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PROSPECTS AND PROBLEMS OF TREE SPICES CULTIVATION IN INDIA

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Introduction

The tree spices comprising of nutmeg, clove and cinnamon are grown in certain pockets of Kerala, Tamilnadu and Karnataka. Reliable statistics on the area and production of nutmeg, clove and cinnamon are not available, since the cultivation is in isolated patches and homestead gardens. A rough estimate has shown that there are approximately 200 ha. each under clove and cinnamon and about 400 ha. under nutmeg (Sri Ram 1976). However, our survey has indicated that this estimate is very much on the lower side with respect to the area under clove and nutmeg. The internal production has been found insufficient and the country imports about 15 tonnes of clove, 40 tonnes of nutmeg and mace and about 40 tonnes of cinnamon valued 2.868 million rupees (Sri Ram 1976.)

The agro-climatic conditions prevailing in the slopes of Western Ghats are highly suited for cultivation of tree spices and there is immense scope for increasing the area under these crops. The improvement of tree spices has also not received any attention till now except for some preliminary work carried out at the Horticultural Research Stations, Kallar and Burliar in Tamilnadu.

One of the items of work taken at this Institute on priority basis is to assemble the valuable germ plasm of tree spices, available within the country as a foundation for further improvements contemplated. Accordingly a survey of these crops were undertaken starting from March 1976 and so far the entire nutmeg, clove, and cinnamon growing areas in

Kerala and Tamilnadu have been covered and 157 accessions of nutmeg, 89 accessions of clove and 139 accessions of cinnamon have been assembled at the experimental farm at Peruvannamuzhi. Brief descriptions of the crops along with the relevant information collected during the survey are given in the following pages.

Nutmeg (*Myristica fragrans* Houtt)

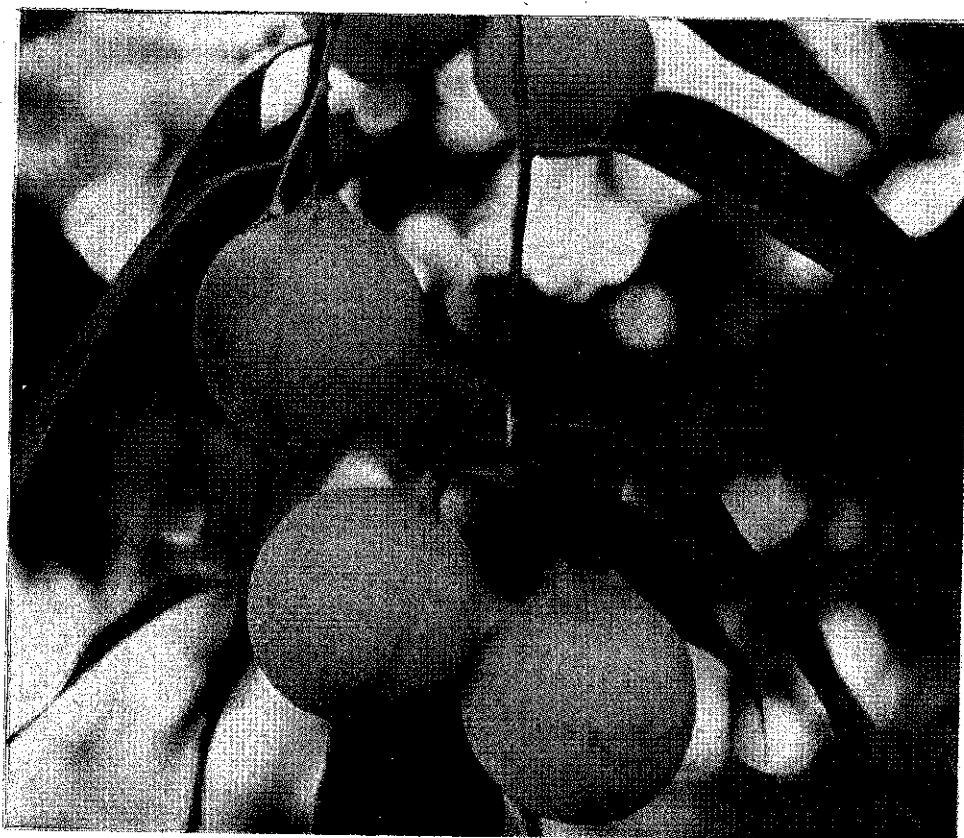
It is indigenous to Moluccas and other islands of the East Indies and it produces two separate spices-nutmeg and mace. The dry shelled seeds are nutmeg and dry aril is mace of commerce. The annual world production amounts to about 7010 tonnes of nutmeg and 4000 tonnes of mace, 60 percent of which is produced by Indonesia (Flach and Cruickshank, 1969). The densely foliated ever-green tree with spreading branches grown to a height of even 200 feet. The oldest plantation in Kalady (Kerala) is reported to be more than 150 years. The tree is generally dioecious except for occasional female flowers observed in a normal male tree, and thus is an obligatory cross breeding species. It takes approximately 9 months for the fruit to develop after pollination. The fleshy fruit is oval in shape and lemon yellow to light brown in colour. When fully matured, the fleshy pericarp splits from the tip, exposing brilliant scarlet aril.

Since it is an obligatory cross-fertilized crop, the variation observed is considerable and the survey has indicated that the plants differ not only for all aspects of growth and vigour, but also, sex expression, size and shape of nutmeg, quantity of mace etc. The weight of individual nuts varying

from 2g. to 15g. were collected during the survey. Trees yielding fruits from few to about 10,000 observed during the survey indicated the untapped yield reservoir existing for exploitation.

The main problem facing the nutmeg cultivation at present is the segregation of seedlings into 1:1 ratio for male and female resulting in about 50% of unproductive trees. Though the determination of sex at seedling stage has been claimed based on leaf form and veins (Prestoe, 1948), the colour of young sprouts (purple-female; green-male) vigour of seedlings (more vigorous seedlings-male) and chromosome morphology (Flach, 1966), none of them have been found reliable till now. The differences in shape of calcium oxalate crystals in female and male nutmeg plants reported recently (Nayar et al 1977) also do not seem to have much practical application since this distinction is clear only in older plants. The only answer seems to be to locate sex-linked characters in seedlings and correlate them with the sex of the adult trees, later. Till then the alternative seems to be the vegetative propagation converting all the male trees in the plantation into female by either budding or grafting. It has been generally found that the ratio of 1:30 (male to female) will be sufficient to have adequate pollination. The success of budding has been reported to a limited extent by Postma (1935) and 60% success in approach grafting on rootstock of other species like *M. malabarica* and *M. beddomii* has been reported by Sundararaj and Varadarajan (1956). The vegetative propagation has not been exploited till now mainly due to inadequate attention bestowed on it. Few grafts of nutmeg planted at Agricultural Research station, Thaliparamba have spreading habit and stunted growth compared to the seedlings planted at the same time. However, some enterprising and

enlightened farmers of Kottayam have successfully established buds and grafts even on a commercial scale. The method followed by them is to graft the male trees as soon as the sex is known after the first flowering. The young male trees are cut back at a convenient height leaving few branches below. Just below the cut end patch budding is done during the end of rainy season. Both for budding and grafting it is desirable to use an erect growing shoot as scion which only will grow into an erect growing tree subsequently. It is possible to convert older (7-10 years) male trees into female by patch budding, provided the budding is done to an erect growing shoot arising from below the cut end. Successful establishment of buds and grafts and subsequent bearing observed in Kottayam, shows that selecting erect branches is very important in grafting and patch budding of nutmeg and if proper attention could be bestowed on this, the problem of sex could be solved practically. In view of the exorbitant cost of grafts and buddings it is necessary to have concentrated approach to produce large number of buddings and grafts of nutmeg and make them available to the growers at reasonable prices.



Nutmegs are generally grown on the river banks since it grows up luxuriously in silts deposited by the river. The seeds are extracted from the fleshy pericarp and sown immediately in sand and it takes about 60 to 90 days for germination. About six months old seedlings are transplanted to alkathene bags or tile pots and about 18 months to 2 year old seedlings are transplanted in the field. The spacing adopted by the farmers at present vary widely. Some nutmeg trees are spaced even at 3 metres apart, and sun light rarely gets in such closely spaced gardens resulting in poor bearing. The maximum spacing adopted by farmer at present is 6 - 7 metres and even this seems to be insufficient. The best yield in nutmeg is observed in the case of isolated trees. In view of this, a spacing at 9 metre apart seems to be the minimum required for nutmeg.

As a rule, only organic manures are applied by the growers. The quantity of farm yard manure, compost, bone meal and fish meal applied vary from garden to garden. Most of the growers are convinced that bone meal is the best for increasing the bearing in nutmeg. However, experimental evidences for the actual nutrient requirement of the crop is lacking.

The fruits are ready for harvest in about 9 months after flowering. The harvesting continues throughout the year though June to August is the peak period. In the case of homestead gardens with the limited number of trees, the owner himself attend to the harvesting which is limited to either collecting the seeds fallen on the ground or harvesting the fruits burst open on the tree. In the case of larger plantations the owners generally give the harvesting on contract basis, and latter to reduce the cost of harvesting, plucks even immature nuts resulting in poor quality nutmeg and mace. Generally the harvesting is done by means of a stick to the end of which a hook or knife is attached. The collected fruits are split open to remove the outer fleshy portion and the mace is separated from the nut by hand and then the nuts and mace are dried separately on drying yard, or in platform arranged in kitchen. The scarlet mace gradually becomes yellowish brown and brittle when it is packed. The drying is not done under hygienic condition and often mould infections are seen on the dried nutmeg and mace. Drying the nut and mace in hot air oven may help to avoid contamination.

Clove—*Eugenia caryophyllus* (Sprengel) Bullock et Aarrison

The clove, is also indigenous to Moluccas or Spice Islands and belongs to the family Myrtaceae. The clove of commerce is the aromatic, dry, fully grown and unopened buds of the clove trees. The annual world production of clove is about 30,000 tonnes, out of which over 12,000 tonnes are used for the production of Kretek cigarettes in Indonesia. Though the Dutch Government restricted the cultivation of clove exclusively to Moluccas Islands, by 19th Century beginning it was smuggled into Mauritius and later on established in the islands of Zanzibar and Pemba. These islands, now part of Tanzania have become the world's largest producer of clove. In India the clove cultivation is limited to the southern parts of Kerala and Kanyakumari, Tirunelvely and Nilgiris of Tamil Nadu. The clove plantation within the country is reported to have originated from few seedlings obtained from Mauritius. The hermaphrodite flowers and their structure ensure complete self-pollination. The germplasm collection from within the country has not yielded any appreciable variability due to these inherent limitations. Only two types have been observed, distinguished by prominent and slightly curved veins in one type and weak and parallel veins in the other. The latter type has generally spreading habit and reported to be good bearer.

The seeds are obtained from professional agents by paying high rate of even upto Rs. 500 per kg. which may contain a maximum of 400 seeds yielding about 250 seedlings finally. The fresh seeds could be sown either by removing the outer husks or as it is and the germination commences in two weeks time and may continue for another 3 - 4 weeks. Our own experience has shown that it will be better to sow the seeds by removing the outer husk. The seeds are sown in sand beds and transplanted to polythene bags after 2 - 3 months where it will remain for 12 to 18 months. The existing rates of seedlings in commercial nurseries vary from Rs. 5 to Rs. 25 according to age and vigour.

Long juvenile phase can be circumvented by an effective vegetative propagation and in this regard some work has been done at the Horticultural Research Stations, Kallar and Burliar. Inarching clove on clove seedlings form May to July was found to be successful vegetative propagation

method at the Burliar. It was also reported from the plantation that the current season shoots arising from older woods appeared to be good scion in the establishment of the grafts than terminal shoots. In Indonesia approach grafting on to young clove seedlings has been attempted but success has been limited till now (Nutman and Roberts, 1953).

Best clove plantations are located in loamy soils with rich organic manures and plenty of irrigation facilities. As in the case of nutmeg the spacing adopted vary widely from 3 metre upto 7 metres and the latter seems to be optimum under the existing circumstances.

Only organic manures are applied by the growers to clove plantation and the quantity applied also varies widely as in the case of nutmeg.

The unopened buds turning slowly pinkish and about 3/4th inches long are ready for harvest. Cloves are picked with care since the opened flowers are no longer valued as a spice. The branches also should not be broken, in which case the succeeding growth is reported to be affected. It is a common practice among the growers not to leave the tree to have fruits (mother of clove) which is likely to have adverse effect on subsequent flowering. The collected buds are separated from the clusters by hand and spread in the drying yard for several days. The correct stage of drying is determined when the stem has dark brown and the rest of the bud lighter brown colour. The properly dried clove will be only about 1/3 weight of the original and it takes about 11,000 to 15,000 dried cloves to make one Kg. The drying practiced by the growers are also not hygienic and probably artificial drying may have to be adopted to avoid contamination.

Cinnamon - *Cinnamomum zeylanicum* Nees

The dried inner bark of *Cinnamomum zeylanicum* is the true cinnamon of commerce. In Great Britain, the term 'Cinnamon' applies to *Cinnamomum zeylanicum* and 'cassia' to *Cinnamomum cassia* (Chinese cinnamon) / but in United States it is officially permitted to use the term cinnamon for both species.

Cinnamomum zeylanicum is bushy ever green tree belonging to the family Lauraceae. It may reach a height of about 10 to 15 metres but in cultivation it is generally grown coppiced or cut back in the bush. Its highly aromatic leaves are 5 to 7 inches in length, pointed and dark glossy green in colour. The flowers are small, yellow and inconspicuous. The berries are 1/2 inch to 1 inch long and are dark purple and ovoid.

The cultivation of cinnamon is in isolated patches and the Randattara Estate at Anjarakandy near Cannanore with an area of 85 ha. is the only large scale plantation in this country. The following



grades of commercial cinnamon are prepared in the estate:

1. Superior grade cinnamon bark quills
2. Quillings
3. Featherings
4. Special scrape chips
5. Ordinary scrape chips
6. Unscraped chips

For preparing quills, the sticks are cut about 40 days after the first rain. The trained workers select sticks suitable for quills. After cutting, the outer bark is scraped with a knife, the bark peeled and dried in the shade for one day and then dried in the sun for three to four days. During the drying the bark curls, assuming the shape of a quill. The smaller quills are inserted into the larger quills, forming pale brown cane like bundles of compound quills.

Cinnamon leaf oil and bark oil are distilled in the Essential Oil Company, attached to the Randattara Estate. The leaves are dried before distilling. The leaf oil distilled is reported to be of highest quality fetching premium price in the International Markets. The physical properties of the leaf oil distilled in the estate are:

Sp. gravity	(15.5°C) - 1.0551
	(20°C) - 1.0494
Refractive index	(70°C) - 1.5388
Optical rotation	(21°C) - +0.5°
Phenols (Eugenols)	- 91%

The cultivation of cinnamon is not popular among the growers, in view of the poor marketing facilities to sell their produce like bark and oils. The official estimate shows that India imports cinnamon worth Rs. 10 lakhs annually. In spite of this shortage, the cultivator is not able to command reasonable price for his produce. Along with the selection and multiplication of the desirable cinnamon types, it is essential to organise the marketing of cinnamon bark and oil in this country to encourage cinnamon cultivation, by ensuring reasonable returns to the growers.

The survey has revealed that organised planting of cinnamon has not been practised in this country.

Except for Randattara Estate and a handful of smaller estates, generally few trees are grown in the backyard as a curio. The variation observed in *C. zeylanicum* is very limited. The original source of seed materials for Anjarakandy is reported to be from Ceylon, some 180 years back and from here it has spread to other areas. The popular method of propagation is through seeds. The genetic variation observed in the germplasm collection can be attributed largely due to the seed propagation practised in this crop.

The spacing of about 3 x 3 m adopted in the larger plantation seems to be quite optimum, since the trees are coppiced after three years of plantings and subsequent cuttings are taken in alternative years. Cultural operations are restricted to weeding twice in an year and digging the soil around during August-September in the bigger plantations. Manuring the crop is considered as a luxury by the growers and generally not practised.

A brief description of diseases and pests of tree spices observed during the survey is given below:-

Diseases

Nutmeg

Fruit rot: Immature fruit split, fruit rot and fruit drop are highly prevalent in majority of the nutmeg gardens in Kerala. Immature nut split and shedding without any infection is noticed in some. In the case of fruit rot the infection starts from the pedicel as dark lesion which gradually spreads to the fruit causing brownish discolouration of the rind resulting in rotting. In advanced stages the mace also gets spoiled emitting foul smell. *Phytophthora* has been isolated from the affected fruits. *Diplodia Matalensis* has been reported to be causing fruit rot in nutmeg (Ramakrishnan and Damodaran, 1954). The causes appear to be both physiological and pathological and need critical investigations. Occasional dark sunken lesions, dark scabbing mostly restricted to the outer layers of the pericarp were also noticed without affecting the mace. Attempts to isolate causative organisms were not successful till now.

Leaf rot and Shot hole: Leaf rot starting from the tips of the leaf and spreading downwards was

noticed. Marginal necrosis which spreads inwards gradually results in leaf rot. In few cases the dark brown leaf spots with chlorotic halo were noticed. The necrotic spots become brittle and fall off resulting in shot holes. *Cylindrocladium quinquiseptatum* has been identified as the causal agent of this disease.

Die-back: Drying up of mature and immature branches from the tip downwards was noticed in some gardens resulting in die-back. *Diplodia* sp. and few non-sporulating fungi were isolated. *D. natalensis* causing die back has been reported (Wilson, 1974).

Thread blight: Two types of thread blights were noticed in nutmeg in majority of the gardens both at Kalady and Kottayam areas. The first was a white thread blight. Fine whitish hyphae aggregate to form fungal threads traversing along the stem and underneath the leaves in a fan shaped or irregular organization causing blighting of the affected portion. The dried up leaves with mycelium form the major source of the disease spread. The fungus has been identified as *Marasmius* sp. The disease is of considerable importance causing foliar damage in certain gardens. *M. pulcher* (Berk and Br.) Petch, has been reported to cause thread blight in nutmeg. (as cited in Weber 1973). The second one is like that of horse hair blight. Fine black silky threads of the fungus form irregular, loose net work on the stems and leaves. Blighting of the leaves and stems was not noticed. However, these threads hold up the detached dried up leaves on the tree, giving a blighted appearance of leaves when viewed from distance. Sometimes the insect eggs were also noticed sticking on to the fungal threads. The fructifications were occasionally found hanging in these tangled hairs, with dark stipes. The fungus has been identified as *Marasmius* sp. The disease does not cause much damage. Horse hair blight caused by *Mequicrinus* has been reported in cacao. (Leston 1970).

Clove

Leaf rot: Both in mature trees and seedlings, leaf rot was noticed in majority of the gardens. The infection starts as dark patches and spots from the edges and some times at random. The progressive rotting involves the whole leaf or tips of the leaf resulting in severe defoliation. *Cylindrocladium*

quinquiseptatum has been identified as the causal agent of this disease.

Seedling wilt: Wilt is a serious problem in majority of the nurseries resulting in death of 5-40% of the seedlings. The leaves of affected seedling loose natural lustre, tend to droop and ultimately dies out. The root system and the collar of the seedling shows varying degrees of discoloration and decay. *Cylindrocladium* sp, *Fusarium* sp, *Colletotricum* sp, *Rhizoctonia bataticola* *Trichoderma* sp, and *Phytophthora* sp. were isolated and the causal agent is yet to be determined.

Cinnamon

Leaf spot: Dark brown leaf spots which appear brittle and sunken are noticed in some which yielded *Gloeosporium* sp.

Seedling blight: In nurseries blighting of the stem with light brown patches was noticed. In several cases this results in death of the seedlings isolations yielded *Diplodia* sp.

Leaf spot caused by *Cepheleuros* sp. appears to be a common foliar disease noticed in all these three crops. The disease problem of these crops need through investigations so as to plan effective control measures.

Pests of nutmeg, clove and cinnamon:

The number of insect pests affecting clove and nutmeg are few compared to other crop plants.

During the survey it was found that the scales and mealy bugs were the important pests affecting the tree spices. The scale affecting nutmeg were collected and got identified by the Commonwealth Institute of Entomology, London as *Lecanium psidii* and the associated ant as *Hypoclinea thoracica*. The scales are seen on the underside of the leaves and younger twigs. In severe cases of infestation the plants give a sickly appearance.

Other non-insect pests are Cuckoo and squirrels. The bird removes the seed with mace from the open fruit and is discarded after eating the mace. The squirrel also extracts the seed and consumes the mace. The discarded seeds show some feeding marks on the seed coat.