

**ECOLOGICAL STUDIES AND ANALYSIS OF GLUCOMANNAN  
CONTENT IN SELECTED *AMORPHOPHALLUS* SPP. OF  
PENINSULAR MALAYSIA**

**DAHLIA SHAHBUDDIN**

**INSTITUTE OF BIOLOGICAL SCIENCES  
FACULTY OF SCIENCE  
UNIVERSITY OF MALAYA  
MALAYSIA**

**2012**

**ECOLOGICAL STUDIES AND ANALYSIS OF  
GLUCOMANNAN CONTENT IN SELECTED  
*AMORPHOPHALLUS* SPP. OF PENINSULAR MALAYSIA**

**DAHLIA SHAHBUDDIN**

**THESIS SUBMITTED IN FULFILLMENT OF THE  
REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE**

**INSTITUTE OF BIOLOGICAL SCIENCES  
FACULTY OF SCIENCE  
UNIVERSITY OF MALAYA  
MALAYSIA**

**2012**

## APPROVAL SHEET

Name of : Dahlia Shahbuddin  
candidate

Title of : Ecological studies and analysis of glucomannan content in  
thesis selected *Amorphophallus* spp. of Peninsular Malaysia.

**Approved by,**

.....  
( Prof. Dr. Halijah Ibrahim)

Supervisor

Date:

## ACKNOWLEDGEMENTS

First and foremost, I would like to thank Allah the Almighty for the blessings and protection over me while doing this research. I would like to express my heartfelt gratitude to my supervisor, Professor Dr. Halijah Ibrahim and my advisor, P. C. Boyce, for the guidance, dedication throughout this project study and their time spent in reviewing the manuscript and for giving many useful comments and suggestions on the thesis.

I would also like to thank Mdm. Noryati Jamil and Mr. Zulkapli for their knowledge and their support during my research. My sincere appreciation also goes to all the post graduate students, Mdm Nurfarahiyah, Mdm Natasha, Mdm Norhati and Mr. Muh Zaki Khairul Insan who had kindly spared their time and shared their knowledge.

Special thanks also go to my parents, Mr. Shahbuddin b. Mohd. Fiah and Mdm. Latifah bt. Abd. Kahar who had given me all their support, wonderful guidance, blessings, encouragement, and continuous morale and financial support. Not forgotten also to my dear husband Hazni Hafiz b. Mohd. Tony who had been very caring and always ready to lend a hand whenever I am in need and for the constant moral support and encouragement throughout.

I would also like to thank University of Malaya for providing financial grant and to the Ministry of Higher Education and Universiti Sains Malaysia (USM) for the scholarship throughout my project research.

**DEDICATION**

*DEDICATED TO MY PARENTS AND HUSBAND*

*WITH LOVE AND PROFOUND GRATITUDE*

## TABLE OF CONTENTS

---

CONTENTS	PAGE
Title page	
Approval sheet	ii
Acknowledgements	iii
Dedication	v
Table of contents	vi
List of figures	xii
List of tables	xv
List of appendices	xvii
List of abbreviations and terminology	xviii
Original literary work declaration	xx
Abstract	xxi
Abstrak	xxiii

## **CHAPTER 1.0 : INTRODUCTION**

1.1	GENERAL INTRODUCTION	1
1.2	OBJECTIVE	5

## **CHAPTER 2.0 : LITERATURE REVIEW**

2.1	THE GENUS <i>Amorphophallus</i>	6
2.1.1	General Morphology of <i>Amorphophallus</i>	6
2.2	WORLD DISTRIBUTION	9
2.3	CLIMATE of PENINSULAR MALAYSIA	10
2.3.1	Sunshine and Surface Temperature	11
2.3.2	Rainfall Distribution	11
2.4	ECOLOGY and CONSERVATION of <i>Amorphophallus</i>	15
2.5	CULTIVATION	15
2.6	PLANTING of <i>Amorphophallus</i> spp.	17
2.7	GLUCOMANNAN (GM)	19
2.7.1	Medicinal Uses of Glucomannan(GM)	23
2.7.1.1	Anti-Obesity Activity of Glucomannan (GM)	24
2.7.1.2	Laxative Effect o Glucomannan (GM)	26
2.7.1.3	Anti-Hyperglycemic and Hypercholesterolemia Activities of Glucomannan (GM)	26
2.7.2	Other Uses of Glucomannan (GM)	27



## **CHAPTER 3.0 : ECOLOGICAL STUDIES OF *Amorphophallus* spp. IN PENINSULAR MALAYSIA**

3.1	INTRODUCTION	29
3.2	MATERIALS AND METHOD	30
3.2.1	Distribution of <i>Amorphophallus</i> spp. in Peninsular Malaysia	30
3.2.1.1	Sample Collections and Survey	30
3.2.2	Studies on Morphological Characteristics and Life Cycle	30
3.2.3	Ecological Parameters	31
3.2.4	Soil Characteristics : Physical	31
3.2.4.1	Soil Texture	31
3.2.4.2	Soil Moisture Content	34
3.2.5	Soil Characteristics : Chemical	34
3.2.5.1	Soil pH	34
3.2.5.2	Soil Mineral Content: Potassium (K), Calcium (Ca), and Magnesium (Mg)	35
3.2.5.3	Total Nitrogen (N)	35
3.2.5.4	Total Phosphorus (P)	35
3.2.5.5	Total Organic Carbon (TOC)	36
3.2.6	Ecological studies : Quantitative Analysis	36
3.2.6.1	Estimates of Abundance of <i>Amorphophallus</i> spp.	37
3.3	RESULTS	39
3.3.1	Distribution of <i>Amorphophallus</i> species in Peninsular Malaysia From Herbarium Records	39

3.3.2	Distribution of <i>Amorphophallus</i> species in Peninsular Malaysia From Survey Conducted	42
3.3.3	Morphological Observations	50
3.3.3.1	Morphological Characteristics of <i>Amorphophallus bufo</i> Ridl.	50
3.3.3.2	Morphological Characteristics of <i>Amorphophallus elatus</i> Hook.f.	51
3.3.3.3	Morphological Characteristics of <i>Amorphophallus elegans</i> Ridl.	51
3.3.3.4	Morphological Characteristics of <i>Amorphophallus oncophyllus</i> Blume	52
3.3.3.5	Morphological Characteristics of <i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	52
3.3.3.6	Morphological Characteristics of <i>Amorphophallus prainii</i> Hook. f.	54
3.3.4	Life Cycle of <i>Amorphophallus paeoniifolius</i>	54
3.3.4.1	<i>Amorphophallus paeoniifolius</i> Flowering Period	58
3.3.5	Ecological Parameters	69
3.3.5.1	Types of Forest and Altitude	69
3.3.5.2	Temperature, Humidity and Light Intensity	70
3.3.6	Soil Characteristics : Physical	73
3.3.6.1	Soil Texture	73
3.3.6.2	Soil Moisture Content	75
3.3.7	Soil Characteristics : Chemical	76
3.3.7.1	Soil pH	76
3.3.7.2	Soil Mineral Content (Ca, Mg, K, Total N and P), and Organic Matter	77

3.3.8	Ecological studies: Quantitative Analysis	81
3.3.8.1	Climatic Records	81
3.3.8.2	Abundance Estimates of <i>Amorphophallus</i> spp.	83
3.3.8.3	Total Density of Vegetation in Site 1 and Site 2	88
3.4	DISCUSSION	90
	<b>CHAPTER 4.0 : GLUCOMANNAN (GM) CONTENT IN SELECTED <i>Amorphophallus</i> spp. OF PENINSULAR MALAYSIA</b>	94
4.1	INTRODUCTION	94
4.2	QUANTIFICATION OF GLUCOMANNAN (GM)	94
4.3	MATERIALS AND METHOD	97
4.3.1	Corm Sampling	97
4.3.2	Purified Glucomannan (GM) Powder	99
4.3.3	Statistical Analysis	100
4.4	RESULTS	100
4.4.1	Glucomannan (GM) Content in <i>Amorphophallus</i> spp Investigated	100
4.4.2	Glucomannan (GM) Content from Original and Transplanted Corms of <i>A. paeoniifolius</i> and <i>A. prainii</i>	101
4.4.3	Variations of Glucomannan (GM) Content in Raw Corms of the Two <i>Amorphophallus</i> spp. With Time (Months)	105
4.5	DISCUSSION	109

<b>CHAPTER 5.0 : GENERAL DISCUSSION AND CONCLUSION</b>	112
<b>REFERENCES</b>	116
<b>APPENDICES</b>	129

## LIST OF FIGURES

Title	Page
<b>Figure 2.1</b> : World distribution of <i>Amorphophallus</i> spp. (Mayo, Bogner & Boyce, 1997)	10
<b>Figure 2.2</b> : <i>Amorphophallus</i> sp. (Mayo, Bogner & Boyce, 1997)	13
<b>Figure 2.3</b> : <i>Amorphophallus</i> sp. flowering (Mayo, Bogner & Boyce, 1997)	14
<b>Figure 2.4</b> : Growth stages of <i>Amorphophallus</i> spp.	18
<b>Figure 2.5</b> : Chemical structure of glucomannan (Okimasu & Kishida, 1982).	22
<b>Figure 3.1</b> : The flowchart for estimating the soil texture by feel (Modified from Thien, S. J. 1979)	33
<b>Figure 3.2</b> : The distribution of <i>Amorphophallus</i> species in Peninsular Malaysia (From Herbarium Records and Field Survey)	49
<b>Figure 3.3</b> : The life cycle of <i>Amorphophallus</i> species (March 2009 – April 2010).	57
<b>Figure 3.4</b> : Variations in leaf shape of <i>Amorphophallus</i> species. Collected from different locations in Peninsular Malaysia	59
<b>Figure 3.5</b> : Leaf samples of <i>A.prainii</i> from Ulu Kenas, Kuala Kangsar, Perak.	60
<b>Figure 3.6</b> : Leaf samples of <i>A.prainii</i> from Maxwell Hill, Perak.	60
<b>Figure 3.7</b> : Leaf samples of <i>A.prainii</i> from Janda Baik, Pahang.	61
<b>Figure 3.8</b> : Leaf samples of <i>A.elegans</i> from Gombak, Selangor.	61
<b>Figure 3.9</b> : Leaf samples of <i>A.elegans</i> from Hutan Simpan Bukit Bauk, Terengganu.	62
<b>Figure 3.10</b> : Leaf samples of <i>A.paeoniifolius</i> from Kg Gintong, Jerantut, Pahang.	62

<b>Figure 3.11</b>	: Leaf samples of <i>A.elegans</i> from Hutan Lipur Ulu Licin, Beruas, Perak.	63
<b>Figure 3.12</b>	: Leaf samples of <i>A.prainii</i> from Hutan Lipur Ulu Licin, Beruas, Perak.	63
<b>Figure 3.13</b>	: Leaf samples of <i>A.elatus</i> from Wang Kelian, Perlis.	64
<b>Figure 3.14</b>	: Leaf samples of <i>A.uncophyllus</i> from Padang Besar, Perlis.	64
<b>Figure 3.15</b>	: <i>Amorphophallus</i> species flowering in their natural habitat. Leaves are absent during flowering.	65
<b>Figure 3.16</b>	: Inflorescence of <i>Amorphophallus</i> spp. from different locations in Peninsular Malaysia.	66
<b>Figure 3.17</b>	: Tubers of <i>Amorphophallus</i> species collected from different sites in Peninsular Malaysia.	67
<b>Figure 3.18</b>	: Flowering period of <i>Amorphophallus paeoniifolius</i> . Leaves are absent during flowering, flowering lasts a week.	68
<b>Figure 3.19</b>	: The mean temperature of locations where <i>Amorphophallus</i> spp. were sampled.	72
<b>Figure 3.20</b>	: The mean humidity of locations <i>Amorphophallus</i> spp. were sampled.	72
<b>Figure 3.21</b>	: The mean light intensity where <i>Amorphophallus</i> spp were sampled.	73
<b>Figure 3.22</b>	: The mean soil moisture content recorded from various localities where <i>Amorphophallus</i> spp. were sampled.	75
<b>Figure 3.23</b>	: Soil pH of several soils where <i>Amorphophallus</i> spp. were sampled	76
<b>Figure 3.24</b>	: Potassium (K) content of soils where <i>Amorphophallus</i> species were sampled.	78
<b>Figure 3.25</b>	: Calcium content of soils where <i>Amorphophallus</i> species were sampled.	78

<b>Figure 3.26</b>	: Magnesium content of soils where <i>Amorphophallus</i> species were sampled.	79
<b>Figure 3.27</b>	: Nitrogen content of soils where <i>Amorphophallus</i> species were sampled.	79
<b>Figure 3.28</b>	: Phosphorus content of soils where <i>Amorphophallus</i> species were sampled.	80
<b>Figure 3.29</b>	: Organic Matter content of soils where <i>Amorphophallus</i> species were sampled.	80
<b>Figure 3.30</b>	: Importance Value (IV) of <i>Amorphophallus paeoniifolius</i> and associated species for season 1 in Jerantut, Pahang.	85
<b>Figure 3.31</b>	: Importance Value (IV) of <i>Amorphophallus paeoniifolius</i> and associated species for season 2 in Jerantut, Pahang.	85
<b>Figure 3.32</b>	: Importance Value (IV) of <i>Amorphophallus paeoniifolius</i> and associated species for season 3 in Jerantut, Pahang.	86
<b>Figure 3.33</b>	: Importance Value (IV) of <i>Amorphophallus prainii</i> and associated species for season 1 in Kuala Kangsar, Perak.	86
<b>Figure 3.34</b>	: Importance Value (IV) of <i>Amorphophallus prainii</i> and associated species for season 2 in Kuala Kangsar, Perak.	87
<b>Figure 3.35</b>	: Importance Value (IV) of <i>Amorphophallus prainii</i> and associated species for season 3 in Kuala Kangsar, Perak.	87
<b>Figure 3.36</b>	: Total density of vegetation in site 1 (Jerantut, Pahang) during the growth season in 2009.	88
<b>Figure 3.37</b>	: Total density of vegetation in site 2 (Kuala Kangsar, Perak) during the growth season in 2009.	89
<b>Figure 4.1</b>	: Steps involved in the preparation of powder samples from <i>Amorphophallus</i> spp.	99
<b>Figure 4.2</b>	: Comparison of Glucomannan (GM) content in raw corm from original and transplanted materials of <i>A. paeoniifolius</i> and <i>A. prainii</i> .	104
<b>Figure 4.3</b>	: Glucomannan (GM) content in <i>A. paeoniifolius</i> and <i>A. prainii</i> against time.	107

<b>Figure Ai</b>	: Poster on distribution of <i>Amorphophallus</i> spp. in Peninsular Malaysia.	138
------------------	--	-----

### LIST OF TABLES

Title	Page	
<b>Table 2.1</b>	: Glucomannan as a valuable natural food additive	20
<b>Table 2.2</b>	: Nutrient content in <i>Amorphophallus</i> tuber compared to sweet potato ( <i>Ipomoea batatas</i> ) and cassava ( <i>Manihot esculenta</i> ) (Pitojo, 2007)	22
<b>Table 3.1</b>	: The three consecutive seasons selected for the ecological studies.	37
<b>Table 3.2</b>	: Distribution of <i>Amorphophallus</i> spp. in Peninsular Malaysia from herbarium records.	40
<b>Table 3.3</b>	: Distribution of <i>Amorphophallus</i> spp. recorded from the field survey.	44
<b>Table 3.4</b>	: Location and types of forest, of <i>Amorphophallus</i> species surveyed.	69
<b>Table 3.5</b>	: Monthly rainfall records for sampling sites in Pahang and Perak for three consecutive seasons in 2009.	81
<b>Table 3.6</b>	: Minimum, maximum and average daily temperatures for sampling sites in Pahang and Perak for 3 consecutive seasons in 2009.	82
<b>Table 3.7</b>	: Mean relative humidity for sampling sites in Pahang and Perak for 3 consecutive seasons in 2009.	82
<b>Table 4.1</b>	: List of species collected for Glucomannan (GM) study.	97
<b>Table 4.2</b>	: Glucomannan (GM) Content in Purified Powder of Several <i>Amorphophallus</i> spp.	101
<b>Table 4.3</b>	: Analysis of Variance (ANOVA) of the Glucomannan (GM) content of original and transplanted corms of <i>A. paeoniifolius</i> and <i>A. prainii</i>	102



<b>Table 4.4</b>	: The Analysis of Variance (ANOVA) of the Glucomannan (GM) content of <i>A. paeoniifolius</i> and <i>A. prainii</i> from two locations of sampling.	102
<b>Table 4.5</b>	: The mean Glucomannan (GM) content of <i>A. paeoniifolius</i> and <i>A. prainii</i> from two sources of sampling.	103
<b>Table 4.6</b>	: Tukey's Studentized Range (HSD) test for Glucomannan (GM).	103
<b>Table 4.7</b>	: Tukey's Studentized Range (HSD) test for Glucomannan (GM) content in different locations.	104
<b>Table 4.8</b>	: The Analysis of Variance (ANOVA) of the Glucomannan (GM) content of <i>A. paeoniifolius</i> and <i>A. prainii</i> with time.	105
<b>Table 4.9</b>	: The Analysis of Variance (ANOVA) of <i>A. paeoniifolius</i> and <i>A. prainii</i> with time.	106
<b>Table 4.10</b>	: Tukey's Studentized Range (HSD) test for variation of Glucomannan (GM) content with time (month).	106
<b>Table 4.11</b>	: The variation of mean Glucomannan (GM) content of raw corms of <i>A. paeoniifolius</i> and <i>A. prainii</i> with time.	108
<b>Table Ai</b>	: Morphological comparison of <i>Amorphophallus</i> spp. found.	129
<b>Table Aii</b>	: Raw data for site 1 (Jerantut, Pahang) : Season 1.	132
<b>Table Aiii</b>	: Raw data for site 1 (Jerantut, Pahang) : Season 2.	133
<b>Table Aiv</b>	: Raw data for site 1 (Jerantut, Pahang): Season 3.	134
<b>Table Av</b>	: Raw data for site 2 (Kuala Kangsar, Perak): Season 1.	135
<b>Table Avi</b>	: Raw data for site 2 (Kuala Kangsar, Perak): Season 2.	136
<b>Table Avii</b>	: Raw data for site 2 (Kuala Kangsar, Perak): Season 3.	137

## LIST OF APPENDICES

Title	Page
<b>Appendix 1</b> : Morphological Comparison of <i>Amorphophallus</i> spp. Found.	129
<b>Appendix 2</b> : Raw data: PCQ Method Analysis	132
<b>Appendix 3</b> : Poster Presentation in The 3 <sup>rd</sup> Regional Conference on Natural Resources in The Tropics (NRTrop3): 3 <sup>rd</sup> -5 <sup>th</sup> August 2009	138

## LIST OF ABBREVIATIONS AND TERMINOLOGY

Abbreviations	Terminology
<b>AA</b>	Auto Analyzer
<b>AAS</b>	Atomic Absorption Spectrophotometer
<b>Ac-GlcManol</b>	Acetylated-glucomannan-oligosaccharides
<b>ADP</b>	Adenosine-5'-diphosphate
<b>ANOVA</b>	Analysis of Variance
<b>ATP</b>	Adenosine-5'-triphosphate
<b>BSE</b>	Boisson Spongial Encaphalitis
<b>CHD</b>	Coronary Heart Disease
<b>DP</b>	Depolymerisation
<b>EC</b>	European Country
<b>EFSA</b>	European Food Safety Authority
<b>ETP</b>	Economic Transformation Programme
<b>FDA</b>	Food and Drug Administration
<b>FRIM</b>	Forest Research Institute Malaysia
<b>Glc:Man</b>	Glucose : Mannose
<b>GM</b>	Glucomannan
<b>GPS</b>	Geographical Positioning System
<b>G-6-P</b>	Glucose-6-phosphate
<b>G-6-P-DH</b>	Glucose-6-phosphate dehydrogenase
<b>HDL-C</b>	High-Density Lipoprotein Cholesterol

<b>HK</b>	Hexokinase
<b>HSD</b>	Tukey's Studentized Range
<b>H<sub>2</sub>SO<sub>4</sub></b>	Sulphuric Acid
<b>IV</b>	Importance Value
<b>K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub></b>	Potassium Dichromate
<b>KEW</b>	Kew Botanical Garden
<b>M-6-P</b>	Mannose-6-phosphate
<b>NADP<sup>+</sup></b>	Dinucleotide phosphate
<b>NADPH</b>	Nicotinamide-adenine dinucleotide phosphate
<b>NRCS</b>	Natural Resources Conservation Service
<b>PGI</b>	Phosphoglucoe isomerise
<b>PMI</b>	Phosphomannose isomerise
<b>SAS</b>	Statistical Analysis System
<b>SFC</b>	Sarawak Forest Center
<b>SING</b>	Singapore Botanical Garden
<b>TC</b>	Total Cholesterol
<b>TCM</b>	Traditional Chinese Medicine
<b>UM</b>	University of Malaya
<b>UNIMAS</b>	University Malaysia Sarawak
<b>USDA</b>	United States Department of Agriculture
<b>β-Gos</b>	β-glucosidase
<b>β-mos</b>	β-mannosidase

## ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: **DAHLIA SHAHBUDDIN** (I.C/Passport No:**850526-71-5176**)

Registration/Matric No: **SGR080114**

Name of Degree: **MASTER OF SCIENCE**

Title of Thesis (“this Work”): **ECOLOGICAL STUDIES AND ANALYSIS OF GLUCOMANNAN CONTENT IN SELECTED *AMORPHOPHALLUS* SPP. OF PENINSULAR MALAYSIA.**

Field of Study: **BOTANY**

I do solemnly and sincerely declare that:

- (1) I am the sole author/writer of this Work;
- (2) This Work is original;
- (3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the work and its authorship have been acknowledged in this Work;
- (4) I do not have any actual knowledge nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;
- (5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya (“UM”), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
- (6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM.

Candidate’s Signature

Date:

Subscribed and solemnly declared before,

Witness’s Signature

Date:

Name:

Designation:

## Abstract

A study was conducted to investigate the ecological parameters and glucomannan content of selected *Amorphophallus* spp. in Peninsular Malaysia. A survey and documentation of *Amorphophallus* spp. were carried out throughout Peninsular Malaysia and the ecological parameters were measured and quantified. The life cycle of *A. paeoniifolius* was studied over a period of one year and two locations, namely Jerantut, Pahang and Kuala Kangsar, Perak were selected for quadrat analysis of *A. paeoniifolius* and *A. prainii*. Samples of four *Amorphophallus* spp. were collected for determination of glucomannan content following the method by Megazyme International Ireland Limited (2004) and Wang et. al. (1998).

A total of six species namely *A. bufo*, *A. elatus*, *A. elegans*, *A. oncophyllus*, *A. paeoniifolius* and *A. prainii* were successfully collected and documented. The species are distributed mainly in disturbed secondary forests and near forest margins. While *A. paeoniifolius* and *A. prainii* are common throughout Peninsular Malaysia, *A. bufo*, and *A. oncophyllus* are restricted in distribution, such as the highlands and northern part of Peninsular Malaysia respectively.

From the field study, it was observed that the optimum growth of *Amorphophallus* species in Peninsular Malaysia can be achieved when the humidity range was between 53 to 85 %. Result from this study indicated that *Amorphophallus* species could grow at locations with high light intensity of up to 2780 Lux. *Amorphophallus* spp. appeared to thrive best at temperatures between 25 -30°C. Results also indicated that all *Amorphophallus* species were tolerant to soil acidity and require a fertile soil with optimum moisture content of 20-25%. Study on the life cycle of *A. paeoniifolius* showed that the plant undergoes 3 phases in its life cycle which was vegetative growth phase, followed by a dormant phase and subsequently the generative growth phase. Quadrat analysis showed that *Amorphophallus* spp. can grow well under the orchard canopy with a little shade from direct sunlight. The Importance Value (IV) of *Amorphophallus* species varied considerably with season for Jerantut and Kuala Kangsar. The Importance Value (IV) was highest during season 3, (September - December), followed by Season 2 (May - August) and lowest during Season 1 (January - April). The pattern of IV coincided well with the climatic conditions. *Amorphophallus* spp. go through dormancy period in dry season (season 1), whereby the IV was highest when both locations were experiencing slightly lower temperature, higher humidity and rainfall in season 3.

The result of the glucomannan (GM) study indicated that *A. oncophyllus* had the highest GM content (58.65 %); followed by mature *A. paeoniifolius* (50.22%); mature *A. prainii* (29.71 %); *A. elegans* (17.01 %); young *A. paeoniifolius* (14.90 %); and young *A. prainii* (9.23 %). Significance difference in GM content of original corm is approximately 15-18 % higher as compared to transplanted corm. This could be due to some physiological changes during the process of transplanting. The study also showed

that the GM content was high in matured corms than in young corms and different at certain growing period.

It can be concluded that *Amorphophallus* species in particular *A. paeoniifolius* and *A. oncophyllus* have great potential to be commercialized in Malaysia. The plants can provide economic levels of glucomannan (GM) in the corm. They are easy to grow under the various types of soil and climatic conditions in Peninsular Malaysia. However, *Amorphophallus* species require certain climatic and ecological conditions to develop the optimum GM content for commercialization.

Keywords: life cycle, *Amorphophallus*, glucomannan.

## Abstrak

Suatu kajian telah dijalankan untuk mengkaji kandungan glucomannan dan aspek-aspek ekologi bagi spesies *Amorphophallus* terpilih di Semenanjung Malaysia. Survei telah dijalankan di seluruh Semenanjung Malaysia dan segala maklumat ekologi diukur dan dianalisis. Kitar hidup bagi *A. paeoniifolius* juga telah dikaji bagi tempoh setahun. Dua lokasi kajian iaitu Jerantut, Pahang dan Kuala Kangsar, Perak telah dipilih bagi analisis kuadrat *A. paeoniifolius* dan *A. prainii*, manakala empat sampel *Amorphophallus* spp. telah diambil untuk kajian penentuan kandungan glucomannan berbandukan kaedah dari Megazyme International Ireland Limited (2004) dan Wang et. al. (1998)

Hasil kajian mendapati 6 spesies *Amorphophallus* yang berjaya dijumpai sepanjang tempoh kajian iaitu *A. bufo*, *A. elatus*, *A. elegans*, *A. oncophyllus*, *A. paeoniifolius* dan *A. prainii*. Spesies ini mudah dijumpai terutamanya di kawasan hutan sekunder dan pinggir hutan. Spesies seperti *A. bufo* dan *A. oncophyllus* mempunyai taburan yang terhad di kawasan tertentu di Semenanjung Malaysia seperti kawasan tanah tinggi bagi *A. bufo* dan hutan sekunder di utara semenanjung bagi *A. oncophyllus*.

Kajian lapangan menunjukkan kadar optimum pertumbuhan *Amorphophallus* spp. di Semenanjung Malaysia adalah apabila kadar kelembapan antara 53 hingga 85 %, dan intensiti matahari sehingga 2780 Lux dan kadar suhu antara 25-30°C. Kajian juga mendapati keseluruhan spesies tidak menunjukkan ciri-ciri spesifik terhadap keasidan tanah. Keputusan menunjukkan spesies *Amorphophallus* memerlukan tanah yang subur dan kelembapan optimum antara 20-25% untuk hidup subur. Kajian ke atas kitaran hidup tumbuhan *A. paeoniifolius* mendapati tumbuhan ini melalui tiga fasa hidup bersilih ganti dalam kitaran hidupnya iaitu fasa pertumbuhan vegetatif, fasa dorman, dan fasa pertumbuhan generatif. Analisis kuadrat menunjukkan *Amorphophallus* spp. hidup dengan baik di bawah kanopi di dusun-dusun yang mempunyai sedikit kawasan teduh. Nilai Kepentingan (IV) bagi *Amorphophallus* spp. berubah mengikut musim bagi kedua-dua lokasi. Nilai IV adalah tertinggi pada musim 3 (September - Disember), diikuti musim 2 (Mei - Ogos) dan terendah pada musim 1 (Januari - April). Corak taburan IV berubah mengikut musim dimana *Amorphophallus* spp. mengalami tempoh dormansi pada musim panas (musim 1), manakala IV tertinggi dicatatkan apabila kedua-dua lokasi mengalami suhu yang sedikit rendah, humiditi tinggi dan taburan hujan yang tinggi (musim 3).

Keputusan untuk penentuan kandungan glucomannan (GM) mendapati *A. oncophyllus* mencatatkan kandungan tertinggi iaitu 58.65%, diikuti *A. paeoniifolius* matang (50.22%); *A. prainii* matang (29.71 %) ; *A. elegans* (17.01%); *A. paeoniifolius* muda (14.90%) dan *A. prainii* muda (9.23%). Perbezaan kandungan glucomannan yang nyata sebanyak 15 % berkurang dicatatkan bagi tumbuhan yang dipindah dari habitat asal. Ini mungkin disebabkan oleh perubahan dari segi fisiologi contohnya perubahan iklim semasa proses perpindahan telah menyebabkan kandungan glucomannan



berkurangan. Kandungan GM adalah tinggi pada tumbuhan lebih matang berbanding tumbuhan muda serta berbeza mengikut masa tuaian.

Kajian ini menunjukkan spesies *Amorphophallus* terutamanya *A. paeoniifolius* dan *A. oncophyllus* mempunyai potensi untuk dikomersialkan di Malaysia kerana mampu menghasilkan kandungan GM yang tinggi dari ubinya. Tambahan pula, Malaysia mempunyai iklim dan keadaan tanah yang bersesuaian untuk penanaman tumbuhan ini. Walaubagaimanapun, untuk menghasilkan kandungan GM yang optimum, ia memerlukan persekitaran, iklim dan ekologi yang tertentu.

Kata kunci: kitar hidup, *Amorphophallus*, glucomannan (GM).