# NODULATION, DRY MATTER ACCUMULATION AND GRAIN YIELD OF COWPEA AND LABLAB VARIETIES UNDER SOLE AND INTERCROPPING SYSTEM WITH MAIZE

#### A DISSERTATION

SUBMITTED TO THE SCHOOL OF AGRICULTURE AND ENVIRONMENTAL SCIENCES, DEPARTMENT OF PLANT PRODUCTION IN THE FACULTY OF SCIENCES, HEALTH AND AGRICULTURE, UNIVERSITY OF THE LIMPOPO, TURFLOOP, SOUTH AFRICA.

BY

# SIBONGILE GIFT MISHIYI [B.AGRIC ED, B. AGRIC ADMIN HONS]

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN AGRICULTURAL MANAGEMENT

OCTOBER 2006

SUPERVISOR:

PROF. KINGSLEY K AYISI

#### **DECLARATION**

I declare that the dissertation hereby submitted to the University of the North for the degree of Masters in Agricultural Management has not previously been submitted by me for a degree at this or any other university, that it is my own work in design and in execution and that all material contained therein has been duly acknowledged.

Signed:	Signed:
Date	Date
MS S C. MIHIVI	PPOEKK AVISI

#### **ACKNOWLEDGEMENTS**

First and foremost, I would like to thank God Almighty for giving me the wisdom to pursue my studies, and for guiding me through life's decisions.

My sincere gratitude goes to my supervisor Prof K K Ayisi, for his endless guidance, patience and understanding. Thank you for sharing your knowledge with me.

To my parents, thank you for taking so much effort and making so many sacrifices to give me an opportunity to study. I owe you a dept of gratitude I can never repay.

A special word of thanks to the Maswanganyi family for their support during my study, in particular John Rhulani. Your contribution is immeasurable, thank you for being there and believing in me.

I would also like to acknowledge NRF for funding this research and Gauteng Department of Agriculture Conservation and Environment for their financial contribution towards the completion of this paper.

#### **DEDICATION**

This study is dedicated to my family that is my parents: Mr T H Mishiyi and Mrs G T Mishiyi; my siblings Makumeke, Dumi, Wisani, Mixo and Risenga. I would like to thank each one of you for the support you have given me. Most of all, this paper is dedicated to my daughters Khani and Masana; your existence makes me want to strive for more.

TABLE OF CONTENTS	
Dissertation abstract	1
CHAPTER 1	
General introduction and literature review	3-11
CHAPTER 2	
Grain yield and yield component response of maize and legume varieties in	
intercrop systems.	12
Abstract	13
Introduction	14-17
Materials and Methods	18-21
Results and discussion	22
Maize grain yield	22-23
Cowpea grain yield	23-24
Harvest index (maize)	25
Harvest index (cowpea)	25-26
Maize yield components	27-28
Cowpea yield components	28-29
Tasselling (Maize)	29-30
Flowering (Cowpea)	30
Physiological maturity (maize)	31
Physiological maturity (cowpea)	31
pLER (maize)	32
pLER (cowpea)	32
Plant height (maize)	33
Conclusions	34
Tables and figures	35-47

### CHAPTER 3

# NODULATION, DRY MATTER ACCUMULATION, ECOLOGICAL INTERACTION AND SYMBIOTIC ACTIVITY OF COWPEA AND LABLAB UNDER SOLE AND

INTERCROPPING SYSTEM WITH MAIZE	48
Abstract	49
Introduction	50-54
Materials and methods	55-56
Results and discussion	57
Maize dry matter accumulation	57
Shoot dry weight	57-58
Root dry weight	58-59
Total dry weight	59-61
Nodule mass	61-63
Nodule number	63-64
Nodule effectiveness	64-65
Trend in nodule production	65
Chlorophyll content	66
Stover yield	66
Ecological interactions of component crops	67
Protein concentration (maize seed)	68
Protein yield (maize)	68
Protein concentration (cowpea seed)	68-69
Protein yield (cowpea)	69-70
Nitrogen yield	70
Conclusions	71
Table and figures	72-91
REFERENCES	92-102
APPENDIX	103-105

## LIST OF TABLES

TABLE		PAGE
2.1	Seed yield and HI of sole and intercropped maize at Syferkuil and Dalmada.	35
2.2	Seed yield and HI of sole and intercropped cowpea at Syferkuil and Dalmada.	36
2.3	Yield components of sole maize, and maize intercropped (M+) with different cowpea and lablab varieties at Syferkuil.	37
2.4	Yield components of sole maize, and maize intercropped (M+) with different cowpea and lablab varieties at Dalmada.	38
2.5	Yield components of cowpea varieties intercropped with maize at Syferkuil.	39
2.6	Yield components of sole and intercropped cowpea varieties with maize at Dalmada	. <b>40</b>
2.7	Tasselling and Physiological maturity of maize intercropped (M+) with different cowpea and lablab varieties at Syferkuil.	41
2.8	Tasselling and Physiological maturity of maize intercropped (M+) with different cowpea and lablab varieties at Dalmada.	42
2.9	Flowering and Physiological maturity of cowpea and lablab varieties as influenced by the cropping system at Syferkuil.	43
2.10	Flowering and Physiological maturity of cowpea and lablab varieties as influenced by the cropping system at Dalmada.	44
2.11	Partial land equivalent ratio (pLER) of maize intercropped (M+) with different cowpea and lablab varieties at Syferkuil and Dalmada.	45

2.12	Partial land equivalent ratio (pLER) of cowpea varieties intercropped with maize at Syferkuil and Dalmada.	46
2.13	Plant height of maize intercropped (M+) with different cowpea and lablab varieties at Syferkuil and Dalmada	47
3.1	Dry matter accumulation of maize intercropped $(M +)$ with different cowpea and lablab varieties at Syferkuil.	72
3.2	Dry matter accumulation of maize intercropped (M +) with different cowpea and lablab varieties at Dalmada.	73
3.3	Dry matter accumulation of cowpea and lablab varieties (sole and intercrop) at Syferkuil.	75
3.4	Dry matter accumulation of cowpea and lablab varieties (sole and intercrop) at Dalmada.	76
3.5	Nodule weight, nodule number and nodule colour of cowpea and lablab varieties at Syferkuil.	77
3.6	Nodule weight, nodule number and nodule colour of cowpea and lablab varieties at Dalmada.	78
3.7	Effective nodule colour of cowpea and lablab varieties at Syferkuil and Dalmada	79
3.8	Chlorophyll content of maize intercropped (M+) with different cowpea and lablab at Syferkuil and Dalmada.	81
3.9	Stover yield of maize intercropped with $(M +)$ different cowpea and lablab varieties at Syferkuil and Dalmada.	82
3.10	Protein concentration and protein yield of sole and maize intercropped (M+) with	83

cowpea and lablab at Syferkuil and Dalmada.

- **3.11** Grain protein concentration and Protein yield of sole maize and maize intercropped (M+) **84** with cowpea and lablab varieties at Syferkuil and Dalmada.
- 3.12 Correlation between above-ground nitrogen concentration and chlorophyll

  content of maize intercropped with (M +) different cowpea and lablab varieties

  at Syferkuil and Dalmada.

## LIST OF FIGURES

FIGURE PAG		E
3.1	Nodule mass of cowpea and lablab varieties in sole and intercropping system with maize at different sampling dates at Syferkuil	86
3.2	Nodule mass of cowpea and lablab varieties in sole and intercropping system with maize at different sampling dates at Dalmada	87
3.3	Nodule number of cowpea and lablab varieties in sole and intercropping system with maize at different sampling dates at Syferkuil	88
3.4	Nodule number of cowpea and lablab varieties in sole and intercropping system with maize at different sampling dates at Dalmada	89
3.5	Ecological interactions of comoponent crops at Syferkuil	90
3.6	Ecological interactions of comoponent crops at Dalmada	91

### **APPENDIX**

TABLE	PAGE

**4.1** Correlation coefficient (r) relating sole and intercropped with (M +) maize yield to various yield components across cowpea and lablab varieties at Syferkuil and Dalmada.

4.2 Correlation coefficient (r) relating sole and intercropped cowpea and lablab varietiesyield to various yield components across at Syferkuil and Dalmada