Chapter - II

Description of Experimental Plant and its Important Species
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2.0 Turmeric

Turmeric botanically known as *Curcuma longa* L. belongs to the family Zingiberaceae of monocotyledons. The dried underground rhizome is taken as a spice. Turmeric is a native of South Asia and Indonesia, from where it spreads to various tropical, sub-tropical and warm temperate zones of the world. The cultivated species of turmeric have become naturalised in various parts of the India including North-Eastern states of the country. Turmeric is one of the oldest spice crops grown in India and the produce has got wide use within the country. India is the largest producer and exporter of turmeric in the world. About 7-8 percent of the country’s production is exported and in the recent years the export demand has considerably increased.

In fact, India is almost a monopoly supplier of this spice in the world market. About one-third of the total production of turmeric in India, comes from Andhra Pradesh alone. Turmeric is produced in almost all the states of the country, like Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra, Bihar, together contribute about 90% of the production. Among them Andhra Pradesh accounts for 38% and Tamil Nadu for 20% of the production. In the North Eastern region, turmeric is cultivated to a considerable extent in Assam, Manipur, Meghalaya and Tripura. The herb is also commonly cultivated in the hills and plain areas of Manipur (Table 2.1 and Fig. 2.0) since time immemorial with progressive increase in terms of area and yield for use as spice and folk medicine. The area under turmeric in India is about 77,400 hectares. The annual production is estimated to be about 5
lakh tonnes. Turmeric appears to have come into use in India as a substitute for saffron and other yellow dyes.

<table>
<thead>
<tr>
<th>Districts</th>
<th>Area (ha)</th>
<th>Production (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imphal West-I</td>
<td>14</td>
<td>168</td>
</tr>
<tr>
<td>Imphal West-II</td>
<td>19</td>
<td>223</td>
</tr>
<tr>
<td>Bishnupur</td>
<td>35</td>
<td>399</td>
</tr>
<tr>
<td>Thoubal</td>
<td>36</td>
<td>416</td>
</tr>
<tr>
<td>Chandel</td>
<td>24</td>
<td>531</td>
</tr>
<tr>
<td>Ukhrul</td>
<td>24</td>
<td>278</td>
</tr>
<tr>
<td>Tamenglong</td>
<td>38</td>
<td>532</td>
</tr>
<tr>
<td>Senapati</td>
<td>28</td>
<td>322</td>
</tr>
<tr>
<td>Churachandpur</td>
<td>47</td>
<td>531</td>
</tr>
</tbody>
</table>

Source: Directorate of Horticulture and Soil Conservation, Govt. of Manipur, India.

Turmeric contains an oil whose main content is curcumin. Beside oil, turmeric also has proteins, carbohydrates, mineral matters and vitamins. Turmeric can be grown on a variety of soil types ranging from light black, ashy loam and red soils to stiff black clay loams and well drained sandy or clayey loam soil both under irrigated and rainfed conditions. Soils rich in loam having good drainage are ideal for the crop. However, the crop is highly sensitive to ill-drained and alkaline conditions. Turmeric is cultivated from almost sea level to 1,200 metres. The crop is mainly grown as an unirrigated crop, in areas with the rain fall of 100 - 200 cm per annum. It is also grown under irrigated conditions. Turmeric
Turmeric is propagated from seeds, but the common method of propagation is through the use of mother rhizomes. The use of mother rhizomes has been recommended as seed material in many countries. The yield of turmeric is found to be influenced by many factors such as transplantation time, varieties and agro-climatic conditions. Turmeric grows well under partial shade but dense shade is harmful for the crop yield.

About 50 commercial cultivars of Curcuma longa L. have been recognised in the country. These cultivars have been classified as long duration (9 months), medium duration (7 months) and short duration (7 months) based on the time taken by the variety of rhizome (Aiyadarai, 1968).

**Commercial Cultivars of Turmeric**

One of the most popular and specific cultivars of turmeric, which are cultivated in different parts of the country are listed below:

- **Sri Lanka:**
  - 'Singapura' is a few turmeric cultivars mainly cultivated in Ceylon.
  - "Kanda naranji" is mainly cultivated in South India.

- **Kerala:**
  - "Kundata" is available in Tamil Nadu. It contains light yellow colour.
  - "Kundata" is available in Mysore. The corms are big with thick and large

![Fig. 2.0 Turmeric cultivation in Manipur, India](image-url-url)

Fig. 2.0 Turmeric cultivation in Manipur, India
can be propagated from seeds, but the common method of propagation is through rhizomes. The use of mother rhizomes has been recommended as seed material in inspite of fingers (bud). The yield of turmeric is found to be influenced by many factors like transplantation time, varieties and agro-climatic conditions. Turmeric can come up well under partial shade but dense shade is harmful for the crop yield.

About 50 commercial cultivars of *Curcuma longa* L. have been recognised in this country. These cultivars have been classified as long duration (9 months), medium duration (8 months) and short duration (7 months) based on the time taken for the maturity of rhizome (Aiyadurai, 1966).

### 2.1 Commercial Cultivars of Turmeric

Some of the most popular and specific cultivars of turmeric, which are widely cultivated in different parts of the country are listed below:


2. ‘China nadari’ is mainly cultivated in South India. It has light yellow colour.

3. ‘Patani nadan’ is available in Tamil Nadu. It contains light yellow colour.

4. ‘Mundaga’ is found in Mysore. The corms are big with thick and large rhizomes.

5. ‘Balaga’ is available in Mysore. It produces small corms with small rhizomes.
6. ‘Deshi’ is mainly grown in Assam and West Bengal. The corm and fingers are small with deep yellow colour.

7. ‘Patani’ is also cultivated in Assam and West Bengal. It has deep yellow colour with specific taste and flavour.

8. ‘Lakadong’ is a local selection of Shillong (Meghalaya). Both corms rhizomes are small with deep yellowish orange colour.

9. ‘Silot Yaingang’ is a local selection of Manipur. Both corms and fingers are large in size with deep yellowish orange colour.

10. ‘Meitei Yaingang’ is also a local selection of Manipur. Corm and its fingers are small with yellow colour.

11. ‘Meitei Yaingang Akhabi’ is a local variety of Manipur. It has small rhizomes with unique bitter taste. It is mainly cultivated for its medicinal uses.

2.2 Synonym and Vernacular of Curcuma longa L.

The synonym of C. longa L. is Curcuma domestica L. Roxb. Curcuma longa plant is variously called by different local names in different regions.

<table>
<thead>
<tr>
<th>Bengali</th>
<th>Haldi</th>
<th>Kannada</th>
<th>Arishina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burmese</td>
<td>Tanum</td>
<td>Konkani</td>
<td>Halad</td>
</tr>
<tr>
<td>English</td>
<td>Turmeric</td>
<td>Manipuri</td>
<td>Yaingang</td>
</tr>
<tr>
<td>French</td>
<td>Curcuma</td>
<td>Malayalam</td>
<td>Manjal, Paccamanjal, Varattumanjal, Haldi</td>
</tr>
<tr>
<td>German</td>
<td>Babilonischer safran</td>
<td>Marathi</td>
<td>Serdchubah</td>
</tr>
<tr>
<td>Gujarati</td>
<td>Haldi</td>
<td>Persian</td>
<td>haldi</td>
</tr>
<tr>
<td>Hindi</td>
<td>Haldi, Haldal</td>
<td>Punjabi</td>
<td></td>
</tr>
<tr>
<td>Sanskrit</td>
<td>Haridrav, Varavarnini</td>
<td>Tamil</td>
<td>Manjal, Muncal</td>
</tr>
<tr>
<td>Telegu</td>
<td>Pasupu</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.3 Morphology

*Curcuma longa* L. is a robust perennial herb, with irregularly shaped tubers (rhizomes), cultivated throughout India (Fig. 2.1). The plant is about 60-90 cm in height with a short thickened underground stem or rhizome produces a tuff of large, lanceolate, smooth, uniform green leaves, petiole is as long as the blade. The rhizome is cylindrical, ovoid, branched and orange coloured. The floral bracts are pale-green ovate, sometimes pink. The flowers are pale-yellow in spikes connected by the sheathing petioles. The flowers are borne in dense spikes terminating the stem. It has a peculiar odour and is slightly bitter and acidic. Plant is cultivated for the rhizome and ornamental purposes. In India, it is usually grown in rotation with rice or sugarcane and often in mixed cultivation with vegetable crops.

2.4 Parts Used

Rhizomes (dried as well as raw) used as a condiment, dye stuff and medicine since time immemorial. The rhizomes are bitter, acrid, thermogenic, anti-inflammatory, antiseptic, laxative and contain moisture - 5.8%, protein 8.6%, fats 8.9%, carbohydrates 63.0%, fibre 6.9%, mineral matter 6.8% and vitamin A and B. The calorific value of turmeric rhizome is 390 calories/100 gm. Rhizome also contains orange yellow volatile oil. The musky odour of turmeric is due to the presence of this volatile oil. The main constituent of the oil is curcumin.

2.5 Some Important Species of Turmeric, Their Properties and Uses

1. *Curcuma aromatica* Salisb : Plant is wild throughout India (Fig. 2.2). It is also called as yellow *Zedoary*. The herb is widely grown in the Himalayan
Fig 2.1 Curcuma longa L.

Fig 2.2 Curcuma aromatica Salisb.
Fig 2.3  
Curcuma amada Roxb.
ranges extending the hilly tracts of North Eastern Regions. In Manipur herb is
grown and well known for its high Medicinal value since old days. It is also
cultivated in Bengal and Kerala.

Vernacular Names

<table>
<thead>
<tr>
<th>Language</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td><em>Wild turmeric</em> (Cochin turmeric, Yellow zedoary)</td>
</tr>
<tr>
<td>Hindi</td>
<td><em>Jangali haldi</em> (Ban-haridra)</td>
</tr>
<tr>
<td>Bengali</td>
<td><em>Ban halud</em></td>
</tr>
<tr>
<td>Malayalam</td>
<td><em>Kasturimannal</em> (Kattumannal)</td>
</tr>
<tr>
<td>Sanskrit</td>
<td><em>Vanaharidra</em> (Aranyaharidra)</td>
</tr>
<tr>
<td>Tamil</td>
<td><em>Kasturimanjal</em> (Kattumanjal)</td>
</tr>
<tr>
<td>Manipuri</td>
<td><em>Tekhau Yaikhu</em> (Yaimu, Yaipal, Yai hanuman)</td>
</tr>
</tbody>
</table>

Wild turmeric is a perennial herb with annulate aromatic yellow rhizome
which is internally orange-red in colour with camphoraceous odour. All the Plant
parts are aromatic. Leaves elliptic or lanceolate oblong, 30-60 cm long. Petioles as
long as blade or even more longer, bracts ovate, recurved with red or pink colour,
flowers are larger, pale and rose coloured.

Rhizomes are bitter, carminative, appetiser and tonic and are used in
combination with astringents and aromatics for bruises, sprains, hiccough.
bronchitis, cough, leucoderma and skin eruptions. Roots are used as a source of
perfume and also medically, both fresh and dried. Crushed rhizome mixed with
water and used as bath water in jaundice. In Manipur young shoots and tender
rhizomes are used as vegetable in boiled chatney.

Vernacular names:

- English: Mango ginger,
- Hindi: Ama haldi,
- Malayalam: Mannayinci,
- Manipuri: Yai hanuman,
- Sanskrit: Karpura haridra,
- Tamil: Mankayinci.

The herb is perennial with its very short and thin rhizome with a leafy tuft, 60-90 cm in height (Fig. 2.3). It is cultivated throughout India. In Manipur, the herb mainly grown for its medicinal uses since old days. Leaves are long, simple, petiolate, oblong-lanceolate, tapering at both ends, and green on both sides. Flowers are white or pale yellow in spikes in the centre of the tuft of leaves.

In West Bengal, rhizome is used as a source of food. The rhizomes are light creamy yellow and sour with aromatic taste like green mango. It also acts as appetiser, carminative, stomachic, digestive and cooling. Rhizomes are also useful in treating wounds, chronic ulcers, skin diseases, pruritus, fever, constipation, sprain, cough and inflammations.


The herb is distributed throughout India. Rhizome is pale oblong and pendulous. Leaves petiolated, narrow lanceolate most acute, striated with fine parallel veins. Flowers are longer than the bracts, petioles are 6-10 inches long with sheathing, radical spike, 4-6 inches long. Flowers bright yellow, expanding at
sunrise and fading at sun set. An excellent kind of *Arrow-root* is prepared from the tubers of this species.

### 2.6 Cultural Practices

The land is prepared on receipt of pre-monsoon showers or when there is sufficient moisture in the soil by giving 2-6 deep ploughings, because turmeric is a deep rooted and exhaustive crop. Beds of about 1 m width and convenient length are prepared with a spacing of about 35-40 cm between beds. The crop is commonly propagated through mother rhizomes or finger buds. The seed material can be stored for 3 to 4 months by heaping in a shaded place. The yield is found to be influenced by the cultivation time, varieties, planting materials and agro-climatic conditions.

Two systems of planting are adopted: (1) Flat bed, and (2) Ridge and Furrow method. The flat bed system of planting was found to give increased yield by 54 to 80% (Aiyadurai, 1966). The spacing of 25 cm x 25 cm for bed method and 45 cm x 60 cm between rows and 25 cm between plants for ridge and furrow method were found optimum (Aiyadurai, 1966). However, other spacing such as 30 cm x 15 cm, 16 cm x 20 cm have also been recommended by some workers. The seed rhizomes are subjected to loose soil at the average rate of 1500 to 2500 kg/ha. Immediately after sowing the seed, beds are covered with a layer of cow dung and soil.

Application of organic fertilizers at the rate of 20-30 tonnes/ha at last ploughing or at planting is ideal for a good crop. The significant effects of nitrogenous and potassic fertilizers on the growth of the plant and yield of turmeric
are well known. The response of phosphorus in turmeric is usually negligible. Aiyadurai (1966) found that 100 kg/ha of Ammonium Sulphate doubled the yield over that of unmanured crop. Fertilizer dosage of 189 : 63 : 126 kg/ha of N:P:K has been recommended for the best yield of turmeric under Andhra Pradesh conditions. However, for Kerala conditions 30:30:60 kg N:P:K per ha has been recommended. In addition, application of N:P:K at the following recommendation is found with significant result:

<table>
<thead>
<tr>
<th>(in kg/ha)</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Presowing application</td>
<td>--</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>2. 30 days after sowing</td>
<td>20</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>3. 60-70 days after sowing</td>
<td>10</td>
<td>--</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>20</td>
<td>50</td>
</tr>
</tbody>
</table>


Mulching the crop after sowing is good for checking weed growth and enhancing yield. Mulching with dhaincha and sunhemp was found to increase the yield (Aiyadurai, 1966). Seasonal crops like maize, chillies, spices, colocasia, etc. can be grown as mixed, companion or inter crops along with the turmeric. The crop can also be economically grown in partial shade of orchards where other crops cannot be well grown. As a pure crop its performance in the N.E. region is definitely better, particularly in the hills, where substantial part of the year remain cloudy and even bright sun does not impart any scorching effects. Irrigation at five days interval in the case of black loam soil has been recommended.

Depending upon the duration of the variety, the crop becomes ready for harvest in 7 to 10 months. The harvesting period extends from January to March.
The maturity of the crop is indicated by the complete yellowing and drying of the plant. Harvesting is done either by ploughing or digging clumps carefully with a spade. Fingers are separated from the mother rhizomes. The mother rhizomes are usually kept as seed materials.

2.7 **Processing (Curing) of Turmeric**

Curing of raw turmeric rhizomes is a very important operation on which quality of the turmeric depends considerably. Local tribals make thin longitudinal sections of the clean turmeric fingers with knife and spread the slices in open for sun drying. The dried slices were then powdered for marketing.

For preparing the dry turmeric, in the plain areas, fresh rhizomes are boiled in copper or galvanized iron containers with sufficient water to cover the rhizomes. Boiling is stopped when a white fumes with characteristics aroma of turmeric appear. The boiled rhizomes are taken out for drying. They are spread uniformly and dried in the sun for 10 - 15 days till they become hard and brittle. The rhizomes are also polished either by rubbing them against a hard floor or shaking them mixed with stones in a long and narrow gunny bag.

An improved technique of curing of turmeric rhizome developed by Mysore Scientists where the clean rhizomes should be boiled in water containing alkaline substances like lime, sodium bicarbonate or sodium carbonate. Alkalinity of the boiled water helps in developing the orange yellow tinge to the core of turmeric. This process is more hygienic.
2.8 **Economic And Medicinal Uses of* C. longa L.*

2.8.1 **Economic Uses**

Turmeric is available in whole or powder form in the market and used as a condiment and colouring agent. The attractive yellow colour and delicate flavour have been most preferred as an essential ingredient of curry powders. It is used to flavour and colour butter, cheese, vegetable, pickles and other food stuffs. It is widely used for dyeing number of articles. Turmeric oil is used in making perfumes. Smearing turmeric paste on the face and limbs clears the skin and beautify the face. The green leaves of turmeric conventionally used as packing material for steam boiling or roasting of various chutney items, simply to enhance its aromatic taste and flavour.

2.8.2 **Medicinal Uses**

(1) Rhizomes of turmeric are used as medicine since ancient time. Turmeric is applied on the swollen parts of the body to remove pain, itching and swelling. It is very beneficial in skin diseases. Its ointments are used as face cream. Turmeric powder or ointment is used to curve various boils and injury. It is also used in the treatment of ulcers, wounds, leprosy, pruritus, allergic conditions and discoloration of skin.

(2) Many people believe that fumes produced by putting turmeric on hot/coal relieves hiccups, unconsciousness, asthma and pain due to scorpion bite.

(3) It is used to expel gases. It alters the process of nutrition and excretion and restores the normal functioning of the body.
(4) Turmeric is useful in constipation, jaundice, cough, general debility, fever and in diabetes. It is a carminative, stimulant, tonic, stomachic and antipurgative and used in bronchitis, diarrhoea, abnormal accumulation of liquid in cellular tissue, jaundice and liver problems.

(5) Turmeric oil is useful in treatment of gall stone and urinary diseases. It is very useful intestinal antiseptic for intestinal chronic problem, especially in chronic diarrhoea.

(6) A paste of turmeric with quicklime and garlic is a very common poultice used all over India for curing sprains and joint swelling.

(7) A paste of turmeric powder and quick lime is applied over a bleeding wound. It seals the wound and stop bleeding.

(8) Turmeric has insecticidal and repellent properties, therefore, which can be used against caterpillars. It can be used as a harmless insecticides without any pollution hazard.

In the light of the above mentioned economic and biological aspects it will be useful to cultivate turmeric at large scale by adopting scientific agronomical practices in the hills and plain areas of the country.

2.9 Growth Regulants with Reference to Biological Processes

In India there is a growing trend to further increase the productivity of various crops including turmeric. Inspite of using high yielding varieties and best
agronomic practices, crops do not give expected yield. Salinity is one of the serious problems in the field of Indian agriculture. The other problems like internal hormonal imbalance, water stress, heat, low and high temperature etc. can be corrected through the exogenous application of suitable growth regulators at the optimum concentration.

Plant growth regulators check the excessive vegetative growth and can be used to have a proper balance between source and sink for increasing the yield of the crops. External application of various chemicals which are either promotory or inhibitory, might have the property to stimulate the metabolic processes. Plant growth and development is generally controlled by growth hormones. All the morphogenic phenomenon from germination to senescence are directly or indirectly controlled and regulated by the endogenous growth substances. Each chemically different hormone has characteristic effect on growth and development. In addition to endogenous growth substances, a number of synthetic compounds have been identified with specific desirable growth regulatory effects. Now-a-days, in the field of agriculture, synthetic growth regulatory chemicals are become important and valuable in the commercial control of crop growth.

The general consensus is that some synthetic growth regulating chemicals produce their effect by changing the internal levels of naturally occurring hormones, therefore, causing modifications in the growth and development of the plant in the desired extent. Role of endogenous growth substances and a number of synthetic chemicals on regulation of the various metabolic processes such as photosynthesis, nitrogen metabolism etc. have been well documented. However, a very little attempt have been made to control biological processes that limit the
crop productivity. Sprouting rate of rhizome, morphology, photosynthetic rate, biomass and yield in turmeric are few important areas where the use of growth regulators is highly rewarding. It is optimistic to believe that growth regulators will be potential tools for enhancing the growth and yield of the crop plants under salinity stress conditions.