UNIVERSITI PUTRA MALAYSIA

POTENTIAL OF EXSEROHILUM MONOCERAS (DRECHSLER) LEONARD AND SUGGS ISOLATED FROM ECHINOCHLOA P. BEAUV. SPECIES AS A BIOHERBICIDE

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By

TOSIAH SADI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Philosophy

October 2010

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

POTENTIAL OF *EXSEROHILUM MONOCERAS* (DRECHSLER) LEONARD AND SUGGS ISOLATED FROM *ECHINOCHLOA* P. BEAUV. SPECIES AS A BIOHERBICIDE

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TOSIAH SADI

October 2010

Chairperson : Assoc. Prof. Jugah Kadir, PhD

Faculty: Agriculture

Echinochloa spp is widespread in the warm temperate, sub tropical and tropical regions. It is ubiquitous in the Malaysia rice fields and serious weedy pest to the crop, especially after the adoption of double cropping, more rapidly maturing cultivars and a shift from transplanting to direct sowing. The problem worsens by the contamination of farm machineries such as tractors and combined harvester and also through seeds contamination. Chemical herbicides are widely used to control the grass which has a negative implication to the environment and public health.

Several fungal pathogens have been reported to be potential biocontrol agents of this weed. This study was conducted to identify potential indigenous fungal pathogens for the control of *Echinochloa spp* and its requirements to be

developed as bioherbicide. *Exserohilum monoceras* isolate 1125 was identified to be the potential fungus to control *Echinochloa* spp. Studies on the efficacy of the fungus indicated that it was effective at concentration of 10^{6} spores/mL, and plant was sensitive at their 4 leaves stage**.**

The fungus attacked *E. crus-galli* var *crus galli, E. crus-galli* var *formosensis, E. colona and E. orizycola* but with different disease intensity. The fungus was safe to all modern rice varieties, turf grasses and the selected vegetable crops tested, indicated that it was highly selective. Before it developed into a bioherbicide, the fungus need to mass produced.

This study indicated that carbon source enhance, mycelium and production also disease efficacy. Addition of Nitrogen source does not increase the mycelium production however the spore production was significantly increased. The CN ratio found to be good for the mycelium and spore production range from 9:1 to 24:1.

Exserohilum monoceras infection was influence by availability of dew and temperature. The fungus needed a minimum 12 hrs of humidity to caused severe disease on the host. The best temperature for infection is within the range 25^{O}C to 35^{O}C. *Exserohilum monoceras* was also effective in field condition. Spore concentration at the rate of 10^{6} spore/mL and 10^{7} spore/mL produced 45% and 50% control of *Echinochloa* in the field respectively. At the rate 10^{8} spore/mL

the fungus caused toxic effect on rice plants but recovered after sometimes.

Disease severity also increased with spray frequency. The apparent infection rate at 10^7 spore/mL (r_L = 0.14 logit/day) was highest followed by 10^8 spore/mL (r_L = 0.13 logit/day) and 10^6 spore/mL (r_L =0.12 logit/day). At the end of the trial, tillers production and dry weight of *Echinochloa* was also reduced. The result of this research indicated that *E. monoceras* has potential as a candidate for bioherbicide in the control of *Echinochloa* in rice field but need some improvement in the formulation.

Abstrak thesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

POTENSI *EXSEROHILUM MONOCERAS* (DRECHSLER) LEONARD DAN SUGGS YANG DIPENCILKAN DARI SPESIES *ECHINOCHLOA* P.BEAUV. SEBAGAI BIOHERSID

Oleh

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Echinochloa spp tersebar secara meluas dikawasan beriklim sederhana panas, sub tropika and tropika . Di Malaysia ia tersebar luas di kawasan sawah padi dan menjadi rumpai yang penting terutamanya dengan tanaman dua kali setahun, kultivar yang lebih cepat matang dan kaedah penanaman tabur terus yang diamalkan. Masalah ini menjadi lebih buruk melalui pencemaran biji benih dari jentera perladangan seperti traktor dan jentuai. Racun kimia digunakan secara meluas untuk mengawal rumpai memberikan kesan negatif terhadap persekitaran dan kesihatan umum.

Beberapa patogen kulat telah dilapurkan berpotensi sebagai agen kawalan biologi *Echinochloa.* Kajian telah dijalankan untuk mengenal pasti kulat patogen tempatan yang mampu mengawal *Echinochloa* dan keperluannya untuk dibangunkan sebagai bioherbisid. Pencilan *Exserohilum monoceras* 1125 dikenal

pasti berpotensi mengawal *Echinochloa*. Kajian mendapati ia berkesan pada kepekatan 10^6 spora/mL dan rumpai adalah rentan pada peringkat 4 daun.

Kulat ini menyerang *E. crus-galli* var *crus galli, E. crus-galli* var *formosensis, E. colona* dan *E. orizycola* dengan kesan yang berbeza. Kulat ini tidak menjangkiti kesemua varieti padi moden, rumput padang, dan tanaman sayur-sayuran yang diuji. Ini membuktikan ia adalah sangat selektif dan sesuai untuk dijadikan agen kawalan biologi.

Kulat ini harus boleh dihasilkan secara pukal jika ia ingin digunakan sebagai bioherbisid. Kajian menunjukkan bahawa sumber karbon mampu meningkatkan penghasilan miselium dan spora juga meningkatkan keberkesanan jangkitan. Sumber nitrogen pula tidak meningkatkan penghasilan miselium tetapi signifikan dalam meningkatkan penghasilan spora. Sementara itu nisbah CN yang bersesuian untuk meningkatkan penghasilan miselium dan spora adalah diantara 9:1 hingga 24:1.

Jangkitan *E. monoceras* keatas *Echinochloa* juga dipengaruhi oleh kelembapan dan suhu. Kulat ini memerlukan kelembapan minima selama 12 jam untuk menjangkiti secara efektif. Julat suhu yang sesuai untuk jangkitan adalah diantara 25^{O}C hingga 35^{O}C. *Exserohilum monoceras* juga berkesan dilapangan. Kepekatan spora pada kadar 10^6 spora/mL dan 10^7 spora/mL memberi kawalan yang baik iaitu 45% dan 50% masing-masing. Pada kepekatan 10^8 spora/mL kulat

ini memberi kesan toksik pada pokok padi, tetapi pulih kemudiannya.

Jangkitan penyakit juga meningkat dengan meningkatnya jumlah applikasi. Kadar jangkitan ketara penyakit yang paling tinggi adalah pada 10^7 iaitu (r_L = 0.14 logit/hari), diikuti oleh 10^8 (r_L = 0.13 logit/hari) dan 10^6 (r_L = 0.12 logit/hari). Diakhir ujikaji didapati penghasilan anak sisi dan berat kering *Echinochloa* juga menurun. Dari keputusan penyelidikan yang dijalankan, *E.monoceras* didapati mempunyai potensi jika ingin di kembangkan sebagai bioherbisid untuk mengawal *Echinochloa* di sawah padi. Walau bagaimanapun ia masih memerlukan sedikit penambahbaikan dari segi formulasi.

ACKNOWLEDGEMENTS

In the name of ALLAH the almighty. Thank you ALLAH for giving me such a supportive supervisors Assoc. Prof. Dr. Jugah Kadir, Prof. Sariah Meon, Assoc. Prof Dr. Abd Shukor Juraimi and Drs. Soetikno. I would also convey my gratitude to them for being very helpful and patient, beside the trust given to me to materialise this Thesis.

To the General Director of MARDI, En. Shahrin Yop, En. Lo Nyok Piang, Dr. Azmi Man, Prof Madya Dr. Senawi Mohd Tamin, Dr. Yusoff Abdullah, Dr. Shukor Nordin, , Dr. Azmi Razak, Dr. Mohamad Rani Mat Yusoh, Dr. Radzali Mispan, Mr. Shokri Othman, Mr. S. Mahendra, Ms Zanariah Zainal Abidin, Mrs Napsiah Abd Rahim, Mrs Norzaimawati and Mr Azrizal for being very supportive in my work.

Lastly to my dearest husband, kids, family and friends thank you very much for the non-stop encouragement and 'doa'.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of **Doctor of Philosophy**. The members of the Supervisory Committee were as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

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TOSIAH SADI

Date: 15 October 2010

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LIST OF ABBREVIATIONS

AUDPC	Area Under Disease Progress Curve
C	Carbon
DGA	D-gluconic acid
IPM	Integrated Pest Management
IWMS	Integrated weed management system
MARDI	Malaysian Agricultural Research and Development Institute
N	Nitrogen
PDA	Potato Dextrose Agar

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