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RICE PRODUCTION AND WEED MANAGEMENT AS AFFECTED BY SALINITY

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RICE PRODUCTION AND WEED MANAGEMENT AS AFFECTED BY SALINITY

BY

MD. ABDUL HAKIM

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RICE PRODUCTION AND WEED MANAGEMENT AS AFFECTED BY SALINITY

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Institute : Tropical Agriculture

Salinity and weeds are major constraints to rice production in Peninsular Malaysia. Rice yield reduction is caused by salinity due to its adverse effect on many important physiological processes. On the other hand, weeds cause yield reduction by competition and allelopathy effect. The present study was therefore designed to select salt tolerant rice varieties and weed species, and also to develop a suitable weed management strategies for rice under saline environments. Surveys were conducted in three major rice growing coastal areas (Seberang Perak, Tanjong Karang, and Muda, Kedah) in Peninsular Malaysia and the results revealed that there were 53 different weeds in the coastal area having 12 grasses, 13 sedges and 28 broadleaved species. Based on relative abundance, the ten most dominant weed species in surveyed area were: *Echinochloa crusgalli, Fimbrystylis miliacea, Leptochloa chinensis, Echinochloa colona, Cyperus iria,*

*Jussia linifolia, Oryza sativa L. (*weedy rice*), Sphenoclea zeylanica, Cyperus defformis* and *Scirpus grossus.* Germination of twelve rice varieties were studied at six salinity levels in the laboratory and the results showed that MR211, MR232 and IR20 were tolerant and MR33, MR52, MR219 and BRRI dhan40 were moderately tolerant based on germination percentage, germination index, vigor index at 4 DAS and dry matter production. Subsequent studies on growth, biochemical constituents, mineral composition and yield response of eight rice varieties to different salinity levels in the glass house revealed that growth of rice plants was arrested instantly at 12 dS m^{-1}. However, MR232 and MR211 were graded as salt tolerant, while MR52 and MT33 were found to be moderately tolerant. Germination of ten weed species were studied under different salinity levels in laboratory and it was found that *C. iria* and *E. colona* showed superior, while *E. crusgalli, J. linifolia, L. chinensis* and *O. sativa* L. (weedy rice) were moderate in terms of seed germination and seedling vigor. Subsequently, the growth and ion accumulation response of six weed species to different salinity levels was studied in the glass house. The results revealed that *C. iria*, *E. colona* and *E. crusgalli* were relatively tolerant, *J. linifolia* and *L. chinensis* moderately tolerant based on growth performance, chlorophyll contents, proline contents and ion accumulation. Critical period of rice-weed competition was studied in a glass house under saline environment and the results showed that the critical period for weed competition under 5% yield loss at 0, 4 and 8 dS m^{-1} were 14 to 55, 12 to 64 and 7 to 80 days after transplanting (DAT), respectively. The critical period for 10% yield loss at 0, 4 and 8 dS m^{-1} were 36 to 45, 32 to 48 and 23 to 64 DAT, respectively. Weed control efficacy of different herbicides under three salinity levels was also evaluated in the glass house and the results revealed that pretilachlor (Sofit®) @ 0.375 kg ai/ha, propanil + thiobencarb (Satunil®) @ 0.9 kg

ai/ha + 1.8 kg ai/ha, bensulfuron (Tekong®) + MCPA @ 0.06 kg ai/ha +0.1 kg ai/ha and pretilachlor @ 0.50 kg ai/ha treatments performed better in terms of weed biomass, weed control efficiency, rice injury rating, rice growth and yield performance. The results showed that higher than recommend rates caused toxicity to rice plants under saline environment. Consequently, among the treatments pretilachlor (Sofit®) @ 0.375 kg ai/ha + one round of hand weeding (at 65 DAT), propanil + thiobencarb (Satunil®) @ 0.9 kg ai/ha + 1.8 kg ai/ha + one round of hand weeding (at 65 DAT) performed better considering the critical period, which was superior under saline environment. Based on the results of the present investigation, it may be concluded that MR232 rice variety can be selected for the coastal zone of Peninsular Malaysia, and major salt tolerant weeds in the rice field may be controlled by considering the critical period of rice-weed competition and spraying herbicides like pretilachlor (Sofit®) @ 0.375 kg ai/ha at 4 DAT followed by one round of hand weeding (at 65 DAT) or propanil + thiobencarb (Satunil®) @ 0.9 kg ai/ha + 1.8 kg ai/ha at 10 DAT followed by one round of hand weeding (at 65 DAT).

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

KESAN SALINITI TERHADAP PENGELUARAN PADI DAN PENGURUSAN RUMPAI

Oleh

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Oktober 2011

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Saliniti dan rumpai merupakan masalah utama bagi pengeluaran padi di Semenanjung Malaysia. Kemerosotan hasil padi ini disebabkan oleh kesan buruk saliniti ke atas proses-proses fisiologi yang penting. Selain daripada itu, rumpai turut menyumbang kepada kemerosotan hasil akibat kesan persaingan dan alelopati. Oleh hal demikian, kajian ini dijalankan untuk memilih varieti padi yang rentan kepada kemasinan dan rumpai, dan juga untuk membangunkan kaedah pengurusan rumpai yang sesuai untuk penanaman padi dalam persekitaran bersaliniti. Satu survei telah dijalankan di tiga kawasan penanaman padi pinggir pantai yang utama (Seberang Perak, Tanjong Karang, dan Kedah) di Semenanjung Malaysia dan keputusan yang didapati menunjukkan terdapat 53 jenis rumpai di kawasan pinggir pantai iaitu 12 dari spesis rumput, 13 spesis rusiga dan 28 spesis berdaun lebar. Berdasarkan kewujudan relatif, 10 spesies rumpai

yang dominan dalam kawasan yang survei ialah: *Echinochloa crusgalli, Fimbrystylis miliacea, Leptochloa chinensis, Echinochloa colona, Cyperus iria, Jussia linifolia, Oryza sativa L. (*weedy rice*), Sphenoclea zeylanica, Cyperus defformis* dan *Scirpus grossus*.. Percambahan 12 varieti padi diuji di makmal pada enam tahap saliniti dan keputusan yang diperolehi menunjukkan MR211, MR232 dan IR20 adalah tolaren manakala MR33, MR52, MR219 dan BRRI dhan40 adalah separa tolaren berdasarkan kepada peratus percambahan, indeks percambahan, indeks kesuburan pada 4 hari selapas semaian dan penghasilan bahan-kering. Berikutnya, kajian kesan ke atas pertumbuhan, unsur biokimia, kandungan mineral dan tindakbalas hasil lapan varieti padi pada saliniti yang berbeza dijalankan di rumah kaca menunjukkan pertumbuhan tanaman padi direncat dengan pantas pada saliniti 12 dS m^{-1}. Namun begitu, MR232 dan MR211 telah diklasifikasikan sebagai tolaren kepada kemasinan, manakala MR52 dan MT33 adalah separa tolaren. Percambahan sepuluh spesies rumpai telah dikaji pada kepekatan saliniti berbeza di makmal dan didapati percambahan *C. iria* dan *E. colona* adalah tertinggi manakala *E. crusgalli, J. linifolia, L. chinensis* dan *O. sativa* L. (padi angin) adalah sederhana berpandukan kepada percambahan biji benih dan kecergasan anak benih. Seterusnya, kajian pertumbuhan dan pengumpulan ion ke atas enam spesies rumpai dijalankan pada kepekatan saliniti berbeza di rumah kaca. Keputusan menunjukkan *C. iria*, *E. colona* dan *E. crusgalli* adalah tolaren, *J. linifolia* dan *L. chinensis* adalah separa tolaren berpandukan kadar pertumbuhan, kandungan klorofil, kandungan prolin dan pengumpulan ion. Tempoh kritikal persaingan padi-rumpai dalam persekitaran bersaliniti dikaji di rumah kaca dan keputusan menunjukkan tempoh kritikal persaingan rumpai bagi mengakibatkan kehilangan 5% hasil pada 0, 4 and 8 dS m^{-1} ialah masing-masing 14 hingga 55, 12 hingga 64 dan 7 hingga 80 hari selepas tanam. Tempoh kritikal

untuk kehilangan 10% hasil pada 0, 4 and 8 dS m^{-1} ialah masing-masing 36 hingga 45, 32 hingga 48 dan 23 hingga 64 hari selepas tanam. Keberkesanan kawalan rumpai oleh pelbagai racun rumpai pada tiga saliniti berbeza juga telah dinilai di rumah kaca dan keputusan menunjukkan rawatan 0.375 kg ai/ha Pretilachlor (Sofit®), 0.9 kg ai/ha + 1.8 kg ai/ha Propanil + Thiobencarb (Satunil®), 0.60 kg ai/ha +0.1 kg ai/ha Bensulfuron (Tekong®) + MCPA dan 0.50 kg ai/ha Pretilachlor (Sofit®) memberikan kesan yang terbaik berpandukan biojisim rumpai, kecekapan kawalan rumpai, penilaian kecederaan padi pertumbuhan dan prestasi hasil padi. Keputusan menunjukkan pada kepekatan racun yang melebihi tahap disyorkan menyebabkan kesan toksik berlaku ke atas padi dalam persekitaran bersaliniti. Berdasarkan keputusan kajian yang telah dijalankan, disimpulkan bahawa varieti padi MR232 boleh dipilih untuk penanaman di kawasan tepian/pinggir pantai di Semenanjung Malaysia dan rumpai utama yang toleran terhadap kemasinan boleh dikawal dengan mengambil kira tempoh kritikal persaingan padi-rumpai dengan menyembur racun seperti pretilachlor (Sofit®) (0.375 kg ai/ha) pada 4 hari selepas tanam dan diikuti dengan satu pusingan merumpai manual (pada 65 hari selepas tanam) atau propanil + thiobencob (Satunil®) (0.9 kg ai/ha + 1.8 kg ai/ha) pada 10 hari selepas tanam diikuti dengan satu pusingan merumpai manual (pada 65 hari selepas tanam).

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I certify that a Thesis Examination Committee has met on 20 October, 2011 to conduct the final examination of Md. Abdul Hakim on his thesis entitled "**RICE PRODUCTION AND WEED MANAGEMENT AS AFFECTED BY SALINITY**"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 Doctor of Philosophy.

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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 other institutions.

MD. ABDUL HAKIM

Date: 20 October 2011

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