UNIVERSITI PUTRA MALAYSIA

PERFORMANCE OF A MODIFIED PADDY TRANSPLANTER PLANTING FINGER FOR SYSTEM OF RICE INTENSIFICATION

BALA IBRAHIM

PERFORMANCE OF A MODIFIED PADDY TRANSPLANTER PLANTING FINGER FOR SYSTEM OF RICE INTENSIFICATION

By

BALA IBRAHIM

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

May 2015

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DEDICATION

To the memory of my late father Dandadi Alh. Ibrahim Muhammad Wurma and my mother Hajiya Rakiya Abdullahi.

The words could have been silent without you.

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

PERFORMANCE OF A MODIFIED PADDY TRANSPLANTER PLANTING FINGER FOR SYSTEM OF RICE INTENSIFICATION

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May 2015

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Problems associated with sustainable and affordable rice production has been a challenge due to scarcity of water and water related resources. The overall objective of this research was to develop a new approach to increase rice production with the limited resources input through management practices that simultaneously provide better growth condition. Two case studies were carried out at (i) experimental field located in the campus of Universiti Putra Malaysia and (ii) Tanjung Karang. The purpose of both case studies was to evaluate a management practice method known as System of Rice Intensification (SRI). Main SRI management practices such as planting depth, missing hill, hill population, number of seedling per hill, soil characteristics of the sites, and moisture content were evaluated using a modified transplanter. The planting finger of the transplanter was modified. The effects of different hill-spacings on 14-days old seedlings of MR219 rice variety were studied using analysis of variances. The experiment was designed at three seeding rates (70g, 75g and 240g) per tray. The plant characteristics at transplanting time consisted of 2 to 3 number of leaves, 2 mm stem thickness, 19 mm stem length and 3.5 mm root length. The machine was operated at a field capacity of 0.04ha/hr, field efficiency of 84% using shift lift gear position 3, and transplanting at 3 mm depth. The planting parameter showed that increase in spacing results in more tillers and more panicles per plant, while hill population and empty grains increases with decrease in spacing. The result of this research showed that the soil clay silt loam with a PH values of 7.5 and 5.0 and a bulk density of 0.86g/cm^3 and 0.88g/cm^3 for Ladang Sepuluh and Tanjung Karang respectively.yield of 9.3 tons per hectare was obtained at a spacing of 24cm x 30cm using a seeding rate of 75g of seeds.

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

PRESTASI JEJARI ALAT UBAH PENANAMAN PADI YANG TELAH DIUBAH SUAI DALAM SISTEM INTENSIFIKASI BERAS

Oleh

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Pengeluaran beras yang mampan dan murah menghadapi cabaran akibat kekurangan air serta sumber-sumber yang berkaitan dengan air. Secara umum objektif kajian adalah untuk membangunkan pendekatan baru bagi meningkatkan pengeluaran beras dengan menggunakan input sumber yang terhad melalui amalan pengurusan yang sekaligus menyediakan persekitaran pertumbuhan yang lebih baik. Dua kajian kes telah dijalankan iaitu (i) di ladang eksperimen yang terletak di kampus Universiti Putra Malaysia dan (ii) sawah padi di Tanjung Karang, Selangor. Tujuan kedua-dua kajian kes ini adalah untuk menilai kaedah amalan pengurusan yang dikenali sebagai Sistem Intensifikasi Beras (SIB/SRI). Amalan pengurusan SIB/SRI yang utama seperti kedalaman penanaman, kehilangan rumpun, populasi rumpun, bilangan anak benih di dalam satu rumpun, ciri-ciri tanah sawah, kandungan lembapan telah dinilai menggunakan alat ubah yang telah diubahsuai. Jejari alat tanaman bagi alat ubah telah diubah suai. Kesan jarak-rumpun yang berlainan bagi anak benih jenis beras MR219 yang berumur 14 hari telah dikaji menggunakan analisis varianas. Eksperimen direka bentuk bagi mengkaji tiga kadar pembenihan (70g, 75g dan 240g) se dulang. Tanaman pada masa pindah tanam mempunyai 2 hingga 3 helai daun, tebal batang 2 mm, panjang batang 19 mm dan panjang akar 3.5 mm. Keupayaan mesin yang digunakan di ladang adalah 0.04 ha/jam, keberkesanan lapangan di tahap 84% menggunakan gear angkat anjak pada kedudukan 3, dan pindah tanaman pada kedalaman 3 mm. Parameter penanaman menunjukkan peningkatan dalam jarak menyebabkan lebih banyak anak dan bulir bagi setiap pokok, manakala populasi rumpun dan padi hampa meningkat dengan kurangnya jarak. Hasil kajian ini menunjukkan bahawa lumpur tanah liat gembur yang masing-masing mempunyai nilai PH 7.5 dan 5.0 serta ketumpatan 0.86g/cm^3 dan 0.88g/cm^3 bagi Ladang Sepuluh dan Tanjung Karang telah menghasilkan 9.3 tan per hektar dengan jarak 24cm x 30cm menggunakan benih yang kadar pembenihannya 75g.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science.

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LIST OF ABBREVIATIONS

AIT	Asian Institute of Technology
AWD	Alternate Wetting and Drying
CCD	Charge Couple Device
CF	Continues Flooding
CRRI	Centre for Rice Research Institute.
DARPA	Defense Advanced Research Project Agency
DAT	Days After Transplanting
DSR	Direct Seeding Rate
FAO	Food and Agricultural Organization
FMRC	Farm Mechanisation Research Center.
FOG	Fibre Optic Gyro.
G	Gram
HST	High Sensitive Transmission.
IADP	Integrated Agricultural Development Project
IMO	Indigenous Micro-organisms
IRRI	International Rice Research Institute
KADA	Kemubu Agricultural Development Project
K-cal/ha	Kilo calories per hectare
kg	Kilogram
kg/ha	Kilogram per hectare.
M	Million.
MADA	Muda Agricultural Development Project
m^2	Meter Square.
m/sec.	Meter per second.
NAP	National Agricultural Policy
OPP	Outline Perspective Plan
PSD	Particle Size Distribution
PLC	Programmable Logic Controller.
RTKPS	Real Time Kinematic Positioning System.
RM	Malaysian Ringgit.

SSC	Saturated Soil Culture
SRI	System of Rice Intensification
t ha	Tons per hectare
T t	Trillion tons.
T units	Tractor units.
TS	Transplanting Shock
TTC	Technology Terrain College
UPM	Universiti Putra Malaysia
US	United State
USDA	United State Department of Agriculture
%	Percentage.
^{o}C	Degree centigrade
$	Dollar

CHAPTER 1

INTRODUCTION

1.1 Overview of Rice

Malaysian citizen consume about 82.3 kilograms of rice per annum on the average. In the year 1998, Malaysia produced about 1.94 million metric tons of rice. Even with this high production potential, it only produces 80 % of what it needs to support itself and must import the rest. The increasing population calls for more research and technological advancement to increase rice production for consumption in the country (Malaysia Agriculture, 2010). Asia has about 50% consumption,which accounts for about 90% global production . It is ranked second in the world after wheat and has an annual production of 678.7 million tons of paddy (Food and Agricultural Organization 2009).

Global rice production in 2010 recorded 464 million tons (696 million paddies) with forecast production in 2011 to increase upto 2.5% to 713 million tons, bearing in mind improvements in weather conditions. In Asia countries (China, India and Pakistan) the output is expected to raise up to 2.5% to reach 645 million. Hardly could you find a household either urban or rural setting where rice is not consumed twice or thrice a week. The demand has made it a most or a necessity to design urgent steps to match demand with supply to prevent scarcity. To cope with demand it has been predicted that about 114 million tons in addition to the present supply is needed in 2035 presenting an increase of 26% (Malaysia Agriculture, 2010). The main production constraints are lack of sound integrated management principles in labour, land, water, crop and lastly inputs which includes seeds, fertilizer and the required plant population. Several machines are under study, for their suitability in the cultivation of paddy, ranging from land preparation, seeding, transplanting of seedlings, weeding, fertigation practices and crop husbandry operations to comply with System of Rice Intensification (SRI) specifications. i.e transplant seedlings of 2 leaf stage at 8-15 days old, adequate spacing between plants to facilitates agronomic activities, adequate land levelling to control water e.t.c.

SRI was introduced to increase rice production through exploitation of genetic capability, creating conducive environment, improving soil condition, reducing production inputs (seeds, labour and water) and alleviating the suffering of rural dwellers (Gujja and Thiyagarajan, 2009). SRI is better understood as a strategy used for irrigated rice production adoptable to the local conditions, which changes the plant, soil, nutrients and water management practices for the sole aim of:- (i) promoting larger and robust root system and (ii) promoting the abundance of diverse and active communities of soil micro-organisms (soil biota) associated with the plant root system (Norman, U. and Amir, K. 2008).

1.2 Statement of Problem

Rice planting is one of the important stages in rice production, particularly in transplanting method. Manual paddy transplanting is tedious, labourious and time consuming operations requiring about 200 to 250 man hour per hectare, which is roughly 25% of the total labour requirement of rice production (Anoop et al, 2007). It is reported that a delay in transplanting by one month reduces the yield by 25% and a delay of two months reduced the yield by 70% (Rao, 1973).

The existing transplanter picks between 5 to 8 seedlings per hill for planting, requiring modification to allow the planting pattern of different spacings with single seedling per hill, 2 to 3 cm planting depths. Modifications have been carried out on the planting finger (kuku kambing), seed rate on tray and planting pattern so that it will only pick one-two seedlings at a time for planting.

The concept of SRI is aimed at reducing of transplanting shock through planting of single seedling at 8 to 10 days old at 2 leaf stage after seed germination. However , the current practice of transplanting older seedlings at 21 days old results in root damage, which eventually endangers the seedling quality and low production. Also, it makes the transplanter to planting more than one seedling while other places are left unplanted making the farmers paying for removal of extra seedlings at the same time replanting in the missing spots

According to the above and the necessity of time saving and crop yield, the introduction of the modified paddy transplanting machine will encourage farmers to mechanized methods of rice transplanting operations to increase their production to meet local and international demand. As a result, there is the need to modify the existing Kubota SPU 60C transplanter planting finger to transplant seedlings at recommended quantity, spacings, content, age to meet the specified guidelines of SRI.

1.3 Research Contribution

This research provides specifically developed perceptive outlooks on the soil and plant requirements, planting finger modification in line with SRI requirements. The two sites study (Ladang Sepuluh and Tanjung Karang) data are meant to provide a demonstrative practical application of the framework for sample environments in Malaysia rice grown areas.

1. Provide a paddy transplanting machine that simplifies and facilitates the operation of transplanting young seedlings at a very tender age, eliminating the walking in a stooping posture and moving in a muddy field for hours.
2. The study will contribute to knowledge-based data and also in providing new and existing knowledge that can be of use in decision making.
3. Provide simple and robust paddy machine in its mechanical structure capable of high productivity level.

1.4 Research Objectives

The main aim of the research was to determine the performance of a modified planting finger of paddy transplanter to comply with SRI guidelines. While the specific objectives are to fulfill the following objectives: -

(i) To modify the planting finger (kuku-kambing) so that it will only pick a maximum of two seedlings for transplanting.

(ii) To determine the suitable seed rate and seed pattern for nursery practices ideal for SRI transplanting.

(iii) To evaluate the performance of the modified planting finger on a Kubota SPU 68C paddy transplanter.

1.5 Research Scope and Limitations.

The study is limited to modification of the planting finger of a paddy transplanting machine and the evaluation of its performance using 14 days MR219 rice variety, transplanting on moist soil, using the transplanter shift gear lever position 3 and the expected yield return per hectare.

1.6 Thesis Outline

The thesis was arranged as follows; Chapter One; highlights the overview of global food security, concept of SRI, statement of problem research contribution and the objectives of the study, while related literatures were reviewed on the developmental stages of paddy transplanter, types of transplanters and SRI as a system of agricultural production in Chapter Two. Chapter Three illustrates the materials, experimental sites as well as the methodology of the research design. Comprehensive results of data collected are presented and fully discussed in Chapter Four. Lastly conclusions are drawn and suggestions offered for future study is presented in Chapter Five.

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