

TABLE OF CONTENTS

PREFACE.....	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES.....	x
LIST OF FIGURES.....	xii
ABSTRACT.....	xv
INTISARI.....	xvi
I. INTRODUCTION.....	1
I.1. Background.....	1
I.2. Statement of Problems.....	3
I.3. General Objectives.....	3
I.4. Expected Outcomes.....	4
I.5. Originality.....	4
II. LITERATURE REVIEW AND THEORETICAL BASIS.....	5
II.1. Literature Review.....	5
II.1.1. The importance of citrus crops.....	5
II.1.2. Citrus Propagation.....	6
II.1.3. Huanglongbing.....	7
II.1.4. <i>Candidatus Liberibacter</i>	9
II.1.5. Vector of Huanglongbing.....	11
II.1.6. Current status of HLB and control techniques.....	12
II.1.7. AMF and their effects on citrus crops.....	16
II.1.8. Metagenomic analyzes on plant roots colonized by AMF	20
II.2. Theory Basis.....	21
II.3. Hypothesis.....	22
III. RESEARCH METHODOLOGY.....	23
A. Material and Equipment.....	23
B. Time and Location.....	29
C. Research design.....	29
1. Experiment I ((Morphological detection and molecular identification of AMF which colonized citrus root seedling naturally before transplanting...)	29
1.1. AMF morphological detection.....	29
1.2. AMF Molecular Verification.....	31
2. Experiment 2 (Identification of HLB symptomatic leaves, twigs and fruits for source of pathogen inoculum.....)	33
2.1. Symptom survey and sample collection.....	33

2.2. <i>Candidatus Liberibacter asiaticus</i> molecular detection by PCR.....	35
2.3. Measure healthy and symptomatic leaf CT-Value.....	36
2.4. Measure the CT-Value of healthy leaf sample.....	37
2.5. Measure the CT-Value of HLB symptomatic leaf.....	37
3. Experiment 3 (Response of rootstocks and rootstock/scion combination against inoculation of AMF and CLas).....	38
3.1. Experiment of rootstock without grafting.....	38
3.2. Experiment of rootstock/scion combination.....	39
4. Experiment 4 (Metagenomic analysis using ITS and 16 S).....	47
D. Data Collection.....	48
IV. RESULTS AND DISCUSSION.....	51
1. Experiment I ((Morphological Detection and Molecular Identification of AMF which Colonized Citrus Root Seedling Naturally Before Transplanting).....	51
1.1. AMF morphological detection.....	51
1.2. AMF Molecular Verification.....	56
Conclusion of Experiment 1.....	59
2. Experiment 2 (Identification HLB Symptomatic Leaf for Source of Inoculum)	60
2.1. Symptom of HLB and sample collection.....	60
2.2. <i>Candidatus Liberibacter asiaticus</i> molecular detection of field sample by PCR conventional	63
2.3. Healthy and symptomatic leaf of ct value with different severity.....	63
Conclusion of Experiment 2.....	67
3. Experiment 3 (Response of rootstocks and rootstock/scion combination against inoculation of AMF and CLas).....	68
3.1. Response of rootstock without grafting.....	68
3.2. Response of rootstock/scion combination.....	91
Conclusion of Experiment 3.....	121
4. Experiment 4 (Metagenomic analysis using ITS and 16 S universal primer)	121
4.1. Metagenomic analysis results of ITS.....	121
4.2. Metagenomic analysis results of 16 S.....	124
Conclusion of Experiment 4.....	128
General Discussion.....	129
Conclusion and Recommendation.....	130
Future Research Work and Application to Industry.....	131
References.....	132
Appendix.....	149