Potential of production in *Elaeis guineensis* Jacq. type resistance to Ganoderma pathogen

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Abstract. This study was established to report the yield production (fresh bunches) of oil palm (*Elaeis guineensis* Jacq.) material planting Resistance Plant (RP) and Non-Resistance Plant (NP) to Ganoderma on the experimental plantation. The data was observed to conduct in oil palm from zero (0) until twenty-five (25) planting years. In 5 years, firstly Ganoderma pathogen was recorded to start low yield production in both materials planting. The production was involved a highest in RP 581,163 FFB/ha and lowest in NP 385,158 FFB/ha. Furthermore, Ganoderma pathogen disease was incidence distinct at 19.95% and 86.42%, respectively. The differentiation analysis of total plants was 196,005 (58.89%). Wherein, a total plant survives of 110 Resistance Plants and 36 Non-Resistance Plants for 25 planting years. Descriptive analysis was performed with Microsoft Excel 2013 showed the Standard Deviation (SD) 7.35 in P Value < 0.05 (95%).

1. Introduction

The year 2020 was certainly a challenge to the oil palm industry production. The oil palm plantation in Indonesia now through more than fourteen (14) million hectares due the most important of economic industrial [1]. The potential production of *Elaeis guineensis* Jacq. declined that a lower fresh fruit bunch (FFB) yield due to abiotic stress on Ganoderma pathogen. For a long time, this case was performed using screening the planting material that resistance pathogen [2]. The performance of the optimal production *E. guineensis* in the discovery germplasm sources of Ganoderma resistance was still examined by the plant breeders.

Ganoderma pathogen established to direct economic loss due to actual mortality and decrease to fresh bunches yield of production [3]. This pathogen was more prevalent with an increase in plant generation. The disease predominance to immature oil palm was the first until the fourth plant generations (0%; 4%; 7%; and 11%) plantings years in North Sumatra plantations. The pathogen incidence of oil palm matures at 1% could lead for an estimated 38 million USD Indonesian economic losses [4]. Ganoderma has been lengthy surviving to root disease rubble in the soil and infected roots for the newly established oil palm during replanting [5].
Besides, the observations on material planting of *E. guineensis* depended on the incidence of natural infection in the field, the process when needed many years. The resistance material planting to Ganoderma that still be able to fresh fruit bunches produce from the start planting is not fully understood. The present study represents the potential of production in *E. guineensis* type resistance to Ganoderma pathogen.

2. Materials and methods
The study was conducted to report the material planting of *Elaeis guineensis* Jacq. covering fresh fruit bunch (FFB) production, wherein distinct of Resistance Plant (RP) and Non-Resistance Plants (NP) from clustering previous study. Primary data from the yield of oil palm performance to assessment was gathered by experimental plantation from Socfindo ltd. (3°19’58”N 99°02’25”E) of the oil palm industry.

The plantation area was 50 hectares/block, wherein sixty plants/plot per one cross. The sample plants used were in standard conditions of 50 replication plants to find uniformity, the area of the plant used was flat soil and not ditch (the presence of stagnant water was thought to be not only a factor of Ganoderma disease). The spacing was 9 × 9 meters (equilateral triangle) with a total crop of 144 plants/ha. Furthermore, the collection data on a yearly basis (from 0-25 planting years). The data analysis was used qualitative descriptive by Microsoft Excel 2013 [6].

3. Results and discussion
3.1. The yield of fresh fruit bunches (FFB) per-year
Competition of *Elaeis guineensis* Jacq. material planting type resistance (RP) with non-resistance plant (NP) to Ganoderma have been reported in experimental plantation Socfindo ltd. The oil palm resistance (RP) produced a yield of fresh bunches higher compared to non-resistance plants (Figure 1).

![Figure 1. The production yield of FFB in Resistance Plants (RP) and Non-Resistance Plant (NP) per hectares in 25 years planting.](image)

**Table 1.** The total FFB production and percentage symptom of Ganoderma.

|                     | Total Production (FFB/Ha) | Ganoderma Pathogen (%) |
|---------------------|---------------------------|------------------------|
| Resistance Plants   | 581,163                   | 19.95                  |
| Non-Resistance Plants| 385,158                   | 86.42                  |

Most a higher the ages of *E. guineensis*, the FFB yield production should be supposed to higher [7]. In this case, the higher yield production of normal plants starts from 15 years to 18 years. However, many factors can affect yield fresh bunches. From the results observed, Ganoderma pathogen disease incidence was recorded up to 86.42% in the highest NP, whereas at 19.95% in the lowest RP (Table
It was reported to total production for RP and NP in FFB/Ha (581,163 RP) and (385,158 NP), respectively. The plants of Ganoderma symptoms have been reported to yield fresh bunches under normal (under the normal potential level) [8]. Then, in year 5 a total of 110 plants survived and still produced (Figure 2). The big effect of Ganoderma pathogen symptom in RP was occurred in 14-16 years after planting.

Figure 2. The total plants survive to Ganoderma pathogen symptom in plantation for 25 years of planting.

3.2. The total fresh bunches of material planting
This case indicated the material planting which survives to Ganoderma pathogen incidence in RP 110 plant/ha from 146 normal plants per hectare (Table 2). A total differentiation of fresh bunches was 196,005 Kilograms/hectare occurred 58.89% (0 to 25 years after planting).

| Total Plants of 25 Years /Hectare | Difference | Fresh Bunches (Kg/Ha) | % |
|-----------------------------------|------------|-----------------------|---|
| Resistance Plants                | Non-Resistance Plants |                                 |   |
| 110                               | 36         | 196,005               | 58.89 |

Table 3. Descriptive analysis of *E. guineensis*.

| Descriptive Analysis | Value |
|----------------------|-------|
| Mean of plants       | 13    |
| Standard Error       | 147.196 |
| Median               | 13    |
| Standard Deviation   | 7.359801 |
| Sample Variance      | 54.166667 |
| Kurtosis             | -1.2  |
| Skewness             | 0     |
| Range                | 24    |
| Minimum              | 1     |
| Maximum              | 25    |
| Sum                  | 325   |
| Count of age         | 25    |
| Largest (1)          | 25    |
| Smallest (1)         | 1     |

*P-Value < 0.05 (95%)*
Ganoderma pathogen reported is less advanced in Kalimantan contrasted with the Sumatra plantation probably caused the younger crop of rotations. Furthermore, the lowest incidence was also considered in Sarawak, Malaysia [9-11]. The distribution frequency analysis gave the standard deviation (SD) 7.35 for a standard error (SE) 147.196 (Table 3). These analyze were then affirm in the sample variance (SV) 54.16 (P-Value < 0.05; 95%).

The long-range strategy should be to breeding the material planting types of resistance to Ganoderma pathogen. However, it is dependent on a multi-studied approach (molecular, physiology, and economic) to understanding the E. guineensis to Ganoderma interaction who can exhibit the mechanisms bound with symptom with pathogenicity, and susceptibility, or resistance also a tolerance of E. guineensis. This study aimed to highlight the knowledge yield of fresh bunches production in 25 planting year simulation when needed to improve and control management of Ganoderma pathogen.

4. Conclusions
The material planting oil palm Non-Resistant (NP) for Ganoderma indicated a weak to competitive yield production from 5 until 25 planting years in all observed. The descriptive analysis of both material planting was standard deviation (SD) of 7.35 in P-Value < 0.05 in the survival of E. guineensis plants. Furthermore, the total plants survive were 110 Resistance Plants and 36 Non-Resistance Plants types, respectively, for 25 years of planting.

References
[1] Rahmadhani T P, Suwandi S and Suparman S 2020 Growth responses of oil palm seedling inoculated with Ganoderma boninense under competition with edible herbaceous plants J Sci Agric 4 pp 45-9
[2] Mudge A, Rama D, Pilotti C and Godwin I 2020 Genetic Diversity and Population Structure of Field Isolates of Ganoderma Boninense from Oil Palm Plantation in Solomon Islands Multidisciplinary Digital Publishing Institute Proc 36 1 p 56
[3] Roslan A and Idris A S 2012 Economic impact of Ganoderma incidence on Malaysian oil palm plantation - A case study in Johor Oil Palm Industry Economic Journal 12 1 (Kuala Lumpur, Malaysia: Malaysian Palm Oil Board) pp 24-30
[4] Darmono T W 2000 Ganoderma in oil palm in Indonesia: Current status and prospective use of antibodies for the detection of infection Ganoderma Diseases of Perennial Crops ed J Flood, PD Bridge and M Holderness (Wallingford, UK: CABI Publishing) pp 249-66
[5] Rees R W, Flood J, Hasan Y, Potter U and Cooper R M 2009 Basal stem rot of oil palm (Elaeis guineensis); mode of root infection and lower stem invasion by Ganoderma boninense Plant Pathol 58 5 pp 982-9
[6] Abbott M L 2014 Understanding educational statistics using Microsoft Excel and SPSS (New Jersey, USA: John Wiley & Sons) p 81
[7] Zu A K S, Adjei-Nsiah S and Bani R J 2012 Effect of processing equipment and duration of storage of palm fruits on palm oil yield and quality in the Kwaebibrem District Ghana Agric Econ Res Rev 1 pp 18-25
[8] Hashemvand K P and Takeuchi W 2020 Assessment of oil palm yield and biophysical suitability in Indonesia and Malaysia Int J Remote Sens 41 22 pp 8520-46
[9] Paterson R R M 2018 Revolutionising Plant Protection towards Agriculture 4.0: Ganoderma disease of Elaeis guineensis using computer simulation of climate change on oil palm growth 10th Int Conf of Plant Protection (Melaka, Malaysia) pp 14-5
[10] Paterson R R M 2019 Ganoderma boninense Disease of Oil Palm to Significantly Reduce Production After 2050 in Sumatra if Projected Climate Change Occurs Microorganisms 7 1 p 24
[11] Flood J, Hasan Y, Turner P D and O’Grady E B 2000 The spread of Ganoderma from infective sources in the field and its implications for management of the disease in oil palm Ganoderma Diseases of Perennial Crops pp 101-12
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