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Commercial Sago Palm Cultivation on Deep Peat in Riau, Indonesia

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Abstract P.T. National Timber & Forest Products (NTFP) initiated a 20000-hectare self-financed commercial sago palm (*Metroxylon sagu Rottb.*) plantation in 1996. It is established on deep peat of about three meters in depth, at Tebing Tinggi Island in the Riau Province of Indonesia. About 8000 hectares have now been completed and continued development of the plantation is progressing steadily at about 2000 hectares per year. The sago palms are cultivated as a non-swamp land crop. An extensive canal system divides the plantation into rectangular planting blocks of 50 hectares. Dams are built at appropriate places to regulate the soil water table to about 20 to 50 centimeters below the soil surface. A combination of rails, roads and canals is used for work realization, supervision, transportation of farm inputs and outputs.

Vegetative offshoots (suckers) are collected as the planting material. They are nursed on floating rafts until the emergence of new roots and fronds before they are transplanted. A square spacing pattern of ten meters is adopted for field planting. Trimming of leaflets to reduce transpiration is carried out when suckers are planted during dry seasons. Census and replacements of dead suckers are carried out at three and six months after planting. In the field, indigenous fern species serve as natural soil cover. Weeding along the planting rows is carried out twice a year, with fertilizers applied immediately after weeding. Sucker growths in each palm cluster are regulated stepwise, so that only one sucker is allowed to further its development in a desired interval of 18 to 24 months.

The plantation is divided into phases of 1000 hectares, each equipped with adequate infrastructure and manpower to carry out routine operations rather autonomously. In the past four years, the infrastructure system has adequately facilitated various field operations. Concurrent agronomic practices and soil water table management have enabled satisfactory growth and development of the sago palms.

Key words: deep peat, management, *Metroxylon sagu*, plantation

インドネシア，リアウ州における厚い泥炭質土壌での商業的サゴ生産

フォー・ショーン・ジョン

要約 ナショナル・ティンバー・アンド・フォレスト・プロダクト社（NTFP）は，1996年にインドネシア，リアウ州，トゥビンティンギ島において，厚さ約3 mの泥炭質土壌での20,000 haに及ぶサゴヤシの商業的栽培を自費で開始した．現在，既に8,000 haのプランテーション開発を完了しており，年間2,000 haの割合で開発が順調に進行している．サゴヤシは低湿状態を回避して栽培されており，プランテーション内に1区画が50 haの長方形となるように運河をめぐらし，適当な箇所にダムを設けて地下水位を土壌表面から20～50 cmに制御できるようにした．この水路は，鉄道，道路とともにプランテーションでの作業，管理業務および生産資材や生産物の運搬に使用される．サゴヤシのサッカーは，筏上で養成し，10 m×10 mの正方形に植え付け，2年毎に除草，施肥，サッカー調整を行っている．プランテーションは，1区画が1000 haの'Phase'に分割し，各々には十分なインフラストラクチャーと人員を配備して，独立的に日常業務が行われている．過去4年間に，NTFPのインフラストラクチャー・システムは種々の圃場作

業を容易にし，同時に地下水位の制御はサゴヤシの良好な生育を可能にした．
キーワード　厚い泥炭質土壌，管理，サゴヤシ，サゴヤシプランテーション

Introduction

A 20000-hectare self-financed sago palm (*Metroxylon sagu Rottb.*) plantation was initiated by P.T. National Timber & Forest Products (NTFP) in 1996. This is the first Forest Plantation Industry in sago in Indonesia and it is located at Tebing Tinggi Island of the Riau Province.

Almost the entire plantation is located on rather well decomposed deep peat of over 3 m in depth. The first batch of field planting began in August 1996 and to date, about 8000 hectares of sago palms have been field planted. The plantation is developed progressively over a period of 10 years, at about 2000 hectares per year.

Traditional methods of sago palm cultivation with minimal maintenance and without fertilizer applications are replaced with modern agronomic practices. These include essential infrastructure development, systematic field preparation, efficient nursery, proper plant spacing, soil water table control, fire prevention, weeding, fertiliser application, harvesting, administrative and operational management.

Although the sago palm has widely been described as a wet land crop, its growth on constantly wet conditions was poor (Haantjens 1968, Kraalingen 1983). From numerous observations made in semi-wild gardens and naturally occurring sago stands since the mid 1980s, there is little doubt that appropriate drainage of surface water will favour sago palm growth. Controlled field drainage is also of utmost importance to facilitate plantation operations such as infrastructure development and fertilizer applications.

Peat is extremely poor in nutrient contents (Tie and Lim 1977). Although sago palm is one of the few crops that can grow on peat, its cultivation on deep peat without fertilizer application and proper water table control is disappointing. Prolonged juvenile growth and decreased starch yield (Johnson and Raymond 1956; Flach 1984; Jong 1988, 1995; Tie, et al 1987; Jong and Flach 1995; Yamaguchi et al 1997) are the common problems encountered. Apart from the depth of the peat, the degree of decomposition and compactness of the peat are other key factors affecting the growth of sago palms on deep peat.

The NTFP Sago Plantation

Cultivation of sago palms on deep peat as a non-swamp land crop

To utilize deep peat for sago palm plantation, controlled field drainage is essential. This provides a comparatively drier environment for infrastructure development and field operations. The technical difficulties of fertilizer application on constantly wet fields are also solved. Appropriate drainage also improves the peat through mineralization.

At NTFP sago plantation, an extensive canal network is constructed about a year prior to field planting. Primary canals (five meters in width and three meters in depth) are constructed at every one and two kilometres respectively in an E-W and N-S direction. A secondary canal (three meters in depth and width) is made centrally in between the E-W oriented primary canals. This divides the plantation into rectangular planting blocks of 100 hectares. A green belt of 100 meters in width in an N-S direction is conserved along the centre in between the primary canals, further dividing each planting block into about 50 hectares. Dams are built at appropriate places along the canals so that the soil water table is regulated at about 20 to 50 centimetres below the soil surface. To adjust the level of soil water table, the overflow outlet in the dam may be lowered or raised. Normally, a higher soil water table is maintained for a few months during and just after field planting of sago palm suckers.

Infrastructure development

The accommodation of staff and workers; transportation of farm inputs, workers and harvested products were planned before project implementation. A sound transportation system enables the accessibility to every part of the plantation to carry out planting, work supervision, maintenance and carriage of

farm inputs and outputs.

A combination of rail, road and canal is used at NTFP sago plantation. The canals are navigable by small boats powered by small diesel engines. Spoils from the canals are left to dry and then compacted to make roads. Within the plantation, the furthest distance to a canal/road is 250 meters. The rail is mainly used for transportation between the seaside and the plantation camps. Farm tractors, jeeps, motorcycles and boats are the main transportation vehicles used within the plantation. During the rainy season, boats are more frequently used. These canals are also used for nursery, fire control/prevention as well as for the transport of harvested sago logs in the future.

Field preparation, nursery and planting

Field works are mainly carried out by contract workers or contractors. After jungle felling, planting rows are cleared, either mechanically or manually to facilitate access in subsequent lining and planting works. The felled vegetation and rapidly establishing fern species are serving as natural soil cover.

Suckers are the planting materials used and are supplied by contractors. Upon arrival, they are graded and treated with a wide spectrum pesticide and fungicide. Nursery of suckers is carried out as quickly as possible. A raft nursery system is adopted as it gives the highest sucker survival rate (above 80%) and requires little maintenance. Besides, the sucker-laden rafts can be towed to the planting destination along the canals any time within the nursery period.

A square spacing pattern of 8 m was adopted initially but was changed to 10 meters later owing to limitation in planting material supplies. Holing and transplanting are carried out manually by contract workers. During dry season, fully opened leaflets are trimmed before the suckers are field planted. Census and replacement are scheduled at three and six months after planting with minor gap filling carried out during subsequent maintenance.

Maintenance

Agronomic practices like weeding, sucker thinning, manuring, pests and diseases controls are the routine maintenance carried out. Roads, canals, rails and buildings are also regularly maintained.

Weeding is normally carried out twice a year. A passage of two meters in width along the planting row is weeded manually by slashing or chemically by a contact herbicide. Inter-row weeding is mainly confined to the cutting down of taller vegetation and is carried out once a year. Following each weeding, sucker regulation and fertiliser applications are carried out. In sucker control, one desired sucker in each cluster is retained for perpetuation in a desired interval of 18 to 24 months. With such a sucker control programme, a mature palm cluster is expected to consist of about 6–8 palms of different growth stages, providing regular supply of palms for subsequent harvesting.

Based principally on the estimated nutrient contents of a sago palm trunk and leaf (Flach and Schuiling 1989), a preliminary fertiliser dosage has been formulated (Table 1). Dolomite is spread in a circular band whereas other fertilisers are buried in shallow pockets encircling the palm cluster. Special attention has been paid to the supply of potassium, zinc and copper as they are more likely to be in short supply in peat (Jong & Flach 1995, Nitta et al 1999).

Although serious pests and diseases have not been commonly found, inspections of pest infestation were routinely carried out. Controls and treatments were carried out as soon as they are detected.

Management

An organizational structure is formulated according to the works needed in the NTFP Plantation. Matters pertaining to personnel, payroll, purchase, accounting, inventories and public relations are shouldered by the administrative manager. The plantation operation manager is to organize the staff to execute the required operations viz., infrastructure development, land preparation, nursery, planting and maintenance.

To facilitate the execution of daily operations, the plantation is divided into phases of 1000 ha. Each phase is equipped with sufficient manpower and infrastructure to operate rather autonomously.

The operational management of a commercial sago palm plantation differs somewhat from that of other

Table 1 Preliminary fertiliser rate (grams/cluster/year) for sago palms on peat

Palm age (yr)	Dolomite	Urea	Rock phosphate	Muriate of potash	Copper sulphate	Zinc sulphate	Borate
1	300	50	50	50	50	50	20
2	500	150	50	50	50	50	20
3	2000	400	200	200	50	50	20
4	3000	600	400	400	50	50	20
5	4000	800	400	400	50	50	20
6	4500	1000	600	900	50	50	20
7	4500	1000	600	1100	50	50	20
8	5000	1100	800	1300	50	50	20
9	5000	1400	900	1800	50	50	20
10 ≦	3500	1300	1000	2100	50	50	20

established plantation crops. New encounters that are without precedence need to be resolved from time to time. Field operations need to be optimized through the understandings in sago palm agronomy, situational analyses, experiences, modifications and adaptation of available management systems.

Constraints and resolutions

Constraints were mainly encountered during the first two years. The shortage of planting material had delayed new plantings and replacement, resulting in growth unevenness in sago palms planted in 1996 to 1998. Sucker shortage coupled with planting target requirement by the licensing authority compelled NTFP to carry out direct planting in 1997. This increased the sucker mortality rate in the field to about 50%, which was further amplified by the El-Nino weather effect. The shortage of suckers have been effectively resolved through the adjustment of subsequent plant spacing from 8 meters to 10 meters square, search for new sucker supplies and the use of raft nursery to increase their survival rates.

Other obstacles encountered and overcome in the course of NTFP plantation development include (a) the lack of competent staff and workers, (b) the trial of various options in the system of field work contract, (c) encroachment by villagers, (d) the choice and modification in the methods of land preparation, nursery and planting.

Table 2 Growth data of young sago palms cultivated on deep peat

Year of sampling	Palm height (m)	Leaf production rate (no. of fronds/year)	Crown size (total no. of leaf)
1998	1.2	13.6	9.5
1999	2.6	12.2	13.0
2000	4.5	9.4	14.1
2001	7.0	9.3	14.3

Research and development

Research and development is carried out actively. The current research emphases are plant growth in relation to nutritional requirements as well as pest controls. A 50-hectare fertilizer experiment was laid down in 1998. Plant and soil analysis is studied in collaboration with a few Japanese Universities. Research and development will be continued to address the future management needs and yet unforeseen problems in the sago plantation.

Growth assessment of sago palms

Growth data are collected annually by field sampling. Table 2 shows the rough growth data of young sago palms planted in early 1997. As the rate of frond emergence and crown size change with age, it is not applicable to compare them with those reported for older palms. However, the crown size and visual appearance of these palms resemble those of similar age found in smallholder sago gardens on mineral

soils.

Discussion

At NTFP sago plantation, the incorporation of weeding, water table control, fertilizer application and sucker regulation has so far yielded satisfactory results. In the past 4 years, normal growth of the young sago palms has been observed throughout the plantation. The sago palms are responsive to added nutrients. A water table of 20–50 cm below the soil surface appeared conducive for the healthy growth of these palms. It also facilitates infrastructure development, crop maintenance and other field operations. Soil amendments through water table management and addition of appropriate nutrients appeared essential to improve the growth of the sago palms on deep peat.

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