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A project submitted to Faculty of Agriculture, University Putra Malaysia, in fulfillment of the requirement of PRT 4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science

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CERTIFICATION FORM

This project report entitled "Effects of Micronutrients (Boron, Copper, Manganese) on Ganoderma boninense Suppression on Oil Palm Seedlings Measured by Using Proximal Sensors (spectroradiometer GER 1500 and SPAD 502 chlorophyll meter)" is prepared by Mohammad Hilmi Bin Mohd Zahir 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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ABSTRACT

Ganoderma disease is known as biggest threat in the Southeast Asia country, mainly Malaysia and Indonesia. The disease is hard to control because of its characteristics that are soil borne and cannot be detected for early infection. This study was done to investigated the manipulation of micronutrients (Boron, Copper, Manganese) on *Ganoderma boninense* suppression, and to measure the effectiveness of proximal sensors; spectroradiometer GER 1500 and SPAD 502 Minolta on heatlh condition of Ganoderma boninense's infected oil palm seedlings treated with Boron (B), Copper (Cu), and Manganese (Mn). The experiment was done for eight months. Tenera's variety of oil palm seedlings was used for five treatments that are T1 (control 1, non inoculated + Basic fertilizer), T2 (control 2, inoculated + Basic fertilizer), T3 (Basic fertilizer + 3 mg B/kg of soil), T4 (Basic fertilizer + 2 mg Cu/kg of soil), and T5 (Basic fertilizer + 2 mg Mn/kg of soil). Correlation coefficient between spectral reflectance of different wavelengths and SPAD with bulb severity shows averagely high value of Pearson correlation coefficient. However, only correlation of SPAD and bulb severity shows significant difference at 0.05 significant level. The regression between SPAD and bulb severity shows the highest result of regression. This could be related to suppressed chlorophyll production and damaged cell structure with different treatment of micronutrients. T3 treatment was successful to lower the disease severity levels. Proximal sensors used in this experiment were worth to indicate early infection of *Ganoderma boninense*.

ABSTRAK

Penyakit Ganoderma telah dikenali sebagai ancaman yang terbesar dalam kalangan Negara Asia Tenggara terutamanya di Malaysia dan Indonesia. Penyakit ini amat sukar untuk dikawal kerana ciri-cirinya yang berasal daripada tanah dan susah untuk dikesan pada peringkat awal jangkitan. Kajian ini dilakukan untuk mengkaji kesan manipulasi mikronutrien (B, Cu, Mn) terhadap pembantutan *Ganoderma boninense*, dan untuk menyukat keberkesanan penderiaan jarak dekat; spektroradiometer GER 1500 dan SPAD 502 klorofil meter terhadap keadaan kesihatan anak pokok kelapa sawit yang telah dijangkiti *Ganoderma boninense* yang mana telah dirawat dengan Boron (B), Kuprum (Cu), and Mangan (Mn). Anak pokok kelapa sawit varieti *Tenera* digunakan untuk eksperimen ini yang mempunyai lima rawatan, iaitu rawatan T1 (kawalan 1, tidak diinokulat + baja asas), rawatan T2 (kawalan 2, diinokulat + baja asas), rawatan T3 (baja asas + 2 mg B/kg tanah), rawatan T4 (baja asas + 2 mg Cu/kg tanah), dan rawatan T5 (baja asas + 2 mg B/kg tanah). Pekali korelasi antara pantulan spektrum yang berlainan panjang gelombang dan SPAD dengan keterukan umbisi menunjukkan jumlah pekali korelasi *Pearson* yang tinggi secara puratanya. Bagaimanapun, hanya korelasi antara SPAD dan keterukan umbisi menunjukkan perbezaan siginifikan di tahap signifikan 0.05. Regresi antara SPAD dan keterukan umbisi menunjukkan hasil regresi yang paling tinggi. Perkara ini boleh dikaitkan dengan penghasilan klorofil yang berkurang dan struktur sel yang musnah dengan perbezaan rawatan mikronutriens. Rawatan T3 berjaya mengurangkan tahap keterukan penyakit. Penderiaan jarak dekat yang digunakan dalam eksperimen ini berbaloi untuk mengenalpasti jangkitan awal *Ganoderma boninense*.

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CHAPTER 1

INTRODUCTION

Oil palm (*Elaeis guineensis*) is planted around 15 million ha in the world (FAO, 2009, Fitzherber *et al.*, 2008; Koh and Ghazoul, 2008; Koh and Wilcove, 2008a). Oil palms are suitable for planting only in the tropics and have mainly been cultured in Indonesia, Malaysia and Thailand in Southeast Asia, Nigeria in Africa, Colombia and Ecuador in South America and Papua New Guinea in Oceania (FAO, 2009).

Among the biggest threats to sustainable oil palm production in South East Asia is Ganoderma diseases, caused by *Ganoderma boninense* (Flood *et al*., 2000). Wong *et al*. (2012) described that Ganoderma disease is considered to be the most crucial and lethal oil palm disease in the Southeast Asian countries, mainly in Malaysia and Indonesia. The disease is difficult to control because there is no early recognition system that can be trusted due to lacking of information of Ganoderma spp. (Rolph *et al*., 2000).

Nowadays, significant reduction of the disease can be attained through appropriate healthy managements of plant, but only to minimize the introduction of the pathogen since it is impossible get a field of zero pathogen (Sanderson *et al.*, 2000). Susanto *et al*. (2005) said that the disease is hard to control because of the characteristics of *Ganoderma boninense* that is soil borne, making the fungicide less efficient. The effect of fertiliser on oil palm may be one of the solutions to suppress the disease although it is too early to find out how effective fertilisers are against *Ganoderma boninense.*

Early detection of the Ganoderma disease is important to prevent high loss. In the early days, the *Ganoderma* disease could only be analysed through the symptoms in the field such as older leaves wilting and falling; and also with the presence of basidiomata of *Ganoderma boninense* (Lelong *et al*., 2010). Another early method was boring into diseased material in the tree for testing and afterward utilizing either a colorimetric system utilizing ethylenediaminetetraacetic acid (EDTA) (Natarajan *et al*., 1986) or a semi-selective media to develop *Ganoderma* on agar plates (Darus *et al*., 1993). Both of these methods were drawn out and not exceptionally precise and it is currently perceived that when basidiomata is evident, the illness is now entrenched (Utomo and Niepold, 2000).

As the effects of micronutrients towards suppression of Ganoderma are not widely research, more study needs to be conducted on this subject matter as an early detection mechanism. Thus, this study was established to address the following objectives:

i. To examine the manipulation of micronutrients (Boron, Copper, and Manganese) on *Ganoderma boninense* suppression, and
ii. To measure the effectiveness of proximal sensors (spectroradiometer GER 1500 and SPAD 502 Minolta) on analyzing the health condition of *Ganoderma boninense* infected oil palm seedling treated with micronutrients mentioned in objective (i).

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