



UNIVERSITI PUTRA MALAYSIA

***EFFECT OF SUCKER PRUNNING ON SAGO PALM
(Metroxylon sagu Rottb.) GROWTH PERFORMANCE***

PETER STANLEY ANAK HOWELL

FSPM 2017 5



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By

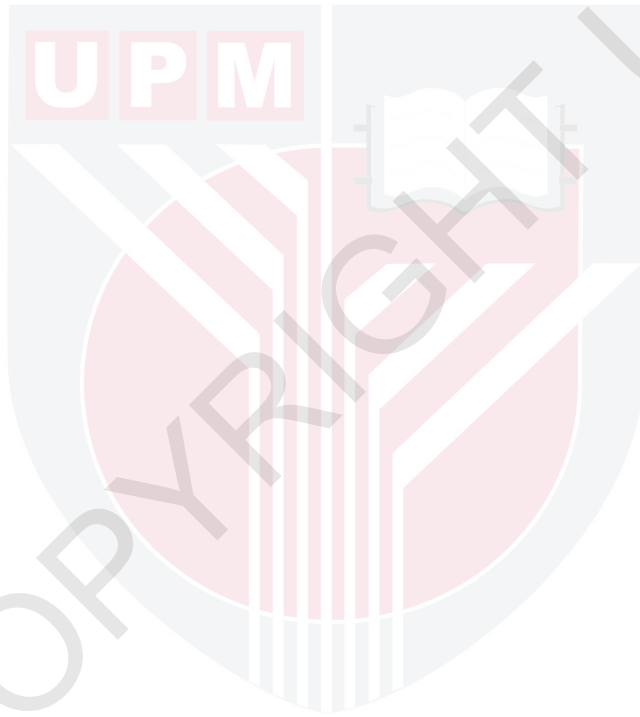
PETER STANLEY ANAK HOWELL

**Thesis Submitted to the School of Graduate Studies,
Universiti Putra Malaysia, in Fulfilment of the
Requirement for the Degree of Master of Science**

November 2017

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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(*Metroxylon sagu* Rottb.) GROWTH PERFORMANCE**

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PETER STANLEY ANAK HOWELL

November 2017

**Chairperson: Associate Professor Shahrul Razid Bin Sarbini, PhD
Faculty: Agriculture and Food Sciences, Bintulu**

Sago palm (*Metroxylon sagu* Rottb.) had been commercially cultivated in Sarawak for both export and domestic consumption. Sarawak is the world main exporter for sago starch which is one of the state important agriculture commodities. Currently, the world demand for sago starch had increased tremendously, however the supply is insufficient. Inconsistent harvesting with lengthy harvesting interval had been known to affect the supply of sago logs. Lack of knowledge for systematic sago sucker management is also one of the reasons that hinder the palm growth performance resulting in low and inconsistent sago logs supply to the mills. The objectives of this study were to determine the effect of sucker pruning on the sago mother palm and succession sucker growth performance as well as the allocation of above ground biomass of the sago cluster.

The study was conducted on an existing sucker pruning trial in Sungai Talau Research Station, CRAUN Research, Dalat, Sarawak, which was established in 2007 on a deep peat area. The study consisted of five sucker pruning treatments that were carried out three times each year. Number of trunking palm, trunk or palm base girth circumference, trunk height and frond count were recorded yearly to determine the growth performance for both mother palms and succession suckers. The cluster's fresh weight was determined by felling every single palm within the cluster, separated into different vegetative parts and weighed. Adequate amounts of samples were collected and dried using drying oven to estimate the above ground biomass ratio allocated between the different vegetative parts.

Results showed significant difference for growth performance of both mother palms and succession suckers and also on the allocation of biomass within the sago cluster when sucker pruning was done. Pruned sago clusters with regulated number of palms at certain period of time exhibited higher formation of trunking palms with broader base girth and taller trunks. The biomass ratio allocation pattern was found to be higher in trunks and frond formation followed by leaves production.

Sucker pruning activity may have minimised competition for nutrient, sunlight and growing space between palms within the sago cluster. Less congested cluster with evenly spread palms enabled each individual growing palm to receive optimum nutrient, sunlight and space for optimum growth performance. Congested sago cluster were observed to have tensed competition for growth factors and concentrated more on fronds and leaves production instead of trunk.

The outcomes of the study showed that sago clusters under T4 produced higher number of taller and broader trunking palms for both mother palm and succession suckers with high biomass allocation for trunk formation. Sucker pruning system, initiated after three years of field planting, conducted three times a year with one succession sucker to be retained every 18 months interval to be recommended to improved sago growth performance and sustainability of yield production. However, study on the nutrient uptake, starch yield and growth performance for sago palm cultivated on different type of soil in response to sucker pruning should be initiated.

Abstrak tesis yang dikemukakan kepada Senat of Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Master Sains

**KESAN PENCANTASAN SULUR TERHADAP PRESTASI
PERTUMBUHAN POKOK SAGU (*Metroxylon sagu* Rottb.)**

Oleh

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November 2017

Pengerusi: Profesor Madya Shahrul Razid Bin Sarbini, PhD
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Penanaman pokok sagu (*Metroxylon sagu* Rottb.) di Sarawak telah dilakukan secara komersial untuk tujuan eksport dan kegunaan domestik. Sarawak adalah pengeksport utama untuk kanji sagu di dunia di mana ianya merupakan antara komoditi pertanian yang penting. Pada masa ini, permintaan dunia terhadap kanji sagu telah meningkat secara mendadak tetapi bekalan kanji sagu tidak mencukupi. Penebangan yang tidak konsisten dengan jarak penebangan yang panjang telah memberi kesan terhadap bekalan batang sagu. Kekurangan pengetahuan terhadap pengurusan sulur sagu juga merupakan salah satu penyebab yang menghadkan kadar pertumbuhan pokok sagu dan ini menyebabkan bekalan batang sagu yang rendah dan tidak konsisten ke kilang. Objektif kajian ini adalah untuk menentukan kesan pencantasan sulur terhadap kadar pertumbuhan pokok induk dan sulur susulan serta pembahagian biojisim rumpun sagu di bahagian atas permukaan tanah.

Kajian ini telah dijalankan di tapak kajian pencantasan sulur yang telah dimulakan pada tahun 2007 di kawasan tanah gambut dalam di Stesen Penyelidikan Sungai Talau, CRAUN Research, Dalat, Sarawak. Kajian ini mengandungi lima rawatan pencantasan sulur yang dilakukan sebanyak tiga kali setahun. Jumlah pokok berbatang, ukurlilit pangkal pokok atau batang, ketinggian batang dan jumlah pelepah direkod setiap tahun untuk menentukan kadar pertumbuhan kedua-dua pokok induk dan sulur susulan. Berat segar rumpun sagu ditentukan dengan cara menebang kesemua pokok sagu di dalam rumpun, dipisahkan mengikut bahagian vegetatif yang berlainan dan ditimbang. Jumlah sampel yang secukupnya diambil dan dikeringkan dalam ketuhar pengering untuk penentuan nisbah pembahagian biojisim antara bahagian vegetatif yang berbeza.

Keputusan kajian menunjukkan perbezaan yang signifikan untuk kadar pertumbuhan pokok induk dan sulur susulan dan juga pembahagian biojisim dalam rumpun sagu apabila aktiviti pencantasan sulur dilakukan. Rumpun sagu yang dicantas sulurnya dan mempunyai jumlah pokok sagu yang terkawal pada satu-satu masa, menunjukkan jumlah pembentukan pokok berbatang yang banyak dengan pangkal batang yang lebar dan batang yang tinggi. Corak pembahagian biojisim juga didapati lebih tinggi untuk pembentukan batang dan pelepah diikuti oleh penghasilan daun.

Aktiviti pencantasan sulur mungkin telah meminimalkan persaingan terhadap nutrien, cahaya matahari dan ruang pertumbuhan antara pokok di dalam rumpun sagu yang sama. Keadaan rumpun sagu yang luas dengan taburan pokok yang sekata, membolehkan setiap pokok menerima jumlah nutrien, cahaya matahari dan ruang yang secukupnya untuk pertumbuhan yang optima. Rumpun yang sesak menunjukkan persaingan terhadap faktor pertumbuhan yang tinggi dan lebih cenderung untuk membentuk pelepah dan daun yang banyak berbanding pembentukan batang.

Hasil kajian menunjukkan bahawa rumpun sagu di bawah rawatan T4, menghasilkan banyak pokok berbatang yang tinggi serta lebar dan pembahagian biojisim yang tinggi. Pencantasan sulur yang dimulakan pada tahun ketiga selepas penanaman, tiga kali setahun dengan satu sulur susulan dikekalkan setiap lapan belas bulan. adalah disyorkan untuk meningkatkan kadar pertumbuhan dan pengeluaran hasil yang berterusan. Walau bagaimanapun, kajian terhadap reaksi pokok sagu yang ditanam di kawasan jenis tanah yang berlainan terhadap pencantasan sulur dari segi pengambilan nutrien, penghasilan kanji dan kadar pertumbuhan perlu dilakukan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
CRAUN	Crop Research and Utilisation Unit
DNMRT	Duncan New Multiple Range Test
LCDA	Land Custody and Development Authority
RCBD	Randomised Complete Block Design
SAS 9.3	Statistic Analysis System (Software version 9.3)
SSSED	Sago Smallholder Satellite Estate Development
S1	Succession sucker 1
S2	Succession sucker 2
S3	Succession sucker 3
S4	Succession sucker 4
S5	Succession sucker 5
T0	Treatment 0 (Control)
T1	Treatment 1
T2	Treatment 2
T3	Treatment 3
T4	Treatment 4

CHAPTER 1

INTRODUCTION

Sago palm (*Metroxylon sagu* Rottb.) has been exploited mainly for the starch stored in its trunk and has been used by man as food source in the South East Asia and Melanesia region. Sago palm is known by different name by different people such as *sagu*, *mulong* or *rumbia* in Malay (Malaysia), *sagu* in Javanese (Indonesia), *sak-sak* (Papua New Guinea), *sa kuu* (Cambodia) and *sa khu* (Thailand) (Flach, 1997). In Sarawak it is known as *saguk* by the Bidayuh, *balau* by the Melanau and Penan. Sago starch is still an important staple food for some natives in New Guinea Island, Maluku Islands (Moluccas), Sulawesi, Kalimantan (Indonesian Borneo) and Siberut Island of West Sumatra (Ehara, 2015). Nevertheless sago starch is still a complementary food for other natives in other part of South East Asia especially in Malaysia, Indonesia, Thailand, Brunei and the Philippines besides rice.

Nowadays, studies on sago starch has been intensively conducted as it have the potential to substitute other starch such as wheat, corn, rice, tapioca, yam and potatoes for food and non food industries. Besides starch, other parts of sago palms have been used by man. The leaves have been utilised as thatch materials, bark can be used as firewood and extracted sago pith waste (*hampas*) can be use as animal feed. Further studies have shown that sago biomass can be utilized for bio-fuel production, compost fertilizer, fibre composite board and household furniture (CRAUN report, 2016).

Sago starch production in New Guinea, Thailand, Indonesia, the Philippines and Brunei are mostly for domestic consumption. Sago starch produced in Malaysia especially from Sarawak is produced for both export and domestic consumption and is one of the major commodities for Sarawak after oil palm, pepper, rubber and cocoa. Although Sarawak is not the world's largest producer, but it is the sole exporter of world sago starch with the export volume of 51,000 metric tonnes valued at RM91 million recorded in 2011 (PELITA, 2013). Most of the sago starch is exported to Peninsular Malaysia, Japan, Singapore, Thailand, Taiwan, Vietnam, China and United States of America. World demand on sago starch especially for food industries have increased tremendously but the supply is insufficient. To meet the demand, it is critical to carry out studies in improving and sustaining the supply of sago log in order to increase starch yield.

Despite having the potential as a commercial starch producing palm, agronomy studies on sago palms especially on the agronomical and

cultural practices are quite limited as compared to other main commodity crops such as oil palm, rubber, paddy, cocoa and pepper. Longer gestation stage of at least 12 years to complete one full growth cycle might discourage researcher to conduct any scientific studies on sago palms. Considering sago palm has been categorised as commodity crop, shortening the longer gestation stage is essential to increase and sustain sago log production. Commercial sago plantations and smallholders required trunk harvesting to be done at least yearly from the same sago cluster to enable the sustainability of sago trunk production. However, this requirement had not been materialised because of the inconsistent in sago log harvesting. Information gathered from sago farmers in Dalat district revealed that harvesting of sago logs was done within the interval of three to four years from the same sago cluster (Nawi Lembang, sago farmer, Dalat, pers. Comm. July 2014).

Comparing to other crops, sago palm is found to grow vigorously on much fertile soil even with only minimal palm maintenance. Besides, pest infestation was hardly experienced except for occasional palm damaged by wild boars, monkeys and palm weevils. Because of these, some farmers were reported to visit their sago farms only during harvesting or suckers extraction activities, where weeding and removal of dead fronds may be carried out. However, observation reviewed that some farmers did practiced sucker pruning with improper sucker pruning system. Information on the proper agronomy practices for sago palm was scarce and as a result palms are left to grow without any proper and systematic palm maintenance resulting in low and inconsistent sago log productivity with longer harvesting intervals experienced by both sago plantation and smallholder (Ipor *et al.*, 2005). Other palm maintenance such as fertilizer application was not consistently done and systematic suckers regulation were not carry out which resulting in an impenetrable cluster (Jong, 1995; Schuiling and Flach, 1985).

Previous studies on sago palms had been conducted by Sarawak Department of Agriculture in the 90's but information was too limited and not sufficient to assist sago farmers to have better agronomic cultural practices for sago cultivation. Observations on normal sago palm growth have found out that the ability to produce suckers have an adverse effect on the palm growth performance. Currently sago farmers in Mukah division practised minimal suckers regulating system, usually after harvesting activities which occur at least once in three to four years. Continuous production of sago suckers without any system to regulate it may eventually resulting in a dense cluster where palms of different growth stage will compete for nutrient, light and growing space which are essential for optimum palms growth (Irawan *et al.*, 2015).

Observation on highly dense sago palm clusters showed that smaller suckers will grow weaker and tend to die off because of the intense competition with the much stronger and bigger suckers. Besides that, intense competitions may lengthen palms unproductive (rosette) stage which may delay trunk formation stage, poor palms growth with low starch yield and prolong harvesting interval period (Irawan *et al.*, 2015; Yanagidate *et al.*, 2009; Flach, 1997 and Jong, 1995). Normal growth of sago suckers to creep away from the mother palm or other suckers as reported by Nabeya *et al.* (2015), explained the importance to allow certain number of growing suckers at a time in order to reduce competitions for growth factors that might fasten vertical trunk growth and sustain productivity. Study by an agriculture consultation group showed that sago palms grown in the plantation without any proper sucker regulating system have a poor growth performance with low trunk productions and starch yield (Ecosol report, 2005).

Hence, managing or regulating certain number of sago palms within the cluster by mean of sucker pruning will reduce or minimise competition for nutrient, sunlight and growing space in order to improve sago palm growth performance especially on the development of sago trunk and shorten the harvesting interval in order to increase and sustain sago log productivity.

The general objective of this study is to identify main morphological and physiological changes under different sucker pruning treatment for mother palm and succession suckers within the sago cluster. The outcome of the study is to determine proper systematic suckers regulating regime to improve trunk formation besides sustain sago log production and starch yield.

The specific objectives of this research are as follow:

- (1) To determine the effect of sucker pruning on the growth performance of the mother palm within the sago palm cluster.
- (2) To determine the effect of sucker pruning on the growth performance of succession sago suckers within the sago palm cluster.
- (3) To determine the effect of sucker pruning on the allocation pattern of above ground biomass within the sago palm cluster.

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