

4 Cultivation and Management of Cinnamon

J. Ranatunga, U.M. Senanayake and R.O.B. Wijesekera

Introduction

In Sri Lanka, cinnamon has originated in the central hills where several species of related taxa occur, especially in places such as Kandy, Matale, Belihull Oya, Haputale and the Sinharaja forest range. Currently, cinnamon cultivation is concentrated along the coastal belt stretching from Negom to Matara. Of late, cultivation has spread to the inland areas of Kalutara, Ambalangoda, Matara and Ratnapura (Fig. 4.1). The area under cinnamon cultivation in Sri Lanka is around 15,500 ha (Anon, 1996a). The bulk of the cinnamon plantation is about 70–80 years old, most of which belongs to small holders. Only about 10% of the plantations exceed 8–10 ha. Sri Lanka commands about 60% of the world export market and exports about 7,000 t of quills and chips per year, apart from cinnamon leaf oil and bark oil.

In the systematic cultivation methods prevalent in plantations in Sri Lanka, cinnamon is maintained as a bush with four to five slender shoots growing up two to three metres. (Fig. 4.2). The economic life span of a cinnamon plant is around 30–40 years (Senanayake, 1977; Wijesekera *et al.*, 1975). In two to three years after planting, depending on the climatic factors, the plants reach a height of 1.5–2 m, with three to four shoots, and are then ready for harvesting. Generally, cinnamon can be harvested two to three times per year depending on the rainfall and soil fertility. After harvesting, the leaves are separated and the stems are peeled to remove the bark. The processing of different products then begins.

Sri Lanka dominates in the supply of cinnamon. Other important sources are the Seychelles, Madagascar and India. Cassia is found in China, Indonesia, India, Taiwan and other countries in South-East Asia, and the Pacific Ocean Islands. However, most cassia oil in international trade is of Chinese origin.

Soil, climate and varieties

Cinnamon is a hardy plant, which can grow well in almost all types of soils under a wide variety of tropical conditions. In Sri Lanka, it is cultivated under varying conditions ranging from semi-dry to wet zone conditions and soils varying from the silver sands of Kadirana, Ekala and Ja-ela to the loamy, lateritic, and gravelly soils of the Kalutara, Galle and Matara districts (Fig. 4.1). The ideal temperature for growing cinnamon is between 20 °C and 30 °C. Rainfall should be in the range of 1250–2500 mm. Generally, cinnamon does not thrive well in the drier parts of the low-country. It thrives well as a forest tree at 300–350 m above sea level.

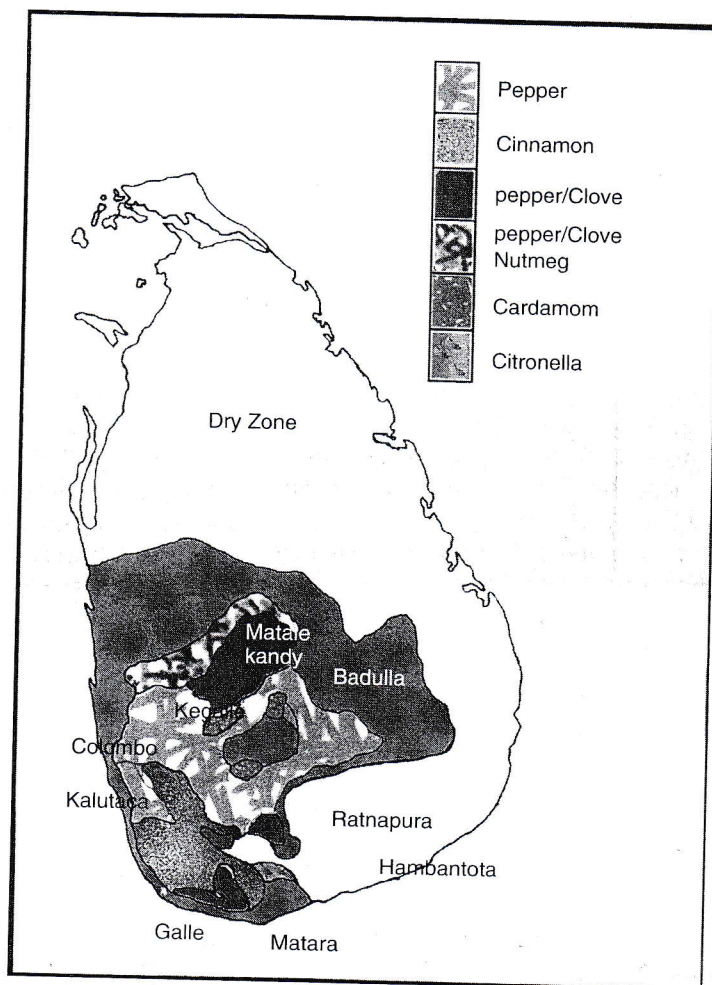


Figure 4.1 Distribution of cinnamon and other spices in Sri Lanka.

The quality of bark is greatly influenced by soil and ecological factors. The best quality cinnamon is produced on white silicacious sandy soils like the 'silver sands' of the Negombo district. Yield is higher in other soils but the quality is coarser than in sandy soils.

Varieties

There are several species of *Cinnamomum* found in South and South-East Asia. In addition to the true cinnamon (*C. verum*), there are other species which are endemic to Sri Lanka (Wijesekera *et al.*, 1975). It has been reported that eight different types (cultivars) of cinnamon are grown in Sri Lanka. These are distinguished by pungency of bark and petiole, texture of bark and the structure of leaves (Anon, 1996b). However, no botanical description of such varieties are available. They are known by the following local (Sinhalese) names:



Figure 4.2

Panni Kur
Naga Kur
Panni Mi
Veli Kuru
Sewala Ka
Kahata K
Penirca
Peiris u

In add
screening

Propaga

Cinnam
Howeve
are colle

1. erec
2. vigo
3. eas



Figure 4.2 Field plantation of cinnamon.

Panni Kurundu, Pat Kurundu or Mapat Kurundu

Naga Kurundu

Panni Miris Kurundu

Veli Kurundu

Sewala Kurundu (or Sevel Kurundu)

Kabata Kurundu

Penirasa Kurundu

Peiris Kurundu

In addition, there are 19 high quality, high yielding selections, identified through screening of 210 different accessions by the Department of Export Agriculture of Sri Lanka.

Propagation and Field Planting

Cinnamon can be propagated from seeds and cuttings of young three-leaved shoots. However, propagation by seeds is easier and is the most common practice. Ripe seeds are collected from selected mother plants with desired characteristics such as:

1. erect stem with smooth bark;
2. vigorous growth;
3. ease of peeling the stem bark;

4. resistance towards pests and diseases;
5. chemical composition of the oil (*viz.* high oil content of the bark and leaves and desired chemical characteristics of oil).

Propagation by seeds

Ripe seeds collected from mother plants having desired characteristics are heaped in the shade for two to four days until the pulp turns black and disintegrates. The seeds are then separated mechanically, washed and dried in the shade. Over-fermented and light seeds are discarded and the rest are used for planting. According to the Department of Export Agriculture, the seed viability diminishes rapidly with time, and the viability is very low after five weeks. As such, it is important to use fresh seeds for germination.

There are three methods for establishing seedlings for cultivation:

1. Direct sowing of seeds in groups of four to five in the field;
2. Transplanting of nursery raised plants (root balling method);
3. Seedlings raised in polythene bags.

Direct sowing of seeds

When seeds are sown directly in the field, $0.3 \times 0.3 \times 0.3$ m holes are dug at a spacing of $1.2 \text{ m} \times 1 \text{ m}$ and filled with top soil. Seeds are sown in groups of 15–20 in each hole. The main disadvantages of this method are:

1. unnecessary competition among seedlings;
2. a longer period of germination;
3. ill effects of adverse environmental and climatic conditions.

Nursery or root ball method

Nursery beds 1 m wide and of a convenient length are prepared. Seeds are planted 20 cm apart in rows and 10 cm apart within a row. Seeds are planted in lots of seven to ten in a 4 cm diameter hole at a depth of 4–8 cm and covered with a thin layer of soil. Beds are shaded with polythene or coconut leaf and watered daily in dry weather. After the seedlings have reached a height of 12 cm, the shade is removed gradually. When seedlings are three to four months old it is necessary to remove weak seedlings leaving only three well grown seedlings in a hole. Plants are ready for planting out in the field in eight to ten months times. Before removing seedlings, nursery beds should be watered thoroughly to enable the removal of the seedlings with soil without damaging the root system. Then the seedlings are removed from the bed in such a way that the root system is well covered with a ball of surrounding soil, keeping it in the centre of the soil ball. The soil ball with three seedlings can be transported to the field for planting. This is the most common method adopted by farmers.

Raising seedlings in polythene bags

Cinnamon seedlings are also raised in polythene bags ($10 \text{ cm} \times 20 \text{ cm}$) filled with a mixture of top soil/cow dung (1:1). About five to seven seeds are sown in a bag and at

the age of three to four months excess seedlings are removed leaving the best three seedlings in the bag. The plants are ready for field planting in about six months time.

Vegetative propagation

Propagation by shoot cuttings

Cinnamon can also be propagated by cuttings of young three-leaved shoots or by layering. Partially matured shoots with a node are removed from selected mother plants with the desired characteristics. Single node shoots are prepared by making a sloping cut at the node. Cuttings should be put into water immediately and maintained in water until planted in polythene bags. Polythene bags 10 cm diameter by 20 cm long should be filled and pressed to be firm. The filled polythene bags should be put together within frames made of bamboo or suitable supports to give beds not more than 1 m wide. The soil under the pots should be forked over to ensure good drainage. One cutting should be placed in each bag. The bed of polythene bags and cuttings must be kept cool and moist. In order to prevent water losses through evapo-transpiration the bags must be covered with polythene. It is also important to provide shade as protection from direct sunlight. After three to four months the shade has to be removed gradually for the hardening of the plantlets. The rooted plantlets are ready for planting after 10–12 months. Vegetative propagation techniques for *C. verum* and *C. cassia* have been reported from the Indian Institute of Spices Research, Calicut, Kerala, India (Rema *et al.*, 1997). For further details see Chapter 2).

Propagation in vitro

In vitro propagation has the potential for rapid multiplication of selected plant types with desired characteristics. The possibility of using plant tissue culture techniques for the rapid multiplication of cinnamon has been established. Rai and Jagadishchandra (1987) induced multiple shoots from hypocotyl segments of seedlings on Murashige and Skoog's basal medium, supplemented with α -naphthalene acetic acid (NAA) and 6-Benzylamino purine (BAP) at 0.5 mg/l. However, there is no information about the adoption of tissue culture technology for the commercial micropropagation of cinnamon so far, and this is an area needing research and development. Nirmal Babu *et al.* (1997) also reported micropropagation of *C. verum*, *C. cassia* and *C. camphora* from mature trees. Mini *et al.* (1997) have reported the induction of somatic embryogenesis in seedling cultures (see Chapter 2 for details).

Air layering

The possibility of propagation of cassia through air layering has been recorded. According to Krishnamoorthy and Rema (1994) propagation of cassia has been achieved through air layering with 50% to 87.5% success, depending on the time of the year (see Chapter 2 for more details).

Field Planting

On flat land cinnamon can be planted in straight lines and on sloping land planting on contour lines is recommended. Holes (30 cm $\times$ 30 cm $\times$ 30 cm) for planting are dug

at 1.2 m × 0.6 m spacing and filled with top soil. At this spacing 14,000 holes can be dug in one hectare. Planting must be done during the onset of rains at a rate of three plants per hole. A single hectare plantation requires 42,000 plantlets. Planting holes could also be sown direct with prepared seeds during the rainy season. If the inter plant spacing is too close then a situation results where the plants tend to grow elongated as they seek sunlight. This impairs the eventual flavour characteristics of the bark.

Maintenance

Soil management

When the land is sloppy the following soil conservation measures should be adopted:

- Digging of contour drains at suitable distances depending on the slope and the rainfall. Drains should be deep enough to allow for the settlement of eroded soil.
- Mulching with pruned branches and weeds.

Burying weeds and pruned leaves around rootstocks is helpful for better stooling. Gathering earth up to the rootstock without mounting should be done as cinnamon is a surface feeder. Rootstocks should be exposed to sunlight to allow new shoots to develop and to prevent termite attack.

Fertilizer Application

Fertilizer application is important for the commercial cultivation of cinnamon for higher productivity, as cinnamon is normally grown as a long-term monoculture. In the absence of fertilizer application the supply of nutrients in the soil will become exhausted, leading to mineral deficiencies and a drop in yield, which includes dry matter yield as well as the oil content of bark and leaves and also poor stooling. The fertilizer requirement may be based on the results of field experiments, soil and plant tissue analysis or the symptoms of mineral deficiencies or toxicities. As such, the optimum applications will vary from one region, plantation or field to another in accordance with local conditions. The Department of Export Agriculture of Sri Lanka recommends the following fertilizer mixture and quantities.

Composition	Ratio by Weight	Mineral content in the Mixture
Urea	2	N – 23%
Rock phosphate (28% P ₂ O ₅)	1	P ₂ O ₅ – 07%
Muriate of Potash (60% K ₂ O)	1	K ₂ O – 15%

The fertilizer requirement will also vary according to the age of the plantation. Following are the recommended rates of fertilizer for young plantations:

First year – 200 kg/ha/annum
 Second year – 400 kg/ha/annum
 Third year – 600 kg/ha/annum

The above is an important rain. Fertilizer After application there are some 500 kg/ha would be a

After the doubled for may be de

Training

The chief capable of age of about coppiced with a sh the cut f outside. C removed to two y allow each generates ten years.

It is al growth o plant to s important as this en

Replanting

When ci reduced low yield is conten the root preparat

Pest and

There are areas of in a dec be brou Department 1996b).

The above quantities have to be applied as two splits at six month intervals. It is important to apply fertilizer when the soil is moist or at the commencement of rains. Fertilizer should be applied at a 50 cm radius around the plant or between rows. After application of the fertilizer it is important to fork it into soil. In addition, when there are symptoms of magnesium deficiency the application of Dolomite at the rate of 500 kg/ha two to three months before applying the recommended fertilizer mixture would be advantageous.

After three years when the cinnamon is mature, the dose of fertilizer should be doubled for every successive application thereafter. However, the fertilizer requirement may be determined according to the yield potential.

Training of Plants and Pruning

The objective of training cinnamon plants is to establish a strong base which is capable of producing a greater number of healthy stems. When seedlings attain the age of about two years, and the basal diameter is about 4–6 cm, the main stem is coppiced or cut back to a height of about 4–6 cm from ground level. Cutting is done with a sharp knife having a long handle (*keththa*) at a 30° angle in such a way that the cut faces inwards. This will promote the tillering from the base towards the outside. Only three strong and straight tillers are retained while all others should be removed so as to promote the growth of these shoots as the main stems. After one to two years, the main stems are harvested (pruned) alternately. It is necessary to allow each base of the pruned stem to initiate three healthy new stems. This practice generates five to eight stems from a single bush for harvesting per year after eight to ten years.

It is also important to remove side branches of the main stem to promote strong growth of stems. In addition, the pruning of side branches will expose the base of the plant to sunlight, which is believed to initiate more tillers from the base. It is also very important to make sure that all the harvesting cuts are made at an angle of 30° inward as this encourages the clump to spread outwardly.

Replanting

When cinnamon plants are about 40–50 years old, their regenerating ability gets reduced considerably, resulting in decreased yields. Hence replacement of old or low yielding plantations becomes necessary. If large-scale replanting of a plantation is contemplated, then it becomes worthwhile to consider the possibility of distilling the root bark to produce the camphor-rich root bark oil used in pharmaceutical preparations.

Pest and Diseases

There are no major pests affecting the production of cinnamon. However, in certain areas of Sri Lanka minute insects attack leaves causing gall formation, which results in a decrease in the leaf oil yield by about 20%. The gall-forming insects could be brought under control by spraying a systemic insecticide. According to the Department of Export Agriculture, Sri Lanka, two types of galls are formed (Anon, 1996b).

4,000 holes can
ins at a rate of
rtlets. Planting
y season. If the
ts tend to grow
aracteristics of

d be adopted:

oe and the rain-
ded soil.

etter stooling.
e as cinnamon
new shoots to

cinnamon for
onoculture. In
l will become
includes dry
stooling. The
soil and plant
As such, the
to another in
e of Sri Lanka

a the Mixture

3%
7%
5%

e plantation.

Gall-forming mites – Erioplytes boisi Gerber

Galls can be found on the upper surface of leaves. The galls are pinkish in colour at the beginning which, as they mature, turn green. Mites lay eggs in the leaf tissue and gall formation starts immediately.

Jumping plant louse – Trioza cinnamini Boelli

Galls can be found on the lower surface of leaves. The eggs are laid on the leaf surface and the gall formation appears to be due to the feeding effects of emerging nymphs.

In addition, two other minor pests have been found in Sri Lanka. The first, the clear wing moth causes damage to the base of the old cinnamon plants when its larvae makes holes through feeding. The other pest, a Shoot Borer, feeds on the tender shoots which results in the death of the upper part of the shoot. Singh *et al.* (1978) reported that there are several major pests, including cinnamon butterfly (*Chilasa clytie*), shoot and leaf webber (*Sorolopha archimediass*), leaf miner (*Acrocercops* sp.) and chafer beetle (*Popillia*) in the cinnamon growing tracts of India.

Apart from these pests, several diseases of cinnamon have also been reported.

Leaf spot or leaf blight – Colletotrichum gloeosporioides

Symptoms are seen as brownish leaf spots and these may enlarge to make large lesions. Spraying 1% Bordeaux mixture or any other copper fungicide may be necessary to control the disease.

Black sooty mould – Stenella sp.

The blackish growth on the leaf surface is the characteristic symptom of the disease. The fungal growth is confined only to the surface and no penetration into the leaf tissue occurs. As this disease does not affect the yield severely, application of fungicides is not necessary.

Harvesting

Cinnamon is ready for harvesting after two to three years when the plant reaches a height of 1.5–2 m with three to four shoots and the bark turns brown in colour. The main shoot is coppiced or cut back to a height of about 6 cm from ground level. Two to three crops are taken annually depending upon the rainfall.

Normally the harvesting of mature sticks is done following the two rainy seasons when the new flush of leaves have hardened. At this time the bark peels off easily. Under good management conditions, harvesting could be done more than twice per year (Anon, 1996b). Such a practice, coupled with the split application of fertilizer, can help to increase the yield.

References

- Anonymous (1973) Cinnamon cultivation and processing. Department of Minor Export Crops, Sri Lanka.
Anonymous (1996a) Cinnamon. Department of Export Agriculture, Sri Lanka.

Anonymous (1996b)
of Export Agricu
Coppen, J.J.W. (19
Products 1/Flavou
Ibrahim, J. and Go
J. Essential oil R
Krishnamoorthy, P
J. Spices and Aro
Mini, P.M., John,
Micropropagati
B. Sasikumar,
and Aromatic P
Nirmal Babu, K
and Aromatic c
Rai, R.V. and Ja
tissue culture
Rema, J., Krish
a review.
Senanayake, U.
Cinnamomum
Singh, V., Dub
of cinnamor
Wijesekera, R
of Scientific

- Anonymous (1996b) *Cinnamon Cultivation and Processing*, Technical Bulletin No. 5. Department of Export Agriculture, Sri Lanka.
- Coppen, J.J.W. (1995) Cinnamon oils (including cinnamon and cassia). In *Non-wood Forest Products 1/Flavours and Fragrances of Plant Origin*, FAO, Rome, pp. 7–15.
- Ibrahim, J. and Goh, S.H. (1992) Essential oils of cinnamon species from Peninsular Malaysia. *J. Essential oil Research*, 4, 161–171.
- Krishnamoorthy, B. and Rema, J. (1994) Air layering of cassia (*Cinnamomum aromaticum* Nees). *J. Spices and Aromatic Plants*, 3, 48–49.
- Mini, P.M., John, C.Z., Samsudeen, K., Rema, J., Nirmal Babu, K. and Ravindran, P.N. (1997) Micropropagation of *Cinnamomum verum* (Brecht and Presl.). In S. Edison, K.V. Ramana, B. Sasikumar, K. Nirmal Babu and J. Eapen Santhosh (eds) *Biotechnology of Spices, Medicinal and Aromatic Plants*, Indian Society for Spices, Calicut, India, pp. 35–38.
- Nirmal Babu, K., Ravindran, P.N. and Peter, K.V. (1997) *Protocols for Micropropagation of Spices and Aromatic crops*, Indian Institute of Spices Research, Calicut, Kerala, India, p. 35.
- Rai, R.V. and Jagadishchandra, K.S.J. (1987) Clonal propagation of *Cinnamomum zeylanicum* by tissue culture. *Plant Cell Tissue and Organ. Culture*, 9, 81–88.
- Rema, J., Krishnamoorthy, B. and Mathew, P.A. (1997) Vegetative propagation of major spices—a review. *J. Spices and Aromatic Crops*, 6, 87–105.
- Senanayake, U.M. (1977) Ph.D. Thesis. *The Nature, Description and Biosynthesis of Volatiles of Cinnamomum* spp. University of New South Wales, Australia.
- Singh, V., Dubey, O.P., Nair, C.P. and Pillai, G.B. (1978) Biology and bionomics of insect pests of cinnamon. *J. Plantation Crops*, 6, 24–27.
- Wijesekera, R.O.B., Ponnuchamy, S. and Jayewardene, A.L. (1975) *Cinnamon* – Ceylon Institute of Scientific and Industrial Research (CISIR), Colombo, Sri Lanka, p. 48.