UNIVERSITI PUTRA MALAYSIA

COMPETITIVE ABILITY OF CULTIVATED RICE MR219 AND MR269 AGAINST WEEDY RICE BIOTYPES

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By

ABDULRAHMAN BASHIRA OLAJUMOKE

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

October 2016

DEDICATION

Dedicated to the memory of my late father

and

my mother, husband and kids Ubaidah and Imran

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Master of Science.

COMPETITIVE ABILITY OF CULTIVATED RICE MR219 AND MR269 AGAINST WEEDY RICE BIOTYPES

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October 2016

Chairman : Prof. Abdul Shukor Juraimi, PhD
Faculty : Agriculture

An investigation to evaluate the competitive ability of MR219 and MR269 cultivated rice against three weedy rice biotypes viz: awn-spikelet (AWB), open panicle (OWB) and compact panicle (CWB) weedy rice biotypes was carried out in the greenhouse, Field 2, Faculty of Agriculture, Universiti Putra Malaysia from October, 2014 to November, 2015. The experiment was designed in a randomized complete block design with four replications. The replacement series method was used to vary the weedy rice density to cultivated rice at proportions of 00:100, 25:75, 50:50, 75:25 and 100:00 in other to evaluate the effect of density and their competitiveness. The result showed that the growth of the cultivated rice was affected differently by different biotypes of weedy rice. The density of weedy rice within the two cultivated rice was significant ($p < 0.05$) on the growth of MR219 and MR269. Increasing relative yield loss (RYL) of both cultivated rice was observed as weedy rice density increases. While this increase was significant ($p < 0.05$) for the effect of CWB and OWB on the RYL of the MR219, only AWB significantly reduced the RYL of MR269. Under varying nitrogen (N), MR269 produced higher yield grain in monoculture and compared to MR219. The application of different flooding regime to the competition of MR219 and MR269 with weedy rice in this research did not significantly enhance the competitiveness of the cultivated rice. The harvest index and above ground biomass in both cultivated rice were significantly reduced by the competition of weedy rice in both nitrogen and water treatment. However, MR269 appeared to perform better in terms of tolerance to weedy rice competition for yield. Added N of 100 kg/ha can be said to enhance its performance. The result of this work showed that despite the cultivated rice competitive ability against the weedy rice biotypes, the weedy rice is agronomically and physiologically more vigorous, and weedy rice free condition would be essential for optimum rice yield.

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

KEUPAYAAN DAYA SAING PADI MR219 DAN MR269 TERHADAP BIOTIP PADI ANGIN

Oleh

ABDULRAHMAN BASHIRA OLAJUMOKE

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Pengerusi : Prof. Abdul Shukor Juraimi, PhD
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Kajian untuk menilai keupayaan daya saing kultivar padi MR219 dan MR269 terhadap tiga biotypes padi angin iaitu: awn-spikelet (AWB), panicle terbuka (OWB) dan panicle padat (CWB) biotypes padi angin telah dijalankan di Rumah Hijau, Ladang 2, Fakulti Pertanian, Universiti Putra Malaysia dari Oktober 2014 hingga November 2015. Eksperimen ini telah disusun dalam reka bentuk blok lengkap rawak dengan empat replikasi. Kaedah siri penggantian telah digunakan untuk membeza kepadatan padi angin berbanding padi dengan nisbah 00: 100, 25:75, 50:50, 75:25 dan 100: 00 bertujuan untuk menilai kesan kepadatan ke atas persaingan. Hasil kajian menunjukkan bahawa pertumbuhan padi terjejas berbeza mengikut biotypes padi angin. Kesan kepadatan padi angin untuk kedua-dua varieti padi ditanam adalah signifikan dari peringkat vegetatif sehingga matang. Kehilangan hasil relatif (RYL) disebabkan oleh persaingan padi angin adalah lebih tinggi pada MR269 dibandingkan dengan MR219. Sementara itu OWB menyebabkan relatif yield loss (RYL) tertinggi di kedua-MR219 (36% pada 75:25 padi: kepadatan padi angin) dan MR269 (76% 75:25, padi:kepadatan padi angin). Peningkatan kepadatan padi angin menyebabkan peningkatan RYL pada MR219 dan MR219. Di bawah pelbagai kadar nitrogen (N), MR269 mengeluarkan hasil yang lebih tinggi dalam persaingan dengan tiga biotypes padi angin berbanding MR219 dan toleransi kepada persaingan adalah lebih tinggi pada 100 kg/ha nitrogen. Penggunaan pengairan yang berbeza untuk persaingan MR219 dan MR269 dengan padi angin dalam kajian ini mendedahkan bahawa MR269 menunjukkan lebih toleransi kepada pertandingan pada takat air ladang dan takat air tepu. Indeks tuai dan biojisim bahagian atas permukaan tanah untuk dua varieti padi telah dikurangkan dengan ketara oleh persaingan padi angin dalam kedua-dua rawatan nitrogen dan air rawatan. Walau bagaimanapun, MR269 menunjukkan prestasi hasil padi yang lebih baik dari segi toleransi kepada persaingan padi angin. Penambahan 100 kg/ha nitrogen boleh dikatakan dapat meningkatkan prestasi padi ini. Walaupun hasil kajian ini menunjukkan sifat berdaya saing padi terhadap biotypes padi angin, namun padi angin adalah secara agronomi dan fisiologi lebih kuat, dan keadaan bebas padi angin sangat penting untuk hasil padi optimum.

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LIST OF ABBREVIATIONS

AWR	Awn-spikelet Weedy Rice
CWR	Compact-panicle Weedy Rice
DF	Days to Flowering
DM	Days to Maturity (DM)
DRS	Direct Seeded Rice
DAS	Days After Sowing
FGN	Number of Filled Grains/Panicle
GF	Grain Filling
MARDI	Malaysian Agricultural Research and Development Institute
MGT	Mean Germination Time
OWR	Open-panicle Weedy Rice
PCA	Principal Component Analysis
PW	Panicle Weight
QTL	Quantitative Trait Loci
RYL	Relative Yield Loss

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The dietary consumption of rice by world population is the highest compared to all other foods. Hence, rice is an important cereal crop for the world population (Juliano, 1993). It is a staple food in Asia, American, Caribbean, African and Sub-Saharan Countries. Trends in regional production of rice is presented in Figure 1.1, and a general decrease in global production is evident (FAO, 2014). This decease has been attributed to climate change, water table depth increase, labour and energy scarcity. These lead to the management of water and labour for more yields (Singh *et al*., 2013). Among the strategies to cope with water scarcities and reduction in wetlands is the shifting from puddle transplanting to direct seeded rice (DSR). In this method rice seed are easily planted with less energy and water requirement (Farooq *et al*., 2011). One of the major threats to rice production in DRS is the weedy rice evolution.

Weedy rice is a threat to rice production as it competes with cultivated rice, diverse and difficult to control and causes yield loss (Chauhan *et al*, 2013). Its manifestation has been reported worldwide in rice fields, while its origin is thought to be from Southeast Asia where rice originated. Wild and weedy varieties of rice are phylogenetically group under the genus *Oryza* as they share some of the attributes of the two cultivated species *Oryza sativa* and *O. glaberrima* (Khush, 1997). Weedy rice is also known as wild rice, red rice, 'padi angin,' windy rice, air rice, varinellu, wild rice etc. Different varieties behave differently with cultivated rice.

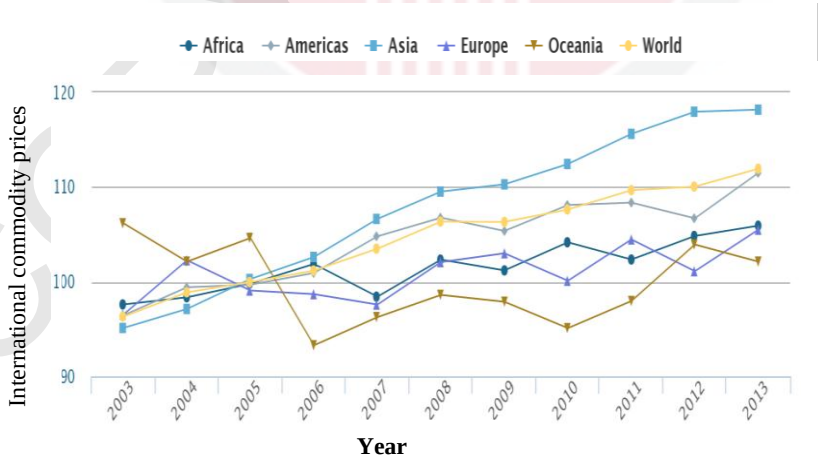

Figure 1.1: Trends in rice production in different regions (FAO, 2014).

In Malaysia, weedy rice was first discovered in Tajung Karang rice fields in 1988 (Wahab and Suhaimi, 1991) and its economic loss in the area was high (Azmi and Karim, 2008; Azmi *et al.*, 2005). Similar loss in cultivated rice due to weedy rice variant infestation has been reported in India (Abraham and Jose, 2014) and this makes some farmers to abandon rice cultivation in the area. The extent of loss resulted from weedy rice infestation signifies its ability to compete against rice and this necessitates understanding of its effective control.

The shifting to direct seeding system bestowed additional advantage on weedy rice, because it is well adapted to different environment, more stress tolerant than rice, making its problem to be more severe (Azmi and Karim, 2008). In direct seeded planting, there is no flooding at the period of crop emergence hence, weedy rice and cultivated rice emerge together simultaneously, and the two cannot be differentiated. Moreover, the emerging rice seedlings are less competitive with weeds (Rao *et al.*, 2007). Therefore, one of the major threats of direct seeded rice production currently is weedy rice.

Management of weedy rice has been largely dependent on the use of traditional method. Effective nitrogen management aimed to increase the ability of the rice to compete with weedy rice variants. Proper water management such as flooding suppresses the emergence and biomass of seedling and weedy rice plant density. Thus, understanding the competitive ability of different weedy rice biotypes against cultivated rice in response to added nitrogen, density and moisture could play a major role in strategies of managing weedy rice.

The threat imposed by weedy rice has necessitated the need for understanding the effective traditional control measure like water requirement, soil depth, nitrogen management and density of weedy rice in rice fields, especially in Malaysia where direct seeded planting is commonly practiced. Proper management of cultural methods would control weedy rice and this was investigated in this research. Flooding is regarded as an important element of cultural management of weed in rice planting. This is due to the fact that optimal timing and flooding depth affect the abundance and growth of weeds in rice fields (Chauhan and Johnson, 2010a). Furthermore, selective herbicides to control weedy rice are not available. Managing weedy rice is a challenging problem for farmers because of its physical and physiological similarities to cultivated rice. However, information on the effect of moisture regimes on seedling emergence and growth of weedy rice is not available in Malaysia. The availability of such information may help to design the cultural management strategies for weedy rice in Malaysia. This research is therefore designed to study the competitive ability of different weedy rice variants (available in peninsular Malaysia) against cultivated rice with respect to density, nitrogen uptake and varying water regime.

1.2 Objectives of the research

i) To determine the competitive relationship of weedy rice biotypes at different densities against cultivated rice.
ii) To determine the competitive outcomes between weedy rice and cultivated rice as a function of the added nitrogen and competition levels.
iii) To determine the effect of different water regimes on the growth of weedy rice biotypes and cultivated rice**.**

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