KFRI Research Report No. 245 ISSN 0970-8103

UNDERPLANTING RATTAN IN RUBBER PLANTTIONS

R.C. Pandalai

Kerala Forest Research Institute
Peechi - 680 653, Kerala, India

October 2002

KFRI Research Report No.245

UNDERPLANTING RATTAN IN RUBBER PLANTATIONS

[Final Report of The Research Project KFRI 194/93]

R.C. Pandalai
Division of Silviculture

Kerala Forest Research Institute
Peechi - 680 653, Kerala, India

October 2002

ABSTRACT OF THE PROJECT PROPOSAL

1.	Project No.	:	KFRI 194/93
2.	Title of the project	:	Underplanting rattans in rubber plantations
3.	Objectives	:	1. To standardize the planting techniques of rattan in rubber plantations 2. To standardize the age of rattan seedlings for underplanting in rubber plantations 3. To compare the performance of different rattan species under rubber
4.	Date of commencement	:	July 1992
5.	Scheduled date of completion	:	June 1995
6.	Funding Agency		Plantation Corporation of Kerala Limited, Kottayam
7.	Project Team Principal Investigator	:	R.C. Pandalai
8.	Study Area	:	Athirappally, Vazhachal Forest Division
9.	Duration of study	:	Three years

CONTENTS

Abstract i

1. Introduction 1
2. Materials and Methods 3
3. Results and Discussion 6
4. Conclusions 15
5. Research Results of Practical Utility 16
6. Acknowledgements 17
7. References 18

ABSTRACT

A field experiment on the feasibility of introducing different rattan species as an undercrop in rubber plantations was carried out at Athirappally Estate (10° 17' North latitude and 76° 27' East latitude) Kalady Plantation of Vazhachal Division belonging to the Plantation Coporation of Kerala Limited. The initial establishment rate of rattan seedlings in rubber plantation was promising with *Calamus hookerianus* Becc. and *Calamus thwaitesii* Becc. and Hook. f showing above 90 per cent survival towards the end of 24 months. Seedlings of these species also attained maximum height during this period. However, lack of protection, especially from grazing animals, brought down the survival percentage of the seedlings. Of the different species tried, *Calamus hookerianus* and *C. thwaitesii* were the promising ones that could recoup even after physical injury from grazing. Production of the climbing organ in rattan - the flagellum, started from the third year of underplanting. Management of this thorny whip like organ that can interfere with tapping activity in rubber plantation is a very important silvicultural aspect that has to be studied in detail before attempting large scale underplanting of rattan in rubber plantations.

1. INTRODUCTION

Kerala is one of the largest rubber (*Hevea brasiliensis* H.B.K. Muell.Arg.) growing states of India. As per scientific planting schedules, rubber growers are advised to plant rubber along the contours especially while planting in slopes and undulating terrains. Hence, in rubber plantations it is not always feasible to follow a systematic spacing regime between rubber plants or rows. However, there are also plantations with regular spacing in plains, available in the State. In either case it is a fact that considerable amount of area is left vacant in rubber plantations, which can be made use of for underplanting species like rattan to provide a supplementary income for rubber farmers through greater utilization of their land resource.

Rattans are fast depleting from the tropical forests on account of lack of proper management practices and illegal cutting. Mohamad and Noor (1986) opined that planting rattans under rubber plantations could help restock the species that are being depleted in their natural environment. The present project is an attempt to study the feasibility of introducing rattan in rubber plantation as an undercrop.

There are inherent problems involved in introducing rattan in rubber plantations. Rattan being a clump-forming, climbing palm, with enormous thorns all over the plant body, unless planted properly and carefully may cause injury to the rubber tappers who work during the early hours of the day in low light. Rattan such as *Calamus hookerianus* and *C. thwaitesii* produces massive clinging stems that may break the branches or even the whole trees to which they climb during their growth. Moreover during harvesting rattan culms are cut at the base and are separated from the mother clump by pulling them down. Hence, the strength of the rubber tree to withstand these impacts has to be a prime consideration to be thought of before introducing rattan in rubber plantations.

The distribution of single stemmed rattan like C. *dransfieldii* Renuka and *C. vattayila* Renuka is restricted and these are not easily available in the forests of southern India. Therefore, it was not possible to get the seeds of these species and raise seedlings for underplanting.

According to Mohamad and Noor (1986), growing rattan under rubber is an economically viable proposition and more than 650 ha area of rubber plantations has already been underplanted with rattans by various agencies in Malaysia. They further pointed out that even if rattan was introduced in rubber

plantations, it did not have any adverse effect on the latex production. At the same time there would be increase in productivity of rattan. The versatility of rattan is that it can be grown easily in a variety of ecological conditions. Lakshmana (1993) points out that the attractive returns from rattan, apart from improving the ecology of the area by enhanced production of biomass are the other advantage of introducing rattan in rubber plantations. He cites the examples of other countries where experiments on growing rattan in both abandoned rubber plantations and in areas of shifting cultivation were being undertaken, for consideration.

The present project was an attempt to underplant some of the common and most useful species of Rattan getting depleted in the forests of Kerala. The specific objectives of the project were as under:

1. To standardize the planting techniques of rattan in rubber plantations.

2. To standardize the age of rattan seedlings for underplanting in rubber Plantations.

3. To compare the performance of different rattan species in rubber plantation.

2. MATERIALS AND METHODS

2.1. Study site

The field experimentation of underplanting rattan was conducted in a 1975 rubber plantation at Athirapally Estate, belonging to Plantation Corporation of Kerala Limited, Kottayam (PCK). The rubber plantation was raised by PCK using the RRIM 600, budded propagules, adopting contour planting in an area having undulating terrain. Plant to plant distance was 5.6 m and row-to-row distance was approximately 6.6 m. This difference was due to the fact that row-to-row distance varied in rubber plantations depending on the contour and correspondingly the distribution of rubber trees also varied. Tapping of trees for latex commenced during 1983 and rattan was underplanted in June 1993.

2.2. Rattan nursery

Rattans selected for the present study were *C. hookerianus* Becc., *C. karnatakensis* Renuka & Lakshmana, *C. pseudorivalis* Becc. *C. pseudotenuis* Becc. ex. Becc. and Hook f., *C. rotang* Linn. and *C. thwaitesii* Becc. and Hook f. Of these, *C. karnatakensis* Renuka & Lakshmana, is usually seen in southern districts of Karnataka and *C. pseudorivalis* Becc. in the Andaman and Nicobar Islands.

Except for *C. pseudorivalis*, for which wildlings were obtained from the Andaman and Nicobar Islands, fruits of all the five species were collected from the forest areas of Kerala and Karnataka (Table 1).

Table 1. Areas of seed collection of different rattan species for raising seedlings

Sl. No.	Species selected	Area of seed collection	Month and year
1.	*Calamus hookerianus*	Nelliyampathi (Kerala)	April, 1992
2.	*Calamus karnatakensis*	Agumbe (Karnataka)	April, 1992
3.	*Calamus pseudorivalis**	Andaman and Nicobar Islands	March, 1992
4.	*Calamus pseudotenuis*	Peerumedu (Kerala)	March, 1992
5.	*Calamus rotang*	Harippad (Kerala)	May, 1992
6.	*Calamus thwaitesii*	Nelliyampathi (Kerala)	April, 1992

* wildlings

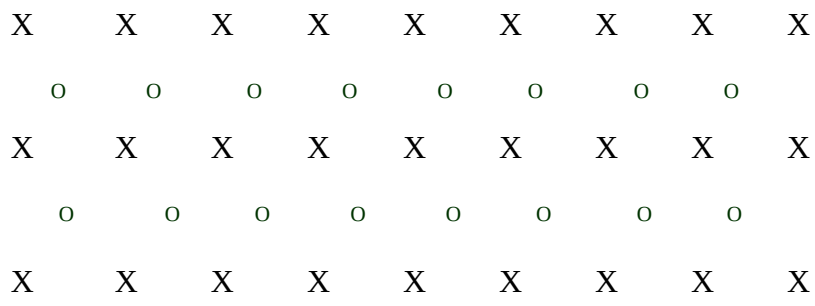
The fruits were soaked in water for about 48 hours and then de-pulped. The seeds were cleaned through repeated washings with water. (Pandalai, 1995). Seeds were then sown on a fine layer of sawdust in a raised nursery bed. Seeds germinated in about 30 to 90 days depending on the species. The seedlings were pricked out into polybags of 20 cm x 28 cm size filled with a potting medium containing three parts sieved and cleaned forest soil, two parts sand and one part dried and powdered farmyard manure.

Wildlings of *C. pseudorivalis* were collected by gently pulling them out from the forest floor after profusely irrigating the area. The wildlings were packed in moist sawdust and placed in moist gunny bags. These were then transported to the mainland and potted in polybags (20 cm x 28 cm) filled with the potting mixture already mentioned. The wildlings were maintained in the nursery at the Field Research Centre of KFRI at Veluppadam.

2.3. Field planting of rattan seedlings

Twelve to 15-month-old rattan seedlings of the six species (Table 1) were underplanted in a 18-year old rubber plantation where regular tapping was being practised.

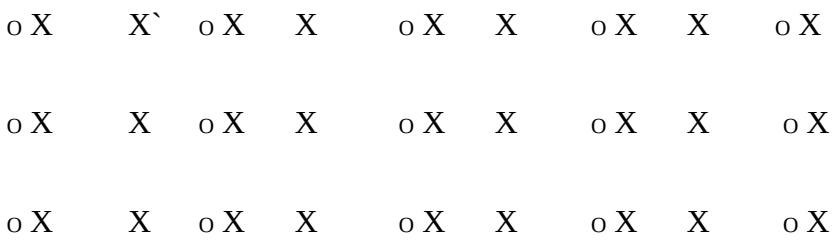
Two patterns of planting methods were studied - quincuncial and alternate row planting. In the first case, while aligning the plots, stakes were fixed in such a way that one stake occupied the central position in a group of four rubber trees—following the quincuncial pattern of planting (Fig. 1). The space between the stakes was, however, maintained at a minimum of 6 m.



X-Rubber; O- Rattan

Fig. 1. Diagrammatic sketch showing quincuncial planting of rattan in rubber plantation

In the second method of planting, the stakes were positioned at about one and a half meter away from a rubber tree on the same side (Fig. 2). Since harvesting of mature rattan is cumbersome and needs lot of space, only alternate rows were planted with rattan. In this type of planting also a minimum of 6 m space was left between two rattan seedlings.



X-Rubber; O- Rattan

Fig. 2. Diagrammatic chart showing the alternate row planting of rattan in rubber plantations

As the rubber plantation where the present study was conducted was well maintained and regularly tapped, weed growth was minimal. However, a spot weeding was carried out for the ease of planting work. Pits of size 45 cm x 45 cm x 45 cm were taken in May, along with the pre-monsoon showers, and planting was carried out immediately.

Periodic growth monitoring was carried out and observations on survival, production of leaves, flagellum, and height of rattan were made and data gathered from all the species planted. Comparison of the growth and field performance of different rattan species was also made.

3. RESULTS AND DISCUSSION

3.1. Raising of seedlings in nursery

It was observed that flowering and fruiting was a regular phenomenon in rattan and every year a mature female rattan plant produced enormous quantity of fruits (Fig. 3). In species like *C. hookerianus* flowering and fruiting occurred even twice a year; during April - May and September - November. Maturity of the fruits could be ensured by the golden yellow colour attained while still remaining attached to the mother plant. As in the case of any other forest trees, seeds should be collected from mature rattan plants. Usually the fruiting branch is cut and the fruits are separated out. The fruit/seed characteristic features like fruit weight/seed weight etc has been given in Table 2.

Fig. 3. Fruits of rattan

Table 2. The fruit/seed characteristics of different rattan species used in nursery

Sl. No.	Species selected	Number of fruit/kg	Number of seeds/kg	Number of Seed required for $1m^2$	Seeds required (in Kg) for sowing in $15m^2$ (standard nursery bed)	Fruits to be collected (in Kg) for getting sufficient seeds for sowing in 15 m^2 (standard nursery bed)
1.	*Calamus hookerianus*	1600	4980	115	1725	5.400
2.	*Calamus karnatakensis*	1590	4818	119	1785	5.430
3.	*Calamus pseudorivalis*	Wildlings from the Andaman and Nicobar Islands				
4.	*Calamus pseudotenuis*	1557	4714	122	1830	5.550
5.	*Calamus rotang*	1850	4002	144	2160	4.665
6.	*Calamus thwaitesii*	271	852	676	10140	31.875

Fresh seeds (Fig. 4) always gave high germination percentage to the tune of 90-98. The rattan seedlings thus obtained were strong and healthy, without any pest or disease problems/ infestations. The seedlings were plantable when they attained 20 to 25 cm height in about 12 to 15 months. However in a similar study with single stemmed rattan (*Calamus mannan* Miq.*)* planted in a 13-year-old rubber plantation, Mohamed and Noor (1986) successfully used 10-month-old seedlings for under planting. One-year-old seedlings of six rattan species showed high survival percentage when outplanted in a moist deciduous patch of forest in Kerala (Pandalai, 1995).

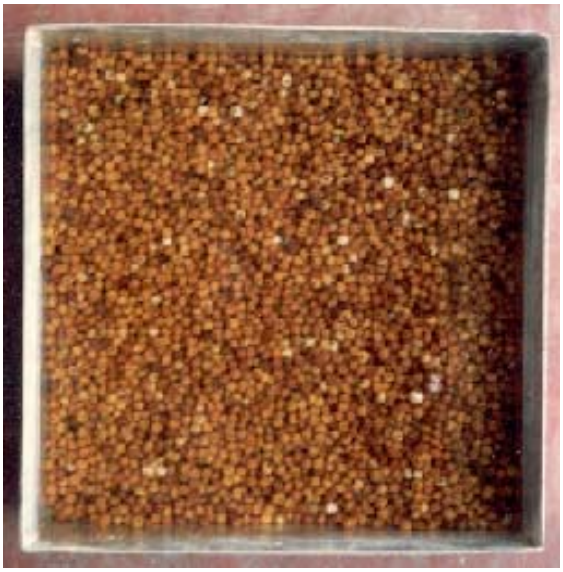


Fig. 4. The cleaned seeds of *C. hookerianus* ready for sowing

3.2. Growth of seedlings in the nursery

In general, in nursery the initial growth and development of rattan seedlings, of all the selected species used to be very slow. During the initial developmental stage, the seedlings were irrigated and provided with partial shade (Fig. 5). Seedlings of *C. hookerianus* and *C. thwaitesii* recorded maximum height growth of 20 cm and 19.8 cm respectively and production and development of leaves were also faster in these species during the nursery stages (Table 3). This was followed by *C. rotang* and *C. karnatakensis*. However, height growth and development of leaves in *C. pseudotenuis* and *C. pseudorivalis* were comparatively slower than the other species used in the trial (Table 3).

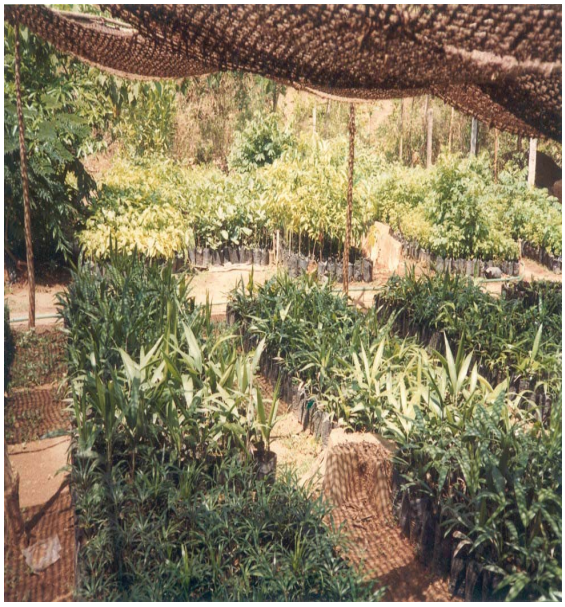


Fig. 5. Rattan seedlings under shade in the nursery

Table 3. Growth of the seedlings of different rattan species in nursery

Selected species	Height and number of leaves observed in seedlings at different stages							
	6 months		9 months		12 months		15 months	
	Height (cm)	Number of leaves	Height (cm)	Number of leaves	Height (cm)	Number of leaves	Height (cm)	Number of leaves
Calamus hookerianus	7.8	8	8.9	10	14.1	12	20.0	11
C. karnatakensis	6.5	6	8.0	8	10.2	10	14.4	8
C. pseudorivalis	5.2	4	5.8	6	6.8	6	9.2	8
C. pseudotenuis	5.7	6	6.9	6	8.8	8	11.7	8
C. rotang	6.8	8	8.1	8	11.8	10	16.0	10
C. thwaitesii	7.2	8	9.8	8	13.0	10	19.8	12

All the species except *C. pseudorivalis* attained plantable size within a period of 12 to 15 months of growth in the nursery (Fig. 6). The wildlings collected from the forest areas of the Andaman and Nicobar Islands, however, registered poor growth even when they were grown along with other species, under similar conditions in the nursery.

Fig. 6. Plantable seedlings (12-15 month old) of different rattan species

Seedlings of 12 to 15 months were found to be the best for field planting as they attained about twelve to twenty cm height by this period. Six-month-old seedlings were too small for outplanting and even if outplanted were prone to be smothered by weeds as the rattan seedlings fail to keep pace with the profuse and fast growth of weeds.

3.2. Growth of seedlings in rubber plantation

3.3.1. Survival

Both quincuncial and alternate row planting had no effect on the growth and development of rattan seedlings in rubber plantations. Seedlings of all the six rattan species underplanted in the 18-year-old rubber plantation showed maximum survival rate after six months of outplanting (Figs. 7 and 8). Decreasing trend in survival rate was first noted in *C. pseudorivalis* from the sixth month of field planting (Fig. 7); the survival rate of *C. karnatakensis* and *C. psedotenuis* also diminished over time. *C. rotang,* being a species that prefers marshy conditions, performed well in low lying areas of the rubber plantation. *C. hookerianus* and *C. thwaitesii* were the two species that grew very well under rubber and were very much successful in both the planting methods (Figs. 9 and 10). Both the species showed tremendous recouping capacity also even after getting damaged by grazing cattle.

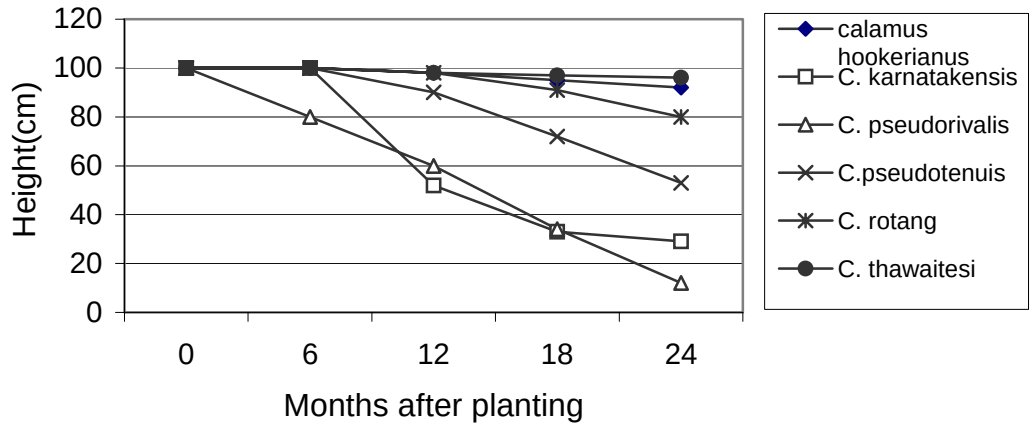


Fig. 7. Survival percentage of six species of rattan up to 24 months after planting in rubber plantation (quincuncial pattern)

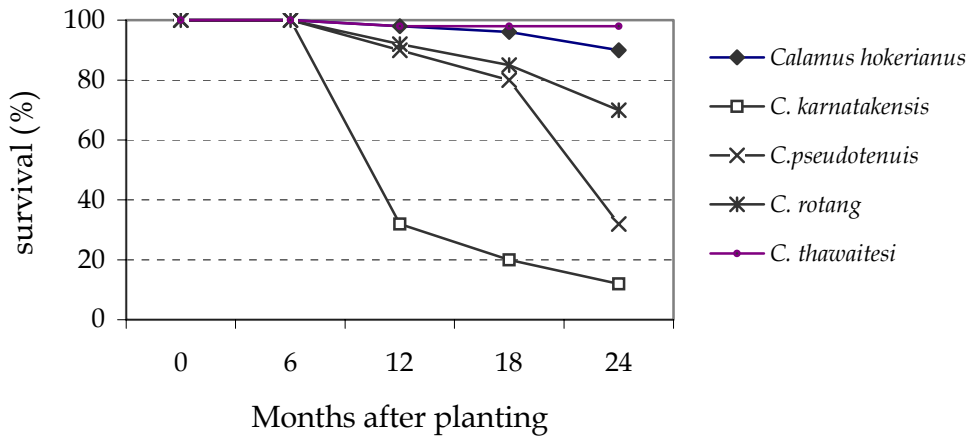


Fig. 8. Survival percentage of five species of rattan up to 24 months after planting in rubber plantation (alternate now planting)

Fig. 9. A well established seedling of *C.thwaitesii* (quincuncial pattern of planting)

Fig. 10. A well established seedling of *C. hookerianus* (alternate row planting pattern)

3.3.2. Height growth of seedlings in rubber plantation

Rattan, in general, exhibited very slow height growth during the initial stages of establishment. However, once established, the growth rate increased and by the third year of planting even the climbing organ, flagellum, developed in seedlings of *C. hookerianus* and *C. thwaitesii* underplanted in rubber plantation.

In the present study as in the case of survival, rate of height growth of seedlings also showed declining trend over time. *C. hookerianus* and *C. thwaitesii* recorded maximum height growth (Fig. 11 and 12) and the pattern of height growth was also very much uniform in both the species. The other species, *C. karnatakensis, C. pseudorivalis, C. pseudotenuis* and *C. rotang* exhibited lesser height growth. This tendency of putting on poorer height growth was indicative of the fact that the seedlings of these four rattan species were liable to be grazed and trampled by cattle. These seedlings also showed very poor vigour to recoup after the physical injury from cattle grazing and trampling. However, seedlings of *C. hookerianus* and *C. thwaitesii* showed excellent capacity to recoup from damage.

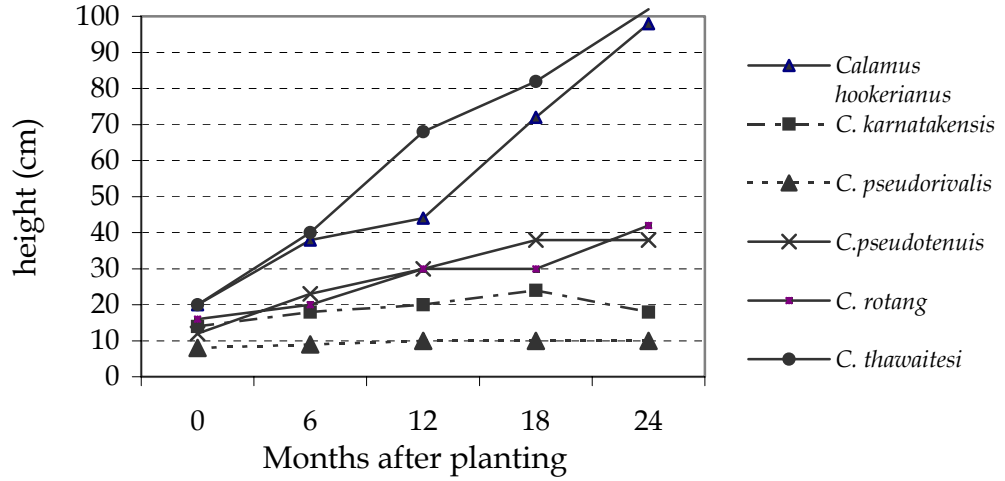


Fig. 11. Height of six rattan seedlings up to 24 months after planting in rubber plantation (quincuncial pattern)

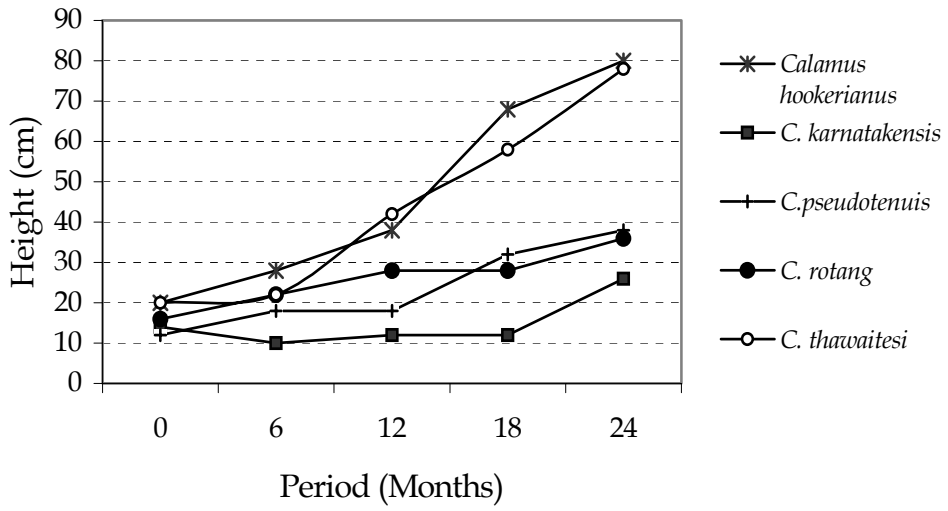


Fig. 12. Height of five-rattan seedling up to 24 months after planting in rubber plantation (alternate row planting pattern)

In a similar study, Mohamad and Noor (1986) observed better growth rate of rottan manau (*C. mannan*) seedlings when underplanted in a rubber plantation in peninsular Malaysia. They suggested that the enhanced growth of rattan was probably due to the added advantage of fertilization in rubber plantations. They further pointed out that growing rattan under rubber helped only in increasing the income of rubber growers through making optimum use of the other wise wasted land area in their plantations.

3.3.3 Leaf development of seedlings in rubber plantation

Development and opening of leaves from the leaf sheath is recognized as an important growth activity exhibited by monocots. In rattan the production and opening up of leaves was slower in the initial stages, however soon after the field establishment of the plant, the process of leaf development was rapid. In species like *C. hookerianus* and *C. thwaitesii* the process was so quick that the flagellum also started growing from the leaf axis within a span of 22 months of planting. In the present study only *C. pseudorivalis* was slow in leaf development compared to the other species. (Figs. 13 and 14). In *C. karnatakensis* also leaf production was comparatively slower during the initial stages of establishment but gradually picked up towards the later stages (Figs. 13 and 14).

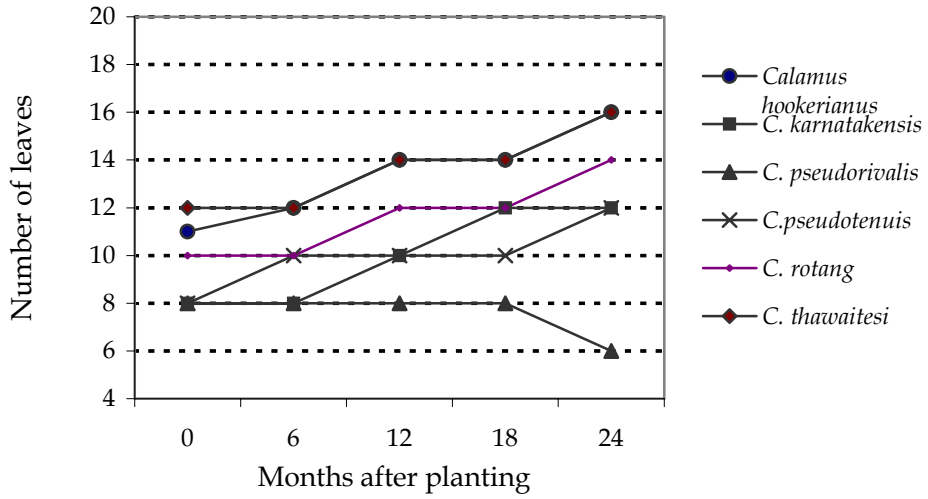


Fig. 13. Production of leaves (number of leaves of six rattan species up to 24 months after planting in rubber plantation (quincuncial pattern)

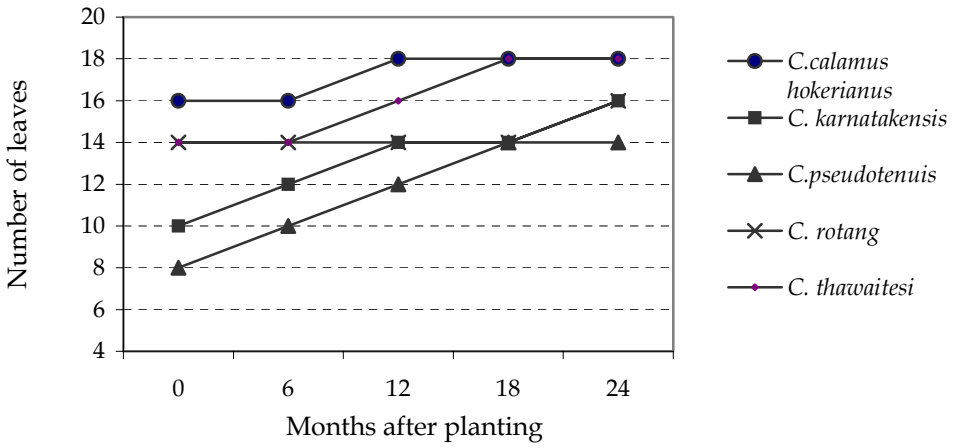


Fig. 14. Production of leaves (number of leaves of five rattan species up to 24 months after planting in rubber plantations (alternate row planting pattern)

3.3.4. Development of flagellum

The development of flagellum was observed in both *C. hookerianus* and *C. thwaitesii* during the field establishment and growth. Rudimentary buds of the flagellum were observed, at the top of the sheath, obliquely opposite to the petiole in both the species by February-April of 1995 - after 22 months of growth and field establishment. During the pre-monsoon showers of May-June the flagellum developed further and started growing outwards. Silvicultural management of these climbing organs was very much essential especially as the tapping of rubber trees took place in the early hours of the day when the light is very low under the canopy. Unmanaged flagella could cause physical injury to the tappers.

Managing the flagellum of rattan growing in alternate rows of rubber trees was easier when compared to those growing in the quincuncial design (central position of the four rubber trees). This was an added advantage of this type of planting design especially when rattans were introduced as an undercrop in rubber plantations. Noor and Mohamad (1986) experimented with a series of planting designs and have also recognized alternate row planting as a method suitable for easier management. Mild pruning of the flagellum at the base, training/directing the flagellum to points farther away from the basal tapping portions of the rubber trees are some of the silvicultural techniques that have to be experimented in order to overcome the inconvenience to tappers.

4. CONCLUSIONS

1. Rattan can be successfully introduced as an undercrop in rubber plantations.

2. *Calamus hookerianus* and *C. thwaitesii* are suitable rattan species for underplanting. These can not only withstand the physical injury of cattle grazing and trampling but can also recoup after the injury especially when underplanted in unprotected rubber plantation.

3. Out of the two planting methods tried, alternate row planting has the advantage of better and easier management (ease in pruning/training the thorny flagella, etc) Otherwise there is no difference in growth of rattan planted in quinqucial or alternate row planting.

4. Silvicultural techniques for managing rattan in rubber plantations are to be studied in detail before introducing the species.

5. RESEARCH RESULTS OF PRACTICAL UTILITY

Rattan can be successfully introduced in rubber plantations preferably after 15 years of planting rubber so as to make maximum use of the otherwise wasted inter space. *Calamus hookerianus* and *C. thwaitesii* are the two promising species that can be introduced in rubber plantations. The alternate row planting method is preferable for better management. Silvicultural techniques for managing the flagellum are to be studied in detail before attempting large-scale underplanting of rattan in rubber plantations.

6. ACKNOWLEDGEMENTS

I am extremely thankful to the Plantation Corporation of Kerala, Kottayam for the financial assistance provided for the project work. I am indebted to Dr. K.S.S. Nair former Director and Dr. J.K. Sharma, Director KFRI for their keen interest and constant encouragement. Thanks are also due to Dr. R. Gnanaharan, Research Co-ordinator, and Mr. K.C. Chacko, Division of Silviculture, Dr. C. Renuka, Division of Botany, Dr. C. Mohanan, Division of Pathology, for the useful suggestions and editorial scrutiny of the report.

The constant encouragement and valuable suggestions of Mr. K.C. Chacko, Silviculturist-in-Charge, Dr. K.V. Bhat, Scientist, Division of Wood Science, Dr. E.M. Muralidharan, Division of Genetics and Dr. T. Surendran, Division of Plant Physiology are gratefully acknowledged.

I am extremely thankful to Mr. V. Asokan for the excellent DTP work for the final draft. I also thank full to Mr. T.A. Devassy, R. Santhoshkumar, Project Fellows, Mr. P.J. Joseph, Technical Assistant, and Ms. S. Ajitha, Word Processing Assistant and for various helps rendered.

The field staff of Plantation Corporation of Kerala, Athirapilly Estate were extremely helpful in laying out the experimental plots, planting and maintenance work I extend my sincere gratitude to them.

7. REFERENCES

Lakshmana, A.C. (1993). Rattans of South India. Evergreen Publishers, Bangalore, India 180 pp.

Mohamad, A.B. and Mohamad Noor, N.S.B. (1986). Intercropping of Rattan Manan (*Calamus mannan*), with rubber (*Hevea brasiliensis*). Pertanika 9:161-165.

Mohamad, B., Mohamad. Noor, N.S. and Ibrahim, A.G. (1990). Rattan growing under rubber in peninsular Malaysia-status, problems and prospects. Conference for Forestry and Forest Products. October 3-4, 1990. Kuala Lumpur. 10 p

Mohamad. Noor N.S.B. and Mohamad, A.B. (1986). Rattan as a supplementary crop in rubber plantations. Rubber Growers Conference. Oct. 20-23, 1986, Ipoh Parak.15 p.

Pandalai, R.C. (1995). Rattan Silviculture. Final Technical Report, Rattan (India Phase II), Kerala Forest Research Institute, Peechi, India. 10 pp.