

# Entrepreneur India

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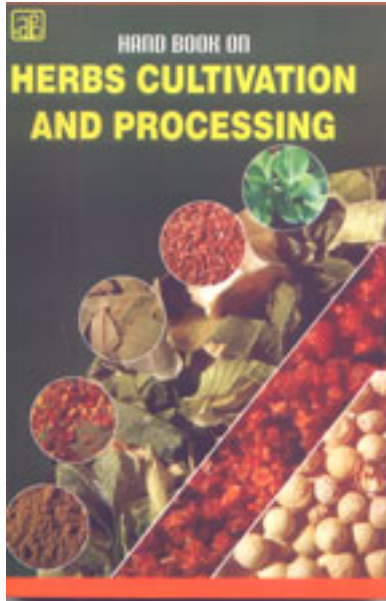
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Handbook on Herbs Cultivation and Processing



<b>Code:</b>	ENI87
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India is one of the leading herbs producer and exporter in the world. Several meticulous researches were conducted and experimented with herbs. They arrived at more precise conclusions about the usefulness of diverse plants and herbs that are utilized in different fields like medicine, cosmetics, perfumes and so on. The Ayurveda healing is completely based on herbs, which have definite medicinal importance or significance. In the primeval times, the Indian sagacious held the view that Ayurveda herbs are the only resolution to treat numeral health related problems and diseases. Herbal products are replacing the synthetics products because of its harsh nature. Herbal products are in huge demand in the developed world for health care for the reason that they are efficient, safe and have lesser side effects. Growing herbs is easy to do, and people continue to turn their love for gardening into successful businesses growing and selling fresh cut herbs, herb plants, and other herb related products. Producing herbs for the medicinal market has received a lot of interest from potential commercial growers, but it is still a new and uncertain market. Medicinal herb products may include all plant materials such as foliage, flowers, seeds, fruit and roots. They may be used fresh or in the form of their extracts or chemical compounds isolated from them to produce drugs for human or veterinary medicine. Production of medicinal herbs is limited by the demand for them in international trade. According to the research there are over 20,000 common medicinal plants used in different parts of the world. Over 100 herbs are used on a regular basis. The decision to cultivate medicinal herbs should only be made in response to demand for particular herbs. The market is very competitive and could easily be oversupplied.

This book majorly deals with general characters and composition of herbs, official parts and names of herbs, cultivation of herbs and its medicinal uses etc. The major contents of the book are Acacia, Aconitum Napellus, Acrous Calamus, Adhatoda Zeylanica, Althaea officinalis, Linn, Amaranthus, Linn, Amorphophallus cam Panulates, Aristolochia Indica, Atropa Belladonna, Brassica, Calotropis, Procera (Ait.), Capsicum Annuum, Linn etc.

The book covers systematic account of most plants used in medicines. This is an indispensable book which provides cultivation techniques of various herbs with their processing. The text of each plant is divided in two portions: the first devoted to the description of the species, its localities and other purely botanical matter and the second to the general character, composition, properties which are employed in medicines or otherwise. The book is very useful for new entrepreneurs, ayurvedic institutes, libraries and consultants.

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NATIONAL MEDICINAL PLANTSARD

Preamble

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**Sample Chapter:**

# Acacia

## SYNONYMS

*Delile* subsp. *indica* (Benth.) Brenan syn. *A. arabica* Willd. var. *indica* Benth, Babul, Black Babool, Indian Gum Arabic Tree.

## DESCRIPTION

A moderate-sized, almost evergreen tree with a short trunk, a spreading crown and feathery foliage, found throughout the drier parts of India. The tree generally attains a height of c 15 m and a girth of 1.2 m, though trees up to a height of 30 m with a girth of 3 m have also been recorded. Bark dark brown to almost black, longitudinally fissured or deeply cracked; leaves 2.5-5.0cm long, bipinnate with spinescent stipules, pinnules narrowly oblong; flowers golden-yellow, fragrant, crowded in long-stalked globose heads, 1.5cm in diam, forming axillary clusters of 2-5 heads; pods flat, 7.5-15.0cm, contracted between the circular seeds. Babul is perhaps the most important tree of the drier parts of India. There are three recognized varieties in India: (1) var. *cupressiformis* Stewart (Ramkanta or ramkanti babul or kabuli kikar) with its characteristic broom-like ascending branches. This variety is not much used; (2) var. *vediana* Cooke (Kaora, kaulia, kauria or vedi babul) is a smaller variety with shorter bole and rough, fissured bark. The wood is inferior to that of the telia babul and is usually considered fit only for firewood; (3) Telia babul-the much prized typical variety (godli teli or telia babul) with a spreading shady crown of feathery foliage and moniliform pods. This variety is most extensively grown in plantations or in natural forest crops.

## HABITAT

Babul is indigenous to the plains of Andhra Pradesh and Maharashtra, and is cultivated or found self sown throughout the drier parts of India, ascending to an altitude of 900m. It is essentially a tree of the plains, occurring on flat or undulating ground and ravine country, seldom extending into hilly regions.

The tree is gregarious and forms either pure stands or is dominant. It is a strong light-demander and the crop comes up in even-aged groups or patches of varying extent. Patches of *A. nilotica* subsp. *indica* are usually termed babul bans or sometimes babul meadows with their grassy undergrowths. In the plains of Punjab and Uttar Pradesh it is found scattered, and is frequently grown along canal banks. It is occasionally found in the drier parts of Bihar, specially in Chota Nagpur, on embankments and waste lands. In central India it occurs chiefly as scattered trees in fields and waste lands, and along roadside bunds and railway embankments. In southern India also, babul is found in greater or less abundance throughout the plains in the drier parts of Tamil Nadu, Andhra Pradesh, Karnataka, but not in the moist regions of the West coast. It has also been observed in the terai areas of Kumaun region.

## CULTIVATION

Babul is characteristic of the dry regions, but does not thrive without irrigation if the climate is too arid. In regions where it is indigenous or has become naturalized, the absolute maximum shade temperature varies from 40 to 50°C and the absolute minimum from - 1 to 15°C, and the normal rainfall from 7.5 to 125cm. The tree is frost-tender, but is drought-resistant so long as the sub-soil moisture holds out, it is not fire-resistant. Babul thrives best on riverain alluvium subject to inundation, and on black cotton soil. It is also found on alluvial loam in the plains of northern India, on loamy soil in the peninsula and in tank beds in Tamil Nadu. It survives even on usar (saline) soils.

The tree is seldom leafless. Leaf-shedding commences before May and continues up to the end of May; the new leaves appear during March-May. The trees generally flower during the rainy season, but flowering may extend to Dec-Jan; fruiting is usually from April to June. Trees commence to bear fruit at an early age, and seed annually. The pods are readily eaten by sheep, goats and cattle, and the seeds are disseminated

by them. Under natural conditions germination commences early in the rainy season and continues for sometime. For vigorous natural reproduction, complete sunlight, abundant moisture, loose soil and absence of grass and weed are essential.

Direct sowing, either in lines or on ridges, has proved successful for afforestation. Choice of a suitable site, treatment of the soil, preparation of seed, weeding and thinning at regular intervals are essential for obtaining good results. Within a year or two the new plants attain a height of 1.5-2.0 m. In afforestation studies carried out in different arid habitats of Rajasthan, babul was found suitable for shallow alluvial soils overlying hard calcareous pans within the 300-400 mm isohyet.

## DISEASES

Babul is attacked by a number of fungi causing much damage. *Fomes pappianus* Bres. attacks, injured and old trees, causing the wood to become brittle and crumble away. Other fungi recorded on babul are *Phyllactinia acaciae* Syd. and *Sphaerostilbe acaciae* Tilak. Three new species of deuteromycetous fungi, viz. *Diplodia acaciae* Tilak & Rokde, *Cytospora acaciae* Tilak & Rokde and *Fusicoccum indicum* Tassi have also been recorded on babul (Troup, II, 432; Biol Abstr, 1962, 40, 20898; 1966, 47, 58920).

The four most destructive insect pests of babul are *Coelosterna scabrator* Fabr., *Psiloptera fastuosa* Fabr., *P. coerulea* Oliv. and *Aeolesthes holosericea* Fabr. *C. scabrator* is a dangerous root borer, whereas, the others strip the bark off the shoots and branches. *A. holosericea* also destroys the wood by tunnelling.

Babul has been recorded as a new host of *Hemaspidopectus cemereus* Green.

The angiospermic parasite, *Cuscuta* sp. has also been observed on the plant. The timber is attacked by marine borers belonging to the genera *Teredo* Linn., *Martesia* Sowerby and *Limnoria*, which reduce its underwater durability, thus making it unfit for use in marine construction. Babul timber from Maharashtra, tested at different harbours, gave a good rating only at Cochin harbour. Among the grazing animals, goats and camels are the most destructive. Sheep and buffaloes are also harmful; lopping for fodder, as also for thorn hedges, causing much injury to babul.

## USES

### TANNIN

Babul bark is the most important tanning material of northern India and is used in village tanneries from Haryana to West Bengal. A large quantity is consumed by the tanning industry in Kanpur. Babul bark is obtained mainly as a by-product when trees are felled for timber or fuel. It is separated from the logs by beating them with wooden mallets and the strips thus obtained are dried in the open, chipped into smaller pieces and sent to the tanneries without any grading. The proportion of bark to wood is roughly 1:5 by weight; and a plantation of c 620 trees per hectare, when 15 years old, may be expected to yield c5 tonnes of bark (Rao, Tanner, 1966-67, 21, 341). The tannin content of the bark varies considerably; sometimes it is as high as 20 per cent, but on an average, the bark delivered to the tanneries contains much less tannin, c12 per cent. It decreases somewhat during storage. The bark from older trees, though richer in tannin, is likely to be of high colour. The bark from branches yields 7-12 per cent tannin. The deep colour and high non-tan content of the bark are serious disadvantages. Several polyphenolic compounds have been reported to be present in the bark and those identified are (+)-catechin, (-)-epicatechin, (+)-dicatechin, quercetin, gallic acid, (+)-leucocyanidin gallate, and two polymeric tan fractions, T1 (Butanol solubles) and T2 (Butanol insolubles) which form almost the entire tanning material component responsible for the tanning potency of babul liquor, with fairly good affinity towards hide powder. The polyphenols of the bark are fungitoxic and it has been shown that the lower molecular weight polyphenols are mainly responsible for this activity. The bark also contains sucrose.

Leather made from babul bark is firm and durable, though harsh and dark coloured. Babul tannin is very good for heavier leather. In combination with myrobalans, babul gives excellent finished leather. Also, it

was found that pre-treatment of the leathers with myrobalans followed by tanning with condensed tannins, including babul tans, reduced the time taken for penetration of the tanning materials and also most of the properties of the pre-treated leathers were found to be better than those tanned directly. A blend of 2 parts of babul and 1 part of myrobalans was used in tanning to produce E.I. leather kips. The kips produced have been found to be satisfactory in colour and yield.

## TIMBER

The sapwood is wide and whitish; heartwood pinkish white to light red when first exposed, turning reddish brown with age, generally mottled with darker streaks. The wood is dull with somewhat rough feel, without characteristic odour or taste, moderately heavy to heavy (sp gr, c0.8; wt, 817-865 kg/cu m), straight- or somewhat twisted-grained and coarse-textured. It provides a very strong and hard timber. The wood seasons well even in the log and is moderately refractory. It is liable to split in the hot weather, and should be converted under shade.

The timber is fairly durable if well seasoned; it is easily treatable under the open tank process. Heartwood is not readily attacked by white ants. It is hard and tough, and somewhat difficult to saw. It works well by hand, finishes to a good surface, takes a fair polish, but requires a good deal of filling. The data for the comparative suitability of the timber, expressed as the percentages of the same properties of teak, are: wt, 118; strength as a beam, 93; stiffness as a beam, 84; suitability as a post, 82; shock-resisting ability, 126; retention of shape, 83; shear, 151; hardness, 135; and nail- or screw-holding property, 113.

Babul is one of the favourite timbers for native wheelwright work, being used for felloes, spokes, naves and axles for the bodies of carts, and also for shafts and yokes. It is used for agricultural implements such as ploughs, harrows, clod crushers and Persian wheels. It is also used to make well curbs, tent pegs, boat handles, knees for boat-building, oars, sugar- oil-presses, bedsteads, railway wagon buffers, hookah-stems, tops, dies for cloth stamping, walking-sticks, and for carving and turnery. It is suitable for hammer handles and is used by the railways for anvil blocks and railway keys.

It was tried in power transformers, but found unsuitable; its dielectric strength (a specimen from Raipur) was found to be 5.4 kv/cm along the grain and 17.5 kv/cm across the grain with dielectric constants 3.20 and 2.06 respectively. The wood is in great demand for fuel. It has a calorific value of 4,224 cal.

## GUM

The gum of *A. nilotica* subsp. *indica*, although called gum arabic, is not the true gum arabic which is obtained from *A. Senegal*. In trade, in Bombay, three chief varieties are recognized: (i) True gum arabic, (ii) East Indian gum, and (iii) Indian gum arabic. Most of the true gum arabic, used in India, comes direct from Saudi Arabia and Africa. These imported gums are carefully sorted, cleaned and graded according to size and colour of the fragments. The smaller pieces are pulverized and sold as powdered acacia gum. The smaller lumps and finer fragments are marketed under the names maklai or safed gundar. The East Indian gum is imported entirely from Aden and other Red Sea ports. It is hand picked and graded in Bombay, and re-exported to Europe and America. Indian gum arabic is the name given to the commodity of Indian origin. It consists of a mixture of babul and other acacia gums. Two varieties of this gum are known, viz. gum bavoal and gum ghati. The former consists of acacia gums from *A. nilotica* subsp. *indica*, *A. catechu* and *A. modesta*. Occasionally, it is found mixed with gums from *Anogeissus latifolia*, *Azadirachta indica* and *Feronia elephantum* Correa. Gum ghati has only up to 40 per cent of acacia gums.

The gum exudes from wounds in the bark, mostly during March-May. Though some trees yield a maximum of c 1 kg per year, the average is only a few grammes. The yield lessens with the increase in age of the trees and it is believed that tapping accelerates the flow, but it is not often practised.

Babul gum occurs in the form of rounded or ovoid tears. Each tear is about a centimetre in size and the colour varies from pale-yellow to brown or almost black, according to the age of the tree and the conditions of collection. The crude gum is first broken into smaller pieces, cleared and carefully sorted according to



size and colour. It is generally considered inferior to true gum arabic, especially for medicinal purposes. But if proper care is given to collection and grading, the gum obtained conforms to the B.P. requirements for acacia gum, except with regard to the optical rotation.

Babul gum is very slightly dextrorotatory, whereas the gum of *A. Senegal* is slightly laevorotatory. It contains 13 per cent of moisture and on ignition it leaves behind 1.8 per cent of ash (CaO, 52.2; and MgO, 19.7%). The gum contains galactose, L-arabinose, L-rhamnose, and four aldobiouronic acids, viz. 6-O-(b-glucopyranosyluronic acid)-D-galactose; 6-O-(4-O-methyl-b-D-glucopyranosyluronic acid)-D-galactose; 4-O-(a-D-glucopyranosyluronic acid)-D-galactose; and 4-O-(4-O-methyl-a-D-glucopyranosyluronic acid)-D-galactose. The 3,5-di-O-methyl-L-arabinose and a new crystalline arabinobiose, 2-O-b-L-arabinopyranosyl-L-arabinose (C<sub>10</sub>H<sub>18</sub>O<sub>9</sub> · ½ H<sub>2</sub>O, mp 103°) have been isolated from the gum. It also contains arabinobiose, 3-O-b-L-arabinopyranosyl-L-arabinose (Anderson et al, J chem Soc, Sec C, 1967, 1476; Chalk et al, Canad J Chem, 1968, 46, 2311).

Good quality babul gum is used in calico-printing and dyeing, as a sizing material for silk and cotton, and in the manufacture of paper. Generally, it finds application in all industries where a mucilage or adhesive is required. It is used as a substitute for true gum arabic as an adhesive, though its adhesive strength is somewhat lower. It is fried in ghee and used in the preparation of sweetmeats. It was tried as a possible icecream stabilizer, and its effect on the flavour of plain icecream has been studied. Best results were obtained with the gum at 0.5 per cent level. Babul gum is used as a masticatory. It is not suitable for making European type of confectionery. In pharmacy, it is used as a substitute for true gum arabic, and in the indigenous medicine, it is credited with numerous virtues. It is useful in diarrhoea, dysentery, diabetes mellitus, sore-throat, etc. Inferior varieties are employed in the manufacture of matches, inks, distempers and certain types of paints and mortars [Rao & Misra, Indian For, 1963, 89, 519; Shabnam, ibid, 1964, 90, 50; Chopra et al, 1958, 492; Bhatnagar et al, J Res Indian Med, 1973, 8(2), 67; Biol Abstr, 1973, 56, 54492; Chakravarty, Bull bot Soc Bengal, 1975, 29, 97].

Unfortunately, the collection of gum in India does not receive proper attention as it is entirely in the hands of ignorant people. The crude material, consisting of a mixture of various gums, reaches Bombay from all parts of the country, especially from the Deccan and the western regions, for marketing.

## CHEMICALS AND ITS USES

The seeds of babul (*Rajasthan-Hilario*) are eaten roasted or raw in times of acute scarcity. Analysis of the seeds gave the following values (dry basis): moisture, 8.83; crude protein, 26.4; fat (ether extr), 3.3; N-free extr, 62.9; crude fibre, 2.7; and total ash, 4.7%; calcium, 673.0; phosphorus, 420.0; iron, 4.95; niacin, 3.17; ascorbic acid, 4.51; and thiamine, 0.24 mg/100g. The essential amino acid composition of the seed protein is: histidine, 3.7; lysine, 4.3; methionine, 0.4; cystine, 0.49; phenylalanine, 3.6; tyrosine, 1.58; leucine & isoleucine, 8.8; valine, 4.2; and threonine, 3.3 g/16g N.

The seeds on extraction with petroleum ether yield a brownish oil (6.7%) having the following characteristics: n<sub>D</sub><sup>20</sup>, 1.4593; iod val, 98.6; sap val, 302.1; and unsapon matter, 2.8%. The oil contains: saturated acids, 27.4; oleic, 30.5; and linoleic acid, 42.1%.

In a survey of potentially allergenic plants in Pondicherry, it was reported that *A. nilotica* subsp. *indica* was likely to cause pollen allergy. Anthesis occurs during July-Sept, and pollination during Dec-March. The bark is astringent and demulcent, and shows anti-viral properties; an extract of the bark completely inhibited the propagation of potato virus X. A decoction of the bark is used for gargling. Pods are reported to be effective in urinogenital disorders.

## Capsicum Annum, Linn.

### SYNONYMS

*C. longum*, DC. *C. grossum*, Willd. *C. cordiforme*, Mill., Capsicum. Pod Pepper.

## DESCRIPTION

A bushy herb, usually annual, reaching 2 feet or a little more in height. Stem smooth, angular or striate, hollow, dichotomously branched, the branches spreading. Leaves alternate, one coming off from the side of each bifurcation, spreading, on rather long petioles, ovate, 2-3 inches long, acute at both ends, entire, dark green, thin, glabrous, the upper ones much smaller. Flowers solitary in each bifurcation, on short peduncles, erect, or stiffly curved downwards, thickened at the top. Calyx cup-shaped, truncate, with 5 very small denticulate teeth, persistent, smooth, green. Corolla rotate, with a short tube, the spreading limb cut more than half way down into 5 ovate, acute, faintly ciliate segments, pale greenish-yellow. Stamens 5, inserted on the corolla-tube, short, erect; filaments tapering upwards; anthers about as long as filaments, 2-celled, basifixed, the cells dehiscing longitudinally, purplish-blue. Ovary conical, smooth, 2-celled, with numerous ovules, style rather thick, longer than the stamens; stigma terminal, thickened. Fruit indehiscent, oblong, conoid, ovate or nearly globose, scarcely pulpy, inflated, incompletely 2-celled, skin thin, tough, smooth and very shining, usually brilliant scarlet, often wrinkled. Seeds numerous, compressed, oval or somewhat reniform, nearly smooth, bright yellow; embryo curved into a ring; radicle thick; endosperm scanty.

## HABITAT

It is probable that the *Capsicum* is a native of some part of South America, and that it was consequently unknown in the Old World before the discovery of that Continent. It must, however, have been very early introduced into Southern Europe, as before the middle of the 16th century it was commonly cultivated in Spain, Italy, and Germany. In India, it seems to have been brought about the same time, probably, directly from America, by the Portuguese; in England the plant was cultivated by Gerard in 1596, and probably earlier. At the present time it is grown everywhere in the warmer regions of the globe, and can scarcely be said to be known in a wild state. As with other widely cultivated species, there are very numerous varieties, many of which have been described as separate species. The fruit is typically erect and oblong, but it may be drooping and very variable in form, from long cylindrical to almost globular; the colour is usually scarlet, but may be orange, yellow, white, purple, or mottled; there is also a mild variety which is cultivated about Naples, and much eaten there, though scarcely known elsewhere. The plant is generally somewhat shrubby in hot countries.

## OFFICIAL PART AND NAME

Capsium; the fruit of *Capsicum annuum*, *Capsicum fastigiatum*, Blume, and of other species of *Capsicum* (U. S. P.). *Capsicum* is also called in the Pharmacopoeia of the United States, Cayenne and African Pepper. *Capsicum annuum* is not recognised in the British Pharmacopoeia, or the Pharmacopoeia of India, but it was formerly official in London, Edinburgh, and Dublin Pharmacopoeias. The only species recognised in the British Pharmacopoeia and the Pharmacopoeia of India is *Capsicum fastigiatum*, Blume.

## GENERAL CHARACTERS

The fruits of the various species and varieties of *Capsicum* are commonly known under the general name of Pod Pepper, as is noticed under *C. fastigiatum*. The variety of Pod Pepper which is usually sold in this country under the name of Capsicums or Chillies is the fruit of *C. annuum*. These fruits vary much in form, size, and colour; but the dried fruit, as more generally seen in commerce, and in our pharmacies, is somewhat flattened, more or less shrivelled, from two to three or more inches in length, and from  $\hat{A}1\frac{1}{2}$  to  $\hat{A}3\frac{3}{4}$  of an inch in breadth. It is oblong-conical in form, more or less tapering towards the apex, and having the remains of the calyx and stalk usually attached at its base. The colour is reddish or yellowish-brown; the pericarp tough and leathery; and the seeds flattened, and of a yellowish-white colour. The taste is hot and pungent; but it has no evident odour. The powder of the ripe and dried fruit is of a more or less bright red colour, and, as noticed by us in describing *Capsicum fastigiatum*, it probably furnishes much of the

Cayenne pepper of commerce.

## COMPOSITION

The acidity of Capsicum has been attributed since the time of Bucholz and Braconnot to the thick, yellowish-red or reddish-brown, oleo-resinous liquid obtained by ether from the alcoholic extract. This substance has received the name of capsin. This so-called capsin has for some time been regarded as a complex substance, and the recent experiments of J. C. Thresh with the fruit of Capsicum fastigiatum have proved that the real active principle of capsicum is a crystalline substance, which he has named capsaicin. This principle is intimately associated with a red fatty matter, which Thresh has ascertained to be essentially composed of palmitic acid. Although the experiments of Thresh were especially made with the fruits of C. fastigiatum, the composition of those of C. annum are doubtless essentially the same; and for further particulars, therefore, of the chemical nature of capsicum, we refer to our notice of that plant.

## CULTIVATION

### Soil

Chilli is cultivated on almost all well- drained and aerated soils, except on salty lands. The black and retentive soils are best for a rain-fed crop, and rich, friable, well-drained, loamy soils are preferred for an irrigated crop. On light soils, it is solely grown as an irrigated crop. It is also grown on light or heavy, red loams under heavy manuring and good drainage as in the Godavari and Visakhapatnam districts of Andhra Pradesh. On sandy loams and alluvial soils, good crops are raised with liberal manuring and irrigation. In Kerala, the crop grows well on well-drained, fertile lateritic loams; it is also rotated with mundan (dry) paddy on soils with limited depths, and on hillslopes. The crop is not very sensitive to acidity, but a strongly acidic soil should be limed to bring it to a moderate or slightly acidic level. Though grown in tracts of considerable salinity, the general pH is 7.6, but it tolerates a pH of 5.0. Alkaline soil is also not suitable. The lime and humus-rich soils give higher yields. The crop also suffers from the deficiency of oxygen.

## PREPARATION OF LAND

For a nursery, a high-level area near any watersource is selected for proper drainage and easy irrigation. The soil is dug upto 25cm, and brought to a fine tilth. The seedlings grown on raised beds are more vigorous than on levelled beds. Organic manure at the rate of 25 tonnes/hectare is generally added to the nursery; ash also may be applied. Sheep-penning is done in some states and is reported to improve the brightness of red colour of the fruits. Application of Furadan granules to the soil before sowing has been recommended to prevent the attack of nematodes and mosaic disease. Also, ammonium sulphate from 68 to 185 kg/ha is recommended as top-dressing. In Andhra Pradesh, the nursery is supplied with 53-70 tonnes farmyard manure, followed by sheep-penning at the rate of 2,500-5,000 sheep per hectare. In Tamil Nadu and Karnataka, the nursery is supplied with cattle manure and ash. A top-dressing of fertilizer to supply 13.5kg N/ha is given in Tamil Nadu 20 days after sowing. In Kerala, the nurseries are grown in coconut plantations. Well-decomposed and powdered manure is mixed with the soil and sprinkled over the nursery to cover the seeds. In Maharashtra, sieved farmyard manure or compost is added at the rate of 37 tonnes/ha. When the seedlings are 15 days old, ammonium sulphate at the rate of 108-183 kg/ha is applied. A 10 m<sup>2</sup> seedbed needs 627 g ammonium sulphate and 2.5 kg each superphosphate and potassium sulphate to produce vigorous seedlings. In the Surat district of Gujarat, castor-cake is added to the nursery, 20 days after sowing. In and around Delhi, a mixture of cowdung and soil is sprinkled. If the seedlings are stunted, a solution of ammonium sulphate (1-2 handfuls in 9-14 litre water) is sprinkled, followed by the sprinkling of normal water to wash the leaves; this process is repeated, if necessary. Covering the nurseries with grass has been recommended in Haryana to protect the young seedlings from the hot sun. The size of the beds differs from place to place from 1.8-2.4 m x 0.9-1.2 m to 18-27 m x 1.2 m. The beds are raised by a minimum of 15-24 cm for proper drainage. The soil should be sterilized with for

maldehyde or steam, or the bed drenched with copper sulphate solution 15 days after sowing to prevent the diseases caused by excessive moisture.

The field should be ploughed at least 60 cm deep (as the plant has long taproot) soon after the harvest of the preceding crop, and the soil exposed to the sun to destroy the pests. The field should be ploughed 4-6 times crosswise along with manure or compost, and harrowed. It should be brought to a fine tilth and planked smooth before preparing suitable sizes of beds. The field is made ready for planting by the end of July when the rains set in and enough moisture accumulates for transplanting. Deep furrows are ploughed at 60 cm x 60 cm or 22 cm x 30 cm distance. These furrows are repeatedly split and brought close before the final ploughing. This is not necessary on dry land, where transplanting is done after the receipt of heavy rains. When cropped with tobacco, a spacing of 55 cm apart for chilli and 80 cm apart for tobacco is given. For partially rain-irrigated crop on medium-black soils, ridges and furrows are opened at the time of final top-dressing.

## Seed

Since the crop is primarily cross-pollinated, some typical plants of the cultivar which are robust and high yielding are chosen from the centre of the field for purity of seed. The selected, healthy fruits are allowed to ripen on the plant; they are dried and stored under damp-proof conditions till the next season. Seeds from the first flush of pods show maximum percentage of germination, as the sprouting declines with subsequent flushes. The same trend is reported for the weight of fruit and seed, and the percentage of seed to fruit. The seeds are removed from the fruits one week before sowing. The dried fruits can be stored as such for two seasons, and the seeds for one season only without any deterioration in germinative capacity. The viability of seeds can be maintained for five months if treated with fungicides, such as Captan (4 g/kg), sulphur dust (4 g/kg), Bavistin (2 g/kg), Vitavax (2 g/kg) and Benlate (4 g/kg). Vivipary has been reported in some cultivars from Tamil Nadu, which reduces the value of chillies.

The seeds are light and germinate in 3-10 days. A good-quality seed gives germinative percentage upto 90. The seed should be floated in water to discard the lighter ones, and washed to remove the pungency, as it facilitates germination and reduces the attack of ants. Germination can be hastened by soaking the seeds in aqueous solution of  $\alpha$ -naphthaleneacetic acid (NAA 50 ppm) for 4-5 days. Good germination occurs at soil temperatures of 18.3-26.7°C. To protect the seed from black ants after sowing, the seed should be rubbed with a few drops of kerosene oil, or the edges of the beds dusted with BHC (5%).

## Seed rate

A higher rate of seed is needed for the rain-fed crop than for the irrigated crop, as 3-8 seedlings are planted per hill for the former and 1-2 seedlings for the latter. The rate also depends upon the cultivar grown. In Andhra Pradesh, 2.4 kg is sown in the nursery which yields up to 150,000 seedlings, sufficient for one hectare. More than this rate causes damping-off in the nursery and the seed rate is directly proportional to the death-rate; in other regions 1-2 kg seed is sown for seedlings sufficient for one hectare. For direct sowing, 3.3-11.0 kg seed is used per hectare.

## Sowing

The seed is directly broadcast in the field, or sown in the nursery to raise the seedlings for transplanting. The seeds, mixed with fine sand or ash, are broadcast in thin layers in the beds or in lines, and gently but firmly pressed with hand, and covered with cattle manure. Black ants cause damage to the seeds and seedlings. The beds are watered with a rose-can to prevent washing away, and irrigation is continued till germination is complete. Later, irrigation should be given regularly through channels till the growth is vigorous. After the seedlings establish, watering is done once in two days to harden the seedlings, but the beds are never left dry.

The seeds are kept covered for quick germination, conservation of moisture, and to prevent the exposure of

seeds during watering, as well as to heat. A thin layer of mulch of straw, leaves, gunnybags, grass and *Cajanus cajan* stem are employed in Andhra Pradesh; in Kerala, leaves of coconut are used during the summer, and cotton stalks in Gujarat. When seeds start germinating in 10-20 days the mulch is removed. The first irrigation is given immediately after sowing, avoiding submergence and formation of crust. The second irrigation may be given 4-5 days after the first one depending upon the weather. Generally, overwatering and excessive moisture should be avoided. The nursery bed is intercultured with a pointed stick; 2-3 weedings are given. If the seedlings are crowded, the bed is thinned by removing unhealthy seedlings to prevent the plants becoming tall and leggy. The seedlings are topped on a sunny day, 7-10 days before transplanting, to encourage branching and sturdiness; also, topping wards off leafcurl and aphids. It was, however, reported from Maharashtra that topping and pruning of roots do not have any additional advantage. The seedlings reach 15-22 cm in 15-56 days and are ready for transplanting. Spraying copper fungicides, such as Perenox (0.3%) and Bordeaux mixture (1:1:50), to control damping-off, leafspot, etc. and Endrin (2- 3g/l water) on 15-30 days old plants to control diseases and pests results in erect and healthy seedlings. Before uprooting the seedlings for transplanting, a drenching is given to prevent damage to root system. The uprooted seedlings should be washed in BHC solution to prevent infestation by thrips. In regions where winter is severe for the early crop, the seeds are sown in the nursery in November, and the seedlings are over-wintered by providing windbreaks or covered with polyethylene sheets. These seedlings are transplanted in the open fields, as the season warms up, and the danger of frost is over.

Broadcasting of seeds, however, is limited as the plants are very delicate. The seed is sown broadcast in parts of Cuddapah and Guntur districts of Andhra Pradesh and in Ramanathapuram in Tamil Nadu. In some areas, 6-7 seeds are sown in lumps on 0.8- 1.25 cm ridges and 20.0-22.5 cm apart, as the seedlings surface better in a group than when they are thinly sown.

### Transplanting

The seedlings are transplanted when they are 15-56 days old and attain 15-22 cm in height with 7-8 internodes; in Andhra Pradesh and Tamil Nadu, 42 days old seedlings are transplanted under rain-fed as well as irrigated conditions. The beds are drenched before the actual uprooting. The seedlings are carefully uprooted, one each at a time to avoid crushing the stem and damaging the roots; levering up the seedlings is recommended for uprooting. These are covered with wet gunnybag or cloth for preservation, if necessary. They are dipped in a solution of Endrin (2.0-5.6 g/l) or washed with BHC to free them from pests and white ants. Transplanting should be done early morning or later in the afternoon; cloudy or drizzling weather is the most ideal period for continuous transplanting. In the absence of rain, the beds are heavily watered. It is reported that a second transplanting 10 days after the first induces earliness and increases the yield to almost 25 per cent besides extending longevity. The best time for planting under rain-fed conditions is the first fortnight of September (Chauhan, 360; Aiyadurai, 123; Mudaliar, 421; Purewal, loc. cit.; Muthukrishnan et al, loc. cit.).

### Spacing

The spacing of the seedlings depends upon the cultivar, and varies from 13 to 15 cm x 30 to 90 cm in various regions according to local practices. Though closer spacing ensures higher yields, the yield of individual plant decreases; wider spacing, however, increases the yield of the individual plants. Also, closer spacing is reported to produce earlier crop. The small-fruited cultivars are planted in rows 45 cm apart from each other; and for the large-fruited cultivars a spacing of 90 cm or more between the rows and 60 cm between plants is given on very fertile soil when the growing season is long. In the Ramanathapuram and Tirunelveli districts of Tamil Nadu, chilli is grown with betelvine with 60 cm between rows and 3.0-4.5 m between the plants and these plants grow up to 4.5 m due to constant shade and irrigation. The seedlings

are planted either at the intersection of markings, or for the irrigated crop on the slant of the ridges. At each intersection, soil should be stirred, 15 cm in diam, to a depth of 7-10 cm, properly mixed and pressed with a trowel. The seedling is placed without twisting or looping the taproot with the green portion above the ground. The soil should then be firmly and gently pressed with hand to ensure proper establishment and for new roots to be formed in c 7-10 days. During this period gap-filling may also be done.

Planting on ridges and furrows is reported to be beneficial over the flat beds, since ridges help to economize irrigation. Where the ridge and furrow method is not followed, a shallow pan around the plant is necessary for immediate watering. In the absence of rains, hand-watering is given for a couple of days following planting, preferably both in the morning and evening, thereafter repeating it once a day till the seedlings establish. In the ridge and furrow method, the water is let into the furrows as the transplanting proceeds and irrigation need not be given for c 5 days (Kolhe, loc. cit.).

## Irrigation

The major chilli growing areas are rain-fed. However, regular and continuous irrigation is important, especially in areas with less rain, since irrigation prolongs the life of the crop and encourages bearing, and pickings may continue till the end of February. The crop is given 8-9 irrigations, depending upon the rainfall, soil-moisture, humidity and the prevailing temperature. Higher level sites need more irrigation. The maintenance of uniform moisture, however, is essential to prevent the drop of flowers and fruits. Excessive moisture in the zone of roots for a long period, as also extended dry periods are detrimental to the crop. Frequent and light irrigations yield better results than heavy ones at long intervals. Irrigation is given every alternate day for the crop during the winter and summer in South India till the seedlings establish. The crop is later irrigated once in 5-10 days, depending upon the frequency of rainfall and the retentiveness of soil moisture and the method of preparing bed. The seedlings establish within a week. At the time of flowering, one irrigation is necessary to prevent flowerdrop, depending upon the availability of moisture.

## Manures and Fertilizers

The chilli is a heavy feeder and responds to heavy manuring. A balanced use of fertilizer is the prerequisite for higher yields. Highly decomposed manure varying from 13 to 128 tonnes/ha, depending upon the locality is added to the field, usually before the first ploughing. Ash also is added. The manure may be applied 2-3 weeks before transplanting to prevent washing off by rains. Sheep-penning may be practised as in the Guntur district of Andhra Pradesh; in some regions, bat-guano is also applied. The manure can be supplemented with oilcakes of groundnut, pongam, margosa, mustard or castor. Green-manuring with leaves such as pongam, is prevalent in Andhra Pradesh, Kerala, Karnataka, Gujarat and West Bengal. Manuring the preceding crop has been recommended in certain regions. The supplementary manure should be applied as a top-dressing before the flowering commences.

In Andhra Pradesh, generally 53-70 tonnes/ha manure is applied along with sheep-penning. In sandy soils, powdered manure or groundnut cake is added as top-dressing at the rate of 550 kg/ha between the fertilizer doses. A month after planting, pig-dung is applied as top-dressing at the base of the plant at the rate of 568 kg/ha. Wild indigo is incorporated at the rate of 20 tonnes/ha in situ into the soil in some parts of Andhra Pradesh at the time of preparation of soil. Pillipesara (*Vigna trilobata* Verdcourt) and Medapesara (*V. radiata* Wilczek) are grown and ploughed in situ after 40-45 days. A basal dose of 128-tonnes per hectare of compost or manure is given in Tamil Nadu; sheep-penning is also carried out. In Malabar region of Kerala, c 14 tonnes manure and 7 tonnes ash are applied as a basal dose. But, when the crop is raised on the ridges as pure crop, a handful of manure is added to the hill at the time of transplanting. After 15 days, 13 tonnes manure and 11 tonnes green leaf are added to each hectare and earthed up. Again, a light dose of manure is given after a month. When grown as an intercrop with coconut, heavy application of manure (35 tonnes/ha) and oilcake 1.3-1.9 tonnes/ha) as a basal dressing or a mixture of 247 kg

ammonium sulphate, 493 kg superphosphate and 123 kg potassium sulphate, or a mixture of 247 kg powdered cake of groundnut, 370 kg superphosphate and 185 kg potassium sulphate has been recommended. A basal dressing of 70 tonnes manure or compost, depending upon rain-fed or irrigated conditions is given in Karnataka. Green manuring with sunn hemp is found advantageous in some parts. A month after transplanting, a good dressing of powdered cake of groundnut, pongam, castor or margosa is applied to the furrows at the rate of 1.3-1.9 tonnes/ha; the last three cakes also check white ants. In Maharashtra, the manure (35-58 tonnes/ ha) is applied in the last harrowing. Spot-application is reported to yield better. Sheep- penning is also carried out whenever possible. Optimum dose of manure or supercompost for the main field is 75 tonnes/ha. Coal, water-hyacinth and bonemeal are reported to increase the yield. In the hilly regions of Uttar Pradesh, Himachal Pradesh and Jammu & Kashmir, a basal dose of 65-78 tonnes manure per hectare is applied. In West Bengal, farmyard manure is liberally applied as a basal dose. Treating the seedlings with *Azotobacter chroococcum* Beijerinck is reported to increase the plant-height leaf-area and number of flowers.

Nitrogenous fertilizers increase the yield in chilli, whereas P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O impart quality; they also increase the yield when applied along with N, at the same time reducing the adverse effects of nitrogen. In the absence of P and K, the N will not be utilized fully. Chilli demands all the three principal elements. Starter solutions comprising urea, single superphosphate and muriate of potash increase the yield. Care should be taken not to apply the fertilizer near the roots, as they are harmful to the root system.

Nitrogen increases the bulk of the plant. An average yield of c 45 kg berries can be obtained per kilogram, nitrogen, which is a very good response. Though the yield of 'Sindhur' increased upto c 171 qt/ha with 150 kg N/ha, it decreased considerably with increased dosage of N. Protein increases with increase in nitrogen and also with phosphorus. When deficient in nitrogen, the growth is stunted and leaves turn pale, or even completely bleached, leading to premature shedding [Ramanathan, Fertil News, 1965, 10(9), 7; Mehrotra et al, ibid, 1968, 13(3), 34; Panwar et al, S Indian Hort, 1985, 33, 240; Narasappa et al, ibid, 1985, 33, 158; Singh et al, Indian Cocoa, Arecanut Spices J, 1985-86, 9, 67; Bajaj et al, Qualit Plant, 1978-79, 28, 287; Padma & Saimbhi, 11].

Most soils in India are deficient in P, resulting in the stunting of plants, and leaves becoming small, bluish green, dirty greyish-green or even brownish dry, and shedding prematurely. Superphosphate is, therefore, included in the mixture of fertilizer; also it contains lime which promotes healthy growth of chilli. The incidence of thrips is also lessened if the soil is supplied with lime. Applying P (ortho- phosphoric acid, 0.5% sol) in split-doses to the soil, and also as foliar-spray after flowering generally increases the vigour, yield, protein and ascorbic acid.

Chilli is very susceptible to cold weather and frost, and potash builds up resistance. During drought, potash enables the plants to withstand and survive the critical periods. It also imparts general resistance to the plant against diseases and pests. Potash is associated with vitamin C and the attractive colour (deep red), glossiness and lustre in the fruit. Potassium deficiency leads to retarded growth although not to the extent as in the case of N and P. Foliar symptoms start with whitish necrotic spots in the older leaves which finally coalesce. The scorch is followed by premature abscission of the leaves.

Chilli responds to micronutrients (Cu, Mn and Zn) when the soil-moisture is favourable. 'Sattur-Samba' a local variety responded well at Coimbatore when Zn was applied; zinc sulphate at the rate of 11 .22 kg/ha over chrysanthemum.

## DISEASES AND PESTS

### Diseases

Chilli is attacked by several fungi, bacteria and viruses.

### Die-back

It is caused by *Colletotrichum capsici* (Syd.) Butler & Bisby and is a serious disease of chillies; circular sunken spots are formed on green or ripening fruits, favoured by moist weather and shade, and heavy dew on the leaves. Infection mainly starts from flowers, or through the petiole. It gradually spreads downwards; branches dry up, followed by flowerdrop, and blackening and shrivelling of fruits or fruit rot. Since the lower portions do not generally suffer, removal of the diseased portion up to the healthy parts and burning them reduce the disease. Since the disease is seed-borne, it can effectively be controlled by treating the seeds with Ceresan (0.2%) or Thiram (0.2%) followed by three sprays of Difolatan (0.2%) starting 60 days after transplanting. Spraying Bordeaux mixture (1%; 563 l/ha) just before flowering and after fruiting is useful in controlling the disease. Brassicol, Bisdithane, Ceresan, Copper Sandoz and Fytolon also reduce the disease. Mancozeb (2.5 g/l of water) at an interval of 15-20 days can be sprayed for checking dieback and fruit-rot. Foltat (0.2%) is also reported to be an effective compound. *Alternaria* sp. also is reported to cause dieback in Allahabad apart from leading to formation of black spots in concentric rings on the leaves.

#### Anthracnose

It is a serious disease of chilli caused by *Gloeosporium* spp., *Glomerella cingulata* (Stonem.) Spauld. & Schrenk and *Colletotrichum capsici* (Syd.) Butler & Bisby. The disease occurs in many parts of India; the plant is affected at any stage, mostly during the monsoon. Anthracnose causes grey or yellow spots and patches of decay appear on the young and half-ripe fruits. They dry and shrivel and drop prematurely. Sometimes, reddish brown spots are also seen on the seedcoat. The organism enters the seed-cavity and infects the seeds. Treating the seed with organomercuric compounds, and with Thiram or Captan or Agrosan GN (2.5 g/kg seed) can control the disease; spraying Dithane M-45 or copper oxychloride or Zineb at an interval of 10-15 days also controls the disease; Benlate and Brestan, Thiabendazole and Demosan are found to be helpful at various stages of attack. Removing and destroying the infected plants will have added advantage.

#### Pests

The major pests that cause severe damage to the crop are sucking - insects, such as aphids (*Aphis gossypii*) and thrips (*Scirtothrips dorsalis*). In the early stages, these pests cause complete crinkling of leaves and stunting. In addition to these pests, white ants also attack both the species of chillies but the damage is localized. Generally, Methamidophos and Acephate are recommended as the most effective compounds against chilli-pest complex.

#### Aphids

The cotton-aphid (*Aphis gossypii*) and green peach-aphid (*Myzus persicae*) are common pests. The colonies infest the undersurface of leaves and tender growth including flowerbuds; these mostly establish from the stage of flowering. Both nymphs and adults suck the sap and the honeydew drop excreted on the lower leaves, and these show the development of sooty mould at a later stage, resulting in yellowing and dropping of the tender portions. Five foliar sprays of Acephate (0.1%), methyl demeton (Metasystox) (0.5%) and Monocrotophos (Nuvacron) (0.1 %) when applied at 10-day intervals give maximum protection against aphids. Malathion 50-EC, Nuvan (0.05%) are also effective foliar sprays to control the aphids. Pirimicarb (0.1%), Lannate (90% WP), Fenvalerate (0.01%) and Heptachlor have also been found to control the aphid. Ethiofencarb (0.05%) and Methamidophos (either Tamaron 0.06% or Monitor 0.05%) are equally effective. Application of Aldicarb, Phorate and Carbofuran to soil, though effective, may have toxic residues on the green fruits. Combined spray of urea (2%) with Methamidophos (0.06%) gave 99 per cent reduction in population of *M. persicae* at Madurai in Tamil Nadu.

#### Flowering and Fruiting

Flowering in chilli generally starts c 30 days after transplanting and in another 21-30 days the green fruits are ready for the first harvesting; but in some areas, the fruiting is reported to take upto 60 days. Irrigation prolongs the life of plants and they continue to bear upto the end of February. Generally, from November



onwards the fruits begin to ripen, reaching the maximum ripening by mid-December, when 70% of the crop is gathered. Ripening gradually proceeds upwards from the bottom of the plant. At Guntur, the flowering starts in the nursery itself, when they are 6 weeks old, and later transplanted. In Andhra Pradesh and Tamil Nadu, the plant generally flowers during the rainy season, one month after transplanting, but these flowers are shed. The later formed flowers set fruits. The rain-fed crop commences flowering in November, which extends up to February, and the crop lasts 6-8 months. The hot-weather crop is transplanted in February and harvested from April. The first flush of fruits is usually plucked green to stimulate further flowering and fruiting. The mild types flower in c 45 days after transplanting, and within 30 days fruits are ready for harvesting which should be before ripening. Flowering in bird chilli commences in November and harvesting in the first week of January and continues till about June at 10-days interval.

## Eletria Cardamomum

### SYNONYMS

*Amomum repens*, Sonnerat. *A. Cardamomum*, White, non Linn. *Alpinia Cardamomum*, Roxb. *Matonia Cardamomum*, Smith, Malabar Cardamom. Cardamom. *Ailum* (Malabar)

### DESCRIPTION

A large perennial herb, with a thick fleshy or woody rhizome giving off fibrous roots below and ringed with the scars of the attachment of previous leaves, branched and sending up flowering stems 6--12 feet in height, which are erect, smooth, gradually tapering, shining and covered with the leaf-sheaths. Leaves large, alternate and distichously arranged, sheathing, sheaths very long, half surrounding the stem and overlapped by those below, terminating above in a short rounded ligule, blade spreading 1-2½ feet long, convolute in vernation, lanceolate or narrowly lanceolate, very acute at the apex, tapering at the base into a very short footstalk, quite entire, firm, smooth and dark green above, pale glaucous-green and finely silky beneath, midrib strong, very prominent beneath, lateral veins very numerous, parallel, coming off at an acute angle. Flowering-stems given off from the upper part of the rhizome-branches and spreading horizontally near the ground, from a few inches to 2 feet long, jointed, flexuous, with numerous large distichous blunt oblong bracts at the nodes, persistent, dry, and withered in fruit. Flowers rather small, stalked, laxly arranged about 4 together in small racemes coming from the axils of the large bracts; a similar bract of smaller size stands opposite the base of each pedicel. Calyx superior, tubular, narrowly oblong, very delicate and transparent, cut into 3 short triangular teeth at the apex. Corolla with a slender delicate tube extending considerably beyond the calyx, divided above into 3 nearly equal, oblong, obtuse, concave membranous pale green segments, the anterior one rather the larger. Androecium of 6 portions in 2 rows; the outer row consisting of 3 unequal staminodes inserted at the mouth of the corolla tube, two being small, horizontal, horn-like, somewhat twisted opposite bodies, and the third large, petaloid (the labellum), rhomboidal-spathulate from a narrow base, obscurely 3-lobed and with the margin undulated, white, with pink or purple veins; the inner row also of 3 unequal parts, two being small, barren, acicular staminodes inserted on the top of the ovary (epigynous), and the third a fertile stamen inserted at the mouth of the corolla between the horn-like staminodes of the outer row; filament rather short, connective thick and fleshy, anther 2-celled, adnate, introrse, the cells contiguous but separated by the style which passes up between them. Ovary inferior, smooth, ovoid, 3-celled, style very slender and thread-like, thickened above, stigma capitate, small, hairy, occupying the space between, the summits of the two anther-cells. Fruit oblong-ovoid, ½-¾ inch long, bluntly triangular, smooth, striate, pale yellowish-grey, pointed, tipped with the withered perianth, pericarp thin, dehiscent loculicidally into 3 valves. Seeds several in each cell, closely packed, angular, obtusely wedge-shaped, dark brown; slightly rough or wrinkled, with a small hilum, attached by their sharp angle to the axis, embryo straight, axile, small, with the radicle towards the hilum and projecting beyond the farinaceous endosperm, from which it is also separated by an investment of

fleshy substance (the vitellus).

## HABITAT

A native of Southern India, growing abundantly in rich humid forests at an elevation of 2500-5000 feet above the sea in the hills of North Canara, Coorg and Wynaad. It is cultivated in the same districts. The flowers are produced in April and May, and the fruit ripens in October and November. A variety occurs wild in Ceylon (*E. major*, Sm.) with a larger and more elongated capsule. The plant has been introduced into Java. In England, the plant is grown at the Kew and Regent's Park gardens, but it does not flower here. There appears to be considerable variety in the form of the corolla; the colour of the labellum is also differently described by Roxburgh, White and Berg.

## OFFICIAL PARTS AND NAME

CARDAMOMUM; the dried seeds of the Cardamom (B. P.). The dried capsules (I. P.). Cardamomum the fruit (U. S. P.)

## CULTIVATION, PRODUCTION, AND PREPARATION

Cardamoms are the produce of Southern India, where the plant, which is commonly called Ilachi, grows wild in the forests; but the fruits are also largely obtained from cultivated plants. The authors of Pharmacographia have described the mode of cultivation as pursued in the forests of Travancore, Coorg, and Wynaad; also on the lower range of the Pulney Hills, near Dindigul, and in Northern Canara and Western Mysore, for particulars of which we must refer our readers to that volume. The gathering of the fruits commences in October, and continues during dry weather for two or three months. The fruits are dried in different ways, thus, in some cases the whole scape of fruits is gathered at once and dried, although all the fruits are not ripe at the same time; or the fruits as they are collected, are carried to the houses, and partially dried for a few days on mats, they are then stripped from their scapes, and the drying completed by a gentle fire-heat. In Coorg, the fruit is stripped from the scape before drying, and the drying is sometimes effected wholly by sun-heat." The seeds are best kept in their pericarps, in which condition they are imported, but when required for medicinal use the seeds should be separated from them, and the pericarps rejected.

## GENERAL CHARACTERS, VARIETIES, COMMERCE, AND COMPOSITION

The fruit of commerce is ovoid or oblong in form, 3-sided, and 3-celled, each cell contains from 5 to 7 seeds, which are arranged in two rows. Its base is rounded, and has frequently the remains of a stalk; and its apex terminates in a short beak-like process. The pericarp is yellowish-grey or brownish-yellow in colour, longitudinally striated, of a papery, and somewhat coriaceous texture, and without taste or odour. Two varieties of Malabar Cardamoms are distinguished in commerce from characters afforded by their fruits, as shorts and short-longs. Pereira notices a third variety under the name of long-longs, but this kind is now but very rarely or ever imported. The shorts are plump, heavy, ovoid, or somewhat rounded in form, from about 4/10 to 6/10 of an inch in length, and from 2/10 to 4/10 of an inch in breadth. The short-longs are more tapering at each end, from about 7/10 to nearly an inch long, and about the same breadth as the shorts. They are distinguished from the shorts not only by their greater length and more tapering character, but also by being of a paler colour, and more finely ribbed.

Cardamoms are also further known in commerce by the districts from whence derived, as Malabar, Madras, and Aleppy. The Malabar Cardamoms, which are commonly brought to Europe by way of Bombay, are of the highest commercial value, being plump, heavy, and of dark colour. They are found in the two forms of shorts and short-longs. The Madras Cardamoms, which are paler coloured and usually in the form of short-longs, are exported from Madras and Pondicherry; and those known as Aleppy Cardamoms are shipped from Calicut or Aleppy, and are usually shorts. The value of cardamoms is estimated by their plumpness, heaviness, and by the soundness and ripeness of their seeds. These conditions are generally most evident

in the shorts of each commercial variety. One hundred parts of the fruit yield on an average, seventy-four parts of seeds, and twenty-six of pericarp, that is, the seeds constitute about three fourths of their weight. The seeds, which are alone official, are about of an inch long, irregularly angular, transversely wrinkled, dark brownish-red externally, and whitish internally. They have an agreeably warm, aromatic taste and odour.

Cardamoms owe their properties essentially to the presence of a volatile oil of which good shorts yield about 4.6 per cent. This volatile oil has the odour and flavour of the seeds in a concentrated degree. Its sp. gr. is about 0.93; it is colourless when fresh, but by keeping it becomes yellow, thicker, and losses in a great measure, its peculiar taste and smell. It is said to consist of a liquid volatile oil, and a crystalline camphor identical with turpentine camphor. It is strongly dextrogyre.

## MEDICAL PROPERTIES AND USES

The effects of cardamoms are those of a very agreeable aromatic; they are used partly on account of their flavour, and partly for their carminative and stimulant properties. They are however, rarely prescribed alone, but commonly either as adjuvants or correctives of cordial, tonic, and purgative medicines. In Great Britain and in the United States, cardamoms are but little used, being only employed in medicine, and to a very limited extent as an ingredient in the preparation of the condiment known as curry powder. But in the East Indies, besides their medicinal use, they are largely consumed as a condiment and for chewing with betel, as described by us under 'Areca Catechu.' In Russia, Norway, Sweden, and parts of Germany, cardamoms are also much in demand for flavouring cakes and in the preparation of liqueurs, &c.

## OTHER KINDS OF CARDAMOM

Besides the Malabar or Official Cardamoms above described, a number of other zingiberaceous fruits have been, or are now, employed in pharmacy, and for other purposes, under the common name of Cardamoms. For a description of these we must, however, refer to special works on *Materia Medica*, and more particularly to Pereira's *Materia Medica* and Fluckiger and Hanbury's *Pharmacographia*.

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