

Advisory Circular No. 2013/10

Rubber based Farming Systems



**Rubber Research Institute
of Sri Lanka**

Rubber based farming systems

Rubber based farming systems enables rubber growers to earn an extra income from their land by integration of other crops and animals. Although most crops could be grown with rubber, their suitability depends on the growth stage of rubber. The following Table could be used as guideline to select such crops. However, care must be taken to select crops in accordance with the factors like market, resources availability and land suitability.

<i>Crops suitable for different growth stages of rubber</i>			
<i>Only during the immature phase of rubber</i>	<i>Intercropping throughout the life cycle of rubber</i>		<i>Only during the mature phase of rubber</i>
<ul style="list-style-type: none"> - Banana - Pineapple - Passion fruit - Sugarcane (only for dry areas) - Annual/seasonal crops 	<i>With no change in planting density of rubber</i>	<i>With reduced planting density of rubber</i>	<ul style="list-style-type: none"> - Cardamom - Vanilla - Rattan - Anthurium
	<ul style="list-style-type: none"> - Coffee - Cocoa 	<ul style="list-style-type: none"> - Tea - Cinnamon - Pepper 	

Crops suitable for intercropping during at the immature phase of rubber

Most sun loving crops are considered suitable, if they can produce reasonable yields before canopy closure of rubber, *i.e.* within the first four years. Suitable spacing of rubber is 2.4 m x 8.1 m (8' x 27'). Tuber crops are not generally recommended due to its effect on soil stability.

Banana

Banana is suitable for in most parts of Sri Lanka due to;

- Ready local market
- Fewer demands on inputs
- Variety of uses
- Familiarity of farmers with the growth requirements

It can be grown successfully during the first 3-4 years of the rubber crop and requires well-drained soil with a pH *ca.* 7 but cannot withstand strong winds.

Varieties

Embul

Commonly grown variety, but local market prices are not attractive

Kolikuttu

Superior quality but highly susceptible to diseases such as bunchitop and panama. Not recommended for the wet zone

Anamalu/Ambun

More suitable for wetter areas

Alukehel

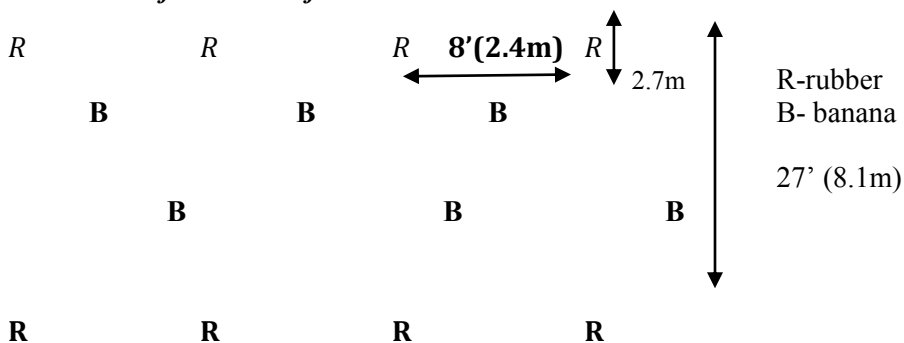
Prefers drier climates

Field planting

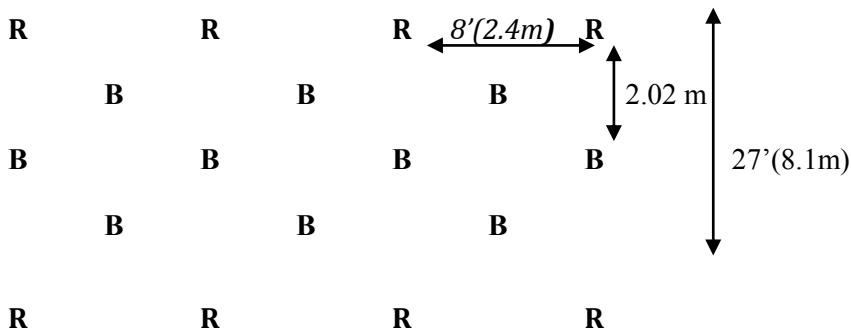
Two to three rows of banana could be grown in between two rubber rows (Plate 1).

Schematic diagram showing the field layout of the rubber/banana intercrop

In the case of two rows of banana with rubber



In the case of three rows of banana with rubber



Within a row the spacing varies from 2.4 m to 3.6 m depending on the variety of banana as follows:

Kolikuttu 2.4 m

Embul 3.0 m

Anamalu 3.6 m

Ambun 3.6 m

Planting holes of dimensions 60 cm x 60 cm x 60 cm should be used and filled with organic manure and topsoil. Clumps should be maintained with three plants at a time, *i.e.* mother plant and two suckers of different sizes.

Pineapple

Although pineapple can be grown in all rubber growing areas, it is popular in Gampaha and Colombo regions due to the close proximity of well-developed marketing systems. Pineapple is considered to be highly profitable, but it requires high labour and capital inputs. It also requires clean weeding and so is only grown on flat or gently undulating land. Sandy loam and lateritic soils with a pH of 5.5 are suitable.

Varieties

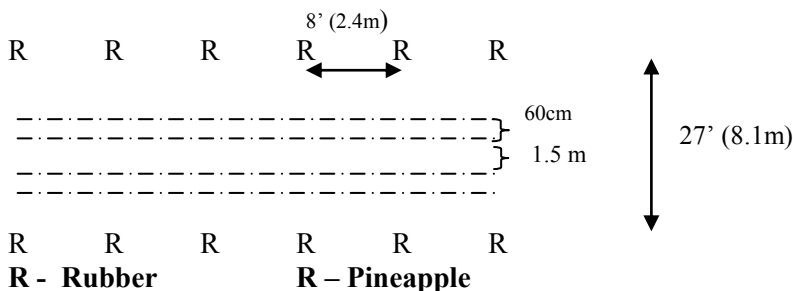
Maurities - very popular as a fresh fruit

Kew - used specially for canning

Field planting

Two paired rows of pineapple with a gap of 1.5 m in the centre, can be planted between the rubber rows (Plate 2). Within the paired rows, suckers are spaced 30-45 cm within and 60 cm between rows. Furrows at about 20 cm deep and 20 cm wide must be prepared for planting of the pineapple rows.

Schematic diagram for the field layout of the rubber/pineapple intercrop



Passion fruit

Passion fruit grows well across a range of climatic conditions, but requires irrigation in dry areas. Soil should be well drained with a pH of 6.0-7.5.

The market price of passion fruit fluctuates drastically in Sri Lanka; hence it is advisable to have an established forward contract with canning factories, if planning to go for large-scale cultivation.

Varieties

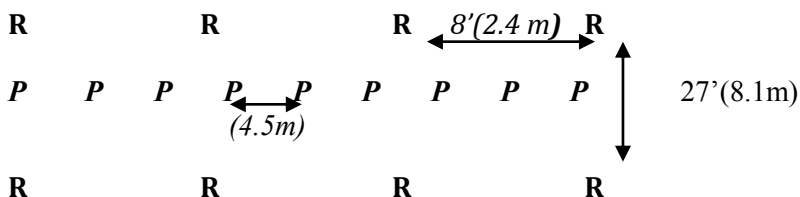
Two types are recommended by the Department of Agriculture for the low country where rubber is grown. “Traditional yellow” fruit type is suitable for both wet and dry areas, whilst variety ‘Mani’, another yellow type, is suitable only for wet areas.

Field planting

Planting of a single row of passion fruit between the rubber rows is well established; however a two rows system of passion fruit is also possible (Plate 3). Within the row, planting is done 4.5 m apart and in the case of two rows a 2 m gap should be left between rows. Planting holes of dimensions 60 × 60 × 60 cm should be used and filled with organic manure and top soil *ca.* 2 weeks before planting.

Schematic diagram showing the field layout of the rubber/ passion fruit intercrop

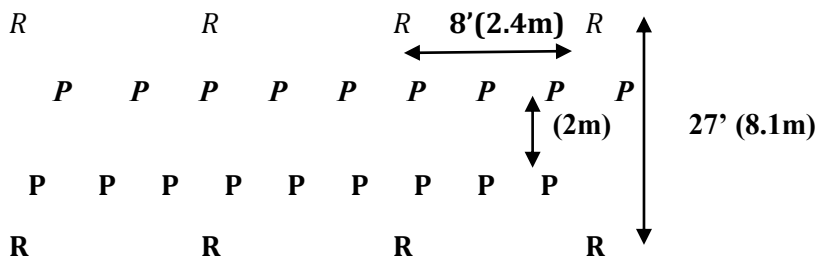
Single row of passion fruit with rubber



R - rubber

P - passion fruit

Two rows of passion fruit with rubber



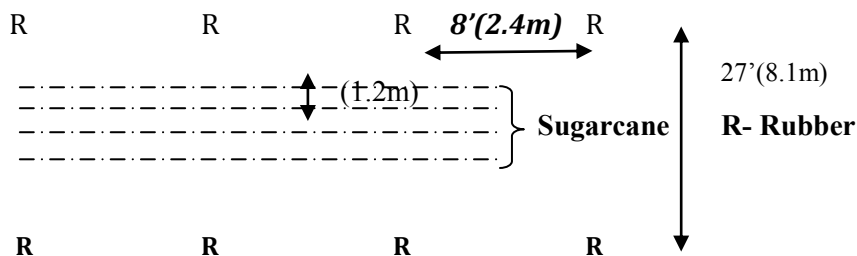
Strong support with posts and string (galvanised wires) should be provided at *ca.* 2 m height for the growth of vine. Only two branches are trained on either side of the plant along the string up to *ca.* 2 m and then, secondary branches which produce fruits, should be encouraged to grow down by removing tendrils.

Sugarcane

This is a crop for drier areas, and particularly the Monaragala district where a good market exists. It is evident that sugarcane alleviates radiation and heat stress on the rubber plant at a very early stage resulting in improved growth. All clones recommended by the Sugarcane Research Institute are compatible with rubber.

Four to five rows of sugarcane with a 1.2 m inter-row distance can be planted between rubber rows (Plate 4).

Schematic diagram showing the field layout of the rubber/sugarcane intercrop



Annual and seasonal crops

In general, most crop types are compatible with rubber during the early stages of the immature phase (Plate 5). Suitable crops are to be identified according to the climatic factors and the market. In the intermediate zone of the country, seasonal crops such as cowpea, millet, maize, brinjals and upland paddy are grown in combination with rubber/banana intercrops. Rubber/banana/brinjal intercrops are also popular in the wet areas of the country. Interchanging crops between wet and drier areas is not always possible due to the reasons associated with specific climatic needs. For example, pulses such as cowpea are not successful in wet areas due to fungal attacks to the pod.

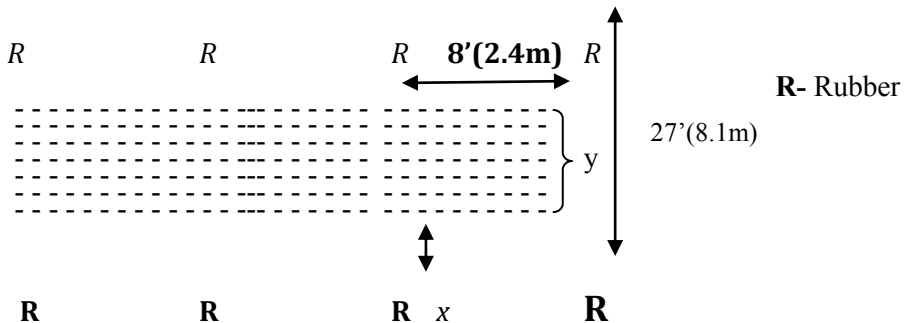
Medicinal plants with rubber

The following plants could be grown with rubber (Plate 6).

Plants	Propagation	Shade requirement
<i>Aerva lanata</i> (Polpala)	by seeds (soaking seeds over night in water)	full sun light
<i>Solanum virginianum</i> (Syn. <i>Solanum xanthocarpum</i>) (Katuwelbatu)	by seeds (soaking seeds over night in water)	full sun light
<i>Piper longum</i> (Thippili)	By stem cuttings	medium shade
<i>Indigofera tinctoria</i> (Nilavariya)	by seeds (soaking seeds over night in water)	low shade
<i>Plumbago indica</i> (Ratnitul)	By stem cuttings	low shade

During the first year of the rubber crop, a gap of 1.2 m between rubber and these crops is sufficient and then in subsequent years, this gap should be increased by *ca.* 0.6 m to cope with growing canopy and root development of the rubber tree.

Schematic diagram showing the field layout of the rubber/Annual and seasonal crops



y - Annual and seasonal crops **x** - 1st year 4' (1.2 m), 2nd year 6' (1.8m)

Some other suitable crops

Citronella is a commercial crop grown widely in the southern region of Sri Lanka and has been grown successfully with rubber during the immature phase. However in practice, citronella has been grown in this area for a long time and productivity has declined drastically. As a consequence, rubber is interplanted with the objective of diversifying income away from a sole dependence on citronella.

Suitable crops for intercropping only during the mature phase of rubber

Two important factors must be taken into consideration when selecting crops for this stage of rubber;

- The crop should be shade tolerant
- The crop should be able to withstand root competition of mature rubber.

Cardamom

Cardamom is most valuable spice, normally grown under the cool climatic condition with an even distribution of rainfall of 1500-2500 mm.

Since rubber is generally grown in the low country, only the varieties screened for low altitudes can be grown under mature rubber. Soils should be rich with organic matter and well drainage. Nevertheless, water stress condition should not exist.

Varieties

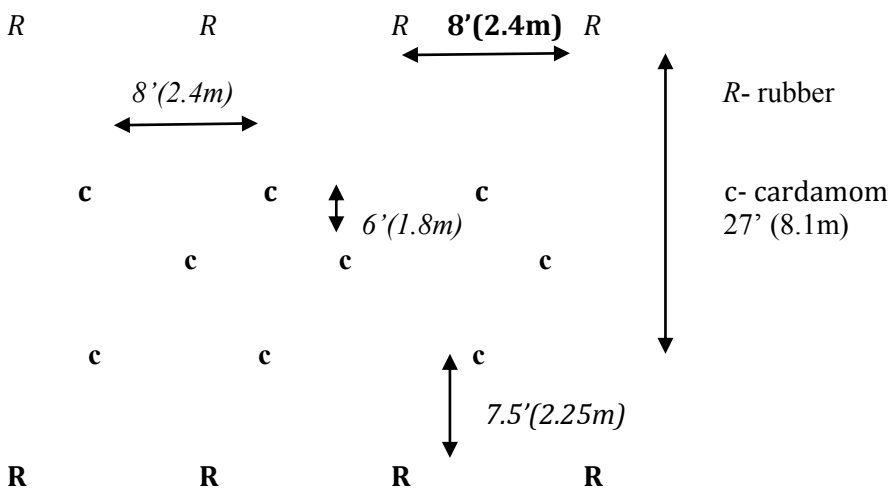
EC1/100, EC1/101, EC1/102 and EC2/400MT which are available from the Department of Export Agriculture.

Field planting

If rubber is spaced at $2.4\text{m} \times 8.1\text{m}$, two to three rows of cardamom can be planted between the rubber rows. Spacing for cardamom is 2.4m within and 1.8m between rows in the case of 3 rows and, *vice versa* for two rows. Even for rubber planted at a narrow spacing (*i.e.* $3.6\text{m} \times 5.4\text{m}$), a single row of cardamom can be established 2m apart. Planting holes of dimensions $40\text{cm} \times 40\text{cm} \times 40\text{cm}$ should be used and filled with organic manure and topsoil.

Schematic diagram showing the field layout of the rubber/cardamom intercrop

Three rows of cardamom with rubber



Other suitable crops

Vanilla

This appears to be a suitable crop under mature rubber, if the soil is well drained loamy and rich in organic matter. Flowering may commence after three years of planting and it takes 7-8 years to obtain the maximum yields.

Propagation is done through cuttings for which mother plants with desired characteristics such as regular and consistent annual bearing, fast growth, free from pest and diseases and sturdy stem with thick large fleshy leaves are selected.

Rattan

Although the effect of rattan on the growth and yield of rubber has not yet been fully evaluated, observations here in Sri Lanka and elsewhere suggest that it is a suitable crop to be grown during the mature phase of rubber. Preliminary observations suggest that sufficient light is available and that other micro-climatic factors under the rubber canopy would not affect the growth of rattan.

Varieties

Species producing thicker cane (locally referred as “Maweval”), would be suitable. As a matter of convenience, it would be better to harvest the rattan at the time of uprooting rubber trees and so leaving *ca.* 15 years for the growth, planting of rattan can be done at 10-15 years after planting of rubber.

Field planting

Planting of a single row of rattan between rubber rows at a distance of *ca.* 3-4 m apart is practically feasible. In addition, rattan requires a minimal amount of cultivation and so appears to be suitable for the reservations on rubber estates (*i.e.* areas subjected to very high erosion which are not planted with rubber).

Intercropping throughout the life cycle of rubber

Poor light penetration through the mature rubber canopy allows only the shade tolerant crops to grow, however should economical attractive sun loving crops be grown, then planting density of rubber needs to be reduced in order to provide adequate solar radiation for the second crop.

Shade tolerant crops to be grown without compromising the rubber density

[i.e. where rubber is planted at a spacing of 2.4 m × 8.1 m (8' × 27')]

Coffee

Three economically important species are available and suited to different climatic regimes. In general, coffee thrives well in soils of pH 6.5, and liming may be necessary for highly acidic rubber soils.

Types

Coffea arabica (Arabica coffee): Well suited to cooler climates and hence higher altitudes. However, it is commonly grown under widely varying elevations from sea level to 1800 m. This species fetches a premium price due to its superior quality.

Coffea canephora (Robusta coffee): Thrives well at low altitudes with warm and humid conditions. Extensively used in instant coffee.

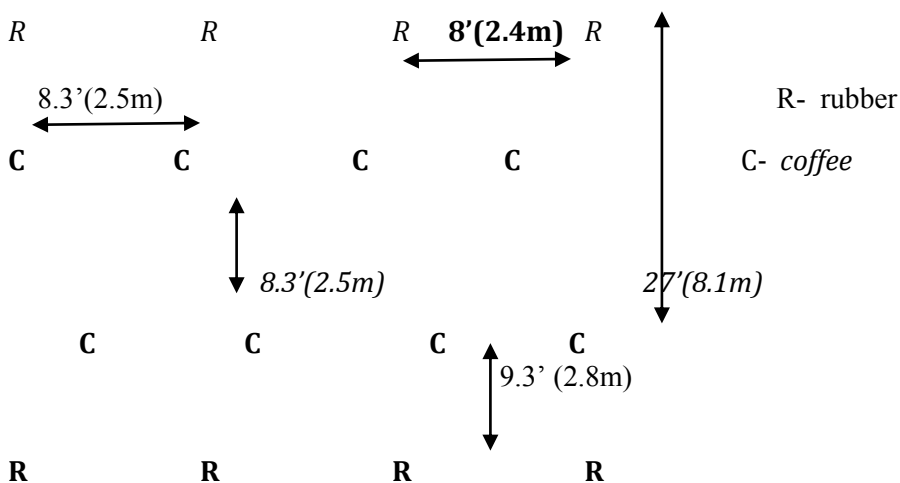
Coffea liberica: Tolerates warm and wet conditions and thrives in different soil types such as clay and peat. Fruits are large and hard, hence processing costs are high. Since the produce has a bitter taste, it is preferred in certain countries like Malaysia and Middle East.

Field planting

One to two rows of coffee can be planted in between the rubber rows and spaced 2.5m between and within rows, with a single stem pruning. Improved yields can be obtained with the two stems training system for which planting needs to be done with a spacing of 3m x 3m (10' X 10'), according to the Department of Export Agriculture, Sri Lanka (DEA). The initial shade required by the coffee during the immature phase of rubber could be provided economically by combining this system with a rubber/banana intercrop.

Schematic diagram showing the field layout of the rubber/coffee intercrop

Two rows of coffee with rubber



Cocoa

Cocoa is suitable for comparatively drier areas of rubber due to disease problems, although high humidity is required during flowering in order to enhance pollination. The best soils are well drained clay loams, rich in organic matter with a pH ranging from 6.0 to 6.5. Cocoa grows well below 600 m altitude with evenly distributed rainfall of 1650-2750 mm and temperatures of 24-27 °C.

Varieties

- Criollo - Creamy white beans with a very good flavour; but lower productivity and more susceptible to pests and diseases.
- Forastero - Dark purple bean; highly productive and resistant to pests and diseases.
- Trinitario - A hybrid of the above two varieties and so has intermediate characteristics.

Field planting

Cocoa plants can be established as a single row spaced at 3m (within the row) between rubber rows with a suitable size of a planting hole of *ca.* 45 cm × 45 cm × 45 cm.

Plants should be maintained with one set of fan branches, hence additional water shoots must be removed. It has been noticed that heavy shade causes an increase in wilted fruits, a physiological disorder related to low photosynthetic productivity.

Anthurium

Growing Anthurium under mature rubber provides an additional income to the rubber grower. Shade level under mature rubber is (*ca.* 70%) advantageous to the Anthurium growers as it reduces the cost of artificial shading.

Variety

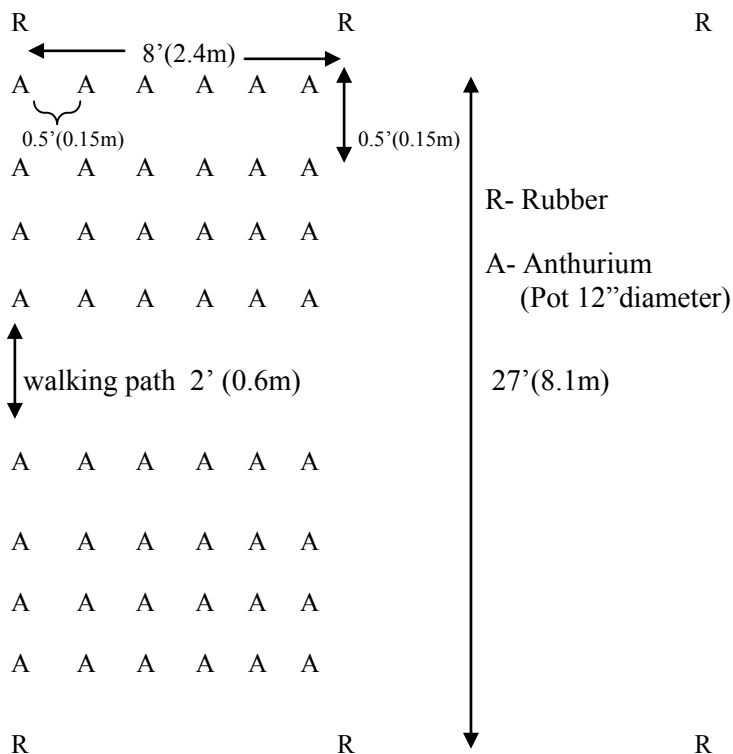
“Tropical red” variety which possesses export quality flowers had shown fine performances under rubber (Plate 10).

Field establishment

Eight rows of anthurium pot plants could be arranged between rubber rows and spaced 0.15 m between and within rows. A distance of 0.6 m (2') should be left between the 4th and 5th row of anthurium as for walking path.

Schematic diagram showing the field layout of the rubber/Anthurium intercrop

Eight rows of anthurium with rubber



Crops that can be grown if the planting density of rubber is reduced

Two spatial systems of planting rubber at a lower density (*i.e.* single and paired row systems) have been proposed by the RRISL in order to provide wider alleys between the rubber rows in order to improve light transmission for other crops.

Single row system

Rubber is planted at a spacing of 2.4 m along rows as usual, but between row spacing is increased to 12 m, reducing the overall planting density by *ca.* 30%.

Paired row systems

Rubber is planted either at 2.7 m × 2.7 m or 3 m × 3 m within the paired row and between row spacing is adjusted to 18m. The former system of paired rows provides a similar density of rubber to that of the single row system, whilst the latter gives only 63% of the sole crop density. The paired row system with an 18m alley is more advantageous over the single row system as far as light availability is concerned however there are practical limitations at the smallholder level where land size is limited for the provisions of such wide gaps.

Tea

The rubber/tea intercrop is well suited to the wetter regions where sole cropping of both rubber and tea is practiced. This fits well with the social context of the smallholder farming community. Under normal circumstances, rubber cannot be tapped very often during the rainy season and farmers can still obtain an income from tea harvests. Also on large estates, this intercrop secures more job opportunities for estate workers. Moreover, rubber/tea intercropping has proven to be economically sustainable under conditions where the market price of one of the component crops falls. The rubber crop also provides a shelter for tea during drought resulting in significantly less casualties than that occurs with sole tea.

Field planting

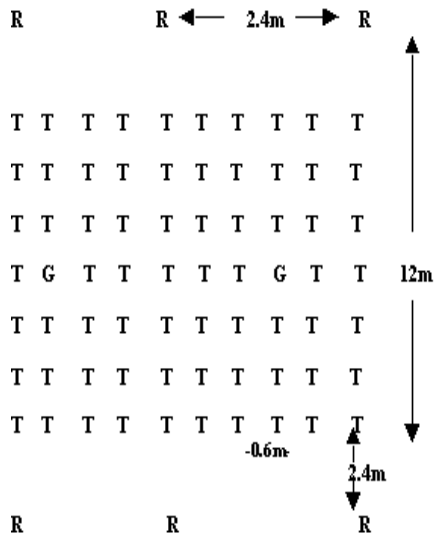
When grown with the single row planting system of rubber, *i.e.* 2.4m × 12m, seven rows of tea may be interplanted between rubber rows at a spacing of 0.6m within and 1.2m between rows. However in the paired row system (Plate 7), at the same spacing 12 rows can be incorporated leaving 2.4 m on either side for intercultivation activities of rubber. In the former system, the stand of tea is *ca.* 70% of the sole crop density, whilst that of the paired row system is almost same (*i.e.* 69.5% and 68.5% for 2.7 m × 2.7 m and 3 m × 3 m paired spacing systems, respectively). The productivity of tea crop begins to decline in the former single row planting system after *ca.* 6 years in growth

and therefore it is advised to reduce rubber canopy around 25% by selective pruning rubber branches.

Planting of tea requires preliminary soil reconditioning which takes *ca.* 1.5-2 years where the soil organic matter content is low. In general, tea clones used in rubber growing areas are TRI 2025, TRI 2027 and S 106. Planting and all other management practices for individual crops are done as per the recommendations of the RRISL and the Tea Research Institute of Sri Lanka (TRISL). The cover crop should be restricted to the area reserved for rubber. Moreover, medium level shade trees such as *Gliricidia* should be raised and maintained until the rubber trees are mature enough to provide sufficient shade.

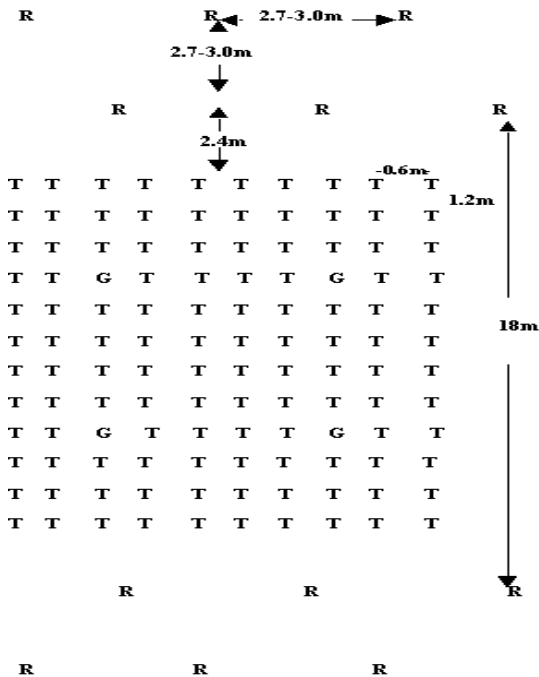
Schematic diagram showing the field layout of the rubber/tea intercrop

Single row system of rubber with tea



T – Tea R – Rubber G - Gliricidia
Tea stand – ~70% Rubber stand – ~70%

Paired row system of rubber with tea



Tea stand – ~69%

Rubber stand – ~69-63%

Cinnamon

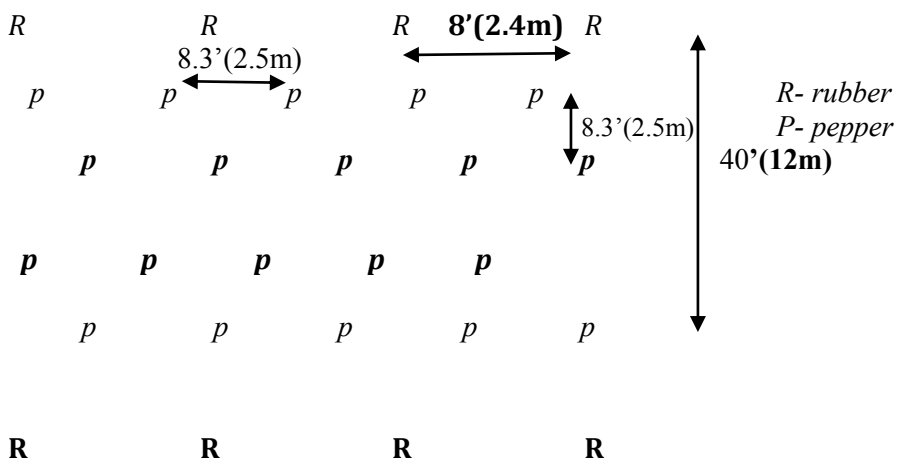
Cinnamon is proven to be an economically important crop with no drastic fall in prices in recent years. Cultivation can be extended to drier regions and most soil types. Evidence indicates that the bark becomes thin under shade of mature rubber but elongated stems may compensate for this weakness. Skilled labour is required to peel off the bark and this is an important factor to be considered before planting.

Within and between- row spacing of cinnamon (Plate 8) is identical to that of tea and so planting densities, spatial arrangements including number of rows between the rubbers, are virtually identical to that used for the rubber/tea intercropping.

Pepper

This is also a commercially important crop and the area under this crop is presently expanding. Considering the sole crop spacing, three and five rows of pepper spaced at 2.5m x 2.5m may be planted successfully towards the centre of the alley of the single and paired row systems of rubber, respectively. If dead rather than live stems are used to support vines, then yield may be improved due to reduced crop competition and perhaps the density of pepper under rubber could also be increased by planting another row with 2m x 2m spacing. As it is the case for many other crops, temporary shades are essential for better establishment of pepper plants.

Schematic diagram showing the field layout of the rubber/pepper intercrop



Other suitable crops

Some crops such as coffee and cocoa which are generally planted with the standard density of rubber, can also be grown to improve yields provided rubber is grown at a reduced density *i.e.* with either single or paired row systems. These crops may be planted in several rows within the alleys of rubber at the spacings recommended for sole cropping leaving a sufficient gap for rubber. In the case of coffee, *ca.* 3 m gap is sufficient for rubber, whilst a minimum of 4 m is required for cocoa.

Other intercropping systems

Planting tree crops along the boundaries of rubber

Most timber species (*eg.* Mahogani, Alstonia) can be planted along the

boundary of rubber crop, provided no other tree crops grown close by. These timber crops could be raised at the time of planting of rubber and other economically important vines, such as pepper, could be trained into. In general, a gap of 4.5 m between timber trees should be maintained. In addition to timber species, arecanut is another economically important crop which can be grown along the boundaries.

Use of tree crops for infilling the vacant rubber plants

Growing tree crops in place of dead rubber plants seems to offer a practical solution to utilizing the otherwise “wasted” resource. Timber crops, which require shade conditions for better establishment (*eg.* Mahogany – damage due to stem borer attack is reduced under shade), or other shade tolerant tree crops (*eg.* arecanut) are suitable for this purpose.

Fertilizer applications and other management practices of intercrops

This should be done according to the recommendations given for individual crops.

Animal husbandry

Although animals can be fed on natural fauna or grasses grown under rubber lands, such use has been obscured by some practical limitations. However recent studies have shown that free range poultry is a suitable system particularly for rubber smallholders (Plate 9).

Veterinary Research Institute (VRI) introduced a cross breed for free range poultry systems under rubber.

(CPRS (Central Poultry Research Station) Brown strain × Indigenous → F1
× Indigenous → Cross breed)

VRI introduced this breed to get higher egg production and environmental adaptability. Rubber Research Institute of Sri Lanka has done a feasibility study to identify the possibility of rearing poultry birds in mature rubber lands. Maximum egg production (Given by VRI for particular breed) can be obtained under rubber without any detrimental effect on rubber and natural fauna.

This system is recommended for the rubber smallholders who are having half an acre to 1 acre land and live in a same piece of land.

25 birds can be introduced to a half an acre mature rubber land with natural fauna. Three cages of 7' × 4' size, could be established in the same piece of land. (Feeding/water troughs also can be kept in these cages) Household refuses can be used as supplementary feed.

