UNIVERSITI PUTRA MALAYSIA

A COMPARATIVE STUDY ON THE PERFORMANCE OF Metroxylon sagu AND Metroxylon rumphil GROWN ON GLEYED MINERAL SOIL AND ORGANIC SOIL

KELVIN LIM ENG TIAN

A COMPARATIVE STUDY ON THE PERFORMANCE OF *Metroxylon sagu* AND *Metroxylon rumphii* GROWN ON GLEYED MINERAL SOIL AND ORGANIC SOIL

KELVIN LIM ENG TIAN

Master of Science
Universiti Pertanian Malaysia

1991

A COMPARATIVE STUDY ON THE PERFORMANCE OF *Metroxylon sagu* AND *Metroxylon rumphii* GROWN ON GLEYED MINERAL SOIL AND ORGANIC SOIL

By

KELVIN LIM ENG TIAN

Thesis Submitted in Fulfilment of the Requirements
for the Degree of Master of Science
in the Faculty of Food Science and Biotechnology
Universiti Pertanian Malaysia

December 1991

ACKNOWLEDGEMENT

I wish to express my sincere gratitude to Dr. Mohd. Nasir Azudin, Deputy Dean, Faculty of Food Science and Biotechnology and Dr. Zaliha C. Alang, Head, Department of Biotechnology, for inspiring me to undertake post-graduate training and for the encouragement and invaluable guidance they have given me under their overall supervision of this research project.

I am also indebted to Prof. M. Flach and Ir. D. L. Schuiling of Wageningen Agricultural University, The Netherlands, Mr. John E. Cecil and Mr. Tie Yiu Liong, Department of Agriculture, Sarawak for their correction, advice and guidance in writing this thesis.

Thanks are also due to Mr. Sim Eng Siong, Mr. Lim Chin Pang and Mrs. Patricia Sim for their help in one way or another leading to this opportunity for post-graduate training.

My present training will not have been accomplished without the support, approval and study leave from the Department of Agriculture, granted by the State Government of Sarawak, Malaysia.

Finally, thanks are due to my beloved wife and son, Elizabeth and Jason, for their patience, support, understanding and encouragement at all time.

TABLE OF CONTENTS

LIST OF TABLES

Table		Page

Table		Page

LIST OF FIGURES

LIST OF PLATES

Abstract of Thesis Submitted to the Senate of
Universiti Pertanian Malaysia in Fulfillment of the
Requirements for the Degree of Master of Science

A COMPARATIVE STUDY ON THE PERFORMANCE OF *Metroxylon sagu* AND *Metroxylon rumphii* GROWN ON GLEYED MINERAL SOIL AND ORGANIC SOIL

By

KELVIN LIM ENG TIAN

December 1991

Supervisor : Mohd Nasir Azudin, Ph.D.

Faculty : Faculty of Food Science and Biotechnology

Sago palm is currently one of the major starch resources in Malaysia, as indicated by the M$14 million average annual export value obtained in the past few years. The two main types of sago palms found in Sarawak are the smooth sheathed *Metroxylon sagu* and spiny sheathed *Metroxylon rumphii*. These are grown all over Sarawak on different soil types ranging from mineral soil, shallow peat and deep peat. To date, no information is available on the performance of these two varieties grown on these soil types. This study was conducted to determine the effect of soil types on the growth, physical characteristics of the palms, the starch quality, and yield of the resultant starch extracted from these palms. The longitudinal and radial starch distribution of the palm, the different methods of estimating starch yields and the leaf nutrient variation of the sago palm were also evaluated.

Results from this study indicated that sago palm performed better on mineral soil than on the marginal peat soil with starch yield ranging from 182 to 260 kg / trunk for Metroxylon sagu in mineral soil compared to 128 to 188 kg / trunk in deep peat. In terms of starch yields against palm maturity, total starch yield was found to increase with palm age up to the 'Angau Muda' (flowering) stage after which the total starch content decreased sharply. The physico-chemical characteristics of the sago starch from both varieties and different stages of maturity did not differ significantly. The longitudinal and radial distribution of the starch in trunk of the palm was uneven. The upper portion of the trunk and the outer segment of the pith had lower starch contents. The starch yield per trunk of sago can be estimated by measuring the trunk length and girth at breast height. Studies showed that estimating of starch yield based on volume basis is easier and more accurate. The study on the variation leaf nutrient content of sago palm recommended frond 9 be sampled for the assessment of the nutrient status of the palm.

Abstrak Tesis Yang Dikemukakan Kepada Senat
Universiti Pertanian Malaysia Sebagai Memenuhi Syarat
Keperluan Untuk Ijazah Master Sains

KAJIAN BANDINGAN PRESTASI Metroxylon sagu DAN Metroxylon rumphii YANG DITANAM DI TANAH LIAT DAN TANAH GAMBUT

Oleh

KELVIN LIM ENG TIAN

Disember 1991

Penyelia : Mohd Nasir Azudin, Ph.D.

Fakulti : Fakulti Sains Makanan dan Bioteknologi

Palma sagu kini merupakan salah satu daripada sumber kanji yang utama di Malaysia, seperti yang ditunjukkan oleh nilai eksport sebanyak M$ 14 juta beberapa tahun kebelakangan ini. Dua jenis palma sagu utama di Sarawak adalah Metroxylon sagu yang licin dan Metroxylon rumphii yang berduri. Palma ini boleh didapati dalam berbagai jenis tanah, daripada tanah liat (mineral soil), tanah gambut cetek (shallow peat) dan tanah gambut dalam (deep peat) di merata-rata tempat di Sarawak. Sehingga kini, tidak ada maklumat mengenai prestasi kedua-dua varieti palma ini dalam jenis-jenis tanah tersebut. Kajian ini telah dijalankan untuk menentukan kesan jenis-jenis tanah ke atas pertumbuhan, sifat-sifat fizikal palma tersebut, mutu kanji dan hasilan kanji yang diekstrak daripada palma-palma tersebut. Taburan kanji di dalam batang palma secara memanjang dan membulat, kaedah-kaedah

berlainan untuk menjangka hasilan kanji dan variasi nutrien daun palma sagu tersebut juga dikaji.

Keputusan daripada kajian ini menunjukkan bahawa palma sagu memberi prestasi yang lebih baik di atas tanah mineral daripada tanah gambut dalam dengan hasilan kanji sebanyak 182 – 260 kg/ batang pokok Metroxyon sagu di atas tanah liat berbanding dengan hasilan sebanyak 128 – 188 kg/batang pokok di atas tanah gambut dalam. Dari segi hasilan kanji melawan kematangan palma, jumlah hasilan kanji didapati bertambah dengan pertambahan umur palma sehingga peringkat "Angau Muda" di mana selepas itu jumlah kandungan kanji menurun dengan mendadak. Sifat–sifat fiziko–kimia kanji sagu daripada kedua–dua varieti tersebut dan daripada kumpulan umur yang berbeza tidak menunjukkan perbezaan yang bererti. Taburan kanji palma secara memanjang dan membulat tidak sekata. Bahagian atas dan segmen luar empular mempunyai kandungan kanji yang lebih rendah. Hasilan kanji sebatang pokok sagu boleh dijangkakan dengan mengukur panjang batang pokok dan ukurlilit pada paras dada. Kajian ini menunjukkan bahawa jangkaan hasilan kanji yang berasaskan dasar isipadu adalah lebih mudah dan tepat. Kajian ke atas variasi nutrien daun palma sagu mencadangkan bahawa daun ke 9 digunakan untuk penilaian taraf nutrien palma tersebut.

Dedicated to my beloved wife and son,

Elizabeth Wong and Jason Lim

CHAPTER 1

INTRODUCTION

An Overview

Malaysia, in particular the State of Sarawak, is the world leader in the field of sago starch production and sago research. Sago holdings have been known to exist in Sarawak for 400 years or more. Known locally as "rumbia" or "balau" in Melanau, the sago palm (Metroxylon spp.) is found in the vast areas of contiguous equatorial peat swamp of Sarawak. Grown under semi-wild conditions, it has a special niche in this marginal land resource and provides a livelihood for many of the inhabitants associated with this resource. Figure 1 shows the major sago producing areas in Sarawak. An informal survey by Wee (1977) indicated that at least 84 villages, comprising some 6,000 households with a population of 40,000 were working or dependent on commercial sago exploitation. Among agricultural products, sago starch currently ranks as the State's fifth highest revenue-earner after pepper, rubber, oil palm and cocoa. Sarawak exports about 30,000 tonnes of sago starch annually earning about M$14 million (US$ 5,263,158) in 1988 (Azudin and Lim, 1990).

To sustain and further develop the sago starch industry, the Sarawak government has made a commitment to promote the industry in the state.

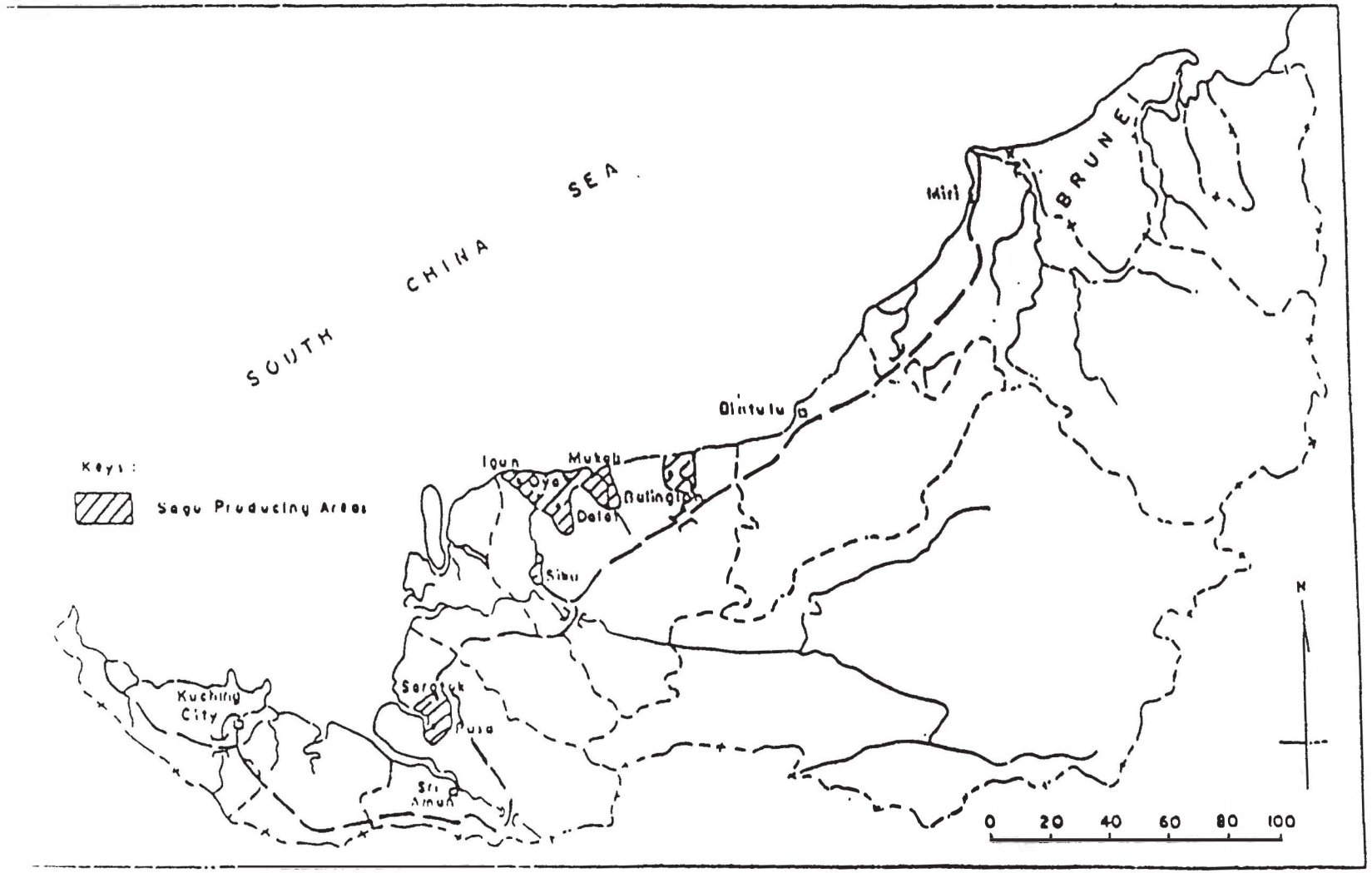

Fig. 1

Main Sago Producing Areas In Sarawak

Through her local agencies (Sarawak Economic and Development Corporation, Land Custody and Development Authority) and the Department of Agriculture, research has been intensified and various projects implemented to fulfil this commitment. In 1982, a Sago Research Station was established by the Department of Agriculture in Dalat, Sibu covering an area of 204 ha. A Sago Research Laboratory was also set up to carry out research on various aspects of sago processing, starch quality improvement and sago starch utilization. In 1987, the Sarawak government set up a 10 million dollar modern sago factory in Mukah through the Sarawak Economic Development Corporation (SEDC) to produce high quality refined sago starch. A sago plantation was also established by the Land Custody and Development Authority (LCDA) near Mukah. Under this project, approximately 2,278 ha are currently being developed and a total of 16,188 ha (40,000 ac) is planned for development within the ten-year period (1987-1997) (Kueh et al., 1987). In the past few years a number of privately owned modern multimillion dollar sago factories have also been set up in Dalat, Mukah and Sibu, producing high quality sago starch for export. All these developments have increased the demand for sago logs. This will not only encourage more farmers to rehabilitate their sago groves but also to extend their plantings.

Research work on sago, in general, is scarce, despite the versatile usefulness of the commodity. Most of the sago research in Sarawak is carried out by the Department of Agriculture and the focus is currently toward the improvement of crop production through agronomic trials, botanical, and soil studies, as well as pest and disease control. Only very recently has research begun in earnest on the characteristics of the sago starch, its chemical modification and uses in the food industry (Azudin, 1990). To date, most of the studies on the performance of sago palm in Sarawak have centred on Metroxylon sagu, (Plate 1) the smooth sheathed variety. Perusal of the literature reveals little information on the performance and starch yield of Metroxylon rumphii, (Plate 2) the spiny sheathed variety. The lack of this information gives rise to conflicting opinions on the performance of these two varieties. Sago farmers in the Mukah and Dalat areas in the Sibu Division of Sarawak believe that Metroxylon rumphii produces less starch per trunk than Metroxylon sagu. However, sago farmers in the Balingian, Pusa and Saribas areas claim otherwise. Most factory owners in Mukah and Dalat therefore prefer to purchase Metroxylon sagu due to its purportedly greater starch content. This uncertainty has caused a great discrepancy in the price of sago logs from these two varieties. At present Metroxylon sagu can cost as high as

Plate 1. Smooth sheathed Metroxylon sagu (ROTTB.)

Plate 2. Spiny sheathed Metroxylon rumphii (MART.)