



**UNIVERSITI PUTRA MALAYSIA**

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

**CHIA SHIN ZHI  
FP 2009 24**



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

By

**CHIA SHIN ZHI**

**MASTER OF SCIENCE**

**UNIVERSITY PUTRA MALAYSIA**

**2009**





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

**By**

**CHIA SHIN ZHI**

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

**July 2009**





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. *Drechslera 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 goosegrass 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  $2.5 \times 10^6$  conidia/ml respectively on the four leaf-stage goosegrass 6 days after inoculation. Besides, it also caused 100% disease severity on *Dactyloctenium aegyptium*. 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<sup>0</sup>C are suitable for spore germination and appressorium formation on leave surface. When the incubation temperature was increased to 35<sup>0</sup>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<sup>0</sup>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 epidermal 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<sup>2</sup>) 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<sup>2</sup>). Control sprayed with oil emulsion only or non-inoculated control showed a very low AUDPC (15 unit<sup>2</sup>) 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 rumput dalam masa yang singkat. *Drechslera cynodontis* telah dilaporkan sebagai bioherbisid yang berpotensi untuk mengawal Rumput Kekuasa; akan tetapi, masih mempunyai beberapa kelemahan dari segi keberkesanannya. 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  $2.5 \times 10^6$  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 *Dactylothenium aegyptium*. 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 rumput, 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<sup>0</sup>C adalah suhu paling sesuai untuk percambahan konidia dan pembentukan apresorium di permukaan daun. Apabila suhu pengeraman bertambah kepada 35<sup>0</sup>C, percambahan konidia dan pembentukan apresorium telah dikurangkan. Pada suhu ini (35<sup>0</sup>C), 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<sup>0</sup>C. 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 berbanding 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 pengawalan rumput 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 unit<sup>2</sup>) 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 unit<sup>2</sup>). Penyemburan dengan minyak sahaja atau kawalan (tanpa diinokulasi) menunjukkan AUDPC (15 unit<sup>2</sup>) yang sangat rendah atau tiada pembentukan penyakit ke atas Rumput Kekuasa. Keputusan daripada kajian ini menunjukkan *D. cynodontis* berpotensi digunakan sebagai bioherbisid dalam pengawalan Rumput Kekuasa secara individu ataupun dengan campuran herbisid di ladang. Oleh itu, *D. cynodontis* dicadangkan sebagai agen biokawalan untuk mengawal Rumput Kekuasa secara berintegrasi.



## ACKNOWLEDGRMENTS

First and foremost, I wish to thank god that almighty for his grace and always making thing works out fine for the duration of this project. Sincere appreciation and heartfelt gratitude to my committee member, Associate Professor Dr. Jugah Kadir and Professor Sariah Meon for their enormous guidance, ideas, understanding, concern and moral support throughout the course of this project. Their constant support in this project is gratefully acknowledged.

Special acknowledgement is given to MOSTE by funding the project under IRPA grant. The encouragement and facilities of Universiti Putra Malaysia are gratefully appreciated. Special thanks are also extended to Professor Dr. Dzolklifi Omar, Lab assistants of Pathology Laboratory, UPM, and field staffs at Ladang 2, UPM for various assistance and help during my study. A special note of thanks are to Steve, Kevin, Ng Saw Chin, Lim Ya Li, Yong Jee Jun and the rest of my friends for their help and constructive suggestions that leads me to complete this project successfully.

Last, but not least, unforgotten thanks to my family and my dear friend for their love, blessing, constant encouragement towards the completion of this research.



## 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.

Members of the Examination Committee are as follows:

**ZAINAL ABIDIN MIOR AHMAD, Ph.D.**

Associate Professor,  
Faculty of Graduate Studies  
Universiti Putra Malaysia  
(Chairman)

**KAMARUZAMAN SIJAM, Ph.D**

Associate Professor,  
Faculty of Graduate Studies  
Universiti Putra Malaysia  
(Internal Examiner)

**ABDUL SHUKOR JURAIMI, Ph.D.**

Associate Professor,  
Faculty of Graduate Studies  
Universiti Putra Malaysia  
(Internal Examiner)

**CHUAH TSE SENG, Ph.D.**

Doctor,  
Faculty of Agrotechnology & Food Science  
Universiti Terengganu Malaysia  
21030 Terengganu, Malaysia.  
(External Examiner)

---

HASANAH MOHD. GHAZALI, Ph.D.  
Professor/Deputy Dean  
School Graduate Studies  
Universiti Putra Malaysia

Date:



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:

**Jugah Kadir, Ph.D,**  
Associate Professor  
Faculty of Agriculture  
Universiti Putra Malaysia  
(Chairman)

**Sariah Meon, Ph.D,**  
Professor  
Faculty of Agriculture  
Universiti Putra Malaysia  
(Member)

---

**BUJANG BIN KIM HUAT, PhD**  
Professor and Deputy Dean  
School Graduate Studies  
Universiti Putra Malaysia

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.

---

**CHIA SHIN ZHI**

Date:



# TABLE OF CONTENTS

|   | Page |
|---|------|
| <b>DEDICATION</b>   |      |
| <b>ABSTRACT</b>   | i    |
| <b>ABSTRAK</b>  | iv   |
| <b>ACKNOWLEDGEMENTS</b>   | vii  |
| <b>APPROVAL SHEETS</b>  | viii |
| <b>DECLARATION FORM</b>   | x    |
| <b>LIST OF FIGURES</b>  | xiv  |
| <b>LIST OF TABLES</b>   | xvii |
| <b>LIST OF ABBREVIATIONS</b>  | xix  |
| <br>  |      |
| <b>CHAPTER I GENERAL INTRODUCTION</b>   | 1-1  |
| <br>  |      |
| <b>CHAPTER II LITERATURE LIVIEW</b>   |      |
| 2.1 Weeds   | 2-1  |
| 2.2 Morphology and Biology of goosegrass  | 2-2  |
| 2.3 Distribution of goosegrass  | 2-4  |
| 2.4 Economic Important of goosegrass  | 2-4  |
| 2.5 Integrated Weed Management (IWM)  | 2-5  |
| 2.6 Goosegrass Management   | 2-7  |
| 2.6.1 Cultural control  | 2-7  |
| 2.6.2 Mechanical control  | 2-9  |
| 2.6.3 Chemical control  | 2-10 |
| 2.6.4 Biological control  | 2-11 |
| 2.6.4.1 Classical strategy  | 2-14 |
| 2.6.4.2 Inundative strategy   | 2-15 |
| 2.7 Biological Control of Weeds Using Plant Pathogen                            | 2-16 |
| 2.7.1 Control fungi – <i>Drechslera cynodontis</i>                              | 2-19 |
| 2.8 Effects of Some Epidemiological Factors on Disease<br>Development           | 2-21 |
| <br>  |      |
| <b>CHAPTER III PATHOGENICITY AND HOST RANGE OF <i>DRECHSLERA CYNODONTIS</i></b> |      |
| 3.1 Introduction  | 3-1  |
| 3.2 Materials and Methods   |      |
| 3.2.1 Sample collection and sample processing                                   | 3-3  |
| 3.2.2 Pathogen isolation and identification                                     | 3-3  |
| 3.2.3 Inoculum production   | 3-4  |





|                                      |      |
|--------------------------------------|------|
| 3.2.4 Plant preparation              | 3-5  |
| 3.2.5 Pathogenicity testing          | 3-6  |
| 3.2.6 Host range determination       | 3-6  |
| 3.2.7 Disease assessment             | 3-7  |
| 3.2.8 Data analysis                  | 3-8  |
| 3.3 Results                          |      |
| 3.3.1 Isolation and characterization | 3-9  |
| 3.3.2 Pathogenicity testing          | 3-10 |
| 3.3.3 Host range determination       | 3-14 |
| 3.4 Discussion                       | 3-19 |

#### **CHAPTER IV EFFECT OF SOME EPIDEMIOLOGICAL FACTORS OF *DRECHSLERA CYNODONTIS* ON GOOSEGRASS**

|   |      |
|---|------|
| 4.1 Introduction  | 4-1  |
| 4.2 Materials and Methods                                     |      |
| 4.2.1 Inoculum production                                     | 4-2  |
| 4.2.2 Plant preparation                                       | 4-2  |
| 4.2.3 Effect of conidia concentration on disease development  | 4-2  |
| 4.2.4 Effect of mycelium concentration on disease development | 4-3  |
| 4.2.5 Effect of temperature on disease development            | 4-4  |
| 4.2.6 Effect of light regime duration on disease development  | 4-4  |
| 4.2.7 Data analysis   | 4-5  |
| 4.3 Results   |      |
| 4.3.1 Effect of conidia concentration on disease development  | 4-6  |
| 4.3.2 Effect of mycelium concentration on disease development | 4-10 |
| 4.3.3 Effect of temperature on disease development            | 4-14 |
| 4.3.4 Effect of light regime duration on disease development  | 4-18 |
| 4.4 Discussion  | 4-22 |

#### **CHAPTER V HISTOLOGICAL STUDY OF THE INTERACTION ON *DRECHSLERA CYNODONTIS* WITH GOOSEGRASS**

|                                     |     |
|-------------------------------------|-----|
| 5.1 Introduction                    | 5-1 |
| 5.2 Materials and Methods           |     |
| 5.2.1 Plant and inoculum production | 5-3 |
| 5.2.2 Plant inoculation             | 5-3 |
| 5.2.3 Light microscopy              | 5-4 |
| 5.2.4 Scanning electron microscopy  | 5-4 |



|  |   |
|--|---|
| 5.2.5 Data analysis                                    | 5-5   |
| 5.3 Results  |   |
| 5.3.1 Light microscopy                                 | 5-6   |
| 5.3.2 Screening electron microscopy                    | 5-13  |
| 5.4 Discussion   | 5-18  |
| <br>   |   |
| <b>CHAPTER VI</b>                                      | <b>EFFECT OF SELECTED HERBICIDES ON GROWTH OF <i>DRECHSLERA CYNODONTIS</i></b>            |
| 6.1 Introduction                                       | 6-1   |
| 6.2 Materials and Methods                              |   |
| 6.2.1 Preparation of herbicides and conidia suspension | 6-3   |
| 6.2.2 <i>In Vitro</i> Study                            | 6-5   |
| 6.2.3 <i>In Vivo</i> study                             | 6-6   |
| 6.2.4 Data analysis                                    | 6-7   |
| 6.3 Results  |   |
| 6.3.1 <i>In Vitro</i> Study                            | 6-8   |
| 6.3.2 <i>In Vivo</i> study                             | 6-13  |
| 6.4 Discussion   | 6-19  |
| <br>   |   |
| <b>CHAPTER VII</b>                                     | <b>FIELD EVALUATION OF <i>DRECHSLERA CYNODONTIS</i>, A BIOCONTROL AGENT OF GOOSEGRASS</b> |
| 7.1 Introduction                                       | 7-1   |
| 7.2 Materials and Methods                              |   |
| 7.2.1 Field preparation                                | 7-2   |
| 7.2.2 Weed preparation                                 | 7-2   |
| 7.2.3 Treatments                                       | 7-2   |
| 7.2.4 Plants inoculation                               | 7-4   |
| 7.2.5 Data analysis                                    | 7-4   |
| 7.3 Results  | 7-5   |
| 7.4 Discussion   | 7-11  |
| <br>   |   |
| <b>CHAPTER VIII</b>                                    | <b>GENERAL CONCLUSION</b>   |
|  | 8-1   |
| <br>   |   |
| <b>BIBLIOGRAPHY</b>                                    | B-1   |
| <b>APPENDIX</b>  | A-1   |



## LIST OF FIGURES

| Figures |  | Page |
|---------|--|------|
| 2.1     | Morphology of goosegrass seedling and inflorescence  | 2-3  |
| 2.2     | Conidia of <i>D. cynodontis</i> and the colony of <i>D. cynodontis</i> in PDA  | 2-21 |
| 3.1     | Morphology of a conidium and conidiophore, and germination of the conidium   | 3-10 |
| 3.2     | Effect of <i>D. cynodontis</i> on goosegrass seedlings   | 3-12 |
| 3.3     | Effects of different inoculums of <i>D. cynodontis</i> in causing leaf blight on goosegrass  | 3-13 |
| 3.4     | Reaction of test plants (weedy grasses) to inoculation with conidia of <i>D. cynodontis</i>  | 3-17 |
| 3.5     | Reaction of test plants (turf grasses) to inoculation with conidia of <i>D. cynodontis</i>   | 3-17 |
| 3.6     | Reaction of test plants (crop plants) to inoculation with conidia of <i>D. cynodontis</i>  | 3-18 |
| 4.1     | Effect of different spore concentrations of <i>D. cynodontis</i> on the growth of goosegrass seedlings at 7 days after inoculation | 4-7  |
| 4.2     | Effect of different conidia concentrations on the disease severity on goosegrass six days after inoculation                        | 4-7  |
| 4.3     | Disease progress curves of goosegrass inoculated with different concentrations of <i>D. cynodontis</i>                             | 4-8  |
| 4.4     | Seedlings of goosegrass at 7 days after inoculation with different concentrations of <i>D. cynodontis</i> mycelium inoculum        | 4-11 |
| 4.5     | Effect of different weight of <i>D. cynodontis</i> mycelium on disease development on <i>E. indica</i> at 6 days after inoculation | 4-11 |
| 4.6     | Disease progress curves of goosegrass inoculated with different mycelium concentrations of <i>D. cynodontis</i>                    | 4-12 |



|      |   |      |
|------|---|------|
| 4.7  | Effect of <i>D. cynodontis</i> on goosegrass seedlings kept at different temperatures at 7 days after inoculation   | 4-15 |
| 4.8  | Effect of different temperature on disease severity at 6 days after Inoculation   | 4-15 |
| 4.9  | Disease progress curves for goosegrass caused by application of different concentrations of <i>D. cynodontis</i>  | 4-16 |
| 4.10 | Effect of <i>D. cynodontis</i> on goosegrass seedlings exposed for 7 days in different periods of light/darkness regimes  | 4-19 |
| 4.11 | Effect of different light/darkness regimes on disease severity after 6 days inoculation   | 4-19 |
| 4.12 | Disease progress curve of goosegrass inoculated with <i>D. cynodontis</i> and kept in different light/darkness regimes  | 4-20 |
| 5.1  | Conidia of <i>D.cynodontis</i> germination on goosegrass  | 5-8  |
| 5.2  | germination of <i>D.cynodontis</i> infection on goosegrass under different temperature and incubation time in light and darkness regime                             | 5-9  |
| 5.3  | Process penetration with forming appressorium and germ tube   | 5-11 |
| 5.4  | Effect of <i>D. cynodontis</i> appressorium formation on its infectivity on goosegrass under different temperature and incubation time in light and darkness regime | 5-12 |
| 5.5  | <i>Drechslera cynodontis</i> conidia germinated between 3 hours of inoculation with producing germ tube on the leaf surface   | 5-15 |
| 5.6  | Appressoria (of varying sizes and shapes) formed after Adherence of germ tubes on the leaf surface  | 5-16 |
| 5.7  | Penetration of goosegrass leaf by the fungus hyphae and without hyphae through the necrotic cells in the leaf mesophyll tissues                                     | 5-17 |
| 6.1  | Culture growth of <i>D. cynodontis</i> in serial dilutions of different herbicides  | 6-9  |
| 6.2  | Radial growth and spore production by <i>D. cynodontis</i> in serial dilutions of different herbicides  | 6-10 |



|     |   |      |
|-----|---|------|
| 6.3 | Average of radial growth and conidia production by <i>D. cynodontis</i> in serial dilutions of herbicides                             | 6-11 |
| 6.4 | Clearly shorter abnormal germ tube observed growing in metolachlor and Glyphosate at 0.25X concentration compared with in the control | 6-15 |
| 6.5 | Germination of <i>D. cynodontis</i> spores in serial dilutions of different herbicides on water agar and leaf of goosegrass           | 6-16 |
| 6.6 | Appressorium formation by <i>D. cynodontis</i> in serial dilutions of different herbicides on water agar and leaf of goosegrass       | 6-17 |
| 7.1 | Disease progress curve of goosegrass in the different treatments  | 7-7  |
| 7.2 | Symptoms in the plants treated with different treatment at 4 days after inoculation   | 7-8  |
| 7.3 | Regression of transformed disease severity using logistic model in $(Y / (1-Y))$  | 7-10 |



## LIST OF TABLE

| Table |   | Page |
|-------|---|------|
| 3.1   | Morphology of conidium and conidiophore of <i>Drechslera Cynodontis</i>   | 3-9  |
| 3.2   | Disease development (AUDPC) and disease progress rate ( $r_L$ ) caused by the different <i>D. cynodontis</i> inoculum suspensions on goosegrass                                 | 3-13 |
| 3.3   | Plants tested in host-range study of <i>D. cynodontis</i> and their disease indices   | 3-15 |
| 4.1   | AUDPC, disease progress rates and times taken to reach 50% disease severity in goosegrass infected with conidia of <i>D. cynodontis</i> at different concentrations             | 4-9  |
| 4.2   | AUDPC, disease progress rates and times taken to reach 50% disease severity by goosegrass sprayed with different concentrations of <i>D. cynodontis</i> mycelium                | 4-13 |
| 4.3   | AUDPC, disease progress rates and the times taken to reach 50% disease severity by goosegrass infected by different temperature and maintained at different temperatures        | 4-17 |
| 4.4   | AUDPC, disease progress rates and times taken to reach 50% disease severity in goosegrass infected with <i>D. cynodontis</i> and kept in different of light / darkness duration | 4-21 |
| 5.1   | Analysis of variance (ANOVA) for effects of incubation temperature and light condition on <i>D. cynodontis</i> conidia germination and appressorium formation and goosegrass    | 5-10 |
| 5.2   | Analysis of variance (ANOVA) for effects of incubation times and light condition on <i>D. cynodontis</i> conidia germination and appressorium formation and goosegrass          | 5-10 |
| 6.1   | Common herbicides used against goose grass in Malaysia  | 6-3  |
| 6.2   | Effect of serial chemical dilutions on the spore production of <i>D. cynodontis</i> conidia   | 6-12 |



|     |   |      |
|-----|---|------|
| 6.3 | LC <sub>50</sub> of chemical herbicides on the germination of <i>D. cynodontis</i>  | 6-18 |
| 7.1 | Effects of different treatments on disease severity represented by the AUDPC, slope, days to reach 50% disease severity, tiller number, fresh weight and dry weight on goosegrass | 7-9  |



## LIST OF ABBREVIATIONS

|                 |   |
|-----------------|---|
| °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 <sub>2</sub> | 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                       |

