



**UNIVERSITI PUTRA MALAYSIA**

**WEED CONTROL IN DIRECT SEEDED RICE  
USING SELECTED HERBICIDES**

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WEED CONTROL IN DIRECT SEEDED RICE  
USING SELECTED HERBICIDES

by

A Z M I    B I N    M A N

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of the requirements for the degree of  
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## DEDICATION

I should like to dedicate this work  
to my wonderful wife Normah bt. Talib  
for encouragement and help during the  
preparation of this thesis and to my  
daughters Nor Rumaizah and Nor Diyana.

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## TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
TABLES OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF PLATES	xi
ABSTRACT	xii
ABSTRAK	xiv
 CHAPTER I. INTRODUCTION	 1
 CHAPTER II. LITERATURE REVIEW	 3
Weed Species in Flooded Rice Growing Areas of Malaysia	3
Crop Losses Due to Weeds	7
Factors Affecting Efficacy and Phytotoxicity of Herbicides	9
Chemical Weed Control in Direct Seeded Rice	12
Characteristic of Selected Herbicides	13
2,4-D	13
Benthiocarb	16
Butachlor	17
Molinate	18
Measurement of Weeds and Time of Sampling	20
 CHAPTER III. MATERIALS AND METHODS	 22
Experiment I	22
Experiment II	22
Experiment III	26



	Page
CHAPTER IV. RESULTS	32
Experiment I	32
Percentage of Seed Germination	32
Plumule Length	32
Radicle Growth	35
Experiment II	35
Visual Assessment of Phytotoxicity	40
Effect of Herbicide on Plant Growth and Reproduction	45
2,4-D amine	45
2,4-DIBE-Butachlor	48
Butachlor	50
Benthiocarb	54
Molinate	56
Experiment III	59
Weed Population	59
Effect of Herbicides on Growth of Rice Plant	62
Assessment of Phytotoxicity	62
Plant Height	63
Tiller Number	67
Efficacy of Herbicide on Weed Control	69
Weed Regrowth	69
Effect of Herbicide on Weed Regeneration	76
Effect of Herbicide on Rice Yield	88
Correlation Between Rice Yield and Weed Regrowth	94

	Page
CHAPTER V. DISCUSSION	97
The Weed Problem	97
The Weed Flora	97
Problem of Manual Weeding	99
Chemical Control of Weeds in Direct Seeded Rice	100
Phytotoxicity	100
Method of evaluation	101
Time of Herbicide Application	102
Rate of Herbicide Application	102
Effect of Herbicide on Crop Productivity	105
Efficacy of Weed Control by Herbicide	105
Time of Herbicide Application	106
Method of Herbicide Application	106
Herbicide Specificity	107
Crop Yield and Returns	108
CHAPTER VI. CONCLUSIONS	110
REFERENCES	112
APPENDICES	
I Weeds as the alternate host for pests of rice	119
II Schematic plan of experimental area	120
III Effect of 2,4-D amine on vegetative and reproductive characters of rice plants	121
IV Effect of 2,4-DIBE-butachlor on vegetative and reproductive characters of rice plants	122
V Effect of butachlor on vegetative and reproductive characters of rice plants	123

	Page
VI. Effect of benthocarb on vegetative and reproductive characters of rice plants	124
VII. Effect of molinate on vegetative and reproductive characters of rice plants	125
VIII. Anova - Effect of herbicide on plant height	126
IX. Anova - Effect of herbicide on number of tillers per 0.0625 m <sup>2</sup> produced	127
X. Anova - Effect of herbicide on dry weight of grassy weed regrowth	128
XI. Anova - Effect of herbicide on number of tillers <i>E. crusgalli</i> per m <sup>2</sup>	129
XII. Anova - Effect of herbicide on dry weight of sedges regrowth	130
XIII. Anova - Effect of herbicide on dry weight of broadleaf regrowth	131
XIV. Anova - Effect of herbicide on grain yield production	132
XV. Mean of plant height and tillers number	133
XVI. Mean of grass dry weight regrowth	134
XVII. Mean number of tillers <i>E. crusgalli</i>	135
XVIII. Mean of sedges dry weight regrowth	136
XIX. Mean of broadleaf dry weight regrowth	137



## LIST OF TABLES

TABLE	Page
I. Hectarage of major rice growing areas in Peninsular Malaysia	1
II. Weed species in the main rice growing areas of Peninsular Malaysia (Tanjong Karang, Kerian, Pulau Pinang, Muda area, Kemubu area)	3
III. Herbicides and rates tested in Experiment II	24
IV. Time of herbicide treatment	24
V. Treatment combination for Experiment III	28
VI. Effect of herbicides on the germination of rice seeds	34
VII. Effect of herbicides on the growth of the plumule	36
VIII. Effect of herbicides on the growth of the radicle	38
IX. Visual assessments of phytotoxicity symptoms 14 days after treatment	41
X. Effect of 2,4-D Amine on vegetative growth of rice	46
XI. Effect of 2,4-D Amine on the reproductive characters	47
XII. Effect of 2,4-DIBE-butachlor on the vegetative growth of rice plants	49
XIII. Effect of 2,4-DIBE-Butachlor on the reproductive characters	51
XIV. Effect of butachlor on the vegetative growth of rice	52
XV. Effect of butachlor on reproductive characters	53
XVI. Effect of benthocarb on the vegetative growth of rice	55
XVII. Effect of benthocarb on the reproductive characters	57
XVIII. Effect of molinate on the vegetative growth of rice	58
XIX. Effect of molinate on the reproductive characters	60
XX. Weed population in the experimental area prior to land preparation	61
XXI. Rating of rice crop injury due to application of herbicides	62



TABLE	Page
XXII. Effect of herbicides on plant height at 44 days after sowing	64
XXIII. Effect of herbicide application on plant height at 74 days after sowing	65
XXIV. Effect of herbicide application on plant height at 104 days after sowing	66
XXV. Weed regrowth in unweeded plots	71
XXVI. Visual scoring on general weed control	77
XXVII. Effect of selected herbicides on the number of <i>E. crusgalli</i> tillers	80
XXVIII. Effect of time of molinate application on the dry weight of grass	80
XXIX. Effect of time of application of 2,4-DIBE-butachlor on the regeneration of sedges	87
XXX. Effect of time of application of 2,4-DIBE-butachlor and butachlor on the dry weight of broadleaf weed	90
XXXI. Effect of the rate of application of 2,4-DIBE-butachlor on the dry weight of broadleaf weed	91
XXXII. Effect of rate and time of application of selected herbicides on the yield of rice	92
XXXIII. Effect of herbicide application on rice yields (kg/ha)	93
XXXIV. Correlation between grain yield of rice and the type of weed present at various growth stages	96
XXXV. Calculated concentration of active ingredient (a.i.) of herbicide present in the root zone of rice seedlings based upon application rates used in the experiments (mg/ml)	103
XXXVI. Cost and returns per hectare from the use of molinate in direct seeded rice.	109

## LIST OF FIGURES

FIGURE	Page
I. Synthesis of MCPA from MCPB	14
II. Effect of herbicides on germination	33
III. Effect of herbicides on plumule length	37
IV. Effect of herbicides on radicle length	39
V. Effect of type of herbicide on the number of tillers produced	68
VI. Effect of time of herbicide application on the number of tillers produced	70
VII. Effect of selected herbicides on grass weed regrowth	79
VIII. Effect of selected herbicides on the dry weight of sedges	86
IX. Effect of herbicides on the dry weight of broadleaf	89
X. Simple linear regression between density of <i>E. crusgalli</i> and grain yield of rice at 74 and 104 days after sowing	95

## LIST OF PLATES

PLATE	Page
I View of experimental site	31
II. Phytotoxicity symptoms caused by 2,4-D-Amine. The leaf tips are attached to the collar of the leaf giving a looped appearance of the leaf blade	42
III. Abnormal growth of panicle caused by 2,4-D Amine phytotoxicity	43
IV. Symptom of phytotoxicity showing leaf tips being attached to the collar of the leaf giving a looped appearance of the leaf blade caused by 2,4-DIBE- butachlor treatment	44
V. <i>E. crusgalli</i> seedling (indicated with a pen) is difficult to distinguish from surrounding rice seedlings	72
VI. Severe <i>E. crusgalli</i> infestation in control plots 70 days after sowing (maximum tillering stage). No herbicide treatment or manual weeding was carried out	73
VII. <i>E. crusgalli</i> at matured stage	74
VIII. Panicle of <i>E. crusgalli</i>	75
IX. Plot treated with molinate at 3.3 kg a.i./ha applied at 7 days before sowing	82
X. Plot treated with molinate at 3.3 kg a.i./ha applied at 14 days after sowing	83
XI. Plot treated with molinate at 3.3 kg a.i./ha applied at 35 days after sowing	83
XII. Plot treated with molinate at 6.7 kg a.i./ha applied at 7 days after sowing	84
XIII. Plot treated with molinate at 6.7 kg a.i./ha at 14 days after sowing	84
XIV. Plot treated with molinate at 6.7 kg a.i./ha applied at 35 days after sowing	85



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requirements for the Degree of Master of Agricultural Science.*

*WEED CONTROL IN DIRECT SEEDED RICE  
USING SELECTED HERBICIDES*

*by*

*Azmi Bin Man*

*Supervisor : Professor Madya Dr. Lim Eng Siong*

*Co-Supervisor : En. Sabudin Bin Md. Ali*

*Faculty : Agriculture*

*Selected herbicides for the control of weeds in direct  
seeded rice were studied. The phytotoxicity of the herbicides,  
2,4-D amine, 2,4-DIBE-butachlor, butachlor, benthocarb and molinate  
were evaluated in two studies using petri dishes and plastic pots.  
A field study was also carried out to determine the efficacy of weed  
control of 2,4-DIBE-butachlor, butachlor and molinate.*

*2,4-D amine and benthocarb were found to be highly  
phytotoxic when applied as a preemergent and as an early post-  
emergent. Molinate was safe to apply as a preemergent. All the  
herbicides evaluated were more toxic when applied during the early  
postemergent period 14 days after sowing than when applied later at  
35 days after sowing.*



*It was found that the major weed problem in direct seeded rice fields was Echinochloa crusgalli (Linn.) P. Beauv. The most effective herbicide for its control was molinate. Application of this herbicide at rate 3.3 kg a.i./ha either seven days before sowing or fourteen days after sowing was effective.*

*An increase in yield in the range of 59 to 107 percent over unweeded plots was obtained with the use of molinate for weed control. For the additional expenditure on the herbicide application, a six-fold return was obtained.*



*Abstrak tesis yang diserahkan kepada Senate Universiti  
Pertanian Malaysia sebagai memenuhi sebahagian dari keperluan-  
keperluan untuk Ijazah Sarjana Sains Pertanian.*

*WEED CONTROL IN DIRECT SEEDED RICE  
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*Oleh*

*Azmi Bin Man*

*Ketua Penyelia : Profesor Madya Dr. Lim Eng Siong  
Penyelia : En. Sabudin Bin Md. Ali  
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*Beberapa racun herba dipilih untuk kajian kawalan rumpai  
pada tanaman padi tabur terus. Fitotoksisiti racun-racun herba,  
2,4-D amine, 2,4-DIBE-butachlor, butachlor, benthocarb dan molinate  
diselidiki dalam dua kajian menggunakan petri dish dan pasu. Suatu  
kajian di sawah untuk menentukan keupayaan kawalan rumpai oleh  
2,4-DIBE-butachlor, butachlor dan molinate juga dijalankan.*

*2,4-D amine dan benthocarb didapati sangat fitotoksik  
bila digunakan sebagai pra-cambah dan awal lepas-cambah. Molinate  
adalah selamat digunakan sebagai pra-cambah. Kesemua racun-racun  
herba yang dikaji adalah lebih toksik bila diberikan awal lepas-  
cambah 14 hari selepas tabur dari bila diberikan lewat pada 35 hari  
selepas tabur.*

*Rumpai yang penting didapati pada tanaman tabur terus ialah Echinochloa crusgalli (Linn.) P. Beauv. Racun herba yang sangat berkesan mengawalinya ialah molinate. Masa pemakaiannya pada kadar 3.3 kg b.a./ha ialah tujuh hari sebelum tabur atau empat belas hari selepas tabur.*

*Pertambahan hasil di antara 59 ke 107 peratus ke atas petak tanpa kawalan rumpai telah didapati dengan penggunaan molinate. Untuk tambahan perbelanjaan ke atas pemakaian racun herba, pulangan sebanyak enam kali ganda telah diperolehi.*



CHAPTER I  
INTRODUCTION

In Peninsular Malaysia, rice is generally transplanted. Direct seeding of rice has only recently been introduced. The total hectarage of direct seeded rice crops is still relatively small compared to that planted by the conventional transplanting method (Table 1). Currently about 10,000 hectares of rice are direct seeded. This figure represents only 5 per cent of the total rice area. However, direct seeding of rice offers many advantages over transplanted rice and is expected to be widely adopted. The benefits of direct seeding over transplanting include ease of planting and reduced labour requirements, earlier maturity of 10 to 15 days and higher yields of as much as 66 percent more (IRCN, 1981).

TABLE I. HECTARAGE OF MAJOR RICE GROWING AREAS IN PENINSULAR MALAYSIA (BAKI, 1982b).

Region	Total Area Cultivated (Hectare)	Area Under Direct Seeding (Hectare)
Tanjong Karang	18,000	2,000 - 2,400
Kerian	23,600	0
Seberang Perak	9,090	400 - 440
Pulau Pinang	12,800	80 - 120
Muda Area	94,800	6,000 - 6,400
Kemubu Area	32,400	0



In spite of the advantages of direct seeding, a major problem in a direct seeded rice crop is weed control. In direct seeding, the rice seeds germinate at the same time as the weed seeds and it is difficult to carry out manual weeding. In transplanted rice there is a competitive advantage over weeds at the time of planting and weeding is easy due to the systematic plant arrangement.

In direct seeded rice, due to the problems associated with manual weeding of the crop it appears that the use of herbicide may be the solution to the weed control problem. In Malaysia, phenoxy herbicides (e.g. 2,4-D) have been widely used by farmers for the control of broadleaf weeds in flooded rice (Saharan, 1977). However, with direct seeding of rice, the weeds generally encountered are grasses because the field is not flooded during seeding. Therefore, herbicides suitable for the control of such grass weeds are necessary. Recently several promising herbicides for the control of various weeds have been introduced into the country. However, these have yet to be evaluated for their effectiveness in direct seeded rice crops locally. Hence, the present study was conducted with the following objectives :-

1. To determine the phytotoxic effect of selected herbicides on rice plants.
2. To determine the optimum time for the application of selected herbicides.
3. To determine the effectiveness of selected herbicides for the control of major weeds in a direct seeded rice crop.

# CHAPTER III

## LITERATURE REVIEW

### Weed Species in Flooded Rice Growing Areas of Malaysia

In flooded rice fields the weeds encountered may be classified into broadleaves, sedges, grasses and aquatic plants. In Peninsular Malaysia, a conglomeration of 78 species belonging to 38 genera in 28 families was recorded in five main rice growing areas as shown in Table II (MARDI Ann. Rep. 1982). These species may be subdivided into annual and perennial weeds. The annuals include 5 grasses, 21 sedges and 22 broadleaves. The perennials consist of 12 grasses, 12 sedges and 6 broadleaves. However, only 36 of these species were considered important. They formed about 94 to 96 per cent of the total weeds present in the areas studied.

TABLE II. WEED SPECIES IN THE MAIN RICE GROWING AREAS OF PENINSULAR MALAYSIA (TANJONG KARANG, KERIAN, PULAU PINANG, MUDA AREA AND KEMUBU AREA) (MARDI ANN. REP. 1982)

Family	Species	Life Cycle <sup>a</sup>
Gramineae	<i>Brachiaria mutica</i> (Forssks.) Stapf	P
	<i>B. milliformis</i> (Presl.) C.E. Hubb	P
	<i>Echinochloa crusgalli</i> (L.) Beauv	A
	<i>E. colonum</i> (L.) Link	A
	<i>E. crusgavonis</i> (H.B.K.) Shult	A
	<i>Eragrostis atrovirens</i> (Desf.) Trin. ex. Steud	P
	<i>E. anabilis</i> (L.) P. Beauv	A
	<i>Isachne globosa</i> (Thumb) O. Ktze	A
	<i>Ischaemum indicum</i> (Houtt) Merrill	P
	<i>I. muticum</i> L.	P

TABLE II. CONTINUED

Family	Species	Life Cycle <sup>a</sup>
Gramineae	<i>Leersia hexandra</i> Swartz	P
	<i>Oryza</i> spp	A
	<i>Panicum amplexicaule</i> (Rudge) Nees	P
	<i>P. auricum</i> Ridl	P
	<i>P. repens</i> L.	P
	<i>P. sarmentosum</i> Roxb	P
	<i>Paspalum conjugatum</i> Berg	P
	<i>P. vaginatum</i> Swartz	P
	<i>P. commersonii</i> Sensus Ridl	P
Cyperaceae	<i>Cyperus aromaticus</i> (Ridley) Mattf. Kukenth	A
	<i>C. babakan</i> L.	P
	<i>C. compressus</i> L.	A
	<i>C. diffusus</i> Vahl.	A
	<i>C. distans</i> L.	P
	<i>C. digitatus</i> Roxb	P
	<i>C. esculentus</i> L.	P
	<i>C. ferax</i> (L.) Rich	P
	<i>C. haspans</i> L.	P
	<i>C. iria</i> L.	A
	<i>C. luzule</i> (L.) Retx	A
	<i>C. odoratus</i> L.	P
	<i>C. malacensis</i> L.	P
	<i>C. pilosus</i> (L.) Vahl	P
	<i>C. rotundus</i> L.	P
	<i>Eleocharis cruspavonis</i> L.	P
	<i>E. chaetaria</i> (R.Br.) Roem & Schultes	A
	<i>E. geniculata</i> (L.) R & R	A

TABLE II. CONTINUED

Family	Species	Life Cycle <sup>a</sup>
Cyperaceae	<i>E. retroflexa</i> (R.Br.) Kunth	A
	<i>Fimbristylis acuminata</i> Vahl	A
	<i>F. dichotoma</i> (L.) Vahl	A
	<i>F. diphylla</i> L.	A
	<i>F. globulosa</i> (Retz) kunth	A
	<i>F. milliacea</i> (L.) Vahl	A
	<i>F. retroflexa</i> (L.)	A
	<i>F. schnoides</i> Vahl	A
	<i>Fiurena umbellata</i> Rottb.	A
	<i>Rhynchospora corymbosa</i> (L.) Britt	P
	<i>Scirpus grossus</i> (L.)	P
	<i>S. juncooides</i> (L.) Roxb	A
	<i>S. laterifolius</i> (L.) Gmel	A
	<i>S. mucronatus</i> L.	A
Onagraceae	<i>Jussiaea linifolia</i> Vahl	A
	<i>J. repens</i>	A
	<i>J. suffructicosa</i> Nutt	A
Pontederaceae	<i>Monochoria elata</i> Ridl	A
	<i>M. vaginalis</i> (Burm.f.) Presl	A
Marsileaceae	<i>Marsilea crenata</i> Presl	A
Salviniaceae	<i>Salvinia auriculata</i> Aublet	A
Scophulo- riaceae	<i>Lindernia pendunculata</i> Linn	A
	<i>Limnophylla heterophylla</i> Berth	A
Lentubula- riaceae	<i>Utricularia flexuosa</i> Vahl	P

TABLE II. CONTINUED

Family	Species	Life Cycle <sup>a</sup>
Butomaceae	<i>Limnocharis flava</i> Buch	A
Alistamaceae	<i>Sagittaria guyanensis</i> Humb	A
Convolvulaceae	<i>Ipoemea aquatica</i> L.	A
Rubiaceae	<i>Oldelandia dichotoma</i> (L.) Roxb.	A
Nymphaeaceae	<i>Nymphae lotus</i> L.	P
	<i>Nymphoides humboldtianum</i> (H.B.K.) Kuntze	P
Companulaceae	<i>Sphenoclea zeylanica</i> Gaertn	A
Lemnaceae	<i>Lemna minor</i> L.	A
Ceratophyllaceae	<i>Ceratophyllum demersum</i> L.	A
Amaranthaceae	<i>Alternanthera triandra</i> Lank	P
Azollaceae	<i>Azolla pinnata</i> R.Br.	A
Xyridaceae	<i>Xyris pauciflora</i> Keohne	A
Lythraceae	<i>Rotala indica</i> Keohne	A
Hydrocharitaceae	<i>Blyxa malayana</i> Ridl	A
	<i>Hydrilla verticillata</i> Presl.	A
Parkeriaceae	<i>Ceratopteris pteridoides</i> (Hook) Hieron	A

<sup>a</sup>P - perennial

A - annual

### Crop Losses Due To Weeds

Weeds compete with rice directly for light, nutrients and soil moisture. Indirectly, weeds cause the lowering of water and soil temperature, harbour disease pathogens and insect pests and cause other environmental disturbances such as blockage of irrigation canals and water pollution (Kusanagi, 1981).

Infestation by weeds, besides reducing yield and grain quality also increase the cost of pest control, harvesting, drying and cleaning operations (Chang, 1965; De Datta *et al.*, 1968; Anwar, 1978). Various values have been reported from different countries on the loss of rice yield due to weeds. Okafor and De Datta (1974) reported grain yield losses due to weeds alone in upland rice in the range of 83 to 100 per cent. In Asia, the annual rice crop losses due to weeds were estimated to be 11.8 per cent of the potential production (De Datta, 1981); in India, the yield losses were estimated to 10 per cent (Bharwaj and Verma, 1969); U.S.A. around 15 per cent (Smith *et al.*, 1977) and the corresponding figure for the world is 9.5 per cent (De Datta, 1981).

The reduction of rice yield due to weeds is more severe in direct seeded than transplanted rice. In Taiwan, Chiang and Leu (1981) reported that weed competition resulted in mean yield loss of 16 per cent for transplanted rice and 62 per cent for direct seeded rice. The estimated yield reduction in Korea was 20.8 per cent for transplanted and 40 per cent for direct seeded rice (Kil, 1981). The percentage of yield reduction in transplanted rice in Malaysia