SAGO PALM 4: 21–24 (1996)

Growth and Biomass of Sago Palm (*Metroxylon sagu*) on Deep and Shallow Peat Soils of Dalat District, Sarawak

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Key words: Peat soil, Sago palm, Biomass

サラワク州ダラット地区の熱帯泥炭土壌における サゴヤシの生育とバイオマス

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キーワード　泥炭層を持つ泥炭土壌，サゴヤシ，バイオマス

Introduction

There are about 20,000 ha for sago cultivation in Sarawak and about 60% of these are found in Mukah and Dalat District. Sixty two percentages of sago palm in Sarawak is grown on peat soils and 33% of sago palm is grown on alluvial soil (Tie et al. 1991). It is believed that the center of sago distribution is an island of New Guinea. Sago palm occupies an estimated half million ha of New Guinea (Paijmans 1980), mostly in swamp, which is also distributed, westward to the Mentawei island, west of Sumatera and eastward throughout Melanesia. Even in drier locations than wet tropics sago palm is occasinally cultivated, because it accumulates more than 200 kg of starch in its trunk. Sago palm ultimately used starch to form new trunks (Flach et al. 1989), so that seedlings should not be planted thereafter, having a stable harvest for a long time if density management was adequate (Watanabe 1986). The sago starch has been exploited for food.

Generally sago palm can be grown on peat soils. However, the growth rate of sago palm depends on peat soil types and soil conditions according to the results of Tie et al. (1987). The objective of this study is to determine and compare the growth and biomass of sago palm on deep and shallow peat soils of Dalat, Sarawak, Malaysia in order to expect sago plantation on two types of peat soils.

Study site

The research areas is selected in and around Sungai Talau Peat Research Station (STPRS), Dalat, Sarawak. The STPRS has an area of about

225 ha, of which some 50 ha had been opened up before 1992 (Schuiling et al. 1992). The main objective of STPRS, established in 1982, is to study sago palm (*Metroxylon* sp.) as one of promising wet land crops. The deep (more than 150 cm of peat horizon) and shallow (less than 150 cm of peat horizon) peat soils are distributed in STPRS (Yamaguchi et al. 1994). The content of Morgan's solution extractable Zn, Cu, Fe and Mn in deep peat soils of STPRS shown by Jong and Flach (1995) and Jong (1995) were low, which indicated up to 20% of total amount of elements (Yamaguchi et al. 1994).

Methods

Growth study: Totally eight sago palms in STPRS and farmer's garden were selected in the different growth stages. The size of the palms, the growth rate of their trunks, number of living fronds, dead fronds and scars were measured from 1992 to 1994. Trunk height was measured from the ground to the sheath base of the oldest living frond on the trunk. The growth rate of trunk was estimated by the measurement of length between colored nails which were driven at the sheath base of the oldest living frond on the trunk at every survey . Internode length was calculated by the following equation; (height of trunk — height of sheath base of the oldest living frond) / number of living frond.

Cutting study: Sago palms at 7 and 8 years after planting on the deep and shallow peat soil and a thirteen years palm on the deep peat soil were chosen for cutting study. The trunk was split into logs in 50 cm each from the ground level by a chainsaw. Fresh weight and dry weight of the logs and fronds were measured. The number of living fronds and scars were counted in the field.

Results and Discussion

1. Growth of sago palm on deep and shallow peat soils

Morphological characteristics of sago palms on deep and shallow peat soils are shown in Table 1. The diameter of sago palms on deep peat soils at ground level from 4 to 8 years after planting ranged from 41 to 52 cm, which are smaller than those on shallow peat soils. Trunk height of sago palms on peat soils varied from 226 to 608 cm. The mean growth rates of two 7 years palm trunks was 93.8 ± 11.7 cmyr^{-1} on deep peat soils, Those of 6 years palm was 168.0 ± 6.4 cmyr^{-1} on shallow peat soils. 8 years palms (No. 5 and No. 6) on deep peat soils have already stopped elongation in a while. Internode length of the trunks in this study were 10.4–12.9 cm and 15.5–16.3 cm on shallow peat soils (Table 2), which depended on the rate of frond production (Jong 1995) and nutritional conditions. Therefore, the different growth rates of trunks on two soils seem to be derived from the difference of the internode lengths. Sato et al. (1979) reported that sago palms preferably grow on alluvial soil and

Table 1 Morphological characteristics of sago palms on deep and shallow peat soils

Sample	Age after planting	Soil	Diameter at ground level (cm)	Palm height (cm)	Height of trunk (cm)	Height of sheath base of the oldest living frond (cm)	No. of living fronds	No. of scars
1	4	deep	44.8	450	—	—	14	10*
2	4	peat	41.0	434	—	—	16	20*
3	7	soil	52.2	883	226	150	11	63*
4	7		51.7	813	234	113	11	66*
5	8		49.0	1440	608	473	13	81*
6	8		45.3	1200	600	488	9	84*
7	6	shallow	58.4	1180	330	117	10	15*
8	6	peat soil	55.8	1150	298	143	13	17*

Number of scars containing prostrate stem was counted.

on shallow peat soil with a clayey subsoil. Sago palm also can grow on deep peat soils in spite of fairly suppressive growth in terms of growth time from our results.

2. Biomass of sago palm on deep and shallow peat soils

The trunk diameters of harvested four sago palms at ground level ranged from 56.1 to 60.6 cm (Table 3). There were considerable variations in trunk height, 570 to 882 cm, among sago palms with different ages. Fresh weight of trunk, frond, bark with sheaths of fallen fronds of sago palms were relatively similar. It is supposed from the data that the morphological features of sago palm are regulated by genetic characteristics.

Fresh trunk weight on shallow peat soils showed 568 kg, corresponded to the data from Yamamoto (1994) in case of shallow peat soils (Table 3). There is a small difference between sago palm at 13 years on deep peat soil and one at 7–8 years on shallow peat soil, although distinct difference in dry matter percentages of bark between No. 9 and No. 10 depends on water content of fresh bark.

Table 2 Internode of sago palm trunk

Sample No.*	Soil	Survey in 1992	1993 (cm)	1994	Mean + SD (cm)
3	Deep	7.6	11.6	12.0	10.4 + 3.4
4	peat	12.1	12.3	14.2	12.9 + 1.6
5	soil	11.3	12.5	7.7	10.5 + 3.5
6		14.0	11.2	10.3	11.8 + 2.7
7	shallow	23.7	14.4	10.9	16.3 + 9.4
8	peat soil	12.9	17.8	15.9	15.5 + 3.5

* See Table 1.

Internode length = (height of trunk — height of sheath base of the oldest living frond) / number of living frond.

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Table 3 Fresh and dry weight of harvested sago palms

Sample No	Soil	Age after planting	Trunk height (cm)	Diameter at ground level (cm)		Fresh weight Trunk	Bark	Frond	Total	Dry weight Trunk	Bark	Frond	Total
9	Deep peat soil	13	882	57.9	Weight (kg)	728	162	295	1185	197	88.0	102	387
					%	61.4	13.7	24.9	100	50.9	22.7	26.4	100
					% of dry matter					27.1	54.1	34.7	32.7
10	Deep peat soil	8	570	56.1	Weight (kg)	378	118	225	720	41.1		86.3	
					%	52.2	16.4	31.3	100				
					% of dry matter					10.9		38.4	
11	Shallow peat soil	7/8	570	60.6	Weight (kg)	568	128	313	1009	159	18.4	95.9	274
					%	56.3	12.7	31.0	100	58.2	6.7	35.0	100
					% of dry matter					28.1	14.4	30.6	27.1

Bark = trunk – pith.

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