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# CLOVES

*(EUGENIA AROMATICA)*

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# CLOVES

(*Eugenia aromatica*)

*Description.*—A small-sized tree, attaining a height of 25 to 40 feet. The stem is generally forked and has several erect main branches. The smaller branches do not spread widely so that the tree is bushy and cone-shaped. Cloves are stated to be native of several islands of the Moluccas.

The flowers are borne in groups of three in paniculate cymes. Cloves of commerce consist of the dried unopened flower buds of the tree. The buds consist of a fleshy, sub-cylindrical base crowned with four thick calyx teeth and four lighter coloured petals, which are wrapped together containing the style surrounded by stamens. Good cloves are a rich reddish-brown colour, with fine aroma and flavour. They should be plump in appearance and complete with their crowns.

Cloves owe their aromatic properties to a volatile oil known as oil of cloves, the proportion of which varies from 16 to 19 per cent. by weight. The essential constituent of oil of cloves is a compound known as eugenol. Clove oil is used in perfumery, in soaps, for medicinal purposes, and in the manufacture of vanillin.

Formerly this crop was of considerable importance in Malaya, particularly in Penang and Province Wellesley, but, owing to damage by pests and diseases and competition from rubber planting, its value has become greatly reduced. At the present time about 85 per cent. of the world's production of cloves is from Zanzibar and Pemba. A smaller production comes from Madagascar, and also from the Netherlands Indies and Penang. Returns show that about 350 acres are under cultivation with cloves on Penang Island. Cloves from Penang are always at a premium since, in appearance, they are large and plump and of a bright reddish colour. They have been described as the best cloves in the world.

*Soil and Situation.*—The most suitable soils are well-drained friable clay loams capable of retaining moisture; stiff clays that harden during dry weather are less favourable. The clove tree is very sensitive to excessive ground water, and fails entirely in badly drained, stiff clay soil. It is stated that examination of soils in Zanzibar demonstrates that the tree is tolerant of acidity. The tree is shallow-rooted and the conservation of fertility in the top 18 inches of soil is of great importance. The root system is mainly superficial, consisting of a network of subsidiary roots and spreading to a radius of 15 to 25 feet and descending to a depth of 12 to 15 inches. This shallow-rooting habit causes

the clove tree to be very susceptible to drought, especially in the early stages. In Penang, cloves are cultivated on hills from 200 to 2,000 feet above sea level, with the greatest success at the higher levels. At the Central Experiment Station, Serdang, considerable success has been obtained with this crop on the Hill Quartzite soil of the plains. Although the clove is generally considered an insular plant and established plantations are commonly near the sea, results to-date at Serdang with twelve-year-old trees, demonstrate that it may be grown inland and on the plains, provided soil conditions are suitable.

*Propagation.*—After flowering, the lower part of the flower swells and develops into a fleshy, one-seeded drupe, purple in colour and about 1 inch long, crowned by the persistent calyx teeth and style. The period between opening of the flower and ripening of the fruit is approximately four months. The weight of mature fruits is variable, ranging from 100 to 150 per pound; the hulled seed is about one-third of the entire fruit. The drupe consists of the interior cotyledons enclosing the embryo surrounded by a fleshy mesocarp, and exocarp. At Serdang, the whole fruit is sown but in Zanzibar the hulled seed is favoured. These are lightly pressed into the soil in a vertical position with the radicle pointing downwards. On a plantation scale, the seed is planted in prepared beds under shade, at a distance of 6 inches by 6 inches, and the seedlings partially hardened before transplanting. Although very sturdy seedlings may be raised by this method, serious difficulties arise when the plants have to be transplanted and many casualties occur in the field. The best results have been obtained at Serdang by placing fresh fruits in boxes of prepared soil. The fruits are closely spaced and kept under shade.

Germination takes place in twenty days and is completed in two months, when 75 per cent. germination or more is obtained. Powers of germination are short-lived and the fruits should be planted as soon as collected from below the trees. When the seedlings have two or three pairs of leaves, they are carefully lifted from the seed boxes and transplanted into bamboo joints. It is important to transplant the young seedlings before the tap root has become elongated and twisted. The bamboo joints containing the seedlings are then placed on a firm surface under shade, sufficiently high to permit of watering. With suitable treatment the young plants attain a height of 6 inches within nine months from germination, and carry about ten pairs of leaves. The overhead shade is then gradually reduced and the plants are ready for planting in the field.

*Planting*.—Seedlings having about ten pairs of leaves are planted in their permanent situations in the field during the rainy season. The first half of November is the best time to plant, as the seedlings then have the full advantage of the long wet season; it also permits supplying during the following short wet season which may occur in April and May. The planting distance adopted at Serdang is 20 feet by 20 feet triangular, allowing 124 trees per acre. There are possible objections to this spacing since it is unnecessarily wide in the early stages of growth, and probably too close when the trees mature. In Zanzibar, closer planting is suggested with subsequent thinning, giving an ultimate stand of 48 trees to the acre. On hill land in Malaya the former planting distance is recommended.

To encourage the seedlings to make maximum growth, large planting holes should be provided. Holes 2 feet by 2 feet square and 2 feet deep are recommended. The sub-soil is removed and replaced by a mixture of well-rotted cattle manure, or other organic matter, and surface soil. Experience gained at Serdang shows that unless the seedlings are liberally treated at time of planting, a fairly high percentage of plants die after transplanting in the field. This loss of young plants occurs for about twelve months subsequent to planting. Aided by liberal manuring, clove trees can be established on land that has been opened up from jungle for some years and has grown other crops. After planting, the seedlings are shaded with jungle herbage placed securely round the plants. Even with the greatest care, considerable difficulty is experienced in establishing a satisfactory stand of trees and consequently supplying is necessary. An adequate number of seedlings should be retained for this purpose.

*Cultivation*.—Investigations have been conducted at Serdang to ascertain whether overhead shade is beneficial with this crop in Malaya. Shade trees have a drawing effect on the clove tree and there appears no advantage in their use. It is important to encourage a rounded bushy crown with branches almost to the ground in order to permit maximum flowering and facilitate harvesting. On the other hand, the question of soil erosion is an important one and must receive consideration. Some form of undergrowth is necessary to protect the soil from erosion and maintain a degree of surface fertility. A number of shrubby leguminous plants may be employed for this purpose *e.g. Crotalaria anagyroides, C. usaramoensis,* and *Tephrosia candida.* Two to three rows of such plants should be sown between the rows of clove trees and kept in good condition by periodical pruning. The slopes of Penang hills are exceedingly steep, but

soil wash is prevented to some extent by the numerous granite boulders present. The Chinese growers commonly use the granite rock to build up terraced walls on the lower side of the clove trees with the object of supporting the trees and minimizing erosion.

Since the clove tree forms a mat of roots just below the surface of the soil, competition from weeds or cover crops in the immediate vicinity of the bush must be prevented. For the same reason, hand-weeding should be performed below the trees in preference to the use of implements.

Although information on the manuring of the clove tree is meagre, the tree undoubtedly responds to manurial treatment. At Serdang, young bushes have shown considerably improved growth as a result of applying 3 ounces of sulphate of ammonia in a shallow circular trench well away from the feeding roots of each tree. The following mixture of fertilizers is suggested for mature trees; sulphate of ammonia, 2 parts; rock phosphate, 5 parts; sulphate of potash, 2 parts. An annual application of 3 to 5 lbs. of this mixture should be turned below the soil well away from the mat of roots below each tree. The production of heavy crops is accomplished by Chinese growers in Penang by liberal dressings of prawn refuse (analysing 3.5 to 4.5 per cent. nitrogen, 5.5 to 11.5 per cent. phosphoric acid); as much as 25 lbs. a tree is often applied annually.

*Harvesting.*—Young trees commence to produce small crops when six or seven years old. A flush of young leaves appears, followed by the flower buds. These are green at first but finally turn yellowish with a red tint, at which stage they are fit to gather. The buds are gathered by hand, with the assistance of light ladders and hooked sticks. Since all the buds do not ripen at the same time, it is necessary to go over the trees several times during the harvest season. Flowering shows considerable variation in intensity and occurs locally from January to August with the main crop during May to August. The periodicity of flowering is governed by factors whose nature is imperfectly understood.

*Yields.*—The yield of dry cloves from eight-year old trees is about 3½ lbs. per tree, which rises to about 5 lbs. per tree. It is difficult to estimate yields per acre since it is unusual to find a complete stand of bearing trees, and yields vary from year to year. Under favourable conditions an annual return of 3 to 4 piculs (1 picul = 133 1/3 lbs.) per acre may be obtained. Large trees in Penang which have been heavily manured are stated to yield as much as 15 lbs. of dry cloves per tree.

*Preparation and Uses.*—The freshly collected flower buds are sun-dried for one week on mats or concrete barbacue. It is stated

that, in Zanzibar, during wet weather excellent results are obtained by drying cloves in copra kilns; with careful firing drying is completed in twelve to fifteen hours, and the cloves so treated realize a premium over those sun-dried, because of their brightness. The weight of dried cloves is about 30 per cent. of the harvested flower buds. Care in sorting out all stalks and extraneous matter and grading by hand is undertaken for export.

In addition to their use as a flavouring spice, cloves are employed in European and Malay medicine. Oil of cloves is obtained by distillation; about 17 per cent. from the cloves, 5 to 6 per cent. from the stems and seeds, and 4.5 per cent. from the leaves, all on dry weight, is secured.

*General Considerations.*—Since there is a local demand for this spice, there appears no reason why clove planting should not be extended in Malaya. Low prices for many years have prevented any extension of planting on a large scale, but it is considered that, in suitable localities, the small-holder might plant the clove tree with profit. Preparation is a simple procedure and the crop may be kept in a dry place without deterioration.

*References.*—Articles containing information on cloves are obtainable from the Agricultural Economist and Editor, Department of Agriculture, S.S. and F.M.S., Kuala Lumpur.

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