plants that are checked based on the scale of the disease (0 – 4) [7].

Severity Class	Description
0	Healthy looking plants with green leaves without appearance of fungal mycelium on any part of plants.
1	Appearance of white fungal mass on any part of plants, with or without chlorotic leaves and unopened spear leaves at the centre.
2	Appearance of basidiomata on any part of plants with chlorotic leaves, skirt–like appearance of the leaves resulting in collapse of the lower leaves.
3	Formation of well-developed basidiocarp and bole creation.
4	Death of the plant and creation of bare land

Disease incidence is counted by using the formula below [7]:

$$DI = \frac{\text{The number of the plants with scale 1- 4}}{\text{The total number of whole plants observed}} \times 100\%$$

DI = Disease Incidence (%)

2.3. The Soil Characteristics

Soil analysis is done for each plantation location that is surveyed. A soil sample is taken from a plant that shows the symptom of the basal stem rot disease by using the random purposive sampling method. 300-500 grams of soil is taken from 5 locations from a 10 – 20 cm depth that is composited, which is then put into a plastic bag and labeled. In the next step, the soil sample is put into the cooler box and brought to the laboratory center, Faculty of Agriculture, University of Sumatera Utara, Medan, Indonesia, to be analyzed.

3. Results and discussions

The results of the survey show that the basal stem rot disease has been found in all survey locations, and the incidence of the disease was between 0.71% in Kebun Bukit Kijang 3 and 50% on the 17 years old oil palms in Kebun Bukit Kijang 4 and Bukit Kijang 5 (table 2). Generally, the incidence of the disease was higher on the young plants compared to the old plant (over 30 years). Based on Treu [8] and Susanto *et al.* [9], the basal stem rot disease does not only attack the old oil palms but also attacks the oil palms that have not produced yet.

Table 2. Disease incidence on 5 oil palm locations that are surveyed in desa Bukit Kijang Gunung Melayu, Sumatera Utara, Indonesia.

Locations	Coordinate	Plant age while it is surveyed	The land width (ha)	Year of planting	Number of plants	Disease incidence (%)
Bukit Kijang 1	N 02 °42 '48.0 " E 099 °31 '50.9 "	4	2.7	2011	378	1.42
Bukit Kijang 2	N 02 °42 '38.1 " E 099 °31 '32.0 "	4	1.0	2011	140	4.28
Bukit Kijang 3	N 02°42°37.2° E 099°31°29.3°	33	2.0	1982	280	0.71
Bukit Kijang 4	N 02 °42 '35.1 " E 099 °30 '40.2 "	17	2.0	1998	280	50.0
Bukit Kijang 5	N 02°42°34.6° E 099°30°38.2°	17	2.5	1998	350	50.0

The disease incidence of basal stem rot in Kebun Bukit Kijang 4 and Bukit Kijang 5 was high, which proves that the distribution of the basal stem rot disease during the experimental period is not similar to the reported incidence in previous decades. Now, this disease has spread to the first generation oil palms. The quick infection is related to how contagious the disease is and how the pathogen is distributed; that is, through the contact between the root of the plant and the *Ganoderma* inoculums, weather and basidiospore, and the secunder inokulum in the shape of an alternative house [10] ; [11]. The question remains: why are there a lot of young plants in the first generation (17 years) infected? This is caused by inoculums that have been obtained and started from the seedling. Based on the results of interviews with farmers, it is known that the soil for seedlings is directly taken by the farmers from the oil palm plantation. So, it is predicted that the soil that is used already contains inoculums.

For the plants that are infected by the basal stem rot disease with light symptoms, it is seen that the chlorotic leaves and several lower leaves are dry (figure 1a). For the more serious symptoms, the leaves are dry and broken (figure 1b), the fruiting body is created (figure 1c), the plant collapses (figure 1d), and there are existing holes on the basal stem (figure 1e). The above symptoms are the specific symptoms of the *Ganoderma* basal stem rot disease [12].

From the results of soil sample analysis for all surveyed locations, it is found that the soil pH of the plant with the basal stem rot disease incidence under 50% was 4.30 – 4.93, and the soil pH of the plant with 50% basal stem rot disease incidence is 4.64 – 5.05 (Table 3). The high disease incidence in the Desa Bukit Kijang plantation is associated with the soil texture in this location. The disease incidence is higher on the plantation with the over-50% soil content (Kebun Bukit Kijang 2, 4, and 5). The disease appearance is influenced by the high soil fraction, particularly the ones that are related to the physical character of the soil, such as soil porosity and water circulation.

Figure 1. Symptoms of *Ganoderma* basal stem rot disease in the field: a. chlorotic leaves, b. all leaves dry and the leaf midribs are broken, c. the plant collapses, d. *Ganoderma* fruiting body, e. holes on the basal stem.

Chang [13] reported that land with the sandy soil texture has a higher tendency to be attacked by the basal stem rot disease because this condition influences the natural soil matrix. The *Ganoderma* infection is quicker on the sandy soil because the soil texture has high porosity causing the roots of the plant to reach the inoculum faster. The high soil porosity on the sandy land also has an effect on the *Ganoderma* population. Susanto *et al.* [11] reported that the population of microorganisms in the soil that tends to be sandy is lower than the clay soil texture, but the *Ganoderma* infection in the sandy soil is higher than the clay.

Additionally, the soil's physical characteristics, such as the soil pH, also influence the incidence level of the basal stem rot disease. From table 3, it is clear that the incidence of the basal stem rot disease occurs on an extensive soil pH range, which is from very acidic to acidic. It shows that *Ganoderma* can adapt well to acidic soil. Abadi and Dharmaputra [14] reported that *G. boninense* grows well with the soil pH between 3.0 – 8.5, based on laboratory research.

Table 3. The soil characteristics of the plants that are infected by the basal stem rot disease in the surveyed locations.

Locations	Soil pH	C-org (%)	N-total (%)	Sand (%)	Dust (%)	Clay (%)	Texture
Bukit Kijang1	4.54	1.22	0.13	50.66	18.56	30.78	sandy clay loam
Bukit Kijang2	4.30	2.23	0.18	75.60	18.20	6.20	loamsandy
Bukit Kijang3	4.93	2.82	0.21	40.88	49.16	9.96	silty loam
Bukit Kijang4	4.64	3.12	0.25	72.41	17.69	9.90	sandy loam
Bukit Kijang5	5.05	1.86	0.18	58.88	22.59	18.53	sandy loam

4. Conclusions

This research is the first report of the basal stem rot disease which is caused by *Ganoderma* on the community's plantations in North Sumatera, Medan, Indonesia. The high disease incidence and the lack of knowledge that farmers have about the *Ganoderma* basal stem rot disease on oil palms cause the disease incidence to be high (0.71-50%). The observable symptoms of the basal stem rot disease are chlorotic leaves, the appearance of fruiting body, collapsed plants, and the existence of holes on the basal stem. The incidence of basal stem rot disease is higher on land due to a high sand content (>50%). This condition should be considered by the Indonesian Government to warrant more attention toward the community's plantations, focusing on the oil palms especially and this disease with its increasing infection.

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