



Unit 2 – Topic 3

Processing of major spices – pepper, cardamom, chilli, turmeric

SCIENTIFIC NAME : *Piper nigrum*

Family : Piperaceae

English name : Black Pepper

Indian name: Kali Mirch (Hindi), Kare Menasu (Kannada), Kurumaluku, Nallamulaku (Malayalam), Maricha Ushana, Hopusha (Sanskrit), Milagu (Tamil), Miriyalu (Telugu).

Species : *Piper nigrum* L., *P. betle* L. methysticum Forst (Kava) *P. cububa* *P. longum* *P. retrofractum*

Distribution : Western Ghats of India, North Myanmar, Indonesia, Malaysia, Brazil, Madagascar, Sri Lanka, Vietnam, Thailand, China.

Uses : Spice and condiment.

Introduction:

Pepper is the most important of all spices and popularly known as the ‘**king of spices**’. Black pepper is a dried mature fruit of perennial ever green climbing woody vine. It is one of the most important earliest known spices produced and exported from India. It is the most valuable and important foreign exchange earner among the important spices earning nearly 50% of the total export earnings from all the spices, because of its importance in the spices and unique position in trade and large share in export earnings, it is popularly referred as **king of spices** and **black gold** in trade.

Area and production:

Outside India it is grown in Srilanka, Malaysia, Indonesia, Brazil Mexico, China, Thailand and Madagascar. India accounts for **54%** of the total area under pepper in the world but its share of production is only 26.6% whereas the other countries like Brazil, Indonesia, Malaysia accounts for lesser percentage of area but with more share in the total production due to their higher productivity. In India pepper cultivation is confined to southern states only. It is grown mainly in Kerala (96% area), Karnataka, Tamilnadu and pondicherry. Since ancient time pepper is exported from India. On an average of **85%** of the Pepper produced in the country is exported to USA, Canada and Italy. Till 19th century India



enjoyed monopolistic position in the world market. However now India lost its top position due to low productivity, poor yield and raise of Indonesia and Malaysia countries.

Varieties:

More than 75 cultivars of pepper are being cultivated in India. Majority of the cultivated types of Pepper are monoecious.

Karimunda: most popular variety throughout Kerala. A prolific and regular bearer. Dry recovery is 35%. Yields good quality of Pepper. Suitable for **intercropping as well as for high density cropping**.

Kalluvally: This is grown in North Kerala. It is hardy and regular bearer. It withstands water stress and is **moderately tolerant to Phytophthora wilt**. Spikes are medium long and have a characteristic twisting due to very thick setting. Driage is 40%. It is grown either alone or mixed with other cultivars.

Kottandan, Narayakkodi, Aimpiriyam, Neelamundi, Kuthiravally, Balankottah, Malligesara and Uddagare.

Recently a number of improved cultivars have been evolved and released. They are Panniyur 1, 2 (Krishna), 3 (shima), 4 and 5 : released from Kerala Agricultural University, Pepper Research Station, Panniyur.



Improved varieties of black pepper :

Name of hybrid / variety	Parentage	Yield / vine(Kg)
Panniyur-1	F1 hybrid Uthirankotah x Cheriya kaniakadan	2.5
Panniyur-2 Krishna	Open pollinated seedlings of Balankottah	4.5
Panniyur-3 (Shima)	F1 hybrid Uthirankotah x Cheriya kaniakadan	4.4
Panniyur-4	Selection from Kuthravally II	2.3
Panniyur-5	O.P progeny of Perum kodi	2.75
Sreekara	Selection from Kanmundu (KS 14)	4.8
Subhakara	Selection from Kariamunda (KS27)	4.2
Panchami	Selecton from Aimpiriyan Coll . 856	5.2
Pournami	Selection from Ottaplackal Type coll.No.812	4.7

Sreekara, Subhakara, Panchami, Pournami – released from NRCS, Calicut. **Malabar types:** grown in Malabar region in Kerala. Examples are Kalluvally, Balankottah. They are suitable for **shade**

Cheriyakody, uthirankottah have high percentage of pistillate flowers.

Malvad types: grown in malvad of Karnataka. Workaiamarata variety is preferred for white pepper other examples include doddagya, karimarata, arasilamarata, malligesara, tisara.



Travancore types: these are hardy, the cuttings root easily and climb the support without external help. **Ex.:** Karimunda, veluthanamban (tolerant to wilt), kuthiravally, chola.

Uses:

Black pepper is used for a variety of purposes. One of the principal values of Pepper is its ability to enhance the seasoning of dishes. It is valued for its characteristic aroma, hot pungent and biting taste and is mainly used for flavouring and seasoning. It is largely used as preservative by meat packers and in canning, pickling and baking confectionery and preparation of beverages. Oil and black pepper is a valuable adjunct in flavouring of certain beverages and liquors. The oil absorbed in soaps and in perfumes. It is considered a powerful remedy for various disorders such as dyspepsia, malaria, delirium treatments. The aromatic odour of pepper is due to an essential oil, while the pungency is due to **oleoresin**. The Egyptians used it for embalming. The Asians are said to have used it as an aphrodisiac. It is extensively used in Ayurvedic medicines and pharmacological studies. Alcoholic extract of black pepper was found to be highly toxic to several weevils on stored food products. Pepper extract acts as an effective repellent. The alkaloid '**piperine**' is considered to be the major constituent responsible for the bitter taste of black pepper, it is absent in the leaves and stems. **Piperine** has insecticidal effect on its own.

Climate:

Pepper is a tropical plant it requires warm humid climate for commercial production. It grows successfully between 20° N and South latitude and from sea level up to 1500 m above MSL. The crop tolerates temperature between **10° C to 40° C**. But it requires an optimum temperature of 25 to 35 degrees Celsius. A well distributed annual rainfall of 125 to 200 cm is considered ideal for pepper. Prolonged droughts stop the vegetative growth of the vines.

Soil:

Pepper can be grown in a wide range of soils such as clay loam, red loam, sandy loam and lateritic soils with a pH of 4.5 to 6.0. It thrives better in soils rich in organic matters.



Advantages:

Multiplication is rapid

The root system is well developed.

Better field establishment and more vigorous growth as a result of better root system

Selection of site:

Well drained leveled land and hill slopes are suitable for growing pepper. When the grown on a sloppy land, the slopes facing south should be avoided and the lower half of north and north eastern slopes are preferred for planting. So that the vines are not subjected to the scorching effect of the sun during summer.

System of cultivation:

Pepper cuttings are generally planted with onset of South west monsoon. When pepper is grown as pure crop, pits of 0.5 m³ are dug at a spacing of 2.5 x

2.5 m. Erythrina stem cuttings of 2 m length are its 2 year old seedlings are planted on receipt of early monsoon showers. Certain other trees like **silver oak, *Ailanthus excelsa* and *Garuga pinnata*** are also used. With onset of regular rains, 2 or 3 rooted cuttings are planted around the base of the standard nearly 30 cm away. But in case of coconut and arecanut which have a thick intercoiled root net close to the trunk, pepper cuttings are to be planted **100 to 120 cm** away from the tree trunk. Initially the vines may be allowed to climb on a stick or pole about 2 m tall which is tied to the trunk in a slanting position. After one year when the vine has attained sufficient length it may be separated from the temporary stake and the lower leaves may be nipped off. A narrow trench of 15 cm deep and wide should be prepared from the base of the vine to the base of the tree trunk. The vines may be placed in the trench in such a way that the growing tip is tied to the trunk while other parts of vine are covered with soil. A small ridge is formed over the trench, which should not be disturbed while doing intercultural operations to the palm.



Cultural operations:

The pepper vines are tied firmly as and when they grow. The tying is done around the node, so that the nodal region is firmly attached and pressed against the standards so as to allow the roots to cling to the standards. This is an important operation which has to be attended to carefully as otherwise the vine will have no support. The another practice is that when vine reaches at a height of 75 to 100 cm without branches all the leaves are removed except the terminal 3-4 leaves. The defoliated portions are covered with friable fine soil. This aid in establishing a well developed root system and lateral branches may arise out of them.

Training and Pruning:

The vines are trimmed at the top and prevented from growing too tall for convenience of picking. In Tamil Nadu, pepper vines trained on Silver oak standards are pruned at **6 m** height from ground level for easy picking. The vines are trained up the support to give one main shoot and two lateral orthotropic shoots. These are pruned regularly to encourage the development of lateral fruiting branches but these lateral branches should not be tied to support, as this would discourage the bushy side growth.

The vines are first pruned back to 15-20cm from the ground level, when they developed to 8-9 nodes length. Second pruning is done when a further 9-10 nodes have been produced, to a height of 3-4 nodes of the previous cut. In this way vines are pruned 7-9 times until they reach the top of the support about 3 m high. When this is achieved, the terminal growth of vine is arrested by frequent pinching. The lower portion of vine is kept clean and unbranched at least a meter from ground level.

Regulation of shade:

In Pepper plantation, shade is given to the pepper vines, especially during the hot weather to keep the soil cool and moist and to allow sun light during cool weather to encourage production of flowers and fruits.

The young vines should be protected from hot sun during the summer months by providing them with artificial shade. Regulation of shade by lopping the braches of standards is necessary not only for optimum light to the vines but also for enabling the standards to grow straight. Excessive shading during flowering and fruiting encourages pest infestation.



Adequate mulch with green leaves, saw dust or coir dust or organic matter should be given towards end of the north east monsoon. The base of the vine should not be disturbed to avoid root damage.

During the second year, practically the same cultural operations are repeated. Lopping of standards should be done carefully from 4th year onwards. From the 4th year, usually 2 diggings are given one during May – June and the other towards the end of South West monsoon in October and November. Growing cover crops like *Calapogonium mucanoides*, *Mimosa invisa* are also recommended under west coast conditions to provide an effective cover to prevent soil erosion during rainy season. Further, they dry away during summer leaving thick organic mulch.

Manuring:

Judicious and regular manuring is necessary to get good yields. About 10 kg of well rotten cattle manure or compost is given in April – may. Fertilizers to supply 100 g Nitrogen, 40 grams phosphate and 140 grams of Potash per standard for vines at 3 years and above age may be applied annually in 2 split doses in April-May and August – September. During the first year of planting 1/3rd of above dose and in second year 2/3 rd of the above dose may be given. Manures are applied around the vines at a distance of 30 cm and forked in to the soil. Lime may be applied at the rate of 500 grams per standard. During April in alternate years

Harvesting:

Pepper vines start yielding usually from the **3rd or 4th** year. The vines flower in May-June. It takes 6-8 months from flowering to ripening stage. Harvesting is done from November to February in plains and January to March in hills. When one or two berries on spike turn red in early the whole spike is plucked. Yields vary with the variety and season. A full bearing vine yields one kg of dry pepper. However, individual vines recorded yields up to 3-5 kg of dried pepper.

Harvesting of pepper is carried out according to the **purpose** for which it is harvested.



For preparation of **white pepper** the berries are harvested at a slightly advanced stage of ripeness i.e when the berries turn red (bright orange). To get **black pepper** the berries are gathered at younger stages.

Yield:

Pepper vine attain full bearing stage in the 7th or 8th year after planting.

And yield starts decline after 20-25 years and replanting has to be done thereafter. 7th or 8th year old pepper vine gives 800 to 1000 kg of Black Pepper per ha.

Processing of pepper:

Almost all the produce in India is processed in to black pepper and only a very limited quantity is converted in to white pepper.

Black pepper:

It consists of fully developed, but unripe dried berries of Pepper. The harvested spikes are sun dried for **7 to 10 days** on cement floor or mats, until the outer skin becomes tough black, shrink and wrinkled. Drying is carried till the moisture content gets reduced to **10-15%**. Then the dried berries are separated from the spikes by beating or rubbing between hands or trampling them under the feet. For making good quality of Black pepper of uniform colour, the separated berries are collected in a perforated bamboo basket or vessel and the basket with the berries is dipped in boiling water for 1 minute. The basket is then taken out and drained. The treated berries are sun dried on a clean bamboo net



or cement floor. The recovery of black berry is about **33 % (26 to 36% depending upon the variety)**.

White pepper:

This consists of dried is prepared by removing the outer skin along with the pulp before drying. White pepper is prepared by one of the two methods

- I. Water steeping technique (traditional method)

- II. Steaming or boiling technique (improved method)

I. Water steeping technique:

It is a traditional and slow method. It involves **5 steps**.

- 1. Steeping:** Spikes with fully ripe berries are filled in gunny bags and are steeped in flowing water for about 7 -8 days. During this steeping process, the skin gets loosened from the seed.
- 2. Depulping:** At the end of steeping, the berries are taken out and the skin with the pulp is removed either by rubbing between hands or by trampling under feet.
- 3. Washing:** These depulped seeds are then washed and cleaned with fresh water repeatedly (3-4 times)
- 4. Drying:** The cleaned seeds are sun dried for 3-5 days on cement floor or mats till they become white and the moisture gets reduced to 10-15%.
- 5. Polishing:** The dried seeds are now dull white with colour. They are further cleaned by winnowing or by rubbing with a cloth.

The percentage of recovery of white pepper is about **25% of ripe berries**.



II. Steaming or boiling technique:

This is an improved and quick method developed at CFTRI, Mysore. It involves **4 steps**.

1. **Boiling:** Freshly harvested spikes or berries are boiled for about 15 minutes.
2. **Depulping:** The boiled berries are then pulped mechanically. Boiled berries pass through motorized fruit pulping machine.
3. **Bleaching:** The depulped berries are washed thoroughly by using bleaching powder or any bleaching agent.
4. **Drying:** The cleaned berries are sun dried for 3-5 days on cement floor or mats till they become white and the moisture gets reduced to 10-15%.

Cardamom

Small or lesser Cardamom: *Elettaria cardamomum* (Malabar cardamom)

Large Cardamom: *Amomum subulatum* (native to Eastern Himalayas)

Bengal cardamom: *Amomum aromaticum*

- III. Family: **Zingiberaceae**
- IV. Origin: **Western ghats of South India (Kerala)**
- V. Useful plant part: **Fruit (capsule)**

Out of the above species, most popular species occupying a premier position is small cardamom. Large cardamom is mainly cultivated in Dargeeling, Assam, Himalayas, Nepal, Bhutan, Thailand, Indonesia. Bengal cardamom is grown in Northern Bengal.

Introduction:

1. Cardamom is popularly known as the Queen of Spices and also Green Gold. It is one of the ancient species of India and is also one of the most valued spices of the world. It is



next only to black pepper as the largest foreign exchange earner among various Indian spices.

2. Cultivation of Cardamom is mostly concentrated in the evergreen forests of western ghats in South India. Besides India, Cardamom is cultivated in Guatemala, Tanzania, Srilanka, Vietnam, Combodia and Newguinea.
3. Among three cardamoms small one is the most popular species. India has the largest area (90% of the world area) and is also largest producer (70%). But of late India is facing still competition from Guatemala in the world market for the top position.
4. In India the cultivation of small cardamom is mainly confined to the southern states viz., kerala (60%), Karnataka (30%), Tamilnadu (10%).
5. Among the different spices, exported from India cardamom ranks second after black pepper. Nearly 40% of the production is exported to more than 60 countries.
6. Importance/ uses:
7. Cardamom is used for flavouring and seasoning various food stuffs, confectionery, beverages and liquors. In arab countries, beverage cardamom flavoured coffee is called 'Gawa'. It is generally offered to guests at social and religious functions. In srilanka cardamom is used in manufacturing liquors.
8. The essential oil of cardamom is used for medicinal purposes both in allelopathy and in Ayurveda. It is used as powerful aromatic stimulant, carminative, stomachic and diuretic. Cardamom seeds are chewed to prevent the bad bread, indigestion, Nausia and vomiting. Eating one cardamom daily with a table spoon of honey improve eye sight and strengthens the nervous system and keeps one healthy. It is believed by some people that excessive use of cardamom causes impotency.

Varieties:

Based on the size of the fruit, two varieties are broadly recognized in Cardamom

Elettaria cardamomum var *major* – comprise of wild indigenous type

Elettaria cardamomum var *minor* – comprise of all cultivated types The cultivated types are identified mainly based on the nature of panicle shape and size of the fruits



as follows.

S.No	Particulars	Mysore type	Malabar type	Vazhukka type
1.			Most common and widely cultivated	Natural hybrid between mysore and malabar type
2.	Plant stature	robust	medium	robust
3.	Panicle	erect	prostrate	semi erect
4.	Capsule	bold, elongated	round to oblong	round to oblong.
5	Adaptability	high altitudes (900 – 1200 m)	low altitudes (600 – 900 m)	wide range
6	Productivity	More	Less	Less
7	Resistance	Withstand to winds	More tolerant to thrips and less susceptible to drought	
8	Fruits shape	Pods are bold and elongated	Roundish or egg shaped	Roundish to long



Improved varieties:

Coorg cardamom malabar selection – 1 (CCS – 1)(malabar type): it yields 408 kg per ha dry capsules under rainfed conditions. It was released by National Cardamom Research Station (NCRS), Appangala.

Mudigere – 1(malabar type): it yields 250 to 300 kg per ha dry capsules. It was released by regional agricultural research station, Mudigere (Karnataka).

ICRI – 1(malabar type): it yields 265 to 650 kg of dry capsule. Released by Indian Cardamom Research Institute, Myladumpara.

ICRI – 2 (mysore type): it yields 375 to 760 kg of dry capsule. Released by Indian cardamom Research Institute, Myladumpara.

PV – 1(malabar type): it yields 500 kg of dry capsule. Released by Cardamom Research Station, Pampadumpara.

SKP – 14 (malabar type): it yields 430 to 590 kg dry capsule per ha. Released by ICRI Regional station, Saklespur, Karnataka.

Climate :

Small cardamom is a humid tropical plant. It is grown under natural conditions of ever green forests at an elevation from 600 to 1500 m above MSL. Optimum elevation is 900 to 1200 m. The plant prefers temperature of 10 to 35°C and a well distributed rainfall of 1500 mm per annum. Summer showers are essential during summer i.e. February – April for panicle initiation. Otherwise it affects yield. It does not stand drought and is highly sensitive to winds. Under exposed conditions, the plant does not attain its full vegetative growth because of sun scorching. It grows luxuriantly under shade. Shade trees besides providing shade create a congenial micro climate in the plantation. It keeps the surroundings humid and cool. Moderate shade high humidity cool surroundings well distributed rainfall and wind less areas are very essential for the satisfactory performance of Cardamom.

Soils:

Grows best on well drained humus rich forest soils. Water logging and excessive soil moisture conditions are detrimental. Moisture level should be 40 to 50% of the field capacity of the soil. An ideal site is a sloppy land with good drainage. In India cardamom is grown on red, deep and good textured laterite forest soils having plenty of humus and leaf mould. Ideal pH is 5. to 6.5

Planting:

The best season of planting seedlings or suckers is May- June after the receipt of monsoon showers. The seedlings or suckers are planted in the pits up to collar region for better growth. Cloudy days with light drizzle are ideal for planting.

Shade and shade regulation:

Cardamom is a shade loving plant (pseophyte). Shade help to regulate soil moisture as well as temperature and provides congenial micro climate for cardamom. Shade protects plants from sun-scorching, rains and winds. Shade trees provide mulch material through fallen leaves on the surface and prevent soil



erosion through their root system. Excess shade is also quite detrimental and shade has to be regulated so as to provide 50-60% filtered sunlight.

In South India, many trees are available in the natural habitat to provide shade but an ideal shade tree should have a wider canopy, minimum side branching and it should not shed the leaves during flowering phase of Cardamom, so as not to affect pollination. Some of the common shade trees in cardamom estates are karimaram (*Diospyros ebenum* and *D. elongi*), *Mimusops elangi*, Balangi (*Artocarpus fraxinifolius*), Jack, Red cedar (*Cedrella toona*). The temporary shade trees like *Erythrina lithosperma* and *E. indica* are the most unsuitable as they compete for nutrients and soil moisture. In order to provide adequate light during monsoon, shade regulation may be taken up before the onset of monsoon. A two tier canopy with a height of not more than 3 m between the lower and higher canopy may be maintained. Areas exposed to western side should have adequate shade.

Manuring:

Cardamom is a surface feeder and its growing areas are usually subjected to heavy rain fall conditions, the top soil is subjected to frequent leaching, resulting in the loss of plant nutrients, even though there is annual replenishment of nutrients through the incorporation of fallen leaves of shade trees and cardamom plants. Therefore manuring is very essential.

Under irrigated conditions – 75 kg N; 75 kg P and 150 kg K per ha.

Under rainfed conditions – 30 kg N + 60 kg P and 30 kg K per ha.

Organic manures may be applied at the rate of 5 kg per plant.

Two split doses one during May – June for production of suckers, Second during September to October for initiation of panicle. Half dose can be applied during first year. Full dose can be applied from second year onwards. Being a surface feeder deep placement of fertilizer is not advocated. These fertilizers apply 30 cm away from the plant.

Irrigation:

Cardamom is generally raised as rainfed crop. However, it responds well to irrigation. It is necessary to irrigate the crop during dry periods to get increased yields. Since, cardamom is raised under evergreen forests and on undulated terrain, conventional irrigation methods are not useful.

Intercultural operations:

Weeding:

2-3 weeding per year may be necessary during May- June, August – September and December – January. Paraquat @ 625 ml in 500 litres of water may be sprayed.

Mulching:

It is an important cultural operation in Cardamom. Fallen leaves at the shade trees and uprooted weeds are utilized for mulching. Mulches should be applied during November – December to reduce ill effects of drought conditions during ensuing summer.

Trashing or clearing:

It consists of removing old and drying shoots of the plant once in an year with the onset of monsoon under rain fed conditions and 2-3 times in high density plantations. The plantation is provided with irrigation facilities. Weeding and clearing may be done simultaneously during May- June and August – September.

Packing and digging:

At the end of the monsoon rains a light raking or digging of soil should be



given around the plant up to a radius of 60-75 cm to conserve the moisture to the ensuing dry period particularly in low rainfall areas.

Earthing up: After the completion of monsoon, a thin layer of fertile soil rich in organic matter may be earthed up at the base of plant up to Collar region to encourage new growth.

Cropping:

Cardamom plants start bearing in about 3 years after planting. Flowering starts in April – May and continues up to August – September. Peak flowering will be in the month of May- June. From flowering to maturity the fruit takes 5-6 months.

Harvesting:

Only ripe capsules are harvested at 25-30 days interval, the harvesting is completed in 5- 6 pickings. In most of the areas the peak period of harvest is during October – November.

Yield:

Although the Cardamom plant start bearing from 2nd or 3 rd year of planting, an economic crop can be obtained only from 4th or 5th year. Yield vary with variety and age. Optimum average yield is 50-70 kg of dry capsule per ha. Yields decline from 10th year to 12th year.

1st year of bearing – 25-50 kg per ha (dry capsules)

2nd year of flowering 50-70 kg per ha

3rd year of flowering 70-100 kg per ha

Processing:

The commercial product of Cardamom is the dried capsules. At the time of harvesting the capsules are juicy and fleshy, so they must be cured before sending them to the market.

Bleaching: Green colour of the cardamom capsules plays a vital role in the market. Green colour of the capsules can be preserved by alkali treatment. So freshly harvested cardamom capsules are soaked in 2 % washing soda (Na_2CO_3) solution for 10 min.

Drying: After bleaching, the capsules are dried either by sun drying or in fuel kilns and electric driers. The capsules are sun dried for 3-5 days. These capsules gets bleached and does not store well. Hence, now a days capsules are dried artificially in which drying is incomplete and the green colour remains in electrical drier in capsules are dried at 45 – 500 C for 18 hours.

Fuel kilns: Temperature is set at 50 – 60 0 C over night.

The capsules kept for drying are spread thinly and stirred frequently to ensure uniform drying. The dried capsules are rubbed with hands or coir mat or wire mesh and winnowed to remove any foreign matter.

Storage: Then they are stored according to size and colour and stored in black polythene lined gunny bags to retain green colour during storage. These bags are then kept in wooden chamber.

Sorting: The dried capsules are stored according to their size, colour and stored in black polythene lined gunny bags to retain green colour during storage.



Chilli

Introduction

Family: Solanaceae

Scientific Name : Capsicum annum /Capsicum frutescens

- **Chillie is considered as one of the major commercial crops of the world.**
- **Different varieties are grown for vegetables, spices, condiments, sauces and pickles.**
- **Both green and dried chillies are the important components of our routine diet.**
- **It will give the required pungency, colour, taste and flavour to our dishes.**
- **When chillies taken with food stimulates our taste buds and there by increase the flow of saliva which contains the enzyme analyse which inturn helps in the digestion of starchy or cereal foods etc., into the easily assimilable sugar namely glucose.**
- **The presence of capsaicin in chilli is responsible for its pungency and it has medicinal value.**
- **The extracted capsaicin is used in pain balms, cosmetics, medicines related to heart diseases.**
- **Capsanthin, a pigment in chilli used for natural colouration to Jams, Jellies and squashes, since it is a natural pigment and no harmful or side effects on human health.**
- **Hence, there is lot of demand for chilli oleoresin in the world market.**
- **Chilli also contains vitamin A ,C and E. Because of these reasons chilli is having lot of export potential.**



Harvesting

- Time and stage of harvesting chilli is governed by the purpose for which grown.
- The large part of the crop is producing dry chilli fruits.
- The crop is ready for harvesting green chilli in about a month after transplanting.
- One or two pickings of green fruits can be taken and the produce is disposed of in local market to be used as green salad, vegetable or condiment.
- This practice not only supplements net returns to farmer but also enhances growth of plants and induces them to produce more flowers and fruits
- For dry chillies the fruits should not under ripened or over ripened.
- Crop is ready for harvesting ripe fruits in about three and a half months.
- Picking of fruits continues for about 2 months and 6 pickings are taken annually.
- While harvesting fruits, care should be taken to hold stalks firmly, and fruit should be pulled upward gently, breaking the base of the stalk.
- If it is rainfed crop 2-4 pickings and for irrigated crop 6-8 pickings are generally taken.
- Farmers are under the impression that frequent pickings in irrigated chilli cause breaking of twigs and more labour requirement and thus they will reduce the number of pickings which may not be correct.
- Delayed harvesting of fruits gives poor quality produce.



Post harvest technology

- Pungency, initial colour and colour retention properties of fruits are closely related to maturity.
- Pods left to ripen and partially withered on plant are superior in the above said three qualities.
- However, it should be noted that care must be taken over the extent of withering permitted prior to harvesting, since if prolonged, it can sometimes results in a product with grey colour.

Traditional Sun drying

- Chillies on harvesting have a moisture content of 65-80% depending on whether partially dried on the plant or harvested while still succulent, this must be reduced to 10% to prepare dried spice.
- Traditionally, this has been achieved by sun - drying of fruits immediately after harvesting without any special form of treatment.
- Sun drying even to day the most widely used method in the world.
- Immediately after harvesting of fresh fruits heaped indoors for 2 or 3 days, so that the partially ripe fruits if any ripen fully and whole produce develops a uniform red colour.
- The best temperature for ripening is 22-25°C and direct sun light is to be avoided since this can result in the development of white patches
- Heaped fruits then spread out in the sun on hard dry ground or on concrete floors or even on the flat roofs of houses, frequent stirrings are given during day time in order to get uniform drying and thereby no discolouration or mould growth.
- The drying fruits are heaped and covered by tarpaulins or gunny bags during nights and spread during day time.
- After 2 or 3 days, the larger types are flattened by trampling or rolling to



facilitate subsequent packing into bags for storage and transport.

- Drying by this procedure takes 5-15 days depending on prevailing weather.
- Out of 100 kg of fresh fruits 25-35kg of dried fruits may be obtained.
- Recently in majority of areas the fresh produce dried on open spaces like roadsides and remain exposed to weather for the entire drying period (5-15 days) may cause contamination with dust and dirt, damaged by rainfall animals, birds and insects.
- The losses may range 70-80% of total quantity due to this method.
- Traditional method of harvesting and sun drying involved poor handling of fruits results in bruising and splitting.
- Bruising shows up as discoloured spots on pods, splitting leads to an excessive amount of loose seeds in a consignment, there is a considerable loss in weight and then in price.
- If the harvested fruits are not properly dried and protected from rain and pests, it will loose the colour, glossiness and pungency.

Improved CFTRI method of sun - drying:

- A four - tier system of wire - mesh trays or a single tray of perforated Aluminium took 14 days in sun to dry fruits having a moisture content of 72 to 74% reducing it to about 6%, the traditional method of sun drying takes about 3 weeks to achieve a moisture level of 15-20%.
- The improved CFTRI technology involves the following steps.
- Dip fresh chilli in "Dipsol" emulsion for a short period (approx 5 minutes)

Drain excess emulsion



- For 100 kg of fresh chillies 15 litres of emulsion is required which costs Rs.4/- only.
- Spread the material for drying on racks having multi-tier wire net trays @ 5-10 kg per m² of tray area depending upon ambient temperatures.
- The treated material dry to the commercial level moisture content in about a weeks time.

Advantages of improved CFTRI method are:

- Rate of drying is fast and hence the drying period is only a week as compared to 15-21 days in traditional method.
- Requires less space.
- Helps in better retention of colour and pungency.
- Gives a more hygienic and superior quality product.
- Gives 2% more finished product by weight and thus more profits.

Preparation of Emulsion 'DIPSOL':

- 'Dipsol is a water-based emulsion containing Potassium carbonate (2.5%), refined groundnut oil (1%), Gum acacia (0.1%) and Butylated hydroxy anisole (BHA) (0.001). Thus, 100 kilograms of 'Dipsol' contains as follows;
 - Potassium carbonate 2.5 kg
 - Refined groundnut oil 1.0 kg
 - Gum acacia 0.1 kg
 - BHA 0.001 kg
- Dissolve potassium carbonate and gum acacia in water separately. Similarly, dissolve BHA in refined groundnut oil.
- Mix water - phase solutions and add BHA dissolved in groundnut oil slowly while stirring.



- The mixture is passed through a homogenizer twice at 200 kg/sq.cm.

Solar Drying:

- Recently attempts have been made to develop solar equipment to improve upon the sun - drying techniques, which lead to:
 - (a) better use of available solar radiation
 - (b) reduction in drying time,
 - (c) cleaner and better quality product, free from dust, dirt and insect infestation.
- This equipment is called 'Solar Drier'.
- The RRL (Jammu) has devised a Solar Drier for drying chillies.
- Red chillies of Kashmir are very popular throughout the country as these impart attractive bright red colour to dishes.
- Chillies are produced in substantial quantity in Kashmir valley and it is a common scene to find chillies strung together in thread and hung on walls and doors or spread on roof tops.
- Commercially, plants with fruits still unplucked are harvested and spread out on the ground for about a week for partial drying.
- Thereafter, the fruits are plucked by hand and spread in field for final drying.
- The entire operation takes about 15 days during which chillies are exposed to dirt, dust, fungus attack besides uneven drying.
- A solar drier has been made near Pampore (Jammu and Kashmir) which effects complete drying of the commodity in 4-5 days with a marked improvement in colour and storage characteristics.
- The gadget is very simple and is made of mud, stone pebbles and glass panes only and is specially suited for rural areas.



- It can be conveniently constructed by village artisans.
- With the extensive use of such solar driers, sizeable quantities of red chillies and other dried vegetables of improved quality can be produced in rural areas.
- Work at Agricultural Research Station., Lam on mechanical drying has shown that the produce can be dried within a period of 18 hours with the aid of air blown drier keeping the temperature at 44-46°C.
- This method not only saves time and avoids watch for 10-15 days, but also imparts deep red colour and glossy texture to the fruits which are liked in Foreign trade and fetch higher premium than that of sun drying (the moisture content of dry pods is to be kept at 8-10%).
- The cost of mechanical drying worked out to 25 paise per kg of dry fruits.
- Packing is done after the removal of defective and decolourised pods in gunny bags, Jute boras or palmyrah baskets.

Packing and Storage



- The discolouration of the red pigment of chilli during storage is greatly influenced by moisture content of pods at the time of storage and temperatures at which the produce is stored.
- Storage has a marked influence on the colour of the dried chillies though it has little effect on their pungency.
- Since, colour is one of the main determinants of the price, which a producer receives.
- Greatest influence on colour retention is not infact of the storage conditions but rather of variety of capsicum or chilli grown.
- Delaying in harvesting until pods are partially withered on the plant and then curing the sliced pods provide a product with superior colour retention properties.
- Exposure of dried chillies to air and light accelerates rate of bleaching and so storage in airtight containers away from sunlight is desirable.
- Moisture content higher than 15% is critical with respect to mould growth.
- Chillies should be conditioned to 10% moisture and compressed at 2.5 kg / cm² by using a baling process.
- For retail or consumer packing of chilli powder.
- Packing in 3000 gauge low density polyethylene film pouches are suitable for 100 g consumer unit packs to give a shelf - life of 3 to 6 months.
- Under tropical conditions, 200 - gauge low and high density polyethylene films are suitable for packing of whole chilli in units of 250 g each.
- Such packs can be stored at a cool, dark, dry place for about a year.
- Detachment of stalks from pods resulting in bleeding of seeds from within the pods, leading to loss in pungency.
- As this commodity emits strong odour; it shall be stored in separate compartment as far as possible.



- Chillies are attacked by spice beetle and cigarette beetle during storage.
- The storage temperature has a greater influence in colour retention than does light, air, kind of container or when the spice is stored in the whole or ground form.
- Application of fat - soluble antioxidants has been found to improve colour retention.
- Addition of antioxidants is more effective after curing than before and in the ground spice rather than whole pods.
- Rats have a great liking for chillies in spite of their pungency, and therefore care should be taken in storage to protect chillies against this noxious animal.
- Shelf life of green pepper can be prolonged by using perforated polyethylene bags of 150-200 gauge.
- Ventilation of packages should be adequate to avoid off-flavour development and moisture condensation in packages.
- The lowest temperature range recommended for storing green bell peppers is 7-10°C for up to 2-3 weeks.
- At temperatures below 7°C bell peppers are subjected to chilling injury.
- Peppers having a large surface to volume ratio are particularly susceptible to water loss.
- They must be held in high relative humidity of 90-95% or else they will rapidly become wilted.
- For controlled atmospheric storage of bell peppers, the recommendations are 4-8% oxygen, 2-4% of Carbon dioxide at 13°C.
- Oxygen concentration below 2% combined with 10% Carbon dioxide may cause injury.



Turmeric

B.N: *Curcuma longa* and *Curcuma aromatica*

Family: Zingiberaceae

Origin: South East Asia

Plant part: Rhizome

Underground rhizome is used as condiment, dye stuff, drug and cosmetic. Traditional item of export. India is the largest producer of Turmeric. In India, A.P., leads in Area and Production. In A.P., there are five agro-climatic zones. Duggirala zone, Cuddapah zone, Nizamabad zone, Godavari zone and Agency Turmeric ranks 4th as foreign exchange earner among the spices after Pepper, Cardamom and Ginger.

Climate:

Tropical herb. Grows well 1200 m above MSL. Requires warm and moist climate. Rainfall 100 to 200 cm. Temperature range preferable is 20 to 30° C

Soils:

Can be grown on various soils. Thrives best in well drained, friable, rich sandy or clay loam soils. Crop stands neither water logging nor alkalinity.

Preparation of land:

Give 4-6 deep ploughings to get fine tilth up to 20 -25 cm depth. Field is laid out into beds or ridges and furrows. Bed system gives higher yield by 54 to 80%. Beds of 1 m width and convenient length with a spacing of 40 to 50 cm between beds where natural drainage does not exist, ridges and furrows are prepared at 45 to 60 cm spacing.

Time of sowing:

Short duration varieties: second fortnight of May

Mid duration varieties: first fortnight of June

Long duration varieties: second fortnight of June to second fortnight of July.

Seed rate: mother rhizomes 2000 – 2500 kg per ha Primary fingers 1500 to 2000 kg per ha



Spacing:

Red loamy soils – 30 x 15 cm Black heavy soils – 46 x 23 cm

Method of sowing: sown behind the plough in ridges and furrow system

In bed system, rhizomes are dibbled at 5-10 cm pits. Treat with dithane m 45 0.3% for 30 minutes before sowing. Germination starts in 10-20 days and will be over by 60 days.

Mulching: To protect sprouts.

To conserve moisture To
reduce weed growth

To enhance germination by mulching with dry leaves. Mulch with dry leaves thickly on which a layer of cow dung is spread. Second mulching is done after weeding and application of fertilizers, after 50 -60 days of sowing.



Irrigation:

A good soaking irrigation is given immediately after sowing. Thereafter, irrigate at weekly interval.

Manuring:

20-25 to of FYM during land preparation

60kg N, 60 kg P, 60 kg K per ha before planting the rhizomes. 60 kg N 65 kg K per ha
60 das

60 kg N per ha 120 das

50% of top dressed Nitrogen may be applied in the form of oil cakes. Top dressing should be completed within 120 days after sowing.

After fertilization, the field is given a light hoeing and the clumps are earthed up and irrigated.

Weeding:

3 – 4 weedings are required at 60, 90, 120 and 150 days of planting. Weedings and hoeings are done simultaneously. Plants are earthed up and mulch is replaced. Provision of shade. By raising castor on the bunds and within the crop. Daincha is also grown for shade purpose.

Intercrops:

Maize or chillies are grown as inter crops. Turmeric can also be raised as an inter crop in coconut and arecanut plantations.

Rotations:

Turmeric is a heavy feeder. Hence depletes soil nutrients. Continuous cropping results in build up of diseases.

It is rotated with rainfed paddy, sugarcane, banana, betelvine, vegetables.



Harvesting:

Depending upon the varieties, the crop comes to harvest in **7-9 months**.

1. Main season of harvesting falls in February – April.
2. Maturity indication is complete yellowing and drying up of plants
3. Above ground parts are cut close to the ground level.
4. Field is irrigated 1-2 days in advance of harvesting the crop.
5. Crop is harvested by Ploughing or digging.
6. Rhizomes are gathered by hand picking and cleaned.
7. Rhizomes are washed.
8. Mother rhizomes are separated from the fingers before they are cured.

Yield: Indian average yield is 20,000 to 22,000 kg per ha



Processing:

Fresh rhizomes are not useful for marketing. Curing makes fresh rhizomes marketable. Curing involves **boiling, drying and polishing**.

A. Boiling: is done either by traditional or improved method.

I. Traditional method:

Water is poured to cover rhizomes in the vessels of copper or galvanized iron or earthen material. Mother rhizomes and fingers should be boiled separately, since fingers take long time for boiling. Stop boiling when froth, fumes with typical odour comes.

Rhizomes yield to finger pressure. Over cooking should be avoided as it spoils the colour, while under cooking renders the dried product brittle.

II. Improved method:

50 kg of cleaned rhizomes are taken in a perforated trough made of GI sheet. It is immersed in a pan. Alkaline solution **0.1% sodium carbonate/ sodium bicarbonate** is poured in the trough. Boil till fingers become soft. Alkaline solution helps in imparting orange yellow colour to the core.

B. Drying:

The boiled rhizomes are sun dried in 5.7 cm thick layers for 10 – 15 cm layers. Rack frequently for uniform drying. Dry until they become hard, brittle, break with a metallic sound. After drying they should possess only 8 – 10 % moisture.



C. Polishing:

The dried rhizomes are smoothed by manual or mechanical rubbing. Manually they rubbed on hard surface or trampled under feet. Mechanically they are polished by mechanically operated polishing drums.

D. Colouring:

They are coloured to improve the appearance.

Rhizomes are artificially coloured in **two ways**. Dry and wet colouring. Half polished fingers are coloured.

In dry process – turmeric powder is added in the last 10 min to polishing drum. In wet process – turmeric powder is suspended in water and mixed by sprinkling.

For brighter colour – boiled, dried, half polished fingers are taken in baskets and shaken continuously with an emulsion of

2 kg turmeric powder, 0.04 kg alum, 0.14 kg castor seed oil, 30 g of sodium bisulphate and 30 ml HCl.

Coloured rhizomes are again sun dried before sending to market.