UNIVERSITI PUTRA MALAYSIA

DRECHSLERA CYNODONTIS AS A POTENTIAL BIOHERBICIDE FOR CONTROLLING GOOSEGRASS (ELEUSINE INDICA)

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MASTER OF SCIENCE

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By

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

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Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Master of Agriculture Science

Drechslera cynodontis as a Potential Bioherbicide for Controlling Goosegrass (*Eleusine indica*)

By

Chia Shin Zhi

July 2009

Chairman : Associate Professor Dr. Jugah bin Kadir

Faculty : Agriculture

An ideal bioherbicide should be easy and cheap to produce, viable and efficacious in controlling target weed with definite time. *Drechslela cynodontis* has been reported as the potential bioherbicide for goosegrass; however, its control efficacy has several shortcomings. A study was conducted to determine the suitability of *D.cynodontis* as bioherbicide for controlling gooserass both in the glasshouse and in the field. In the pathogenicity test, mycelium and conidia base concentration have significant effect on disease development as indicated by the high AUDPC values and faster rate of disease development. Significantly higher disease developed (DS=100%) in treatment with 0.05g/ml mycelium and 2.5 x 10^6conidia/ml respectively on the four leaf-stage goosegrass 6 days after inoculation. Besides, it also caused 100% disease severity on *Dactylotenium agegypyium*. The fungus infected other closely related grassy weeds (disease index=3 and 4) and produced small necrotic lesions on crop plants such as rice and corn and are resistant (disease index=2) which recovered after several days. Even though *D.cynodontis* was suitable in various cropping situations, but a crucial understanding of the conditions under which high level of disease development is important. *Drechslera* sp. requires over of 12 hours of dew period for maximum disease development (DS=100%), dew period less than 12 hour resulted on less disease developed. Therefore oil emulsion (10 % palm oil) has been used to circumvent the dew period requirement, as this emulsion has helped in creating higher disease severity. Temperature between 25-30^{0}C are suitable for spore germination and appressorium formation on leave surface. When the incubation temperature was increased to 35^{0}C, conidial germination and appressorium formation were reduced. At this temperature, most infection process was stopped at the stage of germ tubes elongation. Spore germination and formation of appressorium were significantly higher in the dark (91%) compared to light (75%) at 30^{0}C. Understanding the course of the infection and development of *D.cynodontis* could aid in elucidating the mechanism of host death and in determine the suitability of *D.cynodontis* as the biocontrol agent for goosegrass. Conidia started to germinate 3 hr (40.75%) after inoculation on goosegrass in dark condition. Germ tubes were produced abundantly 6 hr (53.75%) after inoculation and penetration occurred after appressorium formation and started to colonize the epidemal cells. For the chemical herbicide interaction study, spore germination was high in treatment containing 0.25X Glyphosate (95%) compare to other herbicides at similar concentration. At this concentration, conidial germination was reduced by 80% with Metolachlor, 72% with Clethodim, 60% with Glufosinate ammonium, and 20% with Paraquat. The interaction between these chemicals and conidia germination indicated a negative linear relationship, where spore germinations are constantly decreased with the increase in herbicide concentration. Sublethal rate of herbicide combined with pathogen may incite synergistic effect, potentially increasing weed control and reducing management costs. Lastly, all the results were supported by mini plot trial. Mixture of glyphosate and mycelium was found highly significant (AUDPC = 490 unit^2) on goosegrass control, resulting in reduced

dry weight and tiller production. Mycelium suspension alone was also very effective in controlling goosegrass (AUDPC = 432.5 unit^2). Control sprayed with oil emulsion only or non-inoculated control showed a very low AUDPC (15 unit^2) or no disease developed on goosegrass. This study suggested that *D. cynodontis* can be used to control goosegrass under field condition with or without chemical as auxiliary. Therefore, *Drechslera cynodontis* exhibited the most ideally biocontrol agent to control goosegrass and compatible with herbicide management tactics in integrated weed management system.

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

Drechslera cynodontis sebagai Bioherbisid untuk Pengawalan Rumput Kekuasa (*Eleusine indica*)

By

Chia Shin Zhi

July 2009

Chairman : Associate Professor Dr. Jugah bin Kadir

Faculty : Agriculture

Bioherbisid merupakan satu idea yang murah dan mudah dihasilkan dalam kuantiti yang banyak di samping juga berkesan untuk mengawal rumpai dalam masa yang singkat. *Drechslela cynodontis* telah dilaporkan sebagai bioherbisid yang berpotensi untuk mengawal Rumput Kekuasa; akan tetapi, masih mempunyai beberapa kelemahan dari segi keberkesananya. Satu kajian telah dijalankan dalam rumah kaca dan di ladang untuk menentukan kesesuaian *D.cynodontis* sebagai bioherbisid untuk mengawal rumput Kekuasa. Dalam kajian kepatogenan, inokula jenis miselium dan konidia telah menunjukkan kesannya ke atas perkembangan penyakit dengan nilai-nilai AUDPC yang tinggi. Penyakit yang berkesan dapat dinyatakan dalam rawatan dengan 0.05g/mL miselium dan 2.5 x 10^6 konidia/mL masing-masing. *D. cynodontis* telah meninggalkan kesan dengan kadar kematian 100% ke atas Rumput Kekuasa di peringkat empat helai

daun pada hari ke-6 selepas penginokulatan. Selain itu, ia juga menyebabkan 100% keparahan ke atas *Dactylotenium agegypyium*. Kulat ini juga menjangkiti rumput-rumput lain (indeks penyakit=3 dan 4) dan juga menghasilkan nekrosis kecil pada tanaman padi dan jagung (indeks penyakit=2), tetapi tanaman ini pulih selepas beberapa hari. Walaupun *D. cynodontis* sesuai digunakan dalam pengawalan pelbagai rumpai, tetapi pemahaman bagi perkembangan penyakit pada tahap yang tertinggi adalah penting. Tempoh cahaya dan kelembapan adalah faktor-faktor yang penting ke atas perkembangan penyakit. Tempoh selama 12 jam kegelapan diperlukan untuk jangkitan maksimum ke atas daun itu. *D. cynodontis* memerlukan sekurang-kurangnya 12 jam tempoh kelembapan untuk perkembangan penyakit maksimum, manakala tempoh kelembapan $<$ 12 jam kurang menghasilkan penyakit ke atas daun tersebut. Oleh itu, emulsi minyak (10 % minyak sawit) telah digunakan untuk memintasi keperluan kelembapan, di samping juga meningkatkan kecederaan yang lebih tinggi ke atas Rumput Kekuasa. Suhu di antara 25- 30^0C adalah suhu paling sesuai untuk percambahan konidia dan pembentukan apresorium di permukaan daun. Apabila suhu pengeraman bertambah kepada 35^0C, percambahan konidia dan pembentukan apresorium telah dikurangkan. Pada suhu ini (35^0C), kebanyakan proses mulai direncat semasa tiub germa memanjang. Percambahan konidia dan pembentukan apresorium adalah lebih nyata dalam keadaan gelap (91%) berbanding dalam keadaan cerah(75%) di bawah suhu 30^0C. Kursus pemahaman kaedah mekanisme jangkitan *D. cynodontis* ke atas hos boleh membantu dalam menentukan kesesuaian *D.cynodontis* sebagai agen kawalan biologi untuk Rumput Kekuasa. Konidia mulai bercambah selepas 3 jam penginokulatan ke atas Rumput Kekuasa (40.75%). Selepas 6 jam penginokulatan, tiub germa banyak dihasilkan (53.75%), penembusan mulai berlaku menjajah ke dalam sel-sel rumput selepas pembentukan apresorium. Dalam kajian penginteraksi racun herba kimia, percambahan konidia adalah tinggi (95%) dengan rawatan mengandungi 0.25x Glyphosate berbandingan herbisid kimia yang lain di bawah dos serupa. Di bawah dos ini, percambahan konidia telah dikurangkan sebanyak 80% dalam Metolaklor, 72% dalam Clethodim, 60% dalam Glufosinate, dan 20% dalam Paraquat. Interaksi antara bahan-bahan kimia ini dengan percambahan konidia menunjukkan satu hubungan linear yang negatif, di mana percambahan konidia adalah berkurangan dengan peningkatan dos herbisid kimia. Dos sampingan herbisid kimia dengan patogen akan memberi kesan sinergi, berpotensi meningkat prestasi pengawaalan rumpai dan mungurangkan kos penghasilan. Kesimpulan ini dapat dikukuhkan lagi dengan keputusan daripada kajian mini plot. Campuran glyphosate dan mesilium telah dijumpai amat penting (AUDPC = 490 unit2) untuk mengawal Rumput Kekuasa, mengakibatkan pengurangan biomas kering dan pengeluaran anak rumput . Penggunaan mesilium secara bersendirian sahaja juga amat berkesan untuk mengawal Rumput Kekuasa (AUDPC = 432.5 unit2). Penyemburan dengan minyak sahaja atau kawalan (tanpa diinokulasi) menunjukkan AUDPC (15 unit2) yang sangat rendah atau tiada pembentukan penyakit ke atas Rumput Kekuasa. Keputusan daripada kajian ini menunjukkan *D. cynodontis* berpotensi digunakan sebagai bioherbisid dalam pengawlan Rumput Kekuasa secara individu ataupun dengan campuran herbisid di ladang. Oleh itu, *D. cynodontis* dicadangkan sebagai agen biokawalan untuk mengawal Rumput Kekuasa secara berintegrasi.

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APPROVAL SHEET NO. 1

I certify that an Examination Committee met on -------- to conduct the final examination of CHIA SHIN ZHI on her Master of Science thesis entitled "DRECHSLERA CYNODONTIS AS POTENTIAL BIOHERBICIDE FOR CONTROLLING GOOSEGRASS (*ELEUSINE INDICA*)" in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Putra Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree.

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This thesis presented to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirement for the degree of Master of Agriculture Science. The members of the Supervisory Committee were as follows:

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Date: 24 November 2009

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently for any other degree at UPM or other institutions.

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CHIA SHIN ZHI

Date:

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

LIST OF ABBREVIATIONS

^{o}C	Degree Celcius
%	Percentage
µL	Micro liter
µm	Micrometer
>	More than
±	Plus minus
ANOVA	Analysis of Variance
AUDPC	Area under disease progress curve
CABI	Commonwealth Agriculture Bureau International
cm	Centimeter
CO_2	Carbon dioxide
CRD	Completely Randomized Design
D	Dark
DI	Disease index
DS	Disease severity
g	Gram
h / hr	Hour
HR	Humidity relative
Kg	Kilogram
L	Light
LC	Lethal concentration

LCB	Lactophenol cotton blue
LM	Light microscopy
LS	Leaf-stage
m	Meter
min	Minute
mL	Milliliter
PDA	Potato Dextrose Agar
ppm	Part per million
r_L	Epidemic rate
R^2	Coefficient
rpm	Rotation per minute
SEM	Scanning electron microscopy
vol / v	Volume
V8	Vegetable juice 8
w	Weight