

Economics of yeast production: By the experiments carried out in the pilot plant at Coimbatore, it has been possible to increase the recovery of yeast from 8% at the start to 14%. This is of course still considered as a low yield and much higher percentages of recovery have been claimed in other countries. Further work in the pilot plant is being pursued to improve production. The cost of production of yeast in the pilot plant has been high (about Rs. 3/- per pound) and two factors have contributed towards it, the high steam charges and the cost of purchasing and transporting molasses, the chief raw material. But this cost of production should not be taken as a standard. The experience so far gained has shown that yeast manufacture can be a profitable concern if it is started as an adjunct to a sugar factory where molasses form a waste product and there is no charge for transport. Further the overhead charges can also be considerably reduced as many of the facilities available in the sugar factory, can be easily utilised for yeast production.

Yeast industry is bound to be of national importance in a country of undernourished population like ours. The raw material is available in plenty as a waste product. It is hoped that the work carried on at Coimbatore will provide the necessary incentive and encouragement to private enterprise.

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Cardamom — (*Elettaria Cardamomum*, Maton)

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Cardamom occurs wild in the evergreen jungles of the Western Ghats in Travancore, Madras, Coorg and Mysore. It is also cultivated in those areas between 2,500 to 4,500 ft. above sea level. It can be grown only under the shade of forest trees and it does well in areas where the annual rainfall is about 100 inches and well distributed. Cardamom is almost entirely a South Indian product though its cultivation extends to Ceylon, Eastern Archipelago and Java to a comparatively small extent.

Cardamoms are used in India for flavouring sweets and curry powders. They form part of some Indian medicines. They are used for flavouring cakes in Europe especially in Russia, Sweden, Norway and parts of Germany. In European medicine, they are chiefly used in tincture of cardamom, as a stomachic, and in combination with other

drugs as an aromatic. The cardamom owes its special properties to a volatile oil it contains. The oil is light yellow, viscid, has the strong aromatic odour of cardamoms and a pleasant cooling taste.

Botanical description : The cardamom plant, *Elettaria cardamomum*, Maton comes under the natural order Scitamineae and family Zingiberaceae. The plants consist of perennial rhizomes throwing up leafy aerial shoots bearing at their bases one or more flowering panicles. The leafy shoots and flowering panicles have a short life of three years. New shoots arise from the bases of old ones, thus extending the rhizome system and resulting in the gradual formation of a large clump of leafy stems.

The leafy shoot consists of a central stem, bulbous at the base and bearing the sheathing leaf bases of the alternate leaf blades. The leaf blades are elongate, elliptic. The flowers are borne on lax panicles usually called racemes which arise from the base of the leafy shoot. These panicles may be erect, flexuous or prostrate according to the variety. Each panicle consists of a main rachis extending up to four feet, bearing short alternate racemes. These racemes bear the flowers. The flowers open in succession from the base towards the apex.

The floral parts are arranged on the trimerous ground-plan of the monocotyledons, but the members of the successive whorls originate in a close spiral series. The outermost whorl, the calyx, is tubular having three toothlike lobes at its apex. The corolla is tubular below and is divided into three distinct lobes, each of which is oblong-linear with slightly inflected margins and the ends turn up at the edges slipperwise. The members of this whorl alternate with those of the calyx whorl. Only one of the six anthers is functional. Three anthers are modified into a false petal called 'Labellum' the attractive and prominent portion of the flower, while the other two anthers are non-functional. The pistil is composed of a trilocular, inferior ovary with a filiform style ending in a capitate stigma.

Varieties : The genus *Elettaria* consists of only one species *Elettaria cardamomum*, Maton. Among the various varieties of the species met with, four are important; the descriptions of which are given below :

1. "*Malabar*" : This is the most common variety widely cultivated in the Cardamon Hills of Travancore and on the Southern side of it, up to the river Tambraparani. The plant is of medium size, neither as robust as the "*Mysore*" nor as small as "*Munzerabad*". The panicles are prostrate and the pods are round and slightly elongate. The lower surface of the leaf is pubescent.

2. "*Mysore*" : Robust plant with erect panicles. Pods are elongate and leaves glabrous.

3. "Ceylon": Slightly more robust than "Mysore". The panicles are erect. The pods are loosely packed in the panicle and elongate. Leaves are glabrous.

4. "Munzerabad": This is a short variety; yields well. Pods are round and arranged closely in the panicles which are prostrate. Leaves are pubescent on their under surface.

Besides the cardamoms proper, there are a few plants closely allied to the cardamoms whose seeds resemble the true cardamoms in taste and smell. They are (1) the round or cluster cardamom (*Amomum kepalage*) of Java, the seeds of which have a camphor-like taste, (2) Korarima cardamom whose fruits are larger, reddish-brown in colour, striated and the seeds tasting like true cardamoms, (3) Bengal cardamoms (*Aframomum aromaticum*) the fruits of which are larger, winged and the seeds tasting somewhat like camphor and (4) Wild cardamoms (*Aframomum xanthoids*) or "Siam cardamoms" the fruits of which are spiny and the seeds resemble closely the genuine cardamoms but with a different flavour.

Distribution and Area: The cultivation of this crop is very restricted as it can grow only under favourable conditions such as the following:

- (i) Elevation ranging from 2,500 to 4,500 above sea level.
- (ii) A well-distributed rainfall of at least 80 inches per year—100 to 150 inches being the ideal
- (iii) The presence of evergreen forest affording shade to the crop throughout the year.
- (iv) A well-developed mulch regularly replenished by shade trees and a well-marked humus accumulation below.
- (v) Good protection from wind.

From the available records, the total area under cardamoms is estimated to be 1,08,400 acres, distributed as follows:

	Approximate area in acres
a. Travancore — Cardamom hills	6,000
b. Mysore — Hassan and Kadur	21,800
c. Madras — Coimbatore, Madura, Ramnad and Tirunelveli	15,000
d. Coorg	10,000
e. Bombay, North Canara	900
f. Cochin	700
	1,08,400

Soils and manuring: The soils most favourable for this crop are those of the evergreen forest. Such soils owe their suitability to the climate and cover of dry leaves dropping from the shade trees. The crop

appears to have an adaptability to get on in a variety of soils, the ideal one being the deep chocolate coloured forest soil. It is also found to thrive well on stony soils and in localities on a shallow zone of humus over white gravel. The presence of a well-developed mulch, a well-marked layer of humus and adequate moisture are the common features of all cardamom-growing areas.

Cardamom is not generally manured, though in Coorg, the practice of applying well-mixed cattle manure and ash is in vogue in small holdings.

Season and climate: Cardamom is a perennial crop. Once it is planted, it continues in the field for 15 to 20 years. It is considered necessary to replant the field after about 15 or 20 years. The soil should be deep and moisture well conserved. It is also necessary that the rainfall should be well distributed.

Preparation of the field: The shrubs and short plants are first cut and then heaped in rows to decay. The debris so collected is utilised to arrest erosion in steep lands. The shade trees are pruned so as to allow adequate sunlight to the plants. Pits are then dug at desired distances usually of the size of 2' x 2' x 1'.

Propagation: Cardamom is propagated by two methods, (1) Vegetatively and (2) through seeds. In the vegetative method of propagation, old clumps are lifted and the rhizomes split into small parts each bearing at least one big and one small aerial shoot. Then each of these parts is planted in a pit. This becomes a full clump in two years. By adopting this system, the crop begins to yield in two years after planting.

The planting of rhizomes has to be done with care. Three-fourths of the soil dug out is pushed and spread inside the pits. The rhizome with its aerial shoots leaning against the slope of the land is placed in the pit and the soil left outside is then spread over the rhizome. The soil is then compacted gently and dry leaves are spread around the plant to serve as mulch.

The selected clump can be propagated vegetatively without any chance of "splitting" in its characters. But the scope of multiplication is limited since more than 20 splits cannot be got from one clump. Further, mosaic disease and insects such as thrips can pass on from the old to the new plantation. The transport of rhizomes is laborious and planting has to be done as quickly as possible as rhizomes pulled out cannot be kept long. The propagation through seeds has the advantage of getting a large number of seeds from one clump. The seed material can be easily transported and the seeds can be treated against pests and diseases. But raising a nursery is difficult and requires experience. The bearing is delayed by a year or two and the cost involved is high.

Nurseries require shade and this is provided either by jungle trees or by artificial sheds. The former is cheap while the latter is more successful. Slopy areas are terraced and reinforced with logs of jungle trees. On level grounds the beds are formed $\frac{3}{4}$ to 1 foot above the groundlevel. The beds are levelled. Over this, fine black jungle soil is spread to a depth about one inch. Ash and well-rotted cattle manure are spread and stirred. Ripe pods are collected and the seeds removed. Ripe seeds alone are taken and washed three or four times to remove the mucilaginous coating over them to prevent ants from carrying away the seeds. The seeds are then dried in shade and mixed with ash before sowing. They are then sprinkled gently and covered with a thin layer of fine sand. A thin layer of grass is spread over them to serve as mulch and the beds are watered frequently. Germination starts after 4 to 5 weeks. Two months after sowing it is advisable to spray 0.5% Bordeaux mixture against nursery diseases. Much virtue is claimed for the leaves and branches of "*Phyllanthus emblica*" for shading the nursery and in Mysore, the branches are stuck in the ground close enough to afford them shade both in the nurseries and for the newly transplanted seedlings. The leaves of *Phyllanthus* soon drop off completely and leave the branches quite bare. The beneficial effect may be due to the astringents, gums or other active principles in the leaves and branches and the leaves are credited with the power of keeping off vermin and insect enemies. In Areca gardens, it is the invariable practice to apply these leaves to cardamom plants as manure and perhaps for the sake of the above advantages as well. When the seedlings are about 6" to 12" high, they are to be lifted and planted 2 feet apart either way in a second nursery. After a year in the second nursery, the plants are fit to be planted in the field. The most common spacing adopted in the final planting is 8 feet either way. The spacing is increased or decreased by a foot or two according to varieties, rainfall and climate.

Intercultivation: The soil in the cardamom field is not generally disturbed. In a few instances the surface soil is scrapped and spread around the base of the clumps. Two or three weedings for the first two years and one weeding per year later on are given in the hot weather before the picking commences. During weeding, the clumps are trimmed off; the dry aerial shoots and dry leaves on the green shoots are pulled out. The parts so removed and the dry leaves are spread around the clumps to serve as mulch.

Harvest and yield: The first crop is usually a small one, the second one a partial crop and the third, that is five years after planting, a full crop. Harvesting is done once in 30-40 days. Pods that are just attaining ripeness are carefully picked at each harvest. The harvested fruits are dried either in a drying house or on

the ground in the sun. Drying houses are fitted with racks of wire mesh or jute hessian and heated by a system of pipes connected with an outside furnace.

In order to obtain the so-called white or bleached cardamoms which is a distinct trade quality that is greatly in demand, cardamoms are subjected to a special bleaching process. The Indian demand is met by a peculiar bleaching process which is confined to Haveri in Southern Bombay – a great trade centre for cardamoms. The process consists in washing the dried cardamoms in water containing a mash of soapnut (both *Sapindus saponaria* and *Acacia concinna*) and also ordinary soap, draining soon, washing again, draining and then spreading out to dry indoors, with occasional sprinkling with well water, and then drying in the sun on the following day. Of late, the use of bleaching powder and sulphur is said to be in vogue. Kiln-dried cardamoms of the larger varieties are green in colour but the smaller cardamom capsules dry a more yellowish-green. The outturn from fresh fruit to dried capsules varies between 20 to 28%.

Yields of cardamom vary widely. The average yield from big cardamoms (Mysore) may be 50 to 100 lbs. of dry capsules and that from small (Malabar) cardamoms, 40 to 80 lbs. per acre.

Method of storage: The dry pods after cleaning are graded and packed in double gunnies. The gunnies are preserved in dry rooms. The produce is disposed off as soon as possible. If however preservation is essential, frequent drying is done to keep off weevils.

Pests and diseases: The insect pests that attack cardamoms are:—

(a) Thrips – *Taeniothrips cardamomi* (Ramakrishna). (b) Shoot and Capsule borer – *Dichocrocis punctiferalis*. (c) Leaf-eating caterpillar – *Eupterote canaraica*. (d) Scale insects – *Diaspis Sp.* (e) Rhizome borer – *Prodiocetes haematicus*. (f) The root borer – *Hilarographa caminodes*.

(c to f): Are of very minor importance and have not occurred so far in pest form.

(a) *Thrips* – (*Taeniothrips cardamomi* Ramakrishna): This is the most harmful. Its appearance result in a marked decrease in the yield. This pest is found in all cardamom-growing areas. Both the nymphs and the adults cause immense harm to the flowers and the developing pods. They take shelter under the leaf sheaths and in the covering panicles and cause minute injuries resembling pin pricks on the tender developing fruits which turn brown, become scabbed and corky. Nicotine sulphate (0.05%) spray, at the rate of 20 gallons of spray solution per acre and Gammexane (0.025) as a dust at the rate of 3 to 4 lb. have proved very effective.

(b) *Shoot and capsule borer*: (*Dichocrocis punctiferalis*): The insect bores through the stem and panicles and causes withering. The capsules are also bored, sometimes causing slight damage. The affected

shoots and panicles are to be removed as early as possible to prevent the further spread of the pest.

Disease: Mosaic: This is the chief virus disease and appears in the shape of pale mottling and curling of young leaves. The size of the shoots dwindles rapidly and finally the clump dies. The infection is carried very rapidly. Complete destruction of the affected crop is recommended. The field may be left fallow for a year or two and then planted with healthy seedlings. No real remedy has so far been found out.

Clumprot: Known as 'falling off' disease, caused by *Pythium* Sp. occurs in patches attacking stray clumps. The aerial shoots when attacked fall prostrate radially around the clumps. The affected shoot breaks off easily due to the rot at its base where it is discoloured. The panicles are also affected thus reducing the yield. Ammonium phosphate, superphosphate or lime when applied at 3 oz per clump check the spread of the disease and also induce fresh growth of aerial shoots.

Economics: Cardamom cultivation is considered to be a profitable business, especially now when cardamom is selling at Rs. 10/- per lb. But its scope is limited due to several conditions that must exist for raising the crop successfully - such as elevation, evergreen forest leaf mulch, rainfall, its distribution and protection from winds. When once the crop is planted, it continues to bear for a number of years. Though the initial cost of preparing the land and planting the area is high, the recurring expenditure is comparatively low.

The economics of this crop is worked out below. The figures may have to be modified for various districts depending upon the labour conditions, the cultural practices in vogue and spacing between the plants.

EXPENDITURE.

Particulars	Labour	Rate	Amount	Cost per acre per year
A. Non-recurring :				
1. Cleaning 'undergrowth' in the forest	25	1-8-0	52-8-0	
2. "Lining" - marking spots for planting	5	"	7-8-0	
3. Digging pits - 680 - 20 per labourer	34	"	51-0-0	
4. Pulling out old clumps and preparing rhizomes for planting.	5	"	7-8-0	
5. Cost of rhizomes for 680 pits		Lump sum	20-0-0	
6. Planting - 50 pits per labourer	14	1-0-0	21-0-0	
7. Extra weeding during the first two years	30	"	45-0-0	
		Total	204-8-0	
Share of non-recurring expenditure apportioned for each year taking the life of the crop as 20 years				10-4-0
B. Recurring :				
1. Annual weeding and cleaning 15 labourers @ 1-8-0			22-8-0	
2. Picking charges @ 0-1-3 per lb. (120 lb. green pods)			9-6-0	
3. Drying, cleaning, and packing - lump sum			4-0-0	
4. Dusting Gammexane against thrips - 12 times a year			30-0-0	

Particulars	Labour Rate	Amount	Cost per acre per year
@ 2-8-0 per time			
5. Supervision charges		5-0-0	
6. Transport charges per acre (lump sum)		2-0-0	
		72-14-0	72-14-0
C. The interest on the capital invested on the purchase of the land or the annual lease thereof.			7-0-0
D. Interest on non-recurring expenditure @ 4% per annum			4-0-0
			94-2-0

Receipts: If dusting against thrips is done once a month, 30 lb. of dry capsules may be expected even on a very conservative estimate.

The crop does not give any yield for the first two years and gives only a poor yield (say half normal) during the last five years. Thus 15½ years out of 20 only may be taken as normal yielding years. So the average annual yield should be taken as $30 \times 15\frac{1}{2} \div 20 = 23\frac{1}{4}$ lbs. or 23 lbs.

The value of 23 lbs. of dry cardamoms at

the present rate of Rs. 10/- per lb. Rs. 230-0-0

Net profit per are Rs. 230-0-0 — 94-2-0 = Rs. 135-14-0

The profit appears to be high but it has been worked out carefully. It should be mentioned here that the present price of Rs. 10/- per lb. of cardamom is phenomenal. Well-informed business men believe that the price may not go down much. Even if it goes down to Rs. 6/- per lb. (40% reduction in prices) the net profit per acre will be not less than Rs. 44/- per acre, which is appreciable.

Conclusion: By cultivating cardamom, the ever green forest is not disturbed much. The big trees remain intact. It is believed, that the adverse effect on rainfall caused by de-forestation is avoided when cardamom is cultivated on a hill. So the forest department, of late, is leasing suitable sites for cultivating cardamoms. Year by year, new areas in the reserve forest are allotted, in small pieces. Enthusiastic agriculturists have an opportunity here to invest their capital on this profitable industry.

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