UNIVERSITI PUTRA MALAYSIA

PERFORMANCE OF Trichoderma harzianum Rifai AS A BIOLOGICAL CONTROL AGENT FOR BASAL STEM ROT OF OIL PALM (Elaeis guineensis Jacq.) CAUSED BY Ganoderma boninense Pat.

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By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Master of Science

February 2005

This thesis is especially dedicated to my family……...

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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February 2005

Chairman : Associate Professor Faridah Abdullah, PhD

Faculty : Science

Basal stem rot (BSR) is a major threat to the oil palm industry. The disease is caused by *Ganoderma boninense,* which rots the internal tissues at the trunk base resulting in stem fracture and death of palm. The present study investigated the efficacy of two isolates of *Trichoderma harzianum* (BIO T32 and BIO T66) as potential biological control agents against BSR based on *in vitro* and *in vivo* trials.

The study revealed that treatment applied as a soil drench using conidial suspension (mean of 1.61 x 10^8 spores/ml) of BIO T32 in addition to a *Trichoderma*-incorporated palm press fibre (ppf) surface mulch, performed better with a significant difference compared to the use of BIO T66. The disease severity index (DSI) of the former was 28.35 compared to 76.67 of the latter. BIO T32 was also a competent biological control agent in the delayed treatment given to pre-infected seedlings at 6 weeks before treatment with BIO T32, giving a DSI of 45, which was statistically significant compared to the infected and untreated control seedlings with a DSI of 86.67. In testing the synergistic

effect by combining the 2 isolates, a poorer performance was observed based on the DSI and plant biomass compared to single application of BIO T32. Isolate BIO T66 which showed good antagonistic properties in the *in vitro* assessment was not found to display similar results in the *in vivo* trials.

A series of treatments were evaluated for their potential as a BIO T32 carrier. Out of the 3 studies, only ppf and compost exhibited promising results in their capacity as surface mulches, where treatments with either one gave a DSI of 30. Both are food base carriers for they increased the growth of oil palm seedlings significantly, with compost displaying better results. Treatment with compost in terms of vegetative growth gave the highest plant biomass, leaf area measurement, nitrogen, phosphorus and potassium (NPK) content in the seedlings compared to the other 2 treatments of ppf and the untreated control seedlings.

In total, the experiment revealed that the application of BIO T32 as a single inoculum was the best treatment, giving a DSI of 28.35. Trials using a single application of BIO T66 and BIO T66 mixed with BIO T32 performed poorly, giving a DSI of 76.67 each and were not significantly different from the infected non-treated control plants. An appropriate interval of conidial suspension's application played a pertinent role in the inhibition of disease as demonstrated in the delayed treatment. The application of compost was found to be an interesting alternative to ppf as surface mulch, which functions also as a *Trichoderma* carrier. Finally, in terms of vegetative growth both ppf

and compost as food base carriers significantly increased plant biomass, total leaf area measurement and N uptake compared to the untreated control.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KEBOLEHAN *Trichoderma harzianum* Rifai SEBAGAI AGEN KAWALAN BIOLOGI TERHADAP PENYAKIT REPUT PANGKAL BATANG KELAPA SAWIT (*Elaeis guineensis* Jacq.) YANG DISEBABKAN OLEH *Ganoderma boninense* Pat.

Oleh

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Penyakit reput pangkal batang adalah serius bagi industri pokok kelapa sawit. Penyakit ini disebabkan oleh *Ganoderma boninense* yang menyebabkan reputan pada pangkal pokok yang mengakibatkan kerosakan batang pokok dan akhirnya kematian. Kajian ini menyiasat 2 isolat *Trichoderma harzianum* (BIO T32 dan BIO T66) dalam kebolehan sebagai agen kawalan biologi yang berpotensi terhadap penyakit reput pangkal melalui ujian makmal dan rumah hijau..

Kajian ini telah membuktikan rawatan aplikasi tunggal menggunakan suspensi konidia (purata 1.61 x 10^8 spora/ml) bersama serabut kelapa sawit BIO T32 memberikan keputusan yang lebih baik berbanding dengan BIO T66. Keputusan keparahan index penyakit (DSI) bagi BIO T32 adalah lebih baik dengan 28.35 berbanding BIO T66 dengan 76.67. BIO T32 juga terbukti sebagai agen kawalan biologi yang berpotensi apabila ia memberikan keputusan yang memberangsangkan bagi rawatan 6 minggu lewat

kepada anak pokok kelapa sawit yang dijangkiti EGB 01 berbanding dengan anak pokok yang tidak dirawat (Kawalan II). Dalam menentukan keberkesanan kombinasi 2 isolate tersebut keputusan yang tidak baik diperolehi melalui DSI, berat kering anak pokok jika dibandingkan dengan rawatan menggunakan BIO T32. Isolat BIO T66 yang memberikan keputusan baik dalam ujian *in vitro* tidak memberikan keputusan yang sama dalam ujian *in vivo*.

Beberapa rawatan telah dikaji sebagai pengangkut BIO T32. Dari 3 rawatan yang dikaji, hanya serabut kelapa sawit dan kompos memberikan keputusan yang memberangsangkan dengan DSI 30 untuk kedua-dua rawatan di akhir eksperimen. Kedua-dua agen pengangkut ini juga telah meningkatan pertumbuhan anak pokok dengan kompos memberikan keputusan yang lebih tinggi dan bererti dalam penyerapan nitrogen, fosforus dan kalium (NPK), berat kering anak pokok serta jumlah luas daun yang paling tinggi berbanding dengan 2 rawatan iaitu serabut kelapa sawit dan kawalan (tidak dirawat).

Secara keseluruhan, kajian ini mendapati rawatan menggunakan BIO T32 secara tunggal lebih berkesan dengan DSI 28.35. Rawatan menggunakan BIO T66 dan kombinasi bersama BIO T32 tidak memberikan keputusan yang memberangsangkan dengan DSI bernilai 76.67 untuk setiap satu. Suspensi konidia yang diberikan pada masa yang betul memberikan keputusan yang memberangsangkan dalam supresi penyakit terutamanya pada anak pokok yang dirawat lewat setelah dijangkiti awal oleh *G.boninense*. Kompos menunjukkan keputusan yang memberangsangkan sebagai agen pengangkut alternatif

kepada serabut kelapa sawit. Akhir sekali, kedua-dua agen iaitu serabut kelapa sawit dan kompos sebagai pengangkut memberikan keputusan yang bererti dalam meningkatkan berat kering anak pokok, jumlah luas daun dan pengambilan nitrogen (N), jika dibandingkan dengan anak pokok yang tidak dirawat.

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LIST OF ABBREVIATIONS

DSI	:	Disease Severity Index
ANOVA	:	Analysis of Variance
DMRT	:	Duncan's Multiple Range Test
PDA	:	Potato Dextrose Agar
MEA	:	Malt Extract Agar
TDW	:	Top dry weight
RDW	:	Root dry weight
PIRG	:	Percentage Inhibition of Radial Growth
NPK	:	Nitrogen, Phosphorus and Potassium
ppf	:	palm press fibre
cfu	:	colony forming unit
w. a. i.	:	weeks after infection
g	:	gram
m	:	meter
ml	:	mililitres
L	:	liter
d	:	diameter
cm	:	centimeter
Kg	:	kilogram
C	:	celcius
rpm	:	rotation per minute

CHAPTER I

INTRODUCTION

The oil palm, *Elaeis guineensis*, is the highest yielding among the oil-producing crops (Ariffin *et al.*, 2000). It is an important species in the tropical regions because of its two main raw materials namely; palm oil and palm kernel oil. Palm oil commands an average yield of about 4 tonnes oil ha^{-1} $year^{-1}$. In the year 2002, Malaysia produced 60% of the world's palm oil with a total production of about 11 million tonnes (World Oils & Fats, 2002).

Like any other crop, the oil palm also faces a lot of pest and disease (P&D) tribulations. From seed germination right up to field planting, the crop is exposed to several P&D problems, some of which is caused by fungi. Some of the P&D problems faced by oil palm industry are the basal stem rot, brown germ, upper stem rot, *Rhinoceros* beetles and bagworm (Turner, 1981). Among these, the current most serious disease is Basal Stem Rot (BSR). For the past 50 years or more, BSR had been causing serious damage to the oil palm plantation in Malaysia. The disease is also prevalent in Indonesia, Zaire, Ghana, Nigeria, Cameroon, San Tome, Principe, Angola, Rhodesia and Papua New Guinea (PNG) (Turner, 1981) with incidence being relatively low in PNG (Pilotti, 2001).

The causal pathogen of this disease is the fungus *Ganoderma*. Not only does it attack oil palms, it is also the causal agent of root and stem rots of other crops namely; coconut,