## TABLE OF CONTENTS

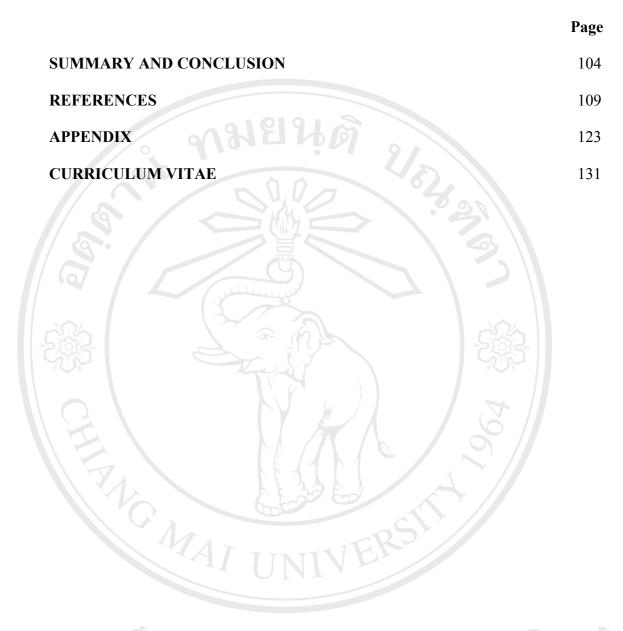
	Page
ACKNOWLEDGEMENTS	iii
ABSTRACT (English)	v
ABSTRACT (Thai)	X
TABLE OF CONTENTS	xiv
LIST OF TABLES	xviii
LIST OF ILLUSTRATIONS	xxi
ABBREVIATIONS	xxiv
GENERAL INTRODUCTION	1
LITERATURE REVIEW	7
Peanut or Groundnut	8
Minirhozotron	9
Root Analysis Software	10
- WinRhizo	10
- Root Measurement System (RMS)	12
Quantitative Analysis of Color System (QuaCos)	13
Peanut drought resistance and tolerance	13
Aspergillus flavus Infection and Aflatoxin Accumulation	15
Green Fluorescent Protein (GFP) Aspergillus flavus	19
Root Exudates and Apparent Aspergillus flavus Resistance	19

xiv

	Page
Experiment 1: Effects of root exudate, drought, and peanut genotype	22
on Aspergillus flavus populations	
Introduction	23
Materials and Methods	26
Sub-experiment 1. Observation of Aspergillus. flavus	26
population on the root and pod zone	
Sub-experiment 2. Peanut root exudates effects on	30
Aspergillus flavus population	
Sub-experiment 3. Exudates and sloughed cells from	34
peanut roots in soil culture	
Results	
Aspergillus flavus population on the root	35
and pod zone under water deficit	
Effects of root exudate on Aspergillus flavus populations	43
Aspergillus flavus growth in soil culture with peanut plants	45
Discussion	46
Experiment 2: Maximizing Aspergillus flavus Infection of Peanut	50
Introduction	51
Materials and Methods Mail Univers	53
Sub-experiment 1. Inoculation methods for maximizing	53
Aspergillus flavus infection	
Sub-experiment 2. Infection of peanut genotypes	58
by Aspergillus flavus	

XV

	Page
Sub-experiment 3. Aspergillus flavus infection of peanut	59
flowers under open-field conditions	
Results	60
Maximizing Aspergillus flavus infection of	60
peanut flowers and pegs	
Infection of peanut flowers and ovary by	66
Aspergillus flavus under growth chamber condition	
Infection of peanut flowers under open-field conditions	69
Discussion	71
Experiment 3: Shoot Traits that Confer <i>Aspergillus flavus</i> and Drought Resistance in Peanut	74
Introduction	75
Materials and Methods	77
Results	81
Soil moisture potential and soil temperature	81
Shoot growth	88
Harvesting and post harvest	93
Aspergillus flavus infection	93
Discussion <b>t c r e c e r v e</b>	99



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright © by Chiang Mai University All rights reserved

xvii

# LIST OF TABLES

Table		Page
1.1	Nutrient components of half strength Hoagland's solution	28
	for peanut culture.	
1.2	Relative Aspergillus flavus population density	40
	$(32\times24 \text{ groups of each image})$ on the root zone at soil 5 cm	
	depth layer of four peanut genotypes grown under water deficit	
	and well-watered condition at the Georgia Envirotron.	
1.3	Relative Aspergillus flavus population density	42
	(32×24 groups of each image) on the pod zone at soil 5 cm	
	depth layer of four peanut genotypes grown under water deficit	
	and well-watered condition at the Georgia Envirotron.	
1.4	Colonization of Aspergillus flavus cultured with	44
	the root exudate solution of four peanut genotypes	
	grown under hydroponic system, which induced water deficit	
	condition by imposing polyethylene glycol for 24 hrs	
	and no polyethylene glycol.	
1.5	Total root length of four peanut genotypes grown	45
	under hydroponic system, which induced	
	water deficit condition by imposing polyethylene glycol	
	for 24 hrs and no polyethylene glycol.	
	Root length measured by a flatbed scanner and WinRhizo.	

### xviii

Table		
2.1	Percent of peanut peg infection by GFP Aspergillus flavus	65
	at 28 days after inoculation by eight combinations	
	of inoculation methods. Main plot treatments were	
	with and without spore suspension inoculation.	
	Subplot treatments were four soil inoculation methods.	
	The absolute control treatment was not infected	
	by GFP Aspergillus flavus.	
2.2	Percent of peanut flower infection by GFP Aspergillus flavus	67
	at 5 days after inoculation with a spore suspension spray	
	and cracked corn inoculum applied to the soil surface.	
	No infection by GFP Aspergillus flavus was observed in	
	the absolute control growth chamber.	
2.3	Percent of infection for peanut flowers and ovaries	70
2.5		70
	by GFP Aspergillus flavus in open-field conditions	
	at 5 days after application	
3.1	Minimum soil moisture potential during each of four	82
	water deficit periods for four peanut genotypes at three soil depths.	
3.2	Correlation coefficients (r values) for relationship	86
	between soil moisture potential and difference	
	in daily maximum soil temperature between	
	water deficit and well-watered condition at 5 cm depth	
	for four stress periods and four peanut genotypes.	
3.3	Fresh weight of mature peanut pods grown under	91

xix

Table		Page
	drought- stressed and well-watered conditions in	
	the Georgia Envirotron, GA, 2001.	
3.4	Levels of significant difference, means, and standard error	94
	of selected plant traits.	
3.5	Correlation coefficients (r value) among plant traits	97
	grown under water deficit and well-watered condition	
	for the four peanut genotypes.	
3.6	Peanut infection by Aspergillus flavus grown under water deficit	98
	and well-watered conditions in the Georgia Envirotron, GA, 2001.	

ลือสิทธิ์มหาวิทยาลัยเชียอใหม่ Copyright © by Chiang Mai University All rights reserved

### LIST OF ILLUSTRATIONS

Figur	Figure	
1.1	Diagram of hydroponic system for peanut cultivation	32
	in green house.	
1.2	Soil moisture potential at three depths through four	36
	water deficit cycles for four peanut genotypes.	
1.3	Root (A, C) and pod (B, D) images as observed by	38
	a minirhizotron camera: (A-B) observed with a white light; (C-D)	
	observed with UV light Fluorescence in C follows the large root,	
	with additional patches of fluorescence near to the right	
	of center near the bottom of the image and scattered	
	fluorescence near the center above the root.	
	Diffuse fluorescence in D is barely visible to the naked eye	
	just above and to the left of the center of the imaged and	
	in the lower right quadrant.	
1.4	Aspergillus flavus population density on roots and pods	39
	as estimated by QuaCos program. (A) A. flavus colonies on roots;	
	(B) A. flavus colonies on a pod.	
2.1	Photograph showing attachment of cuvettes to the sides	55
	of container. Cuvettes were covered with aluminum foil	
	to exclude light so that pegs and pods would develop normally.	
	One cuvette was attached to each of the four sides of the containers,	

Figur	e	Page
	with each cuvette on a container having	
	a different inoculation treatment.	
2.2	Infection of the external surface of peanut flower at 5 days	62
	after inoculation by GFP Aspergillus flavus. Hyphae of	
	GFP A. flavus penetrated into the flower tissues as observed with	
	(A) an UV-illuminated microscope or (B) with white light.	
2.3	Dissected peanut peg at 28 days after inoculation as observed	63
	with a UV-illuminating microscope. (A) Network	
	of GFP Aspergillus flavus hyphae colonizing the embryo inside a peg.	
	Embryo inside peg that is not colonized by GFP A. flavus.	
2.4	Wilted peanut flowers at 5 days after inoculation infected	64
	with GFP Aspergillus flavus that cultured on the M3S1B medium.	
	(A) Whole flower (keel, standard, wing, calyx, hypanthium,	
	stigma and anther) infected with GFP A. flavus	
	and (B) close up as observed with an UV-illuminating microscope.	
2.5	Comparison of pollen grains and spores of GFP Aspergillus flavus.	68
	Pollen grains of peanut flower have diameters more than 10 times	
	larger than spores of GFP A. flavus. (A) The green	
	fluorescent dots were the spore of fungi observed with	
	an UV-illuminating microscope. (B) Spores and hyphae	
	of GFP A. flavus covering the outside of a pollen grain	
	observed under white light at 3 days after inoculation.	

Figure		Page
3.1	Diagram of 214-liter container fitted with four peanut plants,	78
	and moisture blocks and thermocouples installed at 5, 25,	
	and 75 cm depths.	
3.2	The difference between the daily maximum of soil temperature	84
	for the water deficit and well-watered treatment at 5, 25,	
	and 75 cm depths of four peanut genotypes.	
3.3	The maximum and minimum temperature at Georgia	87
	Experiment Station during May to September 2001.	
3.4	Main stem length for four peanut genotypes under	89
	well-watered (•) and water deficit (0) treatments.	
3.5	Individual leaf area of four peanut genotypes response	92
	to well-watered (•) and water deficit ( $\circ$ ) treatment.	

ລິ<mark>ປສີກຣົ້ມກາວົກຍາລັຍເຮີຍວໃກມ່</mark> Copyright © by Chiang Mai University All rights reserved

#### xxiii

#### **ABBREVIATIONS**

GFP	Green fluorescent protein
DAP	Day after planting
UV	Ultra-violet
QuaCos	Quantitative Analysis of Color System
PEG	Polyethylene glycol
CC	Core collection number
LA	Leaf area
LL	Leaf length
MW	Maximum width
Ca	Calcium

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright © by Chiang Mai University All rights reserved

#### xxiv