UNIVERSITI PUTRA MALAYSIA

EFFECT OF NPK ON *GANODERMA BONINENSE* SP. SUPPRESSION ON OIL PALM SEEDLINGS MEASURED BY PROXIMAL SENSING

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FP 2015 149

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A report submitted in partial fulfillment of the requirements for the award of the Degree of Bachelor of Agriculture Science

Faculty of Agriculture
University Putra Malaysia

2015

CERTIFICATION FORM

This project report entitled "Effect of NPK on *Ganoderma boninense* sp. Suppression on Oil Palm Seedlings Measured by Proximal Sensing" is prepared by Siti Noraishah binti Khalid and submitted to the Faculty of Agriculture in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agriculture Science.

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ACKNOWLEDGEMENT

Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this research. I would like to express my deepest gratitude and appreciation to my family especially to my parents, Khalid bin Misringan and Rusiah bt Hussain who are my great supporters during my thick and thin until my project was completed. I might not finish my thesis without them as my inspiration. May Allah give them long-life, bless them and have mercy on them.

Not forgotten my appreciation to my project supervisor Dr. Farrah Melissa bt Muharam, Department of Technology, University Putra Malaysia for her guidance, continuous encouragement, precious time, and support during completing my thesis. May Allah reward this soul with goodness.

Lastly, I would like to thank my coursemates, Siti Hendon bt Md Yunos and Siti Natasha bt Muhd Nasir and not being left out my roommate Nurayshah bt Shaari, research assistant and friends for their help, support, and ideas. May Allah bless them.

ABSTRACT

The Malaysian palm oil industry contributes RM61.29 billion in Malaysian export earnings for 2013. However, basal stem rot (BSR) caused by fungi *Ganoderma boninense* is a major problem in many oil palm plantations, especially in Indonesia and Malaysia since it known as the only pathogenic disease causing significant losses of oil palm plantation in South-East Asia. Many methods have been taken to control this disease, but to date no method gives good control of *Ganoderma* in established plantation. This is because the disease cannot be detected at the early stage, and when the disease symptoms do appear more than 50% of internal tissues are already rotten additionally. There are little studies to the role of nutrition in reducing diseases of tropical tree. Adequate nutrition helps to reduce damage by replacement of root and shoot tissues. Destructive sampling is necessary to examine dry mass and nutrient content of leaves, but this method is quite labour intensive and time consuming. Proximal sensing can offer the opportunity to rapidly collect a huge amount of information regarding the crop canopy and identify plant needs non-destructively. Therefore, this study is conducted to investigate effect of Nitrogen (N), Phosphorous (P), and Potassium (K) treatments toward suppression of *Ganoderma boninense* on oil palm seedlings and to examine and analyze the reflectance of the infected oil palm seedlings using proximal sensors. In this study, data from *Ganoderma* and healthy seedlings have been analyzed to determine the most effective treatment to suppress *Ganoderma boninense* base on their spectral reflectance, chlorophyll contents and the foliar analysis. The result showed that N-excessive and K-excessive treatments have a potential to

suppress *Ganoderma boninense* since *Ganoderma* seedlings responded as good as healthy seedlings where N, P, and K contents between *Ganoderma* and healthy seedlings were not significantly different. In N-excessive treatment, *Ganoderma* seedlings showed higher P and K reading than healthy seedlings. SPAD reading was able to compare relative chlorophyll content between healthy and *Ganoderma* seedlings but failed to discriminate between different fertilizer treatments. In contrast, spectraradiometer was successful to compare spectra reflectance between healthy and *Ganoderma* seedlings at four different wavelengths which are blue, red, green, and infrared wavelengths. Therefore, these treatments can be field tested on oil palms as fertilization programme in order to suppress *Ganoderma boninense.*

ABSTRAK

Industri kelapa sawit Malaysia menyumbang RM61.29 billion dalam pendapatan eksport Malaysia bagi tahun 2013. Walaubagaimanapun, penyakit Reput Pangkal Batang (RPB) yang disebabkan oleh kulat *Ganoderma boninense* adalah merupakan masalah utama di dalam perladangan kelapa sawit di Malaysia dan Indonesia dan dikenali sebagai satu-satunya penyakit berpatogen yang menyebabkan kerugian yang ketara di Asia Tenggara. Terdapat pelbagai cara yang telah dilakukan untuk mengawal penyakit ini. Tetapi, sehingga hari ini tiada cara yang memberi kawalan yang berkesan untuk mengawal *Ganoderma* di ladang. Ini kerana penyakit ini tidak boleh dikesan pada peringkat awal, dan apabila simptom penyakit muncul melebihi 50%, bahagian tisu dalaman juga telah reput. Tidak banyak kajian yang dilakukan tentang fungsi nutrien dalam mengawal penyakit pada pokok tropika. Nutrien yang mencukupi pada tanaman dapat membantu mengurangkan kerosakan apabila tisu-tisu pada akar dan pucuk diganti. Sampel destruktif adalah perlu untuk memeriksa berat kering dan kandungan nutrien daun. Tetapi cara ini memerlukan tenaga buruh dan masa yang banyak. Penderiaan jarak dekat (proximal sensing) boleh mengumpul maklumat lebih cepat dan banyak mengenai kanopi pokok dan mengenalpasti keperluan pokok tanpa perlu merosakkannya. Oleh itu, kajian ini dijalankan bagi mengkaji kesan Nitrogen (N), Fosforous (P), dan Kalium (K) bagi mengawal *Ganoderma boninense* pada anak pokok sawit dan untuk mengkaji dan menganalisis pantulan panjang gelombang pada anak pokok sawit yang dijangkiti menggunakan penderia jarak dekat (proximal sensor). Di dalam kajian ini, data daripada anak pokok *Ganoderma* dan anak pokok yang sihat dianalisis untuk menentukan

rawatan yang paling berkesan untuk mengawal *Ganoderma boninense* berdasarkan pantulan spektra, kandungan klorofil, dan análisis kandungan daun. Keputusan menunjukkan rawatan N-berlebihan dan rawatan K-berlebihan mempunyai potensi untuk mengawal *Ganoderma* disebabkan anak pokok yang dijangkiti *Ganoderma* memberi tindak balas yang baik seperti pokok sihat. Kandungan N, P dan K anak pokok yang sihat juga tidak banyak perbezaan di antara anak pokok sihat dan anak pokok ber*Ganoderma.* Pada rawatan N-berlebihan didapati kandungan P dan K lebih tinggi di anak pokok ber*Ganoderma.* Bacaan SPAD berupaya membandingkan di antara anak pokok sihat dan anak pokok ber*Ganoderma* tetapi gagal untuk membandingkan rawatan yang menerima jumlah baja yang berbeza. Sebaliknya spektraradiometer berjaya membandingkangkan pantulan spektra antara anak pokok sihat dan ber*Ganoderma* pada empat panjang gelombang yang berbeza iaitu gelombang biru, merah, hijau, dan inframerah. Oleh itu, rawatan-rawatan ini boleh diuji di ladang pada pokok kelapa sawit sebagai program pembajaan bagi mengawal *Ganoderma boninense.*

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CHAPTER 1

INTRODUCTION

Oil palm (*Elaeis guineensis*) is the highest yielding crop among the oil producing crops which produces about 4 tonnes oil ha^{-1} $year^{-1}$ (Ariffin et al., 2000). The Malaysian palm oil industry contributed RM61.29 billion in Malaysian export earnings for 2013. The total area planted for oil palm in Malaysia was around 5.2 million hectare (MPOC, 2014). However, basal stem rot (BSR) caused by fungi *Ganoderma boninense* is a major problem in oil palm plantation, especially in Indonesia and Malaysia (Susanto et al., 2005). There are more than 44 species of *Ganoderma* from 34 genera of plants have been identified as potential hosts, including coconut and oil palm, which are the major source of infection of *Ganoderma* stem rot in oil palms (Hasan and Turner, 1998). The only pathogenic disease, *Ganoderma boninense* causing significant losses of oil palm plantation in South-East Asia which is more than 80 % of the stands by the time palms are 25 years old (Turner, 1981). There are several methods and strategy to control basal stem rot (BSR) such as use of uninfected soil in polybags to grow seedlings, prevention of infection in young growing palms, eradication of all sources of *Ganoderma* in the field, and application of biofungicides (*Trichoderma* spp.) (Soepena et al., 2000). Even though many methods have been taken to control this disease, but to date, no method gives good control of *Ganoderma* in established plantation and no genetic resistance to the disease have been described in *Elaeis guineensis* Jacq (Chong et al., 2014; Moller and Schultz, 1997). This is because the disease cannot be detected at the early stage, and when the disease symptoms do appear, more than 50% of internal tissues are already

rotten and has been destroyed by the pathogen (Darmono, 2000; Kandan et al., 2010). Soepena et al., (2000) said that after the palms more than 12 years old, the symptoms only becoming clearer. While the symptoms also can apparent as early as 1 to 2 years after planting in the field in the second and third replanting, it considers as too late to control. Darmono, (2000) found that soil drenching with fungicide may effectively kill the pathogen. However, it is not economically feasible for a large scale application. Another method to detect BSR on infected plants by using an Imunoassay based detection kit. An Imunoassay technique also was recognized as a practically tool to use in field and need less equipment compare to other analyses such as DNA probe analyses. Antigen from isolated mycelia's *Ganoderma* sp. was used to produce antibody against *Ganoderma*. Unfortunately, the antibody only recognizes antigenic materials from in vitro cultures samples and not from field fruiting bodies or spores. Furthermore, the antibody produced was not has the ability to distinguish *Ganoderma* from different hosts (Darmono, 2000).

Tayeb et al. (1999) discovered that one of method to find solution to the disease problem was by manipulation of nutrient either through changing the soil environment or by using soil amendment. However, there are little studies focuses on the role of nutrition in reducing diseases of tropical tree crops (MacMohan, 2012). Marschner (1995) in his study stated that adequate nutrition helps to reduce damage by replacement of root and shoot tissues.

Most of the methods of sampling for detecting *Ganoderma* are usually by destructive sampling method. Destructive sampling is necessary to examine dry mass and nutrient content of leaves, but quite labour intensive and time consuming (Menessati et al., 2012). However, proximal sensing can provide the option to quickly collect a huge

amount of information regarding the crop canopy and recognize plant needs such as non-destructively (Shafri et al., 2011). Proximal sensing is one of technology that can be applied to get rapid information such as SPAD chlorophyll meter which functions to estimate chlorophyll content of plants in the real time diagnosis of the nutritional of plants (Menessati et al., 2012). Thus, since there are little studies focuses on the effect of macronutrients towards *Ganoderma boninense* suppression by using proximal sensing, the aim of this study are:

1.1 To investigate effect of NPK treatments toward suppression of *Ganoderma boninense* on oil palm seedlings.

1.2. To examine and analyze the reflectance of the infected oil palm seedlings using proximal sensors.

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