THE SILVICULTURE OF RATTANS AN OVERVIEW WITH EMPHASIS ON EXPERIENCES FROM MALAYSIA

N. Manokaran
K. M. Wong

A brief account is given of the diversity and uses of rattans and the status of the trade. The need to conserve the diminishing resource base through cultivation is stressed.

Reference is made to early and more recent cultivation trials and to research on propagation. Factors influencing seed quantities and availability, seed storage and germination are discussed. Possible ages for transplanting seedlings are also mentioned.

The growth habits and yield, and growth rates of the commercial species are described. Factors affecting the growth of these rattans, the method of harvest and age at harvest are also touched upon.

The commercial species of rattans are discussed in terms of their silvicultural potential and sites for planting, and a call is made for the introduction of exotics to other areas in the rattan regions for plantation purposes. The problem of seeds for future plantation establishment is expected to be partly overcome by supply from existing plots. In this context, the need to establish seed orchards for this specific purpose is deemed to be urgent.

INTRODUCTION

Rattans are spiny climbing plants belonging to the Lepidocaryoid Major Group of the Palm Family (Moore 1973). In the Malay Peninsula 9 genera occur : *Calamus, Daemonorops, Korthalsia, Plectocomia, Plectocomiopsis, Myrialepis Calospatha, Ceratolobus* (Dransfield 1979a) and *Pogonotium* (Dransfield 1980a) ; aside from these, 2 other genera, viz. *Bejaudia* and *Retispatha* (Dransfield 1980b) are also found elsewhere in South-East Asia.

Away from the centre of diversity converging in the area of the Malay Peninsula (where a total of 104 species of rattans are documented), rattans are also found in the following regions : Sumatra, Java, Borneo, New Guinea, Fiji, the Philippines, Thailand and the northeastern part of the Indian Subcontinent. Elsewhere rattans are found only in West Africa. In all, the rattans of the world may possibly number about 600 species in 14 genera.

Species useful from the commercial point of view number less than perhaps one or two dozen. Of these the most important are the Manau cane of the furniture trade (*Calamus manan*), found in abundance only in the Malay Peninsula and Sumatra and rarely in Borneo (Dransfield 1977a), Rotan sega (*C. caesius*), found only in the Malay Peninsula, Sumatra, Borneo (Dransfield 1977b) and the Philippines (Dransfield 1980c), and Rotan irit (*C. trachycoleus*) found only in South Borneo (Dransfield1977b).

Rotan manau has stems reaching 8 cm in diameter without the leaf-sheath, while Rotan sega and Rotan irit have smaller stems with diameters ranging 7 to 15 mm. The most important use of rattans is in the construction of cane furniture in which rattan sticks, cane, core and split cane are used. The other main uses include basketry and mat-making, mainly involving the smaller canes. In rural areas, both large and slender rattans are used for numerous purposes such as house-building, bridges, twine for tying, ropes, fishtraps, etc.

In recent years the demand for rattans has been on the increase. However, availability of the resource will depend on the rate of conversion of forest lands for agriculture and accessibility to further forested areas. In some areas important rattan species such as *C. manan* have been reported to be increasingly scarce, so that local supplies cannot even sustain the industries of smaller scale througn periods of higher demand (Wong and Rauf 1981).

Under the circumstances efforts to cultivate rattans on a large scale cannot be viewed as merely desirable ; it is necessary if the resource base is to be conserved and has to incorporate input from research on silvicultural aspects and growth.

HISTORY OF RATTAN SILVICULTURE

Early cultivation trials with *C. caesius* and later *C. trachycoleus* were successful in Indonesia (Heyne 1950, Abidin and Djajapertjunda 1973 as reported by Menon 1980), but not so in Malaysia, Philippines, Thailand and India (Brown 1913, Badhwar *et al.* 1957, Ordinario 1973, Thatteiemromya 1950).

In East Malaysia, *C. caesius* has been planted in several acres of secondary forest on the lower Labuk River in Sabah (Meijer 1965) and is commonly cultivated by the Iban people along the Rejang River in Sarawak (Browne 1955).

Since realising the importance of conserving the rattan resource base by organised cultivation, more recent attempts at silvicultural trials and research on propagation has begun, notably in India (Forest Research Institutes at Dehra Dun and Kerala : the Forestry Department at Coorg, Karnataka), Indonesia (BIOTROP and the Forest Research Institute at Bogor), Philippines (Forest Research Institute at Los Banos), Thailand (Forest Department) and Malaysia (Forest Research Institute, Kepong ;

Sabah Forest Development Authority and a private plantation concern).

In India plantations of *C. viminalis* and *C. rotang* started in the Andamans in 1965, and by 1974, 680 ha may have been planted (Sharma 1978 as reported in Menon 1980). In Peninsular Malaysia, trial plots of *C. manan* were established in 1966–1972 at Ulu Langat (Manokaran 1977) and Sungei Buloh in Selangor, and at Kuala Lipis in Pahang. In 1975, the Forest Research Institute at Kepong initiated a project which has now seen fruition of a manual (Dransfield 1979) dealing with the taxonomy, identification and uses, as well as a silvicultural program concentrating on 3 species of economic importance, viz. *C. manan*, *C. caesius* and *C. scipionum*. The Sabah Forest Development Authority (SAFODA) and the Sabah Forest Department of East Malaysia have also established trial plots and nurseries for the cultivation of rattans, mainly *C. trachycoleus* from Kalimantan, *C. manan* from Peninsular Malaysia, and *C. caesius*. Up to 1980, SAFODA has earmarked some 4050 ha of land for rattan cultivation (Johari and Manokaran 1980).

PLANTING STOCK AND SEED STORAGE

In most cases seedlings for planting are obtained from seeds although previously wild seedlings have been collected for use in cultivation in the Philippines (Doloquin 1940). Seeds have also been reported to have been planted directly (Brown 1913).

It is worth noting that *Calamus*, the genus containing the species which are most important commercially, is dioecious, i. e. fruits and progeny are produced only by the female plants. This implies that the distribution and ratio of sexes in any locality may have at least a slight influence on the fruit production.

The number of flowering/fruiting occasions for any one rattan stem depends on its flowering habit. If, as in *Calamus*, the stem can continue growing after one flowering and does so to produce several occasions of flowering, then seed production would be more than once per stem. In contrast, where the stem apex becomes exhausted by simultaneous formation of inflorescences at the topmost nodes, as in rattans belonging to the monoecious, clustering genus, *Korthalsia*, there will be only a single occasion of flowering and fruiting per stem of each clump.

Theoretically, single-stemmed species such as *C. manan* may produce less fruits per plant compared to clustering (suckering) species with many stems per plant, as in *C. caesius*, *C. trachycoleus* and *C. scipionum*.

There may be some seasonality in seed production, as judged from the availability of seeds purchased by the F. R. I., Kepong from the aboriginal people, as well as observations on flowering in trial plots of *C. caesius* (Manokaran 1982b). Flowering of *C. caesius* and *C. scipionum* seems to begin around August, and fruits mature more than 6 months subsequently.

Manokaran (1979) has estimated, based on fruit counts from identified stems of various species, that the number of fruits produced by *C. caesius*, *C. manan* or *C. scipionum* probably runs into tens of thousands. *C. caesius* can have more than 2000 fruits maturing on a stem at any one time ; *C. manan* can likewise have 3000 to 5000 or more.

For practical purposes rattan seeds are not stored for any length of time prior to sowing. With large batches of fruits and the possibility of cleaned seeds (i. e. with the sarcotesta or outer fleshy portion removed) deteriorating and whole fruits being subject to fungal infection, the whole attempt becomes tedious.

In spite of this, laboratory investigations on *C. manan* (Mori *et al.* 1980) showed that storage of whole fresh fruits in well-ventilated conditions at 22 to 28°C could be done for up to two weeks without affecting seed viability. Seeds with the sarcotesta removed dessicated rapidly (Fig. 1) and lost viability in several days. However, naked seeds kept in closed bags at 22 to 28°C maintained a high viability (more than 50%) for about six months.

Sowing Germination and Planting : At the nursery of the F. R. I., Kepong, seeds are sown in beds where the medium consists equal amounts of forest top soil and river sand. The seeds are buried just below soil surface and the bed is covered with sawdust to aid in retaining moisture. Watering is done twice daily and the beds are sheltered by attap.

The general experience is that removal of the sarcotesta was a necessary pretreatment (Table 1) in order to shorten the germination period and obtain good levels of success ; whether the sarcotesta may be a physical obstacle to gas exchange or if it contains inhibitive factors is not clear.

Sufficient humidity may be important to seed germination. Manokaran (1978) found a great fluctuation in germination success for *C. manan* (0.2 to 83%), *C. caesius* (13 to 89%) and *C. scipionum* (31 to 66%), all performed in soil beds. Mori *et al* (1980) attributed the higher germination percentages which they obtained for *C. manan* (up to 90–100%) to the fact that a more humid regime existed in the closed, internally moistened, petri dishes used as germination chambers. Correspondingly, optimal germination rates may be encouraged by using a closed chamber containing moistened paper saw-dust or fine sand. The generally slow rate of germination in rattans (Manokaran 1978) may be due to slow development of the embryo, and not due to any inherent dormancy (Mori *et al.* 1980).

Seedlings at the 2-leaf stage are transferred to polythene bags to which fertiliser (triple superphosphate) has already been added.

The seedlings are then kept under shade as complete exposure would result in scorching of leaves and poor growth.

At the trials conducted by the F. R. I., Kepong, *C. scipionum* and *C. caesius* seedlings were planted at ages of 12–18 months and 9·5–11/8 months respectively (Manokaran 1980, Manokaran 1981a). It is possible that they might be successfully planted out at six months of age. *C. manan* seedlings may be planted at 8 to 12 months of age.

Transplanting is probably best done during the rainy season.

FACTORS AFFECTING RATTAN GROWTH AND YIELD

Growth habits and yield : Clustering species such as *C. caesius* or *C. trachycoleus* continually produce a number of stems per plant by suckering and so can provide sustained harvests. It is, therefore, unfortunate that the most valuable commercial cane, *C. manan*, is a single-stemmed species and as such has merely been a one harvest affair.

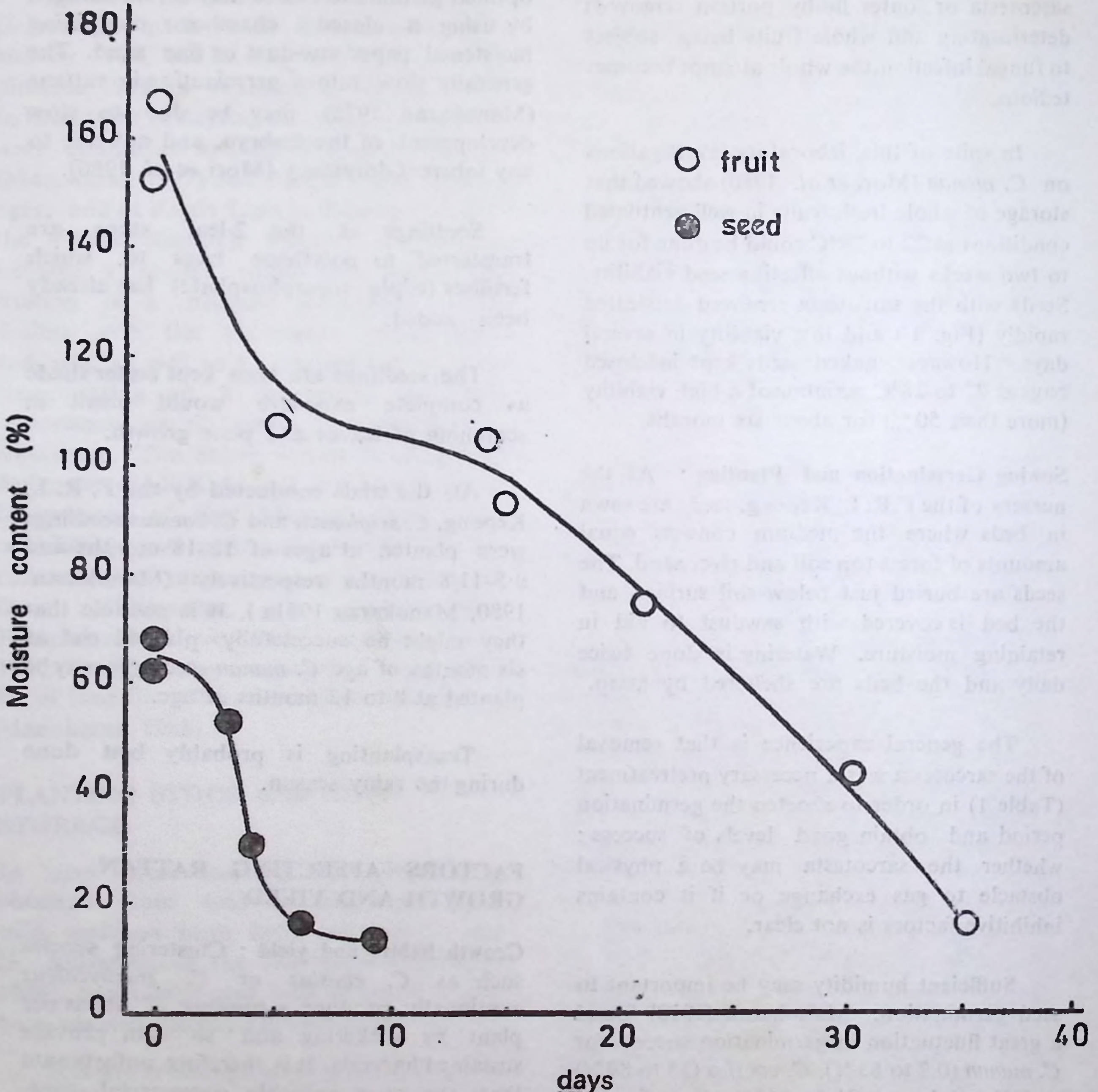

Fig. 1. Changes of moisture content of *Calamus manan* seed and fruit during air drying at room temperature

Table 1. The effect of various pretreatments on the germination of Calamus manan seeds (20 seeds per test)

Treatments		Days to first germination	Days to last germination	Percentage of germination
1. Fresh seed with sarcotesta		No germination for 3 months		
2. Fresh seed without sarcotesta	Batch I	21	37	90–100
	Batch II	26	42	70– 90
	Batch III	28	59	90–100
3. Fresh seed without sarcotesta and pore-cover	Batch I	15	30	100
4. Seed without sarcotesta (Storage of fruits for 7 to 10 days prior to seed extraction ; Batch I)				
(a) No treatment		16	30	100
(b) Chipping off a part of endosperm		17	30	95
(c) Running water for 10 days		20	33	85
(d) Prechilling at 10 to 14°C for 7 days		30	35	100
(e) Adding of KNO_3 solution (10^{-3} to 10^{-5}M) for 7 days*		13	30	100
(f) Adding of GA solution (10^{-5} to 10^{-8}M) for 4 days*		15	27	90
(g) Adding water extracts from sarcotesta during test period		15	27	100
(h) Fungicide treatment (0.1 to 1.0% Benlate)*		13	28	100
5. Seed without sarcotesta (Storage fruits in open bags at room temperature prior to seed extraction)				
(a) Storage for 2 weeks (Batch I)		21	46	90
(b) Storage for 2 weeks (Batch II)		21	71	100
(c) Storage for 4 weeks (Batch II)		20	68	60

*No difference was detected in germination between the different concentrations used

GA : Gibberellic acid

From : Mori *et al.* (1980)

In spite of this, Manokaran (1981b) has reported a total of eleven seedlings of *C. manan*, out of two batches of planted seedlings, which had suckered, each forming 1 to 9 suckers. The possibility that suckering may be induced in this normally single-stemmed rattan raises hopes of having such plants produce more than merely one crop in the future.

As pointed out by Dransfield (1977b), *C. trachycoleus* has a silvicultural advantage over *C. caesius* and this may have influenced the planting of the former on a much larger scale. This is because *C. trachycoleus* has a more open type of clumping, producing additional stems via long stolons as a result of which development of aerial stems experience little competition and can develop to full potential. In contrast. *C. caesius* has a more crowded habit due to subsequent stems emerging on rather short rhizomes, and many of the lateral shoots have an impeded development because of competition. In *C. caesius* the clumps would require clearance of debris to encourage development of new shoots. Johari and Che Aziz (1981) assessed 81 % clump formation among a number of *C. trachycoleus* seedlings at just 12 months after planting in the grounds of the F.R.I., Kepong.

Growth rates : Growth data for rattans are scanty. Manokaran (1982b) recorded for Bukit Cheraka, Selangor, that *C. caesius* seedlings at near-optimum conditions (canopy thinned, poorly drained substrate) can grow as much as 5 to 6 m per year during the first 5 years from planting. However, at 5.1/3 years after planting, harvesting on aneconomic scale was not yet feasible since only one stem had reached the stage of maturity where a 6.1 m length is obtainable.

Light : *C. manan* required adequate light for optimal growth.

In an assessment at Ulu Langat, Selangor, Manokaran (1977) noted that faster growing individuals were found in positions where the canopy was relatively open. Mori (1980) found that one-year old *C. manan* seedlings in Kepong, Selangor showed maximum growth at about 50 % shade condition, above and below which growth was inhibited. It was recommended that, in order to promote growth of seedlings planted in the forest, the light regime should be maintained at 10 to 50 % relative light intensity.

Growth of *C. scipionum* under two different canopy conditions (intact as opposed to manipulated to admit more light to the seedlings) has been evaluated at 2 years (Manokaran 1980) and 7 years (Manokaran, in press) from planting. Again, a relatively more open canopy in the treated plot induced greater stem growth.

Substrate and Spacing : In the case of *C. caesius*, growth at two different habitats (poorly- or well-drained) and under two different planting designs (line-or group-planted), as well as canopy conditions (intact canopy or thinned canopy) was evaluated at 2 years (Manokaran 1981a, Manokaran 1981c Manokaran 1982a) and at 5.1/3 years (Manokaran 1982b) from planting.

Results showed that growth was superior at the treated, line- and group-planted plots at the poorly-drained habitat in terms of clump formation, stem production and stem growth. Survival was still high in 4 out of 6 plots at 5.1/3 years.

Survival : Mortality of *C. manan* and *C. caesius* in the cultivation trials was not related to attacks by pests as it was to suboptimal growth conditions.

In the case of *C. scipionum,* rats and squirrels caused heavy mortality to the planted seedlings (Manokaran 1980).

HARVESTING

Method of harvesting : Harvesting consists essentially of cutting the mature stem, one where leaf sheaths have fallen away, and pulling it out of the canopy.

The immature uppermost part of the stem, usually 2–3 m long, is discarded. As the stem is being pulled down, it is usually twisted around a tree trunk to get rid of the spiny leaf sheaths that adhere to the younger parts. The stems are cut to requisite lengths and bundled for commercial handling.

Harvesting age : Dransfield (1977b) notes that in South Borneo, *C. caesius* is harvested twice, an initial one after 7—10 years followed by a second after a further 4 years. After the second harvest the clumps are supposedly exhausted. He also states that in the case of *C. trachycoleus*, harvests can be made at 2-year intervals after an initial 7–10 year period.

There is no published information as to when the solitary *C. manan* and *C. scipionum* can be harvested after planting. It is estimated, however, that the first and only harvest is possible in 12 to 15 years after planting, provided optimal conditions for growth have been present.

CONCLUSIONS AND RECOMMENDATIONS

The Resource base : In view that supplies from the wild are diminishing due to over-exploitation and conversion of natural forest to agriculture, the resource base of the rattan industry can be conserved only by establishing plantations on a large scale.

One of the problems to be faced in large-scale plantings in the future will be the procurement of sufficient seeds. While existing silvicultural trials would help to an extent as a source of seeds, seed orchards of the commercially important rattan species sould be established quickly in accessible and relatively safe areas.

Potential cane species : Based on results available so far, cultivation trials of *C. trachycoleus* and *C. caesius* show great potential. These species have been successfully cultivated for over 100 years in Kalimantan.

C. manan by virtue of its solitary nature and rather exacting growth requirements, is a difficult silvicultural species, but must be propagated and cultivated sufficiently, since it is the most valuable commercial cane. Trials to investigate the effect of fertilizer application on growth rates and proper management to enhance survival, would be necessary.

Because of poor survival, growth rate and lower market demand, *C. scipionum* should be a cultivation species of lower priority (Manokaran 1980).

Attempts should be, and are being, made to establish large-scale plantations of important rattans in areas other than where they are naturally found. For example, *C. trachycoleus* has been introduced into Sabah and Peninsular Malaysia, and should have great potential for Sarawak as well. Likewise, *C. manan,* which has been introduced from Peninsular Malaysia into Sabah, should also be brought into Sarawak.

Other good-quality cane species which might be introduced into cultivation include *C. tumidus* (Dransfield 1981).

The most likely sites for planting *C. trachycoleus* and *C. caesius* would be on alluvial flats beside rivers or at margins of swamp forests. *C. manan* should preferably be cultivated under sufficient light condition, such as in logged over hilly dipterocarp forest areas. In the meantime, more trials on growth requirements should be performed and existing ones monitored.

While appreciating that the manufacturing phase of the industry is the largest foreign exchange earner and ought to be developed in the producer countries (Manokaran 1976), a shift in emphasis toward export of finished rattan products would increase employment opportunities (Johari and Manokaran 1980).

REFERENCES

Badhwar, R. L., A. C. Dey and Ramaswami 1957. Canes (Rattans) : Their occurrence, cultivation and exploitation in India. Indian Forester 83 (2) : 216–223

Brown, L. C. 1913. Rotan sega. Agricultural Bulletin of the Federated Malay States 2(5) : 127–128

Browne, F. G. 1955. Forest trees of Sarawak and Brunei and their products. Govt. Printers, Kuching, Sarawak

Doloquin, F. O. 1940. Bare-root transplanting of wild rattan seedlings. The Philip. J. of Forestry 3 (3) : 279–282

Dransfield, J. 1977a. The identity of "Rotan manau" in the Malay Peninsula. Malay. Forester 40 : 197–199

———1977b. *Calamus caesius* and *Calamus trachycoleus* compared. Gardens' Bulletin, Singapore : 30 : 75–78

———1979. A manual of the rattans of the Malay Peninsula. Malaysian Forest Records, No. 29, 270 pp

———1980a. *Pogonotium* (Palmae : Lepidocaryoideae), a new genus related to *Daemonorops*. Kew Bull. 34 (4) : 761–768

———1980b. *Retispatha*, a new Bornean rattan genus (Palmae : Lepidocaryoideae). Kew Bull. 34 (3) : 529–536

———1980c. On the identity of sika in Palawan, Philippines. Kalikasan 9(1) : 43–48

———1981. The biology of Asiatic rattans in relation to the rattan trade and conservation. In : H. Synge, ed., The Biological Aspects of Rare Plant Conservation, Wiley & Sons. 179–186

Heyne, K. 1950. De nuttige planten van Indonesia, 3rd ed. Reprint. Uitgeverijw van Hoeve S-Gravengage/Bandung

Johari bin Baharudin and Che Aziz bin Ali, 1981. The growth of one year old *Calamus trachycoleus* at the Forest Research Institute, Kepong. Malay. Forester 44 : 23–27

Johari bin Baharudin and N. Manokaran. 1980. The rattan industry in Peninsular Malaysia : its present status, resource base and future. Paper presented at the International Seminar on Investment Opportunities in the Timber-based Industries in Malaysia, 23rd & 24th October 1980, Kuala Lumpur

Manokaran, N. 1976. Rattans : A potential contribution to increased forest productivity. Paper presented at the 6th Malaysian Forestry Conference, Oct. 1976, Kuching, Sarawak

———1977. Survival and growth of the economically important rattan, *Calamus manan*, in Ulu Langat. Malay. Forester 40 : 192–196

——1978. Germination of fresh seeds of Malaysian rattans. Malay. Forester 41 : 319–324

——1979. A note on the number of fruits produced by four species of rattans. Malay. Forester 42 : 46–49

——1980. Survival and growth of Rotan semambu (*Calamus scipionum*) seedlings at 2 years after planting. Malay. Forester 43 : 481–492

——1981a. Survival and growth of Rotan sega (*Calamus caesius*) seedlings at 2 years after planting. I. Line-planted in poorly-drained soil. Malay. Forester 44 : 12–22

——1981b. Clustering in Rotan manau (*Calamus manan*). Malay. Forester 44 : 557–560

——1981c. Survival and growth of Rotan sega (*Calamus caesius*) seedlings at 2 years after planting. II. Line-planted in well-drained soil. Malay. Forester 44 : 464–472

——1982a. Survival and growth of Rotan sega (*Calamus caesius*) seedlings at 2 years after planting. III. Group-planted in poorly-drained soil. Malay. Forester 45 : 36–48

——1982b. Survival and growth of Rotan sega (*Calamus caesius*) seedlings at 5.1/3 year after planting. Malay. Forester 45 : 193–202

——(in press). Survival and growth of Rotan semambu (*Calamus scipionum*) seedlings at 7 years after planting. Malay. Forester 46

Meijer, W. 1965. Letter to the Editor : Rotan sega in Sabah. Malay. Forester 28 (3) : 255

Menon, K. D. 1980. Rattan : A State-of-the-Art Review. In : Rattan : a report of a workshop held in Singapore, 4–6 June 1979 ; IDRC, Ottawa

Moore, H. E., Jr. 1973. The major groups of palms and their distribution. Gentes Herb. 11 (2) : 27–141

Mori, T. 1980. Growth of Rotan manau (*Calamus manan*) seedlings under various light conditions. Malay. Forester 43 : 187–192

——Zollfatah bin Haji Abd. Rahman and C. H. Tan. 1980. Germination and storage of Rotan manau (*Calamus manan*) seeds. Malay. Forester 43 : 44–55

Ordinario, F. F. 1973. Philippine rattans. FORPRIDECOM Technical Note No. 125. Forest Products Research and Industries Development Commission, National Science Development Board, College Laguna, Philippines.

Thathiemromya, P. 1950. *Calamus caesius* Bl. Vansan Journal, October, Royal Forest Department, Thailand. (In Thai, with English summary)

Wong, K. M. and Abdul Rauf bin Salim. 1981. A preliminary assessment of the potential of Rattan and Bamboo Industry in Kuala Nerang and Baling areas, Kedah. Unpublished report, Forest Research Institute, Kepong, Malaysia

N. Manokaran, Forest Ecologist and K. M. Wong, Forest Botanist, Forest Research Institute Kepong, Selangor, Malaysia