

# **UNIVERSITI PUTRA MALAYSIA**

GRAIN-FILLING RATE AND YIELD IN TWO RICE (ORYZA SATIVA L.) VARIETIES BASED ON CRITICAL PERIOD OF WEED CONTROL

LWIN MAR OO

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

April 2014

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DEDICATION

UP

Dedicated to:

(My Beloved Parents)

U Aung Myint and Daw Myint Myint Khin

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

## GRAIN-FILLING RATE AND YIELD IN TWO RICE (ORYZA SATIVA L.) VARIETIES BASED ON CRITICAL PERIOD OF WEED CONTROL

By

#### LWIN MAR OO

UPM April 2014

#### Chairman : Associate Professor Adam bin Puteh, Ph.D

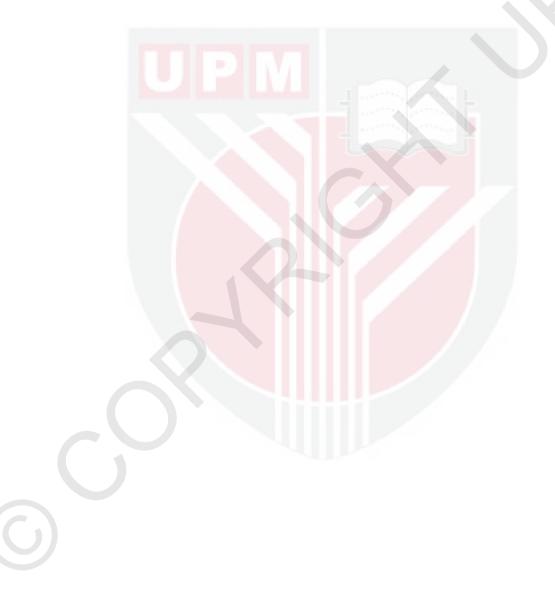
#### Institute: Agriculture

Rice (Oryza sativa L.) is the staple food crop for more than half of the world population. Weed density, duration of infestation and crop growth stages are critical factors which affect rice yield potential. Little has being studied on crop physiological responses to weed infestation, especially during reproductive growth stage. Therefore, this study was carried out to evaluate the grain filling rate and effective grain filling period during different times of weed free and weedy periods. The glasshouse experiments following normal rice culture techniques were conducted for two trials at Field-2, Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia (UPM). Two rice varieties; MR263 and IR64, were used to determine grain filling rate (GFR) and effective grain filling period (EGFP) during critical period of weed control,. The critical period of weed control was the different between the two varieties. The critical period of weed control for5% yield loss for MR263 and IR64 was observed from 10 to 64 DAS and 5 to 91 DAS for Trial I and 13 to 76 DAS and 7 to 65 DAS for Trial II, respectively. For yield losses of 10% level, the critical period of weed control was observed from 19 to 52 DAS and 18 to 63 DAS for MR263 and 10 to 75 DAS and 12 to 55 DAS for IR64 for Trial I.

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The highest grain filling rate was observed when rice plants were free of weeds from sowing to harvest, ( $T_5$ ), which was in the range of 0.7 to 0.9 mg/seed/day for both varieties in both seasons. The EGFP for both varieties varied between 27 – 29 days for *Trial I* and 24 – 27 days for *Trial II*. Grain filling rate was highly correlated with the final grain yield of MR263 and IR64. However, the effective grain filling period was negatively correlated with the grain yield of both rice varieties.

It was found that GFR (mg/seed/day) and EGFP (days) contributed significantly to the final seed weight of both varieties. Percentage filled grain, panicle numbers and final seed weight and grain yield were highly correlated with grain filling rate for both varieties during two trials. EGFP is inconsistent in contributing to the final grain yield of the two varieties used in this study. There were no correlation of effective grain filling duration and grain filling rate with grain yield based upon varieties. Long duration of weed interference during grain filling can reduce grain filling rate, and lead to reduction in final seed weight. Weed free from sowing to harvest ( $T_5$ ) increased the grain filling rate and grain yield for both varieties. Therefore, grain filling rate and yield parameters were affected by weeds interference with crop which contributes to reducing grain yield.



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

### KADAR PENGISIAN BIJIRIN DAN HASIL TUAIAN PADA DUA (*ORYZA* SATIVA L.) VARITEI PADI YANG BERASASKAN KEPADA JANGKAMASA KRITIKAL MENGAWAL RUMPAI

Oleh

### LWIN MAR OO

April 2014

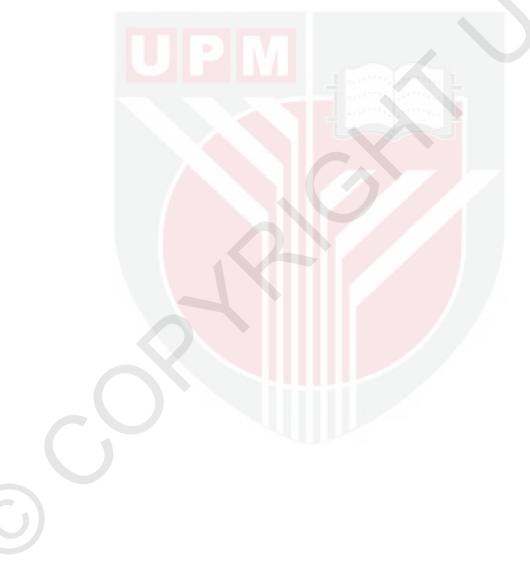
Pengerusi: Profesor Madya Adam bin Puteh, Ph.D Institusi: Pertanian

Padi (Oryza sativa L.) adalah makanan ruji kepada lebih dari setengah populasi penduduk dunia. Densiti rumpai, tempoh infestasi dan peringkat-peringkat pertumbuhan tanaman adalah faktor-faktor kritikal yang memberi kesan kepada potensi hasil padi. Tidak banyak yang telah dikaji berkaitan dengan respons fisiologi tanaman ke atas infestasi rumpai, terutamanya sewasa peringkat pertumbuhan reproduktif. Justeru, kajian ini bertujuan untuk menilai kadar pengisian bijirin dan tempoh efektif pengisian biji dalam tempoh yang berlainan pada keadaan bebas rumpai dan tempoh infestasi rumpai. Eksperimen di rumah kaca dijalankan selama dua percubaan di Ladang-2, Jabatan Sains Tanaman, Fakulti Pertanian, Universiti Putra Malaysia (UPM). Dua varieti padi; MR263 dan IR64 digunakan untuk mengenalpasti tempoh kritikal kawalan rumpai, kadar pertumbuhan biji benih (GFR) dan tempoh efektif pengisian biji (EGFP). Tempoh kritikal kawalan rumpai adalah berbeza bagi dua varieti tersebut. Tempoh kritikal kawalan rumpai untuk kehilangan hasil 5% bagi MR263 dan IR64 di antara 10 hingga 64 DAS dan 5 hingga 91 DAS untuk Percubaan I, dan 13 hingga 76 DAS dan 7 hingga 65 DAS untuk Percubaan II. Untuk kehilangan hasil 10%, tempoh kritikal kawalan rumpai adalah dari 19 hingga 52 DAS dan 18 hingga 63 DAS untuk MR263 dan 10 hingga 75 DAS dan 12 hingga 55 DAS untuk IR64 bagi dua percubaan.



Kadar pengisian bijirin yang paling tinggi apabila pokok padi bebas rumpai dari penyemaian hingga penuaian, (T<sub>5</sub>), dalam lingkungan 0.7 hingga 0.9 mg/biji/hari untuk kedua-dua varieti utuk dua percubaan. EGFP untuk kedua-dua varieti berbeza diantara 27 - 29 hari untuk *Percubaan I* dan 24 - 27 hari untuk *Percubaan II*. Kadar pengisian bijirin mempunyai kolerasi yang tinggi dengan hasil biji untuk MR263 dan IR64. Walau bagaimanapun, tempoh efektif pengisian biji mempunyai kolerasi negatif dengan hasil bagi kedua-dua varieti.

GFR (mg/biji/hari) dan EGFP (hari) dikenalpasti menyumbang secara signifikan kepada berat badan akhir biji benih untuk kedua-dua varieti. Peratusan biji penuh, bilangan panikel dan berat badan biji benih dan hasil mempunyai kolerasi yang tinggi dengan GFR untuk kedua-dua varieti semasa dua percubaan. EGFP adalah tidak konsisten dalam menyumbang kepada hasil akhir biji bagi dua varieti yang digunakan dalam kajian ini. Kolerasi GFR dan EGFP dengan hasil adalah berbeza dan bergantung pada varieti. Tempoh infestasi rumpai ketika pengisian biji boleh mengurangkan GFR dan menyebabkan pengurangan berat badan akhir biji benih. Tempoh bebas rumpai dari penyemaian hingga penuaian ( $T_5$ ) meningkatkan kadar pengisian bijirin dan hasil untuk kedua-dua varieti. Oleh itu, GFR dan parameter-parameter hasil terkesan oleh rumpai gangguan dengan tanaman yang menyumbang kepada penurunan hasil.



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Last but not least, I am grateful to the supervisory committee, Professor. Dr. Abdul Shukor bin Juraimi from the Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia for his warm hearted advice and constructive feedbacks. I certify that a Thesis Examination Committee has met on 10<sup>th</sup> April 2014 to conduct the final examination of LWIN MAR OO on her thesis entitled "Grain Filling Rate and Yield in Two Rice (*Oryza sativa* L.)Varieties based on Critical Period of Weed Control" in accordance with the Universities and University College 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 Master of Science.

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## DECLARATION

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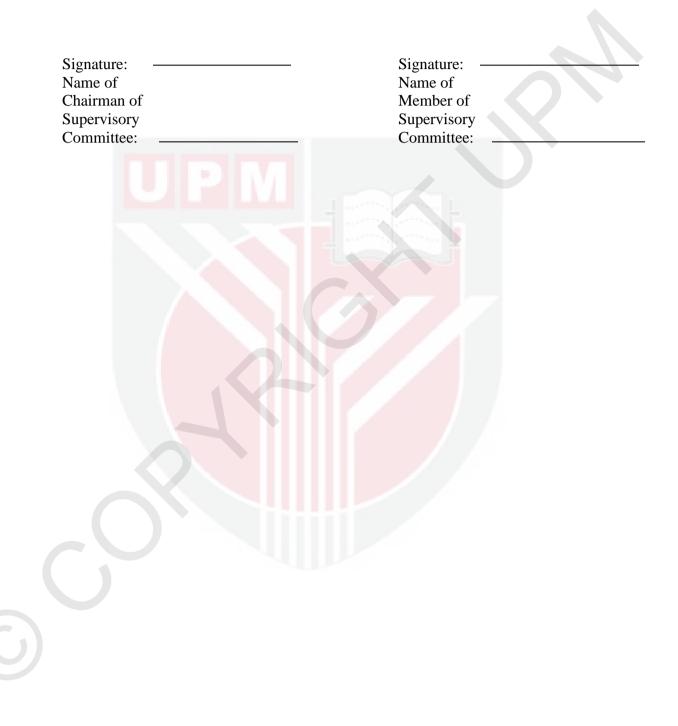
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This is to confirm that:

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## LIST OF ABBREVIATIONS

DAS DAF GFR SW EGFP FSW SAS LSD cm mg	Days after Sowing Days after Flowering Grain Filling Rate Seed Weight Effective Grain Filling Period Final Seed Weight Statistical Analysis System Least significant difference Centimeter Milligram Gram
g	Gram

C



## **CHAPTER I**

#### **INTRODUCTION**

Rice (*Oryza sativa* L.) is the main source of food for more than half of the world population and is a staple food for 3 billion people in the world (IRRI, 2005). It also provides about 35-60% of total calories for human needs (Fageria, 2007). Pinstrup-Anderson *et al.*, (1997) estimated that global rice production must increase by 36% in 2025 to supplement the needs of 4 billion people. Khush (2005) predicted that the rice production must be increased by 40% by 2030 without expanding the rice growing areas. This indicates that efficient crop management is important.

It is a widely accepted fact that weeds will compete for light, nutrients and space during crop production. Nowadays, weed infestation is one of the most limiting factors in rice production and can be a threatening factor for continuous increase in yield. A lot of weed species can be found in rice fields and compete for agricultural inputs at all growth stages of rice plants. So, to overcome these issues, the correct time of weeding during crop life cycle while growing in the field is needed to minimize yield loss. The critical time for weed control in rice is well established. Tagour *et al.*, (2010) stated that the critical time for weed control is the time period between 4 to 6 weeks from sowing in direct seeded rice. Thus, proper weed management during this period will influence yield. How rice plant responded physiologically to weed infestation during the critical time for weed control is little known.

Rice grain yield is especially influenced by grain filling rate and duration of dry matter accumulation (Egli *et al*, 2004). The grain filling period is the basic mechanism for the reproduction of an<sup>-11-1</sup> and cereal crops (Sedghi *et al.*, 2008; Yang *et al.*, 2007) and influenced the final grain yield. Fageria (2007) and Li *et al.*, (2011) believed that grain filling process is directly related to increased productivity and quality in rice. Presently, crop production systems to produce higher grain yield focuses on improving the grain filling processes (Zahedi and Jenner, 2003; Kato *et al.*, 2007).

Little information is available on the responses of grain filling rate and grain filling period to weeds in some crops (e.g. sunflower) (Sedghi *et al.*, 2008). They found that weed infestation influence on grain filling rate in sunflower but, not affecting on the effective grain filling period of crop. In rice, although critical period of weed control well established, but how yield is reduced during this period by affecting grain filling rate and grain filling period of the crops still unknown. Therefore, whether critical period of weed control affect the grain filling rate and grain filling period of rice under direct seeded condition is needed. This will explain rice physiological responses to weed infestation especially during grain filling rate to changes in grain yield potential. Therefore, the glasshouse experiment under controlled environment was carried out to determine the response of grain filling rate and grain filling period during critical period of weed control in two rice varieties under direct seeded condition.

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