



# Good Agricultural Practices

**TURMERIC**



sustainable spices  
initiative - India



## **GOOD AGRICULTURAL PRACTICES – Turmeric**



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**T**urmeric (*Curcuma longa*) (Family: *Zingiberaceae*) is used as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. India is a leading producer and exporter of turmeric in the world. The states of Telangana, Maharashtra, Tamil Nadu, and Andhra Pradesh together contributes 63.4% of India's turmeric production, other important turmeric producers are Orissa, Karnataka, West Bengal, Gujarat, Meghalaya, Assam.

### Climate and soil requirements

Turmeric can be grown in diverse tropical conditions from sea level to 1500 m above sea level, at a temperature range of 20-35°C with an annual rainfall of 1500 mm or more, under rainfed or irrigated conditions. Though it can be grown on different types of soils, it thrives best in well-drained red or clay loam soils with a pH range of 4.5-7.5 with good organic status. Soil with good drainage is essential.

### Varieties

- A number of cultivars are available in the country and are known mostly by the name of locality where they are cultivated. Some of the popular cultivars are Duggirala, Tekkurpet, Sugandham, Amalapuram, Erode local, Salem, Alleppey, Moovattupuzha and Lakadong. Improved varieties of turmeric released by different research organizations are also available. Location specific variety may be selected.
- In Telangana, the long duration types (9 months) like Mydukur, Tekurpet, Duggirala Red, Armur, and KTS-3, medium duration (8 months) type are Kothapet, Krishna and Kesarv and short duration (7 months) types like Kasturi, Suguna, Sudharshana, Amalapuram and Dindigram are grown. Besides, Duggirala Red, Armoor, IISR Prathibha, Mana Pasupu, Chennur Local, PTS-10, Salem are commonly are also grown in Telangana State.
- In Tamil Nadu, Erode local, Salem, Praba, Prathibha, Rajendra Sonia, Roma, Suroma and Suguna are commercially cultivated.
- Recently, a high yielding, short duration (180 days) turmeric variety named IISR Pragati (Acc. 48) with an average yield of 38 t/ha (fresh rhizomes) has been released by ICAR-IISR, Kozhikode and is touted as a boon to turmeric growers. It has stable and high curcumin content (5.02%) across locations and is well suited for cultivation in states of Kerala, Tamil Nadu, Andhra Pradesh, Telangana, Karnataka and Chhattisgarh.



### Seed rate

- A seed rate of 2,500 kg of rhizomes is required for planting one hectare of turmeric. Well developed healthy and disease free rhizomes are to be selected. Whole or split mother and finger rhizomes are used for planting. The mother rhizome can be used for seed material by splitting into two or three pieces with one or two healthy buds.
- The seed rhizomes are to be treated with mancozeb 0.3% (3 g/L of water) for 30 min, shade dried for 3-4 h and planted or seed are treated with *P. fluorescens* (10 g/kg) and *T. viride* (4 g/kg) and then sown.

### Preparation of land

- The land is prepared with the receipt of early monsoon showers. The soil is brought to a fine tilth by giving about four deep ploughings. Hydrated lime @ 500 - 1000 kg/ha has to be applied for laterite soils based on the soil pH and thoroughly ploughed.
- Light soils: Beds of 1.0 m width, 30 cm height and of convenient length are prepared with spacing of 50 cm between beds. Rhizomes are planted at 25 cm x 30 cm.
- Loamy soils: Flat beds of 3 x 1.8 m size are prepared providing necessary irrigation channels. Rhizomes are dibbled at 15 cm apart in the plough furrows spaced 30cm apart.
- Heavy soils: Ridge and furrow system is adopted and rhizomes are sown at 15 to 20 cm spacing. Spacing between ridges is maintained at 45 to 60 cm.
- In alternate method, in wet lands, rhizomes are planted on raised beds of 1.2 m with 20 cm height with convenient length. 30cm wide channels are provided in between. Planting is done with 30 x 15 cm spacing.

### Transplanting

Though transplanting in turmeric is not conventional, it is found profitable. A transplanting technique in turmeric by using single bud sprouts (about 5 g) has been standardized to produce good quality planting material with reduced cost. The technology has been standardized at Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. The technique involves raising transplants from single sprout seed rhizomes in the pro-tray and planted in the field after 30-40 days. The advantages of this technology are production of healthy planting materials and reduction in seed rhizome quantity and eventually reduced cost on seeds.

#### *Pro-tray technology*

- Select well grown, healthy rhizomes and treat with Carbendazim @ 2 g/ L + monocrotophos @ 1.5 mL/L and then cut into single bud.
- Cover these buds with cocopeat and spray with humic acid (0.5%).

- Place the sprouted single buds in portray, which is filled with cocopeat (100g) mixed with *P.fluorescens* (1g) and cover with polythene sheets for seven days
- After sprouting, remove the polythene sheets and keep in 50% shade.
- Spray humic acid (0.5%) after the emergence of leaf.
- Seedlings will be ready for transplanting on 30-35 days.

## Planting

In Kerala and other West Coast areas where the rainfall begins early, the crop can be planted during April-May (planting time vary with location and rainfall receipt) with the receipt of pre-monsoon showers. Small pits are made with a hand hoe on the beds with a spacing of 25 cm x 30 cm. Pits are filled with well decomposed cattle manure or compost, seed rhizomes are placed over it then covered with soil.

Different planting methods are as follows:

- (a) *Flat bed method*: - Planting is done by dibbling rhizome in furrows behind the country plough. The seeds are then covered with loose soil from the ridge. The spacing is 30 x 15 cm. This method has the more chances of occurrence of pest and diseases. Flooding method of irrigation is adopted.
- (b) *Ridges and Furrow method*:- In this method, ridges and furrows are prepared with tractor mounted ridger with a spacing of 45 x 20 cm. This method is better than the flat bed method.
- (c) *Raised bed method*: In this method, raised bed with 1m width and 15cm height is prepared. The spacing between beds is 30cm. Four rows with spacing of 30 x 15cm is recommended with one drip line in lengthwise at the centre.

Raised bed method



Ridges and Furrow method



### Manuring and fertilizer application

Farmyard manure (FYM) or compost @ 30-40 t/ha is applied by broadcasting and ploughing at the time of preparation of land or as basal dressing by spreading over the beds or in to the pits at the time of planting. Organic manures like oil cakes can also be applied @ 2 t/ha. In such case, the dosage of FYM can be reduced.

The fertilizer application in different states is as follows:

State	Soil type	Time of planting (kg ha <sup>-1</sup> )
Kerala	Lateritic soils (Ultisols)	60 kg N, 50 kg P <sub>2</sub> O <sub>5</sub> and 120 kg K <sub>2</sub> O
Andhra Pradesh & Telangana	Sandy Clay loams (Inceptisol), Red soils (Alfisols) and heavy clay soils (Vertisols)	300 kg N, 125 kg P <sub>2</sub> O <sub>5</sub> and 200 kg K <sub>2</sub> O
Tamil Nadu	Clay loams (Mollisols) and heavy clay soils (Vertisols)	125 kg N, 60 Kg P <sub>2</sub> O <sub>5</sub> and 90 kg K <sub>2</sub> O
Orissa	Red soils (Alfisols)	60 kg N, 50 Kg P <sub>2</sub> O <sub>5</sub> and 90 kg K <sub>2</sub> O
Karnataka	Red soils (Alfisols)	120 kg N, 60 Kg P <sub>2</sub> O <sub>5</sub> and 120 kg K <sub>2</sub> O

As the soil fertility will be varying with the soil type, agro ecological conditions or management systems, site specific nutrient management based on the soil test results for major nutrient is advocated. The recommended dose of nutrients for varying soil test values of N, P and K is given in Table 1.

The fertilizers are to be applied in 2 - 3 split doses. Full dose of phosphorus is applied as basal at the time of planting. Equal split doses of N and K is top dressed at 45, 90 (and 120) DAP.

**Table 1.** Soil test based fertilizer recommendations for fresh rhizome yield target levels (ICAR-IISR, Kozhikode)

Soil test value for available nutrients (kg/ha)	Fertilizer recommended (kg/ha) for yield targets	
	30 t/ha	40 t/ha
<b>Nitrogen</b>		
< 150	120	170
150-250	95	125
250-400	50	90
>400	-	25
<b>Phosphorus (P<sub>2</sub>O<sub>5</sub>)</b>		
< 10	60	90
10-30	18	50
30-50	-	-
>50	-	-
<b>Potassium (K<sub>2</sub>O)</b>		
< 110	275	325
110-300	230	300
300-500	150	235
>500	-	140

The recommendation per hectare for Telangana State is as follows:

Application time	Fertilizer	Sole crop (Turmeric)	Inter cropped with maize
<b>Basal application</b>	FYM	10 t	10 t
	Tank silt	10 t	10 t
	Neem cake	200 kg	250 kg
	SSP	150 kg	300 kg
	MOP	25 kg	60 kg
<b>40 DAP</b>	Neem cake	200 kg	250 kg
	Urea	50 kg	90 kg
<b>80 DAP</b>	Urea	50 kg	90 kg
	MOP	25 kg	30 kg
<b>120 DAP</b>	Urea	50 kg	90 kg
	MOP	25 kg	30 kg

Note: Fertilizers should be applied at the base of the plant and covered with soil

#### **Micronutrient application:**

Micronutrient application is imperative for enhanced yield. Hence, foliar application of micronutrient mixture specific to turmeric (developed and licensed by ICAR-IISR,

Kozhikode, Kerala) @ 5 g/L) twice on 60 and 90 days after planting ensures 15-20% higher rhizome yield.

### Mulching

- The crop is to be mulched immediately after planting with green leaves @ 12-15 t/ha. Mulching may be repeated @ 7.5 t/ha at 40 and 90 days after planting after weeding, application of fertilizers and earthing up.
- Normally, this operation is done in rainfed areas particularly in high rainfall regions and slope land.

### Weed management

- Weeding has to be done thrice at 60, 90 and 120 days after planting or depending upon weed intensity. Pre-emergence application of Pendimethalin 1.0 kg/ha or Oxyfluorfen 0.12 kg/ha keeps the weeds away for 3-4 weeks from sowing.
- Post-emergence application of quizalofop ethyl @ 0.05 kg/ha gives good control of most monocot weeds and slows down growth of dicot weeds.

### Irrigation

In the case of irrigated crop, depending upon the weather and the soil conditions, about 15 to 23 irrigations are to be given in clayey soils and 40 irrigations in sandy loams in conventional system of irrigation. Drip irrigation daily or alternate day also useful.

### Plant protection

#### Diseases

##### *Leaf blotch*

Leaf blotch is caused by *Taphrina maculans* and appears as small, oval, rectangular or irregular brown spots on either side of the leaves which soon become dirty yellow or dark brown. The leaves also turn yellow. In severe cases the plants present a scorched appearance and the rhizome yield is reduced.

##### *Management:*

Spray with mancozeb 0.2% or copper oxy chloride 0.25% or propiconazole 0.1% at fortnight intervals.



### Leaf spot

Leaf spot is caused by *Colletotrichum capsici* and appears as brown spots of various sizes on the upper surface of the young leaves. The spots are irregular in shape and white or grey in the centre. Later, two or more spots may coalesce and form an irregular patch covering almost the whole leaf. The affected leaves eventually dry up. The rhizomes do not develop well.



#### Management:

Spray with mancozeb (0.2 %) or copper oxychloride (0.2%) or propiconazole 0.1% at fortnight intervals.

### Leaf blight

Leaf blight is caused by *Rhizoctonia solani*. The disease is characterized by the appearance of necrotic patches with papery white centre of varying sizes on the lamina which spread on the whole surface leaving a blighted appearance. The disease occurs during the post monsoon season.

#### Management:

Spray with mancozeb 0.2% or copper oxy chloride 0.25% or propiconazole 0.1% at fortnight intervals.

### Rhizome rot

The disease is caused by *Pythium aphanidermatum*. The lower leaves of the infected pseudostem show yellowing, collar region of the pseudo stem becomes soft and water soaked, resulting in collapse of the plant and decay of rhizomes.



#### Management:

- Crop rotation
- Use disease free rhizome material for planting
- Provide good drainage facilities
- Rhizome treatment with mancozeb 0.3% or COC 0.25% for 30 minutes before planting.
- When the disease is noticed in the field, the beds should be drenched with COC 0.25% or Metalaxyl -mancozeb 0.125%.

## Nematodes

Root knot nematodes (*Meloidogyne spp.*) and burrowing nematode (*Radopholus similis*) are the two important nematodes causing damage to turmeric. Infected plants show yellowing with reduced growth.

### Management:

- Avoid planting turmeric after Banana or solanaceous vegetables.
- Apply neem cake @150 kg/ha
- Plant marigold as inter/ border crop
- Apply biocontrol agent *Pochonia chlamydsporia* @ 20g/bed

## Insect pests

### Shoot borer

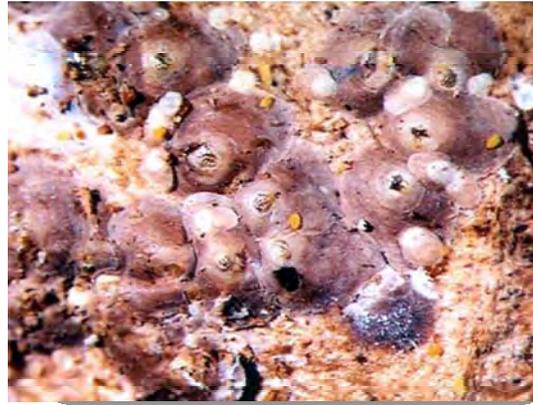


The shoot borer (*Conogethes punctiferalis*) is the most serious pest of turmeric. The larvae bore into pseudo stems and feed on internal tissues. The presence of a bore-hole on the pseudo stem through which frass is extruded and the withered central shoot is a characteristic symptom of pest infestation. The adult is a medium sized moth with a wingspan of about 20 mm; the wings are orange-yellow with minute black spots. Fully-grown larvae are light brown with sparse hairs.

### Management:

- Spray Chlorantraniliprole or Flubendiamide or Spinosad (0.5 mL/ L) at 15 days intervals during July to October. Initiate spraying when the first symptom of pest attack is seen on the inner most leaf.

### *Rhizome scale*



The rhizome scale (*Aspidiella hartii*) infests rhizomes in the field (at later stages of the crop) and in storage. Adult (female) scales are circular (about 1mm diameter) and light brown to grey and appear as encrustations on the rhizomes. They feed on sap and when the rhizomes are severely infested, they become shrivelled and desiccated affecting its germination.

#### *Management:*

- Adapt timely harvest of rhizomes
- Before storage, discard severely infested rhizomes
- Treat seed material with quinalphos (0.075%) (for 20-30 minutes) before storage and also before sowing in case the infestation persists.
- Store rhizomes in sawdust along with dried leaves of *Strychnos nuxvomica*

### Minor pests

#### **Leaf thrips**

The turmeric thrips (*Panchaetothrips indicus*) infests the leaves causing them to roll, turn pale and gradually dry up. The pest infestation is more common during the post monsoon period especially in drier regions of the country.

#### *Management*

- Set blue sticky traps (5 No./acre)
- Spray Neem Oil 3.0 % or NSKE 5.0 %

### Leaf feeding beetle

Adults and larvae of leaf feeding beetles such as *Lema spp.* feed on leaves especially during the monsoon season and form elongated parallel feeding marks on them.



#### *Management:*

Sprays undertaken for the management of shoot borer is sufficient to manage this pest.

### The lace wing bug (*Stephanitis typicus*)

The pest infests the foliage causing them to turn pale and dry up. The pest infestation is more common during the post monsoon period especially in drier regions of the country.

#### *Management:*

- Spray neem oil 3.0 % or NSKE 5.0 %

### Leaf roller

In Infected plants, the leaf rolled longitudinally and the larvae feed within the folded portion.

#### *Management:*

- Spray dimethoate (0.05%) at fortnightly intervals

### Harvesting and on-farm processing

Well managed turmeric crop is ready for harvest in seven to nine months depending on the variety and time of sowing. The crop is generally harvested during January to March. On maturity, the leaves turn dry and are light brown to yellowish in colour. In Kerala, turmeric is grown in raised beds and harvesting is done either manually or by using a tractor. In case of manual harvesting, the land is ploughed, the clumps are carefully lifted with spade and the rhizomes are gathered by hand picking. Harvesting with a tractor attached to a turmeric harvester is followed when the raised beds are taken using a tractor. The harvested rhizomes are collected manually and all the extraneous matter adhering to them is cleared.

### Preservation of seed rhizomes

- Rhizomes for seed purpose are generally stored by heaping in well ventilated rooms and covered with turmeric leaves.
- The seed rhizomes can also be stored in pits with saw dust, sand along with leaves of *Stychnos nux-vomica* (*Kanjiram*).
- The pits are to be covered with wooden planks with one or two openings for aeration.
- The rhizomes are to be dipped in quinalphos (0.075%) solution for 20-30 minutes if scale infestations are observed and in mancozeb (0.3%) to avoid storage losses due to fungi.

### Post harvest processing

- The harvested turmeric rhizomes before entering into the market is converted into a stable commodity through a number of post harvest processing operations like boiling, drying and polishing.
- Boiling of turmeric is taken up within 3 or 4 days after harvest.
- The fingers and bulbs (or mother rhizomes) are separated and are cured separately, since the latter take a little longer to cook.
- The dry recovery of the different turmeric varieties vary widely ranging from 19 to 23%.

### Boiling

- Boiling is the first post harvest operation to be performed at the farm level which involves cooking of fresh rhizomes in water until soft before drying.
- Boiling destroys the vitality of fresh rhizomes, avoids the raw odour, reduces the drying time and yields uniformly coloured product.
- In the traditional method, a vessel made of galvanized iron sheet is used for turmeric boiling. Boiling of turmeric rhizomes is carried out till froth forms and white fumes come out of the pan with a characteristic odour.
- Boiling is considered complete by pressing a pointed stick in to the rhizomes with slight pressure.
- The other indications of the completion of boiling process are softness and easy breaking of rhizomes when pressed between the fore finger and thumb and a yellow interior instead of red one.

- An effective cooking time of 45 to 60 minutes for fingers and 90 minutes for mother rhizomes is considered essential.
- Overcooking and under cooking are found to affect the quality of the rhizome.
- Improved turmeric boiler using steam boiling technique is followed when large quantities of turmeric are to be cured.
- The TNAU model of improved steam boiler for turmeric consists of a trough, inner perforated drums and lid.
- The outer drum is made of 18 SWG thick mild steel to a size of 122 x 122 x 55 cm. A lid is provided with hooks for easy lifting and also provided with an inspection door.
- For easy draining and cleaning, an outlet is placed at the bottom of the drum. Four numbers of inner drums of 48 x 48 x 45 cm size are provided in the outer drum.
- The capacity of four inner drum is 100 kg. The inner drums are provided with a leg for a height of 10 cm, so that the rhizomes will not come in contact with water filled for about 6-8 cm depth in the outer drum.
- The outer drum is placed with more than half of its depth below the ground level by digging a pit, which serves as a furnace.
- This furnace is provided with two openings, one for feeding the fuel and the other one for removing the ash and unburnt.
- After placing the turmeric boiler in the furnace, about 75 litres of water is added (6-8 cm depth).
- About 55 - 70 kg of well washed rhizome is taken in each inner drum and placed in the boiler and the lid is placed in position.
- Using the available agricultural waste materials, mostly, the turmeric leaves, fire is put in the furnace.
- During the boiling process, it takes about 25 minutes to produce steam and boil the initial batch of rhizomes and 10 - 15 minutes for the subsequent batches.
- Through the inspection door, the stage of boiling of the rhizome is assessed by pressing the rhizomes with a hard pin / needle.
- Using a long pole, the lid is removed and the inner drums are lifted one by one. For the next batch, about 20 litres of water is added to the outer drum, depending on the water lost by evaporation.

- The next batch of rhizomes is loaded in all the drums and heating is continued.
- At the end of the boiling process, all the drums need to be cleaned free of mud and soil to avoid damage and enhance the life of the gadget.
- The capacity of the boiler is about 100 kg per batch and the fuel requirement is 70 – 75 kg of agricultural waste materials.

### Drying

- The cooked fingers are dried in the sun by spreading in 5-7 cm thick layers on the drying floor.
- A thin layer is not desirable, as the colour of the dried product may be adversely affected.
- During night time, the material should be heaped or covered. It may take 10-15 days for the rhizome to become completely dry.
- The bulbs and fingers are dried separately, the former takes more time to dry.
- Turmeric should be dried on clean surface to ensure that the product does not get contaminated by extraneous matter.
- Care should be taken to avoid mould growth on the rhizomes. Rhizomes are turned intermittently to ensure uniformity in drying.
- Solar tunnel driers covered by UV stabilized semi-transparent polyfilm sheet of 200 microns thickness can also be used for drying of turmeric.
- The solar radiation is transmitted through plastic sheet, which has a transmissivity of 90%.
- The UV sheet is transparent to the short wave radiations and opaque to long wave radiations.
- During the sunshine hours the short wave radiations are entrapped through the UV sheet, heated by the black absorber at the bottom and is converted into long wave radiation.
- This conversion of short wave radiation to long wave radiation causes an increase in the temperature inside the drier. Heat is transferred from the absorber to the air above the absorber.
- The heated air from the bottom while passing over the products absorbs the moisture. Solar radiation which passes through the transparent cover of the drier, also heats the products in the drier.

- This enhances the temperature and drying rate of the produce inside the drier than in the ambient condition. The yield of the dry product varies from 20-25% depending upon the variety and the location where the crop is grown.
- The starch gelatinized during boiling shrink and during the drying process intercellular spaces increase, enhancing water diffusion and reducing the drying time.

### Polishing and colouring

- Dried turmeric has poor appearance and rough dull outer surface with scales and root bits.
- The appearance is improved by smoothening and polishing the outer surface by manual or mechanical rubbing. Polishing is done till the recommended polish of 7-8% is achieved.
- Usually 5 to 8% of the weight of turmeric is the polishing wastage during full polishing and 2 to 3% during half polishing. Polishing of dried turmeric also helps in removing the wrinkles.
- Manual polishing consists of rubbing the dried turmeric fingers on a hard surface.
- Manual polishing gives rough appearance and dull colour to the dried rhizome. Sometimes, undesirable colouring materials are added during polishing to improve the colour and appearance. But this is not recommended.
- In an improved method, polishing is done by using hand operated barrel or drum mounted on a central axis, the sides of which are made of expanded metal screen.
- When the drum filled with turmeric is rotated, polishing is effected by abrasion of the surface against each other as they roll inside the drum. The turmeric is also polished in power operated drums.
- Large scale polishing units with capacity to polish 500 to 1000 kg per batch is used for polishing turmeric rhizomes at commercial units.
- It takes about 45-60 minutes per batch and about 4% is wasted as dust. The colour of the processed turmeric influences the price of the produce.
- Hence, to obtain attractive product, turmeric powder is sprinkled during the last phase of polishing.

### Cleaning, grading, packing and storage

Although Indian turmeric is considered to be the best in the world, about 90% of the total produce is consumed internally and only a small portion of the production is exported. Turmeric of commerce is described in three ways:

*Fingers:* These are the lateral branches or secondary 'daughter' rhizomes which are detached from the central rhizome before curing. Fingers usually range in size from 2.5 to 7.5 cm in length and may be over 1 cm in diameter.

*Bulbs:* These are central 'mother' rhizomes, which are ovate in shape and are of shorter length and having larger diameter than the fingers.

*Splits:* Splits are the bulbs that have been split into halves or quarters to facilitate curing and subsequent drying.

- Turmeric being a natural produce, is bound to gather contaminants during various stages of processing. The spice is also cleaned to remove such foreign materials.
- A sifter, destoner, and an air screen separator will help remove materials such as stones, dead insects, excreta, and other extraneous matter.
- Cleaned and graded material is packed generally in new double burlap gunny bags and stored over wooden pallets in a cool, dry place protected from light.
- The stores should be clean and free from infestation of pests and rodents. It is not recommended to apply pesticides on the dried/polished turmeric to prevent storage pests.