

**MORPHOLOGICAL AND PHYSIOLOGICAL SCREENING OF RICE
(*Oryza sativa* L.) FOR SALINITY TOLERANCE AT SEEDLING
STAGE USING THE RICE DIVERSITY PANEL**

THESIS

ALFREDO V. ALCANTARA, JR.

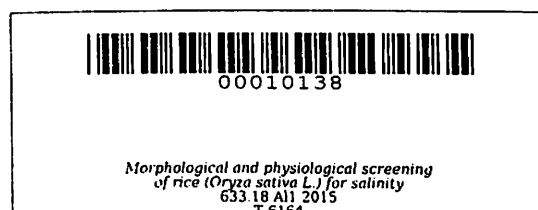
**College of Arts and Sciences
CAVITE STATE UNIVERSITY
Indang, Cavite**

April 2015

**MORPHOLOGICAL AND PHYSIOLOGICAL SCREENING OF RICE
(*Oryza sativa* L.) FOR SALINITY TOLERANCE AT SEEDLING
STAGE USING THE RICE DIVERSITY PANEL**

Undergraduate Thesis
Submitted to the Faculty of the
College of Arts and Sciences,
Cavite State University,
Indang, Cavite

In partial fulfillment
of the requirements for the degree
Bachelor of Science in Biology
(Major in General Biology)



ALFREDO V. ALCANTARA, JR.
April 2015

ABSTRACT

ALCANTARA, ALFREDO, JR. V. Morphological and Physiological Screening of Rice (*Oryza sativa* L.) for Salinity Tolerance at Seedling Stage Using the Rice Diversity Panel. Undergraduate Thesis. Bachelor of Science in Biology Major in General Biology, College of Arts and Sciences, Cavite State University, Indang, Cavite. April 2015. Adviser: Dr. Miriam D. Baltazar; Co-adviser: Ms. Marjorie P. de Ocampo.

The study generally aims to screen rice (*Oryza sativa* L.) accessions under the Rice Diversity Panel tolerant to salinity at seedling stage using morphological and physiological parameters. Specifically it aims to compare the growth and physiological responses of different rice varieties to salinity stress; determine which varieties are considered tolerant or sensitive based on different parameters measured; and assess which physiological characters best contribute to salinity tolerance.

Screening method utilized for morphological scoring was based on modified Standard Evaluation System (SES) scores of visual salt injury at seedling stage developed by IRRI. This involves exposure Yoshida's solution as basal medium supplemented with sodium chloride (NaCl) to obtain a final electrical conductivity (EC) of 12 dS m⁻¹. Physiological screenings done were vigor test, biomass test, chlorophyll content determination and sodium-potassium ratio measurement.

Based on morphological screening, out of 324 rice accessions assessed, 87 (27%) were classified as highly tolerant to saline stress, where M 202, MINGHUI 63, ECIA76-S89-1, MING HUI showed the highest degree of tolerance. There were 195 (60%) accessions considered as tolerant, while 36 (11%) were moderately tolerant. Only 4 (1%) accessions were classified as susceptible and only 2 accessions (C57-5043 and WC4419) were highly susceptible.

Based on statistical analysis, among the physiological parameters used, vigor seedling growth and root biomass do not correlate with the morphological SES scores, while shoot biomass, chlorophyll content and sodium-potassium ratio correlate with the morphological result. These indicate that these physiological parameters must be considered for future studies in developing rice for salinity tolerance.

TABLE OF CONTENTS

	Page
BIOGRAPHICAL DATA	iii
ACKNOWLEDGMENT	iv
ABSTRACT	vii
TABLE OF CONTENTS	ix
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF APPENDICES	xiv
INTRODUCTION	1
Objectives of the Study	4
Significance of the Study	4
Time and Place of the Study	5
Scope and Limitation	5
REVIEW OF RELATED LITERATURE	6
Rice	6
Salinity	6
Sensitivity of Rice to Salinity.....	8
Physiological Mechanisms for Salinity Tolerance	10
Seedling Vigor.....	10
Biomass.....	11
Chlorophyll Content	11

Rice Diversity Panel	12
MATERIALS AND METHOD	13
Research Design	13
Plant Materials.....	13
Seed germination.....	13
Group Screening Parameters into Morphology and Physiology	14
Salinity Stress Symptom Evaluation.....	15
Vigor Test	16
Biomass Measurement.....	17
Sodium (Na ⁺) and Potassium (K ⁺) Content Determination.....	18
Chlorophyll Concentration Measurement	18
Statistical Analysis	19
RESULTS AND DISCUSSION	20
SES Scores	20
Correlation between Morphological and Physiological Traits	24
SES and Vigor Test	25
SES and Biomass	26
SES and Chlorophyll	29
SES and Sodium-Potassium Ratio on Shoots and Roots	30
SUMMARY, CONCLUSION AND RECOMMENDATIONS	31
Summary	31
Conclusion.....	32
Recommendation.....	33

REFERENCES	34
APPENDICES	37

LIST OF TABLES

Table	Page
1 IRRI's Modified Standard Evaluation System (SES) scores of visual salt injury at seedling stage.....	16
2 SES scores of NSF-TV-Set varieties used in this study in comparison with tolerant check – FL478 and susceptible check – IR29.....	22
3 Vigor scores and SES scores of selected varieties in this study	25
4 Shoot Biomass vs SES scores of selected varieties of used in this study.....	26
5 Root Biomass vs SES scores of selected varieties of used in this study.....	27

LIST OF FIGURES

Figure	Page
1 Geographical distribution of varieties with varying degrees of tolerance for salinity at the seedling stage among indica, aus, temperate japonica, tropical japonica, aromatic, and admix subpopulations.....	7
2 Growth stages when rice is tolerant and sensitive to salt stress	9
3 Seed germination preparation	14
4 Screening preparation	15
5 Vigor test	17
6 Biomass measurement	17
7 Na-K content determination	18
8 Chlorophyll concentration measurement	29
9 Tolerance distribution on the rice diversity panel	21

LIST OF APPENDICES

Appendix	Page
A The Rice Diversity Panel (NSF-TV Set) and their country of origin	38
B Screening timetable	49
C Yoshida's solution.....	50
D Experimental set-up of salinized (R1-R3) and non-salinized (C) solutions.....	51
E Examples of salt-induced injuries, and appropriate SES scores for these individuals.....	53
F Vigor scores and SES scores	54
G Scatterplot of SES and plant vigor correlation	64
H Correlation coefficients for the association between morphological and physiological parameters for salinity tolerance	65
I Scatterplot of SES and shoot and root biomass correlation	67
J Scatterplot of SES and chlorophyll content correlation	67
K Scatterplot of SES and shoots and roots Na content correlation.....	68
L Scatterplot of SES and shoots and roots K content correlation	68
M Scatterplot of SES and shoots and roots Na/K ratio correlation	69
N Thesis workflow	70
O English Critic Certificate	71
P IRRI Scholarship Award Letter	72
Q IRRI Intellectual Property Rights (IPR) Agreement	74
R IRRI Code of Conduct Acknowledgement	75
S Curriculum Vitae	76

MORPHOLOGICAL AND PHYSIOLOGICAL SCREENING OF RICE (*Oryza sativa* L.) FOR SALINITY TOLERANCE AT SEEDLING STAGE USING THE RICE DIVERSITY PANEL

Alfredo V. Alcantara, Jr.

An undergraduate thesis manuscript submitted to the faculty of the Department of Biological Sciences, College of Arts and Sciences, Cavite State University, in partial fulfillment of the requirements for the degree, Bachelor of Science in Biology (Major in General Biology) with contribution no. _____. Prepared under the supervision of Dr. Miriam D. Baltazar and Ms. Marjorie De Ocampo (IRRI).

INTRODUCTION

Rice (*Oryza sativa* L.) is a major food crop considered as the staple food for more than half of the human population. Over 3.5 billion people worldwide depend on rice for their energy source, which accounts for more than 20% of their daily human calorie needs (Tonini and Cabrera, 2011). Approximately sixty-five (65) kilos of rice is consumed by an individual per year (Mohanty *et al.*, 2013).

The fast-paced increase in population and the environmental stresses accompanied to rice production challenged rice breeders to develop rice varieties with tolerance to several environmental stresses. These environmental stresses include submergence, drought, heat and salinity which significantly aggravate the condition of poor farmers particularly in local rice-growing areas.