BIOLOGY AND MANAGEMENT OF *FIMBRISTYLIS MILIACEA* (L.) VAHL

By

MAHFUZA BEGUM

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

September 2006

Dedicated

To

My Father, Memory of My Mother and Niece Moonmoon

And

My Husband Md. Zahid Iqbal, Kids Promee and Alvee,
with Whom I experience the Joys and
Responsibilities of Commitment Each Day

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

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Chairman: **Associate Professor Abdul Shukor Juraimi, PhD**

Faculty: **Agriculture**

Most experiments were carried out in a glasshouse at Universiti Putra Malaysia, while the field survey was conducted in ricefields in the Muda area, Kedah. This study was initiated during March 2003 and ended on November 2005. The objectives of the study were to investigate the prevalence of *F. miliacea* in ricefields both above ground as well as in the soil seedbank, its emergence behaviour, life cycle, life table, competitive ability with rice, and its management.

Results from field survey revealed that *F. miliacea* was the fifth most prevalent weed out of 35 species in the Muda area with 46 -52% fields infested and widely distributed over the four districts of Muda with infestation rating scores from traces – 30% weed coverage. Out of 20 weed species identified in the soil seedbank, *F. miliacea* was the most abundant with 66.07% of total seed reserve (equivalent to 750.84 million seeds/ha), of which 55% emerged in soils incubated in trays (411.48 million seedlings/ha), 8% germinated in incubation tests in petridishes (61.59 million seedlings/ha), while 37% or the equivalent of 277.77 million seeds/ha remained dormant or dead.

Fimbristylis miliacea exhibited high emergence (44.38%) from surface seeding. Seeds sown at 0.5 cm depth had significantly reduced emergence (13%) and no seedlings emerged from 1.0 cm soil depth. For flooding durations of 7, 14 and 21 days, per cent emergence and dry matter production were higher under saturated conditions than at 5 and 10 cm flooding depths. A flooding duration of 14 days or more and in flooding depth up to 10 cm showed a clear trend in reduced emergence and dry matter production of *Fimbristylis miliacea*.

During the cropping season (4 month period) each *F. miliacea* plant produced on average of 2.3 tillers/plant and a total of 134 inflorescences, with 84 inflorescences/plant ripening within this period. Each inflorescence comprised of 48 spikelets with 511 seeds and matured after 3 weeks of emergence. Total seeds/plant and 1000 seed weight were 42,275 and 0.035 g, respectively. Time required for seed ripening was 76 days after emergence. This species had three important growth stages: a slow growth stage during the first 4 week after emergence (WAE); a rapid growth stage from 4-9 WAE; and finally, a maximum growth stage from 9-17 WAE. The life table study showed that plants establishing from every 100 seeds of *F. miliacea* plants can reproduce 287,722 seeds with nitrogen treatment, which was 1.66 fold greater than without nitrogen. High death rates in *F. miliacea* among young seedlings indicated a Deevey Type III survivorship curve. Early emerging cohorts had greater survivorship and contributed most extensively to the next generation by producing more than 90% seeds.

The interaction between weed density and nitrogen (N) fertilization had a pronounced influence on rice yield. At low weed densities of up to 500 plants/m^2, rice yields increased with higher N fertilization. On the other hand, at the higher weed density of 1000 plants/m^2, increasing N fertilization to 170 kg/ha had no significant effect on yield. However, rice yield at this level of N fertilization with the lowest weed density of 250 plants/m^2, was similar to the weed-free treatment. Based on the predicted Logistic and Gompertz response curves the critical period for controlling *F. miliacea* in direct-seeded rice was between 14 – 28 days after sowing.

Flooding and use of herbicides are two important weed control methods in direct-seeded rice. Flooding had a major suppressive effect on stand establishment and growth of *F. miliacea*, especially during the early growth stages (7 and 14 DAS). Delayed flooding at 21 and 28 DAS required a 10 cm flooding depth for effective control. All tested herbicides were effective in controlling *F. miliacea*, but the herbicides bensulfuron and fentrazamide increased grain yield by more than 80% compared to the unweeded treatment and were comparable to the weed-free (hand-weeded) treatment.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

BIOLOGI DAN PENGURUSAN *FIMBRISTYLIS MILIACEA* (L.) VAHL

Oleh

MAHFUZA BEGUM

September 2006

Pengerusi: Profesor Madya Abdul Shukor Juraimi, PhD

Fakulti: Pertanian

Sebahagian besar eksperimen telah dijalankan di rumah kaca, Universiti Putra Malaysia, sementara survei rumpai dijalankan di kawasan jelapang padi, Muda, Kedah. Kajian bermula pada bulan Mac 2003 dan berakhir pada bulan November 2005. Objektif kajian ialah untuk menentukan tahap dominan *Fimbristylis miliacea* di kawasan Muda di samping menentukan tahap bank benihnya dalam tanah, tabiat kemunculannya, kitar hidup, jadual hayat, keupayaan daya saing dengan tanaman padi, dan juga pengurusannya.

Keputusan survei mendapati *F. miliacea* adalah rumpai yang ke lima terbanyak daripada 35 spesies yang direkodkan di kawasan Muda dengan 46-52% kawasan didapati diinfestasi, dan mempunyai taburan meluas meliputi empat daerah di Muda dengan skor infestasi bermula dengan sangat sedikit (beberapa pokok) sehingga 30% litupan. Daripada 20 spesies rumpai yang dikenalpasti daripada bank biji benih dalam tanah, *F. miliacea* adalah yang paling banyak iaitu 66.07% (750.84 juta biji benih/ha) daripada keseluruhan yang tersimpan, dengan 55% (411.48 juta anak benih/ha) muncul ketika ujian dalam kotak percambahan, 8% (61.59 juta anak

benih/ha) bercambah dalam piring petri dan 37% (277.77 juta biji benih/ha) dorman atau mati.

F. miliacea menunjukkan kemunculan yang tinggi (44.38%) daripada rawatan penanaman di permukaan. Kemunculan biji benih yang ditabur pada kedalaman 0.5 cm menurun dengan bererti kepada 13% dan tiada benih muncul pada kedalaman tanah 1.0 cm. Untuk tempoh pembanjiran 7, 14 dan 21 hari, peratus kemunculan dan berat kering adalah tinggi pada kedaan tanah tepu air berbanding dalam kedaan air bertakung sedalam 5 dan 10 cm. Pembanjiran selama 14 hari atau lebih dan kedalaman pembanjiran sehingga 10 cm menunjukkan polar penurunan kemunculan dan penghasilan berat kering *F. miliacea*.

Ketika musim penanaman padi (tempoh 4 bulan) setiap pohon *F. miliacea* menghasilkan purata 2.3 anak bilah/pokok dan 134 infloresen, dengan 84 infloresen/pokok yang matang semasa tempoh tersebut. setiap infloresen mengandungi 48 spika dengan 511 biji benih dan matang 3 minggu selepas muncul. Jumlah bilangan biji benih/pokok dan berat 1000 biji benih adalah masing-masing 42275 biji dan 0.035 g. Masa yang diperlukan untuk benih masak adalah 76 hari selepas muncul. Spesies ini mempunyai tiga peringkat pertumbuhan : peringkat pertumbuhan lambat, 4 minggu pertama selepas muncul (MSM); peringkat pertumbuhan cepat, 4-9 MSM; dan peringkat pertumbuhan maksimum, 9-17 MSM. Jadual hayat menunjukkan pokok yang tumbuh daripada setiap 100 biji benih boleh menghasilkan 287,722 biji dengan penambahan nitrogen, 1.66 kali ganda lebih daripada tanpa nitrogen. Kadar kematian yang tinggi dikalangan anak benih *F. miliacea* menandakan kemandirian kelok “Deevey Type III”. Kohort yang muncul awal mempunyai peluang hidup yang besar dengan menghasilkan 90% benih untuk generasi seterusnya.

Interaksi antara kepadatan rumpai dan pembajaan N mempunyai pengaruh yang kuat terhadap hasil padi. Pada kepadatan rendah sehingga 500 pokok/m^2, hasil padi bertambah dengan pembajaan N. Sebaliknya pada kepadatan tinggi 1000 pokok/m^2, penambahan pembajaan N sehingga 170 kg/ha tidak menunjukkan kesan bermanfaat terhadap hasil padi. Walau bagaimanapun pada paras pembajaan N ini, hasil padi pada kepadatan rumpai yang terendah 250 pokok/m^2, adalah sama dengan rawatan bebas rumpai. Berdasarkan peramalan kelok rangsang Logistic dan Gompertz, tempoh kritikal untuk kawalan *F. miliacea* adalah antara 14 – 28 hari lepas tabur.

Pembanjiran dan penggunaan racun herba adalah dua keadah penting kawalan penting di kawasan tanaman padi tabur terus. Pembanjiran menunjukkan kesan kawalan yang kuat terhadap penapakan dan pertumbuhan *F. miliacea,* terutamanya ketika peringkat awal tanaman [(7 dan 14 hari lepas tanam (HLT)]. Menangguhkan rawatan pembanjiran kepada 21 dan 28 HLT memerlukan 10 cm kedalaman air untuk kawalan yang berkesan. Semua racun rumpai diguna dapat mengawal *F. miliacea* dengan berkesan, tetapi rawatan bensulfuron dan fentrazamide dapat meningkatkan hasil padi melebehi 80% berbanding rawatan tanpa kawalan rumpai, dan setara dengan rawatan bebas daripada rumpai.

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I would like to express my humble apology to those persons, who helped me but may not find their names in my narration here.

I certify that an Examination Committee has met on 18 September 2006 to conduct the final examination of Mahfuza Begum on her Doctor of Philosophy thesis entitled "Biology and Management of *Fimbristylis miliacea* (L.) Vahl" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Mohd Razi Ismail, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Rosli Mohamad, PhD
Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Anuar Abdul Rahim, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Mahsor Mansor, PhD
Professor
School of Biological Sciences
Universiti Sains Malaysia
(External Examiner)

HASANAH MOHD GHAZALI, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis 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 are as follows:

Abdul Shukor Juraimi, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Rajan Amartalingam, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Syed Omar Syed Rastan, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Azmi Man, PhD
MARDI
Kepala Batas, Pulau Pinang
(Member)

AINI IDERIS, PhD
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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 it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

MAHFUZA BEGUM

Date: 18 October 2006

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