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BIOCONTROL OF FUSARIUM EAR ROT OF MAIZE USING TRICHODERMA SPECIES

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By

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BIOCONTROL OF FUSARIUM EAR ROT OF MAIZE USING *TRICHODERMA* SPECIES

By
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October 2013

Chairman: Nur Ain Izzati binti Mohd Zainudin, PhD
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The present study conducted to screen the biocontrol agent of different species of *Trichoderma* against Fusarium ear rot (FER), which examined under *in vitro* and plant house conditions. Seventy-two isolates of *Trichoderma* were successfully isolated from rhizosphere of different crops. All isolates were identified into three species such as *T. harzianum* (51 isolates), *T. koningii* (20 isolates) and *T. hamatum* (1 isolate).

Pathogenicity test of six isolates of *Fusarium* (B84c, C116c, C121c, P175c, P191c and P202c) to maize ear (variety Thailand Supersweet) and the symptoms development of FER were observed after seven days of pathogens inoculation. The results proved that *F. proliferatum* P202c and *F. verticillioides* C116c were pathogenic and caused FER. Both pathogens were challenged in dual culture test with 72 identified isolates of *Trichoderma*. *Trichoderma harzianum* T73s gave the highest percentage inhibition of 73.10% and 79.46% against *F. proliferatum* P202c and *F. verticillioides* C116c, respectively. The interaction appeared with the formation of clear zone between the pathogens and *Trichoderma. Trichoderma harzianum* T73s was further tested for its efficacy to suppress FER disease under plant house condition.

The severity of FER was significantly reduced in the maize plants treated with *T. harzianum* T73s every week, immediately after planting (T1) with percentage of disease severity (DS) 10% and 8% against P202c and C116c, respectively. In contrast, the DS of positive control (C3) for P202c and C116c were 95% and 94%, respectively. The ears in T2 moderately suppressed FER with DS 38% and 34% against P202c and C116c, respectively. The ears for negative control that were inoculated with distilled water and uninoculated remained intact. The other treatments (T3 and T4) were unable to reduce the severity of FER disease. This study reported that *T. harzianum* T73s can be applied as a biocontrol agent and has a potential for further tests in the field and commercial scales.

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

KAWALAN BIOLOGI REPUT TONGKOL FUSARIUM PADA JAGUNG MENGGUNAKAN *TRICHODERMA* SPESIS

Oleh
SUHAIDA BINTI SALLEH
Oktober 2013

Pengerusi: Nur Ain Izzati binti Mohd Zainudin, PhD
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Kajian ini dijalankan untuk menyaring agen kawalan biologi beberapa spesis *Trichoderma* yang berbeza terhadap reput tongkol Fusarium (FER), yang dikaji secara *in vitro* dan di bawah persekitaran rumah tumbuhan. Sejumlah 72 pencilan *Trichoderma* telah berjaya diisolat dari rizosfera pelbagai jenis tanaman. Semua isolat telah dikenalpasti kepada tiga spesis iaitu *T. harzianum* (51 pencilan), *T. koningii* (20 pencilan) dan *T. hamatum* (1 pencilan).

Ujian kepatogenan enam pencilan *Fusarium* (B84c, C116c, C121c, P175c, P191c dan P202c) ke atas tongkol jagung (varieti Thailand Supersweet) dan perkembangan simptom FER diperhatikan selepas tujuh hari inokulasi patogen. Keputusan kajian membuktikan bahawa *F. proliferatum* P202c dan *F. verticillioides* C116c adalah patogenik dan menyebabkan penyakit FER. Kedua-dua patogen diuji dalam ujian kultur dual dengan 72 isolat *Trichoderma* yang telah dikenalpasti. *Trichoderma harzianum* T73s memberikan perencatan peratusan yang paling tinggi iaitu masing-masing 73.10% dan 79.46%, terhadap *F. proliferatum* P202c dan *F. verticillioides* C116c. Interaksi kelihatan dengan pembentukan zon jernih di antara patogen-patogen dan *Trichoderma. Trichoderma harzianum* T73s telah diuji selanjutnya untuk kebersanan menahan penyakit FER di bawah persekitaran rumah tumbuhan.

Keparahan penyakit FER berkurang secara signifikan pada pokok jagung yang dirawat dengan *T. harzianum* T73s setiap minggu, sejurus selepas ditanam (T1) dengan peratusan keparahan penyakit (DS) 10% dan 8%, masing-masing terhadap P202c dan C116c. Sebaliknya, DS kontrol positif (C3) bagi P202c dan C116c adalah masing-masing 95% dan 94%. Tongkol jagung pada T2 menahan FER dengan sederhana dengan DS 38% dan 34%, masing-masing terhadap P202c dan C116c. Tongkol jagung bagi kontrol negatif yang telah diinokulasi dengan air suling dan tidak diinokulasi kekal utuh. Rawatan-rawatan lain (T3 dan T4) gagal mengurangkan keparahan penyakit FER. Kajian ini melaporkan bahawa *T. harzianum* T73s boleh menjadi agen pengawalan biologi yang baik dan berpotensi untuk diuji selanjutnya di padang dan skala komersial.

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I certify that a Thesis Examination Committee has met on 29 October 2013 to conduct the final examination of Suhaida binti Salleh on her thesis entitled "Biocontrol of Fusarium Ear Rot of Maize using *Trichoderma* Species" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.

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This is to confirm that:

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
CLA	Carnation Leaf Agar
DS	Disease severity
FAO	Food and Agriculture Organization
FER	Fusarium ear rot
HYV	High Yielding Varieties
LSD	Least significant difference
MARDI	Malaysian Agricultural Research and Development Institute
PDA	Potato Dextrose Agar
PIRG	Percentage inhibition of radial growth
RBA	Rose Bengal Agar
SNA	Spezieller Nährstoffarmer Agar
UV	Ultraviolet
USM	University of Southern Mindanao
v/v	Volume per volume

CHAPTER ONE

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereals in the world and is used in human diet, animal feeds and industrial purposes. According to The Food and Agriculture Organization, FAO (2013), the global production of maize is about 800 million tonnes per year. The United States of America is the major producer of maize in the world with total production of 316 million tonnes (37%) in 2010.

The major maize-producing countries in Asia are China with 177 million tonnes per year followed by Indonesia, India, Philippines and Vietnam (FAO, 2013). Meanwhile, the production of maize is lower in Malaysia as compared to other countries with only about 36 thousand tonnes per year. This phenomenon is due to the Malaysian smallholders are more attracted to the established crops. The climate factor including unpredictable rain during harvesting period, higher labour cost and diseases that attacked the maize also contributed to this phenomenon.

Malaysia is relying on its golden crop, oil palms and this represents 93% of total crops production (FAO, 2013). Many researches succeeded on maximizing and expanding the production of oil palms. However, not many efforts were emphasized on production of other crops including maize. Based on target of Third National Agriculture Policy (NAP3), Malaysia has to increase the production of crops up to 2.4% every year (Department of Agriculture, 2012). Therefore, it is required to focus on problems associated with food productions in Malaysia in order to increase food self-sufficiency and to minimize food import.

From 2006 until 2010, the production of maize in Malaysia decreased by 54% (FAO, 2013). Beside the damage by weeds, animal pests, climatic conditions and the geographical distributions, maize plants are susceptible to plant pathogens. One of the most prevalent diseases of maize is Fusarum ear rot (FER) and the pathogens of this disease are *F. graminearum, F. proliferatum, F. subglutinans* and *F. verticillioides* (Goertz *et al*., 2010).

In Malaysia, FER disease becomes serious and in order to maintain the quantity and quality of maize, this disease has to be controlled. Nowadays, most of fungal diseases are controlled by using synthetic fungicides. However it leads to environmental contamination and developments of fungicide-resistant strains of pathogen (Bressan, 2003). As alternative method, biocontrol has extensively been studied and one of the most promising biocontrol agents is *Trichoderma* species.

The objectives of this study are:

1. To isolate and identify *Trichoderma* isolates obtained from various soil samples.
2. To screen the antagonist activity of *Trichoderma* species against pathogens of FER disease under *in-vitro* condition.
3. To examine efficacy of *T. harzianum* T73s as a biocontrol agent of FER disease under plant house condition.

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