

CINNAMON FOR INTERCROPPING UNDER RUBBER

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INTRODUCTION

The space provided in a five hundred trees/ha plant density is considered adequate to serve the needs of the mature rubber tree. It is also considered as the plant density that gives the optimum latex yield/ha. However, the whole of this space is not utilized by rubber trees until they reach maturity and its use for growing intercrops is a popular practice to increase land productivity. During the immature phase when the rubber trees are small competition from rubber is negligible and many crops can profitably be grown for about four years. But when the growth of rubber trees advance, the shade from their expanding canopies and roots invading into the inter row space adversely affects the performance of intercrops. Consequently, the competitive effects becomes severe after about 5 years under rubber planted with conventional inter row spacings and the growth and yield of intercrops are reduced (Pathiratna & Perera, 2002).

Competition under mature rubber cannot be eliminated completely but can be minimized either by changing the spatial arrangements or adjusting the inter row spacing and tree densities. Selection of plant species/crops that are suitable for growing under some stress of shade and root competition from rubber is another possibility. Crops that tolerate or adapt to shade suits best while those requiring high irradiance for growth such as forage grasses and those that do not tolerate the combined effects of shade and defoliation are not preferred.

Cinnamon being a very profitable crop commonly grown as sole crop has been found to be suitable for growing as an intercrop under rubber. Experimental data shows that it is possible to minimize competition from rubber and to sustain high bark yields from cinnamon by adjusting inter row spacing and following appropriate cultural practices (Pathiratna et al., 2004).

Merits of cinnamon as an intercrop

Cinnamon is a very hardy tree that grows in many parts of the country including all rubber growing districts. In the wild it is a tree that grows to a height of about 10 m. But in plantations continuous coppicing has converted it to a bush with many shoots of varying stages of growth and has proved to be a plant adaptable to coppicing (harvesting) and regeneration under standard harvesting systems. Some important shade adaptation characteristics (Pathiartna et al., 1998) inherited from its natural habitat makes it a crop that can grow and yield under moderate shade (Pathiratna & Perera, 1998). It responds to shade by producing elongated shoots that

helps to maintain high bark yield compensating for the thin bark produced under such conditions (Pathiratna *et al.*, 2004). Percentage dry matter in bark, known as the harvest index, was also found to be highest when the light levels were about 60% (Pathiratna & Perera, 2004).

Cinnamon also responds to mutual shading and competition under high plant densities (17,000 bushes/ha intercropping) by producing elongated shoots that helps to maintain good bark yields. Shorter shoots produced under low plant densities (3980 bushes/ha intercropping) also maintain high bark yields by having higher weight of bark/unit length of shoot (Pathiratna & Perera, 2005).

Severe diseases of epidemic proportions are uncommon in cinnamon. It is also generally free from major diseases that affect rubber, the most important disease being the white root disease of rubber. As the vegetative parts are harvested environmental effects on flowering and fruiting are least important and it's harvesting is unaffected by rain prevalent in most of the rubber growing districts. Possibility of planting cinnamon in rows along contours makes it suitable for growing in sloping lands.

Rubber/cinnamon system

Rubber/cinnamon intercropping systems are not sustainable under rubber planted with narrow inter row spacings. Standard (8.1m × 2.4m) inter row spacing or slightly higher inter row spacings such as 9.6m × 2.4m, 10.8m × 2.4m tested were found to be unsuitable as cinnamon yields declined after about five years *i.e.*; after the 2nd harvest of cinnamon (Pathiratna *et al.*, 2004). But the yield decreases due to competition from rubber was small when wider inter row spacings such as 14.4m, 15.6m or 16.8m or more with 2.4m triangularly spaced paired rows of rubber were used (Pathiratna *et al.*, 2004) (Plate 1). Light availability in the inter row space remained high even after the 7th year while the density of fine roots of rubber in the inter row space remained low except in places close to rubber trees during a seven year period under these systems (Pathiratna *et al.*, 2004). Increased sustainability of the system, therefore depends on the size of the inter row space that helps to avoid competition from rubber.

However, such large inter row spacing systems reduce rubber density below the standard of 500 trees/ha depending on the size of the inter row. This reduction in the rubber tree density leads to heavy losses in the long run (Pathiratna & Edirisinghe, 2004) and may not be acceptable to the rubber growers (Table 1).

To avoid the above loss by maintaining the required number of rubber trees/ha while finding sufficient space for intercropping, the introduction of paired rows instead of single rows is considered appropriate. These systems give higher number of rubber trees/ha (Table 1) and high densities of cinnamon that ensures high bark yield/ha (Table 2).

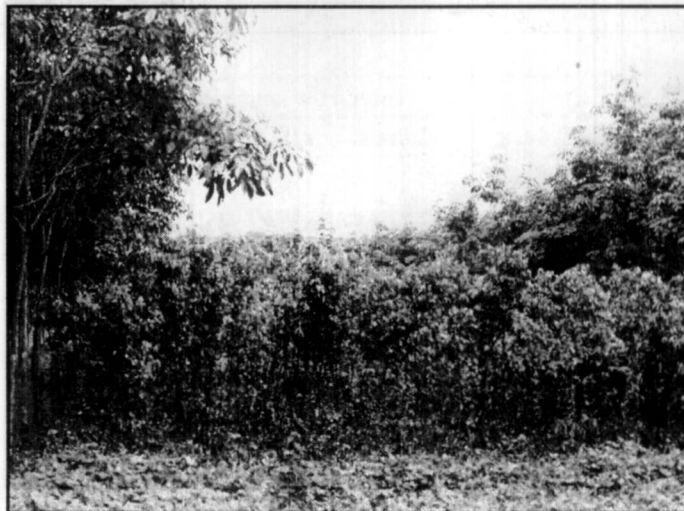


Plate 1. Cinnamon intercropped in a 16.8m interrow space of rubber. Photograph was taken in the 3rd year after the first harvest of Cinnamon

Table 1. Present value of potential revenue forgone and benefits accrued from rubber up to the 12th year due to the reduction /increase of plant density under different inter row spacing systems

	Inter-row spacing treatment (m)				
	8.4m s	12.0m s	14.4m p	15.6m p	16.8m p
Number of rubber trees/ha	496 (-4)	347 (-153)	505 (+5)	471 (-29)	441 (-59)
Revenue forgone/benefit accrued Rs/=	-2880	-110196	+3601	-18502	-37645

Figures in parenthesis are the number of trees less or more than the standard; **s**-single rows of rubber spaced 2.4m in rows; **p**- paired rows of rubber with 2.4m triangular spacing.

The use of the above inter row spacing systems for intercropping cinnamon is made possible by the absence of significant adverse effects on the growth of rubber due to the spacing system or to the presence of cinnamon compared to standard spacing systems (Pathiratna *et al.*, 2004) (Table 3).

Table 2. Number of cinnamon bushes/ha and the bark yield of cinnamon at the 3rd harvest taken in the 6th year after establishment under different inter row spacing systems

	Inter-row spacing treatment (m)				
	8.4m s	12.0m s	14.4m p	15.6m p	16.8m p
Number of cinnamon bushes/ha	9940 (5)	11120 (8)	10100(10)	10303 (11)	10582(12)
Cinnamon bark yield Kg/ha (3 rd harvest)	245	415	478	552	630

Figures in parenthesis are the number of cinnamon rows ; s- single rows of rubber p- paired rows of rubber. Numbers in parenthesis are the number of cinnamon rows in the inter-row

Table 3. The growth in girth of rubber under different inter row spacing systems measured as girth in the 6th year (Figures with the same letter in the last column are not significantly different)

	Inter-row spacing treatments (m)				
	8.4	12.0	14.4	15.6	16.8
Girth (cm)	52.8 bcd	55.2 ab	50.8 cd	49.9 d	49.6 d

Planting of rubber in east-west arranged rows where ever possible can also be practiced to further improve the light availability in such systems. The advantage of east-west oriented rows in allowing more light into the inter-row has been demonstrated even under standard inter row spacing systems (Pathiratna & Perera, 2002; Pathiratna & Perera, 2003).

Viability of the system

Re-growth of cinnamon after coppicing at harvests as well as the bark yield, particularly after the 2nd harvest were greatly reduced in systems with standard inter-row spacings (Pathiratna & Perera, 2002). The total above ground biomass and the yield parameters such as the total length of shoots harvested and percentage dry matter in bark are unaffected over the harvests in wider compared to narrow inter-row spacing systems that results in the sustenance of higher bark yield of cinnamon for a greater period (Table 4) (Pathiratna *et al.*, 2004).

Table 4. *Bark yield of cinnamon (kg/ha intercropping) obtained under the different inter row spacing systems of rubber at the 4 harvests taken in the 3rd, 4th, 5th and 6th years after establishment*

Inter-row spacing system (m)	Kg/ha bark yield of cinnamon			
	1 st harvest	2 nd harvest	3 rd harvest	4 th harvest
8.4	911	661	166	244
12.0	917	775	634	415
14.4	843	740	554	478
15.6	842	801	632	552
16.8	858	780	647	630

Economic benefits

Cinnamon can be harvested 2.5 years after establishment. Experiments conducted so far indicates that the pay back period of rubber/cinnamon intercropping systems involving wider inter-row spacings is 5 years compared to 11 years of sole crop rubber in plantations (Pathiratna & Edirisinghe, 2004). In such systems higher bark yield of cinnamon compensates for the loss due to the reduced number of rubber trees and the net cash flow for the first five years indicates that there is a large excess of income over expenditure in systems involving inter-row spacings greater than 15.6m. Though the 12.0m and other single row treatments show a positive cash flow values, the loss due to the reduction of rubber trees/ha (Table 1) cannot be compensated. The loss seen in the 14.4m inter-row is negligible if the value of leaves and fuel wood are taken into consideration (Table 5).

Table 5. *Total net discounted cash flow in rubber/cinnamon intercropping systems at the 5th year*

	Inter row spacing treatment (m)				
	8.4m s	12.0m s	14.4m p	15.6m p	16.8m p
Total net discounted cash flow Rs/=	-50283	47928	-17553	35586	33274

s- single rows of rubber; p- paired rows of rubber.

The economic benefits shown (Table 4) however do not include the value of leaves that can be used for distilling leaf oil and the large quantity of sticks that can be used as fuel wood left after peeling bark. The quantity of both these left over products is high under wider inter-row spacing systems (Table 6).

Table 6. Quantity of dry leaf and wood left after harvesting cinnamon under different inter-row spacing systems. (The data is from the 3rd harvest of cinnamon taken in the 6th year after establishment)

	Inter-row spacing treatment (m)				
	8.4m s	12.0m s	14.4m p	15.6m p	16.8m p
Amount of dry leaf kg/ha	1694	5398	3603	5179	5556
Weight of fuel wood kg/ha	3588	15168	10017	12080	11657

s- single rows of rubber; p- paired rows of rubber

The other benefits include the additional income for estate labourers whose work normally involves rubber. They can work in rainy days and after normal working hours. All members of the family can take part in peeling and quill preparation as it involves team work.

SUMMARY

Rubber/cinnamon intercropping is sustainable only under wider inter-row spacings of rubber. Paired row systems with wider inter-rows of 14.4m, 15.6m and 16.8m with 10,11 and 12 rows of cinnamon in the inter row are found to be most suitable. These systems accommodate high rubber tree and cinnamon bushes/ha densities without significantly affecting the growth and yield of either crop. Under these spacing arrangements the pay back period of rubber/cinnamon systems can be reduced to five years compared to eleven years in sole crop rubber.

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PERFORMANCE OF RATTAN (*CALAMUS* SPP.) INTERPLANTED UNDER RUBBER (*HEVEA*)

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INTRODUCTION

Rattans are climbing palms found in south east Asia and are widely used as a raw material in the manufacture of furniture and handicrafts. This being the most important forest product next to timber, is always collected from natural habitats despite the threat for extinction. Both heavy exploitation and dwindling natural habitats limit the supply of this material and is insufficient currently to meet the demand. Importation of this raw material to feed the local industry is also limited, as some countries have already banned their export.

Therefore, preserving them in their natural habitats and growing them commercially have become important. In addition to forest plantations there is a possibility of intercropping them under plantation crops such as rubber and also in reservations in rubber estates as most of these species are endemic to rubber growing districts.

*Nine naturally growing species of *Calamus* have been recorded in Sri Lanka (Trimen & Hooker, 1898) and some of these species such as *C. zeylanicus*, *C. thwaitesii* and *C. ovoideus* and *C. pseudotenuis*. are of high commercial importance.*

*In order to study the possibilities of interplanting them under rubber, a trial was started in 1996 using three endemic species, viz., *C. zeylanicus*, *C. thwaitesii* and *C. ovoideus*. All three species yield large canes used in the furniture industry.*

Experimental site

The trial was established at the Rubber Research Institute of Sri Lanka substation in Kuruwita situated in the low country wet zone. The soil is acidic (pH 4.8) and belongs to the order Ultisol. The annual rainfall was about 3000 mm. The rubber trees were 15 yrs. old and has been in tapping for about ten years at the time of the commencement of the experiment in 1996.

The inter-row space available in this area was 9.1m. A single row of rattan spaced 3.0m was planted within this space. This arrangement gave 667 plants of rattan/ha. Planting material was obtained from the Forest Department.

Management practices

Rattans are easily managed and costly management practices are not involved. Weeding around young plants was done and fertilizer was applied annually