





DESCRIPTIVE ANALYSES ON THE NEW BIOTYPES  
OF WEEDY RICES IN SELANGOR NORTH-WEST  
PROJECT, MALAYSIA

MUHAMAD SHAKIRIN BIN MISPAN  
B.Sc. Hons (Malaya)

A Thesis Submitted To  
The University of Malaya  
In Fulfillment For  
The Degree of Master of Science

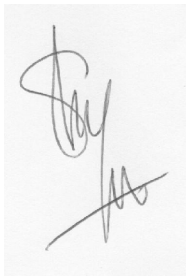
Institute of Biological Sciences  
Faculty of Science  
University Malaya  
Kuala Lumpur  
2008

## DECLARATION

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

In the name of Allah, the Most Gracious, the Most Merciful.

I hereby declare that all the work in this thesis is the results of my own data, effort and observation and all references cited have been acknowledged herewith. I also affirm that this thesis has never been submitted for any other degree somewhere else.



.....  
(Muhamad Shakirin Bin Mispan)  
SGR060048

.....  
(Prof. Dr. Baki Hj. Bakar)  
Supervisor

## **ACKNOWLEDGEMENTS**

Alhamdulillah, praise to Allah that I have completed this thesis successfully.

My special thanks to Prof. Dr. Baki Hj. Bakar with all his effort by providing me with knowledge, experience and acquaintance. As a supervisor, his invaluable advice, generosity and encouragement make this thesis went smoothly as planned.

I also want to thank University Malaya for the financial assistance supported by Fundamental Grant No. PS095/2007B. Thanks also to Prof. Dato' Dr Jamil Maah, Dean of Faculty of Science, Prof. Datin Dr. Aishah Salleh, Head Department of Institute of Biological Sciences and to the University of Malaya for providing the facilities, and scholarship throughout the study.

Thanks to people, farmers and rice growers in Selangor North West Project for allowing me to carry out my study in their rice farms. Their generosity and kindness helped a lot in the study. Thanks also to Shukriah, Latipah and Ilyas for helping me throughout the study.

I wish to record my appreciation to everybody who direct or indirectly support me on the completion of this thesis. Without the support, I cannot finish this thesis as it is.

Last but not least, to my beloved family, my brother, thanks for your understanding and support. To my wife, Wan Norazalini Wan Hassan, thanks for your patience and your unequivocal support.



**In memories;**

**MISPAN BIN ABU**

**SALMAH BINTI SALIM**

*AL-FATIHAH*

## TABLE OF CONTENT

---

DECLARATION	iii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	ix
LIST OF FIGURES	xii
ABSTRACT	xvii
ABSTRAK	xix
<b>CHAPTER 1. GENERAL INTRODUCTION</b>	<b>1</b>
1.1. World Rice Industry and the Challenges	2
1.1.1. Acreage	3
1.1.2. Rice production and trade	8
1.1.3. Consumption	26
1.1.4. Problems and challenge of rice industry	
1.1.4.1. Land	29
1.1.4.2. Labour	30
1.1.4.3. Water shortage and aerobic rice	32
1.1.4.4. Poverty	33
1.1.4.5. Pest management	35
1.1.4.6. Food security and food safety (FSFS)	36
1.2 Rice industry in Malaysia	38
1.3 Weedy and wild rices: Entity and spatio-temporal distribution in Malaysia	50
1.4 Descriptive analyses and growth pattern of wild and weedy rices.	52
1.5 Impact of weedy rice competition to the rice crop.	53
1.6 Objectives of Studies	58
1.7 Structure of Thesis	58
<b>CHAPTER 2. THEY STAND AMONG EQUALS: I. SPATIO-TEMPORAL DISTRIBUTION PATTERN OF NEW BIOTYPES OF WEEDY RICE (<i>Oryza sativa</i> L.) IN SELANGOR NORTH-WEST PROJECT, MALAYSIA.</b>	<b>60</b>
2.1 Introduction	61
2.2 Materials and Methods	70
2.3 Results and Discussion	
2.3.1 NBWR Entities and General Prevalence	75
2.3.2 Seasonal Prevalence	84
2.3.3 Spatial distribution patterns	89

<b>CHAPTER 3. THEY STAND AMONG EQUALS: II. DESCRIPTIVE ANALYSIS ON THE NEW BIOTYPES OF WEEDY RICE (<i>Oryza sativa</i> L.) IN SELANGOR NORTH-WEST PROJECT, MALAYSIA.</b>	<b>101</b>
3.1 Introduction	102
3.2 Materials and Methods	106
3.3 Results and Discussion	
3.3.1 Characterization of NBWR accessions	108
3.3.2 General description of various NBWR accession	109
3.3.3 Multivariate analysis of NBWR accessions	139
 <b>CHAPTER 4. THEY STAND AMONG EQUALS: III. SEED GERMINATION AND GROWTH PATTERNS OF NEW BIOTYPES OF WEEDY RICE (<i>Oryza sativa</i> L.) IN SELANGOR NORTH-WEST PROJECT, MALAYSIA</b>	 <b>150</b>
4.1 Introduction	151
4.2 Materials and Methods	155
4.3 Results and Discussion	
4.3.1 Seed Production	158
4.3.2 Seed weight	160
4.3.3 Time of Shattering	160
4.3.4 Germination Test	164
4.3.5 Temperature Effects	164
4.3.6 Light Requirement	168
4.3.7 Soil Depth	168
4.3.8 Flooding Test	171
4.3.9 Factors Affecting Germination and Emergence of NBWR	171
 <b>CHAPTER 5. THEY STAND AMONG EQUALS: IV. DIFFERENTIAL COMPETITIVE ABILITY OF NEW BIOTYPES OF WEEDY RICE (<i>Oryza sativa</i> L.) AND CULTIVATED RICE VAR. MR 220 SELANGOR NORTH-WEST PROJECT, MALAYSIA</b>	 <b>176</b>
5.1 Introduction	177
5.2 Materials and Methods	182
5.3 Results and Discussions	
5.3.1 Clonal Growth	186
5.3.2 Relative yields	195
5.3.3 Aggresivity index	197
5.3.4 Reproductive effort, vegetative effort and harvest index	197
5.3.5 Path analysis	205



<b>CHAPTER 6: GENERAL DISCUSSION</b>	214
6.1 General – “They Stand Among Equals”.	215
6.2 Weedy and Wild Rices	216
6.3 Spatio-Temporal Distribution Pattern of New Biotypes of Weedy Rice	217
6.4 Descriptive analyses of NBWR	223
6.5 Growth pattern and seed germination of NBWR	225
6.6 Differential competitive ability of NBWR and cultivated rice <i>var.</i> MR220	226
6.7 Epilogue	228
 <b>PUBLICATIONS</b>	 231
 <b>REFERENCES</b>	 233
 <b>APPENDICES</b>	 246

## List of Tables

---

<b>Table 1.1</b>	World's rice rough production ('000 tonnes) in selected countries and regions from 1990 to 2005.	4
<b>Table 1.2</b>	Some attributes on rice industry in the selected regions in the world in 2007.	7
<b>Table 1.3</b>	Total world harvested rice area, rice production and production growth rate from 1960-2008	9
<b>Table 1.4</b>	Total exported rice since 1999 by top rice exporting countries	17
<b>Table 1.5</b>	Rice harvested area ('000 ha) in Asia since 2000	18
<b>Table 1.6</b>	Rice production ('000 t) in Asia since 2000	19
<b>Table 1.7</b>	World estimate population and the projection to 2030	23
<b>Table 1.8</b>	Rough yield of rice in Asia since 2000	24
<b>Table 1.9</b>	Total rice consumption of selected rice producer countries from 1999 to 2008	27
<b>Table 1.10</b>	Acreages and rice production in Malaysian granaries in 2007	39
<b>Table 1.11</b>	Some attributes of rice in Malaysian rice industry since 2000	40
<b>Table 2.1</b>	Weedy and wild rice aggregates in selected rice-growing areas of Asia	63
<b>Table 2.2</b>	Estimates of weedy rice infestations in Peninsular Malaysia from 1995 to 2007	67
<b>Table 2.3</b>	Survey schedule for each farm block in three consecutive seasons	72
<b>Table 2.4</b>	Identification keys for new biotypes of weedy rice in the field	72
<b>Table 2.5</b>	Key morphological traits of new biotypes of weedy rice in the field.	76
<b>Table 2.6</b>	Key morphological traits of prevailing new biotypes of weed rices in South West Project, Selangor, Malaysia.	76
<b>Table 2.7</b>	Variance-to-Mean Ratio values of weedy rice accessions in different farm blocks of rice granaries, Selangor's South West Project, Malaysia.	90

**List of Tables (Cont.)**

---

<b>Table 2.8</b>	Lloyd's Patchiness Index Values of weedy rice accessions in different farm blocks of rice granaries, Selangor's South West Project, Malaysia	93
<b>Table 3.1</b>	Characters used in the analysis and their method of scoring for weedy rice accessions and cultivated rice <i>var.</i> MR220.	107
<b>Table 3.2</b>	A comparison between NBWR main characteristic with ordinary cultivated rice varieties in Malaysia.	110
<b>Table 3.3</b>	Morphological traits of dominant NBWR prevailing in Selangor North West Project, Malaysia.	110
<b>Table 3.4</b>	Eigen values, percent and cumulative variance, factor scores and communality of the most important characters generated from factor analysis.	140
<b>Table 3.5</b>	The first four components axes of the new biotype of weedy rice (NBWR) traits for principal component analysis.	142
<b>Table 3.6</b>	Eigen vectors of major traits of the first four principal components used.	142
<b>Table 3.7</b>	Agglomeration schedule of average linkage (Between Groups) from cluster analysis of 16 new biotype of weedy rice (NBWR) accessions.	147
<b>Table 3.8</b>	Eigen values, percentage, cumulative percentage and correlation of canonical variables determined from 14 traits measured on 16 different new biotype of weedy rice (NBWR) accessions.	148
<b>Table 4.1</b>	Pot sown with new biotypes of weedy rice in different soil depth.	158
<b>Table 4.2</b>	Pot sown with new biotypes of weedy rice in with different water levels.	158
<b>Table 4.3</b>	Summary of results in some germination and qualitative data test of new biotypes of weedy rice.	160
<b>Table 5.1</b>	Treatment combinations and ratios accorded in the replacement series experiment.	182
<b>Table 5.2</b>	Selected plant growth parameters and yield components	183
<b>Table 5.3</b>	Final plant height of MR220 and NBWR in different density regimes (monoculture and mixture).	189



**List of Tables (Cont.)**

---

<b>Table 5.4</b>	Tiller numbers of MR220 and NBWR in different density regimes (monoculture and mixture).	192
<b>Table 5.5</b>	Number of filled grains per panicle of MR220 and NBWR in different density regimes (monoculture and mixture).	194
<b>Table 5.6</b>	1000 grains weight of MR220 and NBWR in different density regimes (monoculture and mixture).	196
<b>Table 5.7</b>	Reproductive effort (RE), vegetative effort (VE) and harvest index (HI) for MR220 and NBWR in different density regimes (mixture and monoculture).	200
<b>Table 5.8</b>	Comparison of path coefficient values of direct effects between weed and rice densities and yield components; and yield components and fecundity of MR220 and NBWR	206
<b>Table 5.9</b>	Path coefficient of the yield components of rice <i>var.</i> MR220 and NBWR. (Path coefficients in parentheses are for NBWR).	211

## List of Figures

---

<b>Fig. 1.1</b>	Rice production in the world for year 2005	4
<b>Fig. 1.2</b>	Top ten countries of the largest rice cultivated area in the world	10
<b>Fig. 1.3</b>	Ton ten highest rice milled production countries in the world	11
<b>Fig. 1.4</b>	World's rice production growth rate from 1960-2007	12
<b>Fig. 1.5</b>	World rice yield growth from 1960-2008	14
<b>Fig. 1.6</b>	Current top ten rice exporter countries in the world	15
<b>Fig. 1.7</b>	Current top ten rice importer countries in the world	16
<b>Fig. 1.8</b>	Total rice export ('000 t) for 2007 in selective Asian countries.	21
<b>Fig. 1.9</b>	Total rice import ('000 t) for 2007 in selective Asian countries	22
<b>Fig.1.10</b>	Diagrams of area harvested of rice in Malaysia from year 2000 to 2007	44
<b>Fig. 1.11</b>	Diagrams of rough yield of rice in Malaysia from year 2000 to 2007.	45
<b>Fig. 1.12</b>	Diagrams of total consumption of rice in Malaysia from year 2000 to 2007.	46
<b>Fig. 1.13</b>	Diagrams of milled production of rice in Malaysia from year 2000 to 2007.	47
<b>Fig. 1.14</b>	Diagrams of import of rice in Malaysia from year 2000 to 2007.	48
<b>Fig. 2.1</b>	Wild and weedy rice distribution in the world 1. Weedy rice ( <i>Oryza sativa</i> ), 2. <i>O.brachyantha</i> , 3. <i>O. eichingeri</i> , 3a. <i>O. barthii</i> , 4. <i>O. australensis</i> , 5. <i>O. alta</i> , 6. <i>O. glumaepedulla</i> , 7. Red rice ( <i>Oryza sativa</i> ), 8. <i>O. rufipogon</i> , <i>O. officinalis</i> , <i>O. ridleyi</i> . The lines across the globe represent the northern and southern latitudinal extremes where rice can be grown.	64
<b>Fig. 2.2</b>	Possible paths of invasion (indicated by arrows) by weedy rices in the Malaysian rice granaries.	69
<b>Fig. 2.3</b>	Map of Peninsular Malaysia and Selangor North West Project (PBLs) area where the study was done.	71

## List of Figures (Cont.)

---

<b>Fig. 2.4</b>	(A) Panicle of NBWR with heavy grain shattering taking place. Inserts (B) shattered grains; (C) range of grain shapes and sizes; (D) range of colour of pericarps.	77
<b>Fig. 2.5</b>	Cultivated rice var. MR219 as tall as NBWR in PBLs, Malaysia	78
<b>Fig. 2.6</b>	Weedy rice previously grow taller than commercial rice in PBLs, Selangor	78
<b>Fig. 2.7</b>	Cutting/slashing/roughing activities practiced by the farmers to control taller biotype of weedy rices in PBLs, Selangor.	78
<b>Fig. 2.8</b>	The spatial distributions of the most common new biotypes of weed rice accessions in 2006-2008 seasons in rice granaries of South West Project, Selangor, Malaysia.	79
<b>Fig. 2.9</b>	Population counts (no. plants/m <sup>2</sup> ) of weedy rice accessions in different farm blocks in the seasons of 2006-2008 in Selangor's North West Project, Malaysia.	81
<b>Fig. 2.10</b>	Importance value index values of weedy rice accessions in different farm blocks and growing seasons of 2006-2008 in Selangor's North West Project, Malaysia.	85
<b>Fig. 2.11</b>	The relationship between Lloyd's mean crowding (m*) and mean density (m) values of weedy rice for different farm blocks and growing seasons of season 1 (2006/2007) in Selangor's North West Project, Malaysia	94
<b>Fig. 2.12</b>	The relationship between Lloyd's mean crowding (m*) and mean density (m) values of weedy rice for different farm blocks and growing seasons of season 2 (2007) in Selangor's North West Project, Malaysia.	95
<b>Fig. 2.13</b>	The relationship between Lloyd's mean crowding (m*) and mean density (m) values of weedy rice for different farm blocks and growing seasons of season 3 (2007/2008) in Selangor's North West Project, Malaysia.	96
<b>Fig. 3.1</b>	Weedy rice accession Acc1	111
<b>Fig. 3.2</b>	Weedy rice accession Acc2	113
<b>Fig. 3.3</b>	Weedy rice accession Acc3	114
<b>Fig. 3.4</b>	Weedy rice accession Acc4	116



**List of Figures (Cont.)**

---

<b>Fig. 3.5</b>	Weedy rice accession Acc5	118
<b>Fig. 3.6</b>	Weedy rice accession Acc6	119
<b>Fig. 3.7</b>	Weedy rice accession Acc7	121
<b>Fig. 3.8</b>	Weedy rice accession Acc8	123
<b>Fig. 3.9</b>	Weedy rice accession Acc9	125
<b>Fig. 3.10</b>	Weedy rice accession Acc10	126
<b>Fig. 3.11</b>	Weedy rice accession Acc11	128
<b>Fig. 3.12</b>	Weedy rice accession Acc12	130
<b>Fig. 3.13</b>	Weedy rice accession Acc13	131
<b>Fig. 3.14</b>	Weedy rice accession Acc14	133
<b>Fig. 3.15</b>	Weedy rice accession Acc15	134
<b>Fig. 3.16</b>	Weedy rice accession Acc16	136
<b>Fig. 3.17</b>	Cultivated Rice var. MR220	138
<b>Fig. 3.18</b>	Generated components plot in rotated space for principal component analysis	144
<b>Fig. 3.19</b>	Dendrogram using Average Linkage (Between Groups) from cluster analysis of 16 new biotype of weedy rice (NBWR) accessions	146
<b>Fig. 4.1</b>	Average filled grains per panicle according to different panicle lengths	159
<b>Fig. 4.2</b>	Percentage of NBWR's seeds according to seed-weight group.	161
<b>Fig. 4.3</b>	Germination percentage according to different seed weight group.	162
<b>Fig. 4.4</b>	Time of shattering for new biotype of weedy rice in Selangor North West Project.	163
<b>Fig. 4.5</b>	Number of seedlings of new biotype of weedy rice (NBWR) according to different group of plant height 20 days after sowing (DAS).	165

## List of Figures (Cont.)

---

<b>Fig. 4.6</b>	Germination rate of NBWR in percentage according to different temperature groups.	166
<b>Fig. 4.7</b>	Seedling height of NBWR 20 days after sowing when grows in different temperature regimes.	167
<b>Fig. 4.8</b>	Seedling height of NBWR 20 days after sowing when grows in different soil depths.	169
<b>Fig. 4.9</b>	Seedling height of NBWR 20 days after sowing when grows in different soil depths	170
<b>Fig. 4.10</b>	Germination rate of NBWR in when submerged in different water depths.	172
<b>Fig. 4.11</b>	Seedling height of NBWR 20 days after sowing when grown in different water depths.	173
<b>Fig. 5.1</b>	Plant height of cultivated rice <i>var.</i> MR220 in monoculture as influenced by different densities and days (after transplanting - DAT)	187
<b>Fig. 5.2</b>	Plant height of new biotype of weedy rice (NBWR) in monoculture as influenced by different densities and days (after transplanting - DAT).	188
<b>Fig. 5.3</b>	Tiller numbers of new biotype of weedy rice (NBWR) in monoculture as influenced by different densities and days (after transplanting - DAT).	191
<b>Fig. 5.4</b>	Relative yield (RY) of cultivated rice <i>var.</i> MR220 and NBWR as influenced by different density proportions.	198
<b>Fig. 5.5</b>	Aggresivity index values of NBWR in three different density proportions.	199
<b>Fig. 5.6</b>	Reproductive effort (RE), vegetative effort (VE) and harvest index (HI) values for MR220 and NBWR in different monoculture densities.	201
<b>Fig. 5.7</b>	Reproductive effort (RE), vegetative effort (VE) and harvest index (HI) values for MR220 and NBWR in different mixture proportions.	202
<b>Fig. 5.8</b>	Path analyses diagram for the relationship between planting densities of rice <i>var.</i> MR220 (RD) and NBWR (WD) on yield components.	207

### List of Figures (*Cont.*)

---

<b>Fig. 5.9</b>	Path analyses diagram for the indirect effect of yield components of rice <i>var.</i> MR220 and NBWR. Path coefficient values in parentheses are for NBWR	212
-----------------	---	-----



**TITLE: DESCRIPTIVE ANALYSES ON THE NEW BIOTYPES OF WEEDY  
RICES IN SELANGOR NORTH-WEST PROJECT, MALAYSIA**

**ABSTRACT**

Weedy rice (*Oryza sativa* . L) is a big threat in rice industry all over the world an also in Malaysia. The infestation of weedy rice caused a big loss to production and yield to the rice farmers. Study in Selangor North West Project for three consecutive seasons in 2006 to 2008 has found a new variety or biotype of weedy rice which has infested rice granaries here. In general, weedy rice is taller than any cultivated rice and it is very to be identified. However, this new biotype of weedy rice (NBWR) stands as tall as any cultivated rice namely MR220 and MR219. As such these NBWR accessions stand among equals morphologically *vis-à-vis* the commercial varieties of rice *i.e.* MR220, MR219 and MR232. Spatial distribution analysis through quantitative index, Variance to mean ratio and Lloyd patchiness index, has found that most NBWR accessions were distributed in clump or cluster and only some of them were distributed randomly. From this Fig., Acc 8 has the highest population and was most dominant accession while Sawah Sempadan was the worst farm block infested by NBWR compared to other farms. Descriptive analysis has observed that NBWR accessions have close morphological traits and really mimic the cultivated rice *viz.* MR220, MR219 and MR84. Multivariate analysis has resulted some characters and traits which can be used to differentiate between MR220 and NBWR accessions. Results show that qualitative characters such as panicle type and pericarp colour can be most important characters to differentiate these plants. Seed germination and growth pattern test have found NBWR was easy to germinate in control environment. However, a few factors seem to disturb the germination. NBWR seeds cannot be germinated in high temperature over 40°C and low temperature below 20°C; soil depth below 5cm and water level below 7cm. On the other hand light does not affect the

germination. Competition between NBWR and cultivated rice *var.* MR220 has found the relationship between these two plants. Results found that MR220 did not affected by the existence of NBWR but not to NBWR. NBWR was affected quite badly in any density regime. This has concluded that the existence of NBWR will not give any problem in rice field. Path analysis has found the relationship between rice density and weed density in affecting the yield components. High density in weed and rice can affect the yield components for both MR220 and NBWR. However, the difference in yield components will not give any obvious impact to the fecundity of rice and weed.

**TAJUK: ANALISIS DISKRIPITIF KE ATAS BIOTIP BARU PADI ANGIN DI  
PROJEK BARAT LAUT SELANGOR, MALAYSIA.**

**ABSTRAK**

Padi angin (*Oryza sativa* L.) merupakan satu ancaman yang amat besar di dalam industri padi seluruh dunia dan tidak ketinggalan juga di Malaysia. Serangan padi angin ini menyebabkan kerugian yang amat besar kepada petani. Kajian di Projek Barat Laut selangor untuk tiga musim berturut-turut pada 2006 hingga 2008 mendapati ada satu varieti atau biotaip baru padi angin yang menyerang kawasan tanaman padi di sini. Secara am, padi angin mempunyai ketinggian jauh melebihi padi biasa dan mudah untuk dikenal pasti namun varieti baru ini tumbuh sama tinggi dengan padi tanaman seperti varieti MR220 dan MR219. Ini menimbulkan satu fenomena bahawa padi angin kini “*berdiri sama tinggi dan duduk sama rendah*” dengan mana-mana varieti padi komersil seperti MR220, MR219 dan MR232. Kajian taburan melalui indeks kuantitatif, nisbah variyen kepada purata dan indeks kerawakan Lloyd mendapati kebanyakan varieti baru padi angin ini (NBWR) adalah tertabur secara berkelompok dan sebahagian kecil adalah secara rawak. Daripada jumlah ini, Acc 8 merupakan NBWR yang paling banyak dan dominan di sini manakala Sawah Sempadan merupakan kawasan yang paling teruk di serang oleh NBWR berbanding kawasan tanaman lain. Kajian deskripsi mendapati bahawa NBWR mempunyai morfologi yang amat mirip berbanding padi biasa. Sebanyak 16 assesi telah dikenal pasti dan kesemuanya amat sukar dibezakan berbanding padi biasa. Analisis multivariate mendapati beberapa ciri bagi padi yang dapat dijadikan sebagai panduan bagi membezakan antara padi angin dan padi biasa. Keputusan mendapati, ciri-ciri kualitatif seperti bentuk panikel dan warna perikap menjadi ciri penting dalam perbandingan kedua pokok ini. Kajian percambahan biji benih dan corak pertumbuhan NBWR pula mendapati bahawa benih NBWR amat mudah bercambah dalam keadaan biasa. Walau bagaimanapun beberapa

faktor telah dikenalpasti dapat membantutkan percambahan biji benih. Percambahan NBWR tertangu dengan perubahan suhu yang melebihi 40°C dan kurang daripada 20 °C; kedalaman tanah melebihi 5cm dan kedalaman air lebih daripada 7cm. Namun begitu, cahaya tidak menjadi faktor percambahan kepada NBWR. Persaingan di antara NBWR dan padi biasa *var.* MR220 mendapati ada saling kaitan antara satu sama lain jika diletakkan bersama. Walau bagaimanapun, padi MR220 didapati tidak terjejas di dalam persaingan ini jika dibandingkan dengan padi angin NBWR. Dalam apa jua keadaan kepadatan, NBWR di dapati amat terkesan dengan kehadiran MR220. Ini menyimpulkan bahawa kehadiran NBWR di dalam tanaman sepatutnya tidak memberi sebarang masalah dalam penghasilan hasil tanaman. Ujikaji Path analisis mendapati saling kaitan antara kepadatan padi dan rumpai mempengaruhi hasil tanaman. Kepadatan yang tinggi dalam kehadiran kedua-dua padi dan rumpai menjejaskan komponen hasil bagi kedua-dua tanaman. Walau bagaimanapun, perubahan komponen-komponen hasil ini tidak memberi impak yang tinggi kepada komponen kesuburan.