

## **TOMATO**

Botanical name: *Lycopersicon esculentum*

Family: Solanaceae

Chromosome no :  $2n = 2x=24$



### **Origin and distribution**

Cultivated tomato originated from Peru (South America) Mexico.

The ancestor of cultivated tomato is cherry type (*Lycopersicon esculenta var cerasiformae* - cherry tomato).

## Species:

Tomato belongs to the family solanaceae. The genus *Lycopersicon* was divided into two sub genera.

1. Eulycopersicon.
2. Eriopersicon.

Eulycopersicon is characterized by red fruited edible species with carotenoid pigmentation and they are annuals.

1. Cultivated tomato - *Lycopersicon esculentum*
2. Small fruited tomato- *Lycopersicon pimpinellifolium*



*Lycopersicon esculentum*



*Lycopersicon pimpinellifolium*

**Eriopersicon** is characterized by green fruited species, anthocyanin pigmentation. The species included are peruvianum, hirsutum and cheesmanii.



*Lycopersicon peruvianum*



*Lycopersicon hirsutum*



*Lycopersicon cheesmanii*

**Growth habit:** Tomato can also be classified depending on the growth habit.

1. **Indeterminate:** terminal buds end with a leafy bud and continue its vegetative growth. Eg: Pusa ruby.
2. **Determinate fruits** terminal buds end with floral bud and further its vegetative growth is checked and are called as Self topping or self pruning types. Eg. Pusa Early Dwarf
3. **Semi-determinate:** have semi dwarf growth and it is between determinate and indeterminate. Number of nodes between two consecutive inflorescences will be around one. Eg: S-12, Roma.



Indeterminate



Determinate fruits



Semi-determinate



Pusa ruby



Pusa Early Dwarf



S-12



Roma

## Nutrition value

- Tomato is a major source of vitamins and minerals. It is widely used as salad vegetable.
- In England, it referred as “**love of apple**” or ‘**love apple**’. In India it is commonly referred as ‘**poor mans orange**’ (**Ascorbic acid 15 mg to 20 mg /100g edible portion**).
- It is also rich in Citric acid and Malic acid. Glutamic acid is an amino acid mostly present in tomato.
- Tomato contains many important minerals like Ca, Mg, P, K, Fe, Zn, Boron.
- The alkaloid present in tomato is called **tamatin and the coloured pigment is called Lycopene**.

## Varieties

Sl.No	Suitable for	Suitable varieties
1.	Plains	Pusa Ruby, Pusa Early Dwarf, Marutham, Arka Vital, Pusa 120, HS – 10, sweet 72, S-12, Co I
2.	Hills	Sioux, Best of all, Pusa Early Dwarf
3.	Processing	Arka Abha,, Arka Meghali, Arka Saurabh, Arka vartnan, Arka Vikas, Arka Vishal.
4.	cold resistant	Pusa Sheetal
5.	Mid season variety	Best of all
6.	Resistant to nematode	SL-120
7.	Resistant to fruit crack	Sioux
	Summer crop	S-12

## Hybrids from IARI:

S.No	Hybrid	Parentage	Characters
1	Pusa Ruby	Sioux X Improved Meeruti	Indeterminate
2	Pusa Early Dwarf	Improved meeruti X Red cloud	Determinate
3	Pusa Red Plum	<i>L. esculentum</i> X <i>L.pimpinellifolium</i>	

## Varieties released from TNAU

CO1, CO2, PKM1, CO3, Paiyur 1 and COTH 1

### TNAU Tomato Hybrid CO 3

- F1 hybrid developed by crossing HN2xCLN 2123A
- Plants semi determinate and suitable for high density planting
- Fruits round, medium sized and borne in clusters of 3-5
- Good fruit quality with TSS of 5.580
- Duration - 145-150 days
- Yield - 96.2 t/ha



## **Soil**

- Well drained loamy soil rich in organic matter with a pH range of 6.5 - 7.5.

## **Climate**

- Tomato is a warm season vegetable require a long season optimum temperature is 21 to 24° C.
- Optimum temperature for seed germination is 30° C.
- Maximum fruit set occurs at a night temperature of 15 to 20° C. High temperature (38° C) accompanied by low humidity and dry winds adversely affect the fruit set.
- Tomato has a yellow pigment Carotene and red pigment (at ripened stage) called Lycopene
- Lycopene is highest at 21-24 °c temperature.
- Production of this pigment drops off above 27 °c temperature.

## **Season of sowing**

May - June and November – December

## **Seed rate**

Varieties : 300-350 g / ha

Hybrids : 100-150 g / ha

## **Seed treatment**

Treat the seeds with *Trichoderma viride* 4 g or *Pseudomonas fluorescens* 10 g or Carbendazim 2 g per kg of seeds 24 hours before sowing. Just before sowing, treat the seeds with *Azospirillum* @ 40 g / 400 g of seeds.

## **Nursery bed preparation**

Tomato is a transplanted crop. Seeds are sown in the area of 225 m<sup>2</sup>. A raised bed prepared by well decomposed FYM is mixed @ 10 kg FYM per m<sup>2</sup> of nursery bed along with 0.5 kg N, P, K per bed and Neemcake 1 kg before sowing.

## Protected nursery

- Prepare the nursery area of 3 cents with slanting slope of 2 % for the seedling production to cover 1 ha.
- Cover the nursery area with 50 % shade net and cover the sides using 40/50 mesh insect proof nylon net.
- Form raised beds of 1 m width and convenient length and place HDPV pipes at 2m interval for further protection with polythene sheets during rainy months.
- Mix sterilized cocopeat @ 300 kg with 5 kg neem cake along with *Azospirillum* and *Phosphobacteria* each @ 1 kg. Approximately 1.2 kg of cocopeat is required for filling one protray. 238 protrays (98 cells) are required for the production of 23,334 seedlings, which are required for one hectare adopting a spacing of 90 x 60 x 60 cm in paired row system.



50 % shade net



Raised beds



- Sow the treated seed in protrays @ one seed per cell.
- Cover the seed with cocopeat and keep the trays one above the other and cover with a polythene sheet till germination starts
- After six days, place the protrays with germinated seeds individually on the raised beds inside the shade net
- Water with rose can everyday and drench with NPK 19:19:19 @ 0.5% (5g/l) at 18 days after sowing



## Field preparation

Plough the land to fine tilth. Thoroughly prepare the field with the addition of FYM @ 25 t/ha and form ridges and furrows at a spacing of 60 cm. Apply 2 kg/ha of *Azospirillum* and 2 kg/ha of *Phosphobacteria* by mixing with 50 kg of FYM.

**Transplanting:** Seedlings are transplanted at 25 to 30 days and 10-15cm height, on the evening of sunny day.

For indeterminate varieties and hybrids, row to row spacing of 60 to 120 cm and plant to plant distance from 45 to 75 cm is adopted.

In case of determinate types spacing is 45 to 60 cm x 30 to 40 cm is adopted.



## Spacing for TNAU varieties

Variety	Spacing
PKM 1, Paiyur 1, COTH 2, TNAU Tomato Hybrid CO 3	60 x 45 cm
CO 3	45 x 30 cm

## Mulching

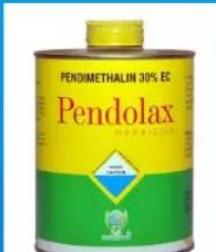
Mulch with black LDPE sheets of 25 micron thickness and bury both the ends into the soil to a depth of 10 cm

## Weed control

Apply Pendimethalin 1.0 kg a.i./ha or Fluchloralin 1.0 kg a.i / ha as pre-emergence herbicide, followed by hand weeding once at 30 days after planting.



Mulching



## Irrigation

Tomato is a deep rooted crop. Roots will grow to a depth of 120 to 150 cm and it has some drought tolerance.

## Layout and planting for drip irrigation & fertigation

- Apply FYM @ 25 t / ha as basal before last ploughing.
- Apply 2 kg/ha of *Azospirillum* and 2 kg/ha *Phosphobacteria* by mixing with 50 kg of FYM.
- Apply 75 % total recommended dose of superphosphate ie 1172 kg / ha as basal.
- Install the drip irrigation with main and sub main pipes and place lateral tubes at an interval of 1.5 m.
- Place the drippers in lateral tubes at an interval of 60 cm and 50 cm spacing with 4 LPH and 3.5 LPH capacities respectively.
- Form raised beds of 120 cm width at an interval of 30 cm and place the laterals at the centre of each bed.
- Before planting, wet the beds using drip system for 8-12 hrs.
- Planting to be done at a spacing of 90 x 60 x 60 cm in the paired row system, using ropes marked at 60 cm spacing.
- Spray Pendimethalin 1.0 kg a.i. / ha or Flu

## Growth regulators

Spray 1.25 ppm (625 ml in 500 litres of water) Triacontanol at 15 days after transplanting and at full bloom stage to increase the yield.

## Intercultural operations

- **Staking:** It is very essential for indeterminate group of varieties because it improves yield and quality of fruits. Stake the plants 30 days after planting with 1 - 1.5 m tall stakes.
- **Training:** Removal the side branches up to 20 cm from ground level.

## Micronutrient spray

Foliar spray of ZnSO<sub>4</sub> @ 0.5 per cent thrice at 10 days interval from 40 days after planting. Spray 19:19:19 + Mn @ 1 % at 60 days after planting.



Staking



Desuckering



## **Protected cultivation**

### **Production practices for cultivation of tomato under shade net**

During summer, the hybrid tomato can be grown in a shade level of 35 per cent under paired row planting system (80 x 40 x 60 cm - between pairs, rows and plants) with a basal application of 50 kg each of N and K and 250 kg of P / ha and fertigation of 200 kg each of N and K through straight fertilizers.

### **Protected cultivation of tomato in polyhouse**

During rainy season, the indeterminate tomato hybrid has to be grown in the medium consisting of FYM : composted coir pith: sand (2:1:1) with irrigation and basal application of 50kg each of NPK/ha as straight fertilizers and 250 kg each of NPK as water soluble and straight fertilizers through fertigation along with black polyethylene mulch (50 microns)



**Tomato under shade net**



**Tomato in polyhouse**

## **Pests**



**Fruit borer**



**Serpentine leaf miner**



**Whitefly**



**Nematode**

## Diseases



Damping Off



Septoria leaf spot



Fusarial wilt



Leaf curl



Tomato spotted wilt virus

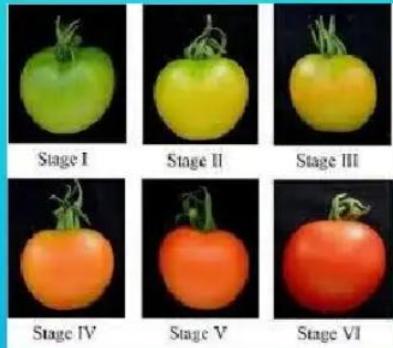


Peanut bud necrosis virus

## Harvesting:

Maturity stage at which tomato should be harvested depends upon the purpose for which they are used and the distance of transportation.

1. **Immature:** means before the seeds have fully developed and before the jelly like substance around the seeds are fully formed.
2. **Mature green:** fully grown fruit shows a brown ring at stem scar. It has light green colour at blossom end and seeds are surrounded by jelly like substance.
3. **Breaker stage:** 1/4th of the surface at blossom end shows pink.
4. **Pink stage:** 3/4th of the surface shows pink.
5. **Hard ripe:** all the surface turn to pink or red but flesh is firm.
- 6 **Over ripe:** fully coloured and flesh is also soft.



### Grading:

Fruits are graded based on size as Super A, Super, Fancy and Commercial according to IIHR.

### Duration

110- 115 days from transplanting

### Yield

Varieties : 30-40 t / ha

Hybrids : 80-95 t / ha

## Physiological disorder of tomato



blossom end rot



fruit cracking



Catface



puffiness



sunscald



blotchy ripening

Tomato is a versatile crop grown worldwide in diverse environments, from open fields to greenhouses. This adaptability requires adjusting fertilization to their specific growth conditions.

Tomatoes thrive in well-drained soils and prefer warm climates (18-27°C). While moderately drought-resistant, tomatoes require proper water management for optimal yield and quality. Outdoor plants need 4,000-6,000 m<sup>3</sup>/ha, while greenhouses can require up to 10,000 m<sup>3</sup>/ha.

### **Tomato growth stages**

The lifecycle of the tomato plant can be split roughly into four periods:

- Establishment - from planting or seeding through vegetative growth until first flower appears
- From first flowering to first fruit set
- From fruit ripening to first harvest
- From first harvest to the end of last harvest

### **Development of the tomato fruit**

After fruit setting, fruit ripens over a period of 45-70 days, depending upon the cultivar, climate and growth conditions. Fruit expansion continues until the stage of green ripeness.

Ripening occurs as the fruit changes color from light green to off-white, pink, red, and finally dark red or orange. Depending on the distance and time to market, yield may be harvested at any time between the pink to dark red stage, the later stages producing fruits richer in flavor.

### **Stages of fruit ripening**

<b>Stage</b>	<b>Description</b>
Breaker	Red stains appear on fruit skin
Pink	Tomato turns pink, not yet ready for consumption
Red	The tomato is red and completely ripe for consumption

### 1. Growing Tomato crop guide: Tomato method

Soil or soilless, protected crop (greenhouse or high plastic tunnel) or open field.

### 2. Tomato crop guide: Soil type

Tomatoes can be grown on soils with a wide range of textures, from light, sandy soils to heavy, clay soils. Sandy soils are preferable if early harvest is desired. Favorable pH level: 6.0-6.5. At higher or lower pH levels micronutrients become less available for plant uptake.

### 3. Growing Tomato crop guide: Climate

Temperature is the primary factor influencing all stages of development of the plant: vegetative growth, flowering, fruit setting and fruit ripening. Growth requires temperatures between 10°C and 30°C.

**Table4:** Temperature requirements during different growth stages:

Growth stage	Temperature (°C)		
	Minimum	Maximum	Optimal
Germination	11	34	16-29
Vegetative growth	18	32	21-24
Fruit setting (night / day)	10 / 18	20 / 30	13-18 / 19-24
Formation of lycopene	10	30	21-24
Formation of carotene	10	40	21-32

Light intensity is one of the major factors affecting the amounts of sugars produced in leaves during the photosynthesis, and this, in turn, affects the number of fruits that the plant can support, and the total yield.

#### 4. Growing Tomato crop guide: Irrigation

Tomato plants are fairly resistant to moderate drought. However, proper management is essential to assure high yield and quality.

The water requirement of outdoor grown tomatoes varies between 4000 - 6000 m<sup>3</sup>/ha. In greenhouses up to 10,000 m<sup>3</sup>/ha of water are required. 70% or more of the root system are in the upper 20 cm of the soil. Therefore, a drip system equipped with a fertigation device is advisable.

On light soils or when saline water is used, it is necessary to increase water quantities by 20% - 30%. Water requirements will differ at various growth stages. The requirement increases from germination until beginning of fruit setting, reaching a peak during fruit development and then decreasing during ripening.

Mild water stress during fruit development and ripening has a positive effect on fruit quality: firmness, taste and shelf-life quality, but may result in smaller fruit. Late irrigation, close to harvesting, may impair quality and induce rotting.

Water shortage will lead to reduced growth in general and reduced uptake of calcium in particular. Calcium deficiency causes Blossom End Rot (BER) (see page 15). On the other hand, excessive irrigation will create anaerobic soil conditions and consequently cause root death, delayed flowering and fruit disorders.

Acidic (low pH) irrigation water is undesirable, as it might lead to the dissolution of toxic elements in the soil (e.g. Al<sup>3+</sup>).

#### 5. Growing Tomato crop guide: Specific sensitivities of the tomato plant

##### **Sensitivity to soil-borne diseases**

Tomatoes are prone to soil-borne diseases caused by fungi, viruses or bacteria. Therefore it is recommended to avoid growing tomatoes on plots that used for other sensitive crops (peppers, eggplants, Irish potatoes, sweet potatoes, cotton, soybeans and others) on recent years. A regime of 3-year rotation between small grains and tomatoes is recommended.

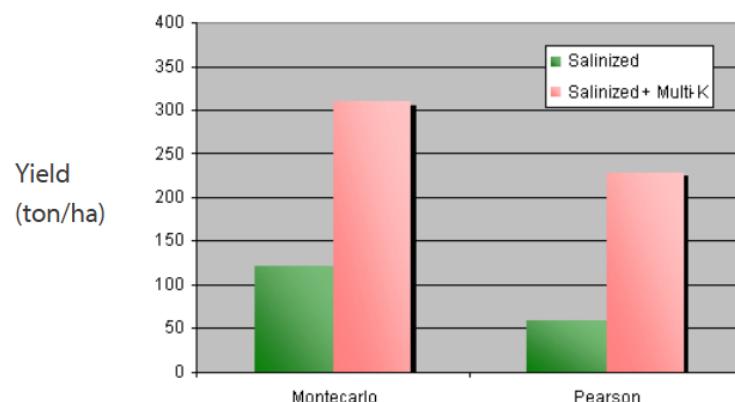
##### **Sensitivity to salinity**

Under saline conditions, sodium cations compete with the potassium cations for the roots uptake sites, and chloride competes for the uptake of nitrate-nitrogen and will impede plant development (Fig.2) and reduce yield.

Salinity will result in a potassium deficiency in the tomato plants, leading to a low fruit number per plant. Corrective measures under such conditions must include the following steps:

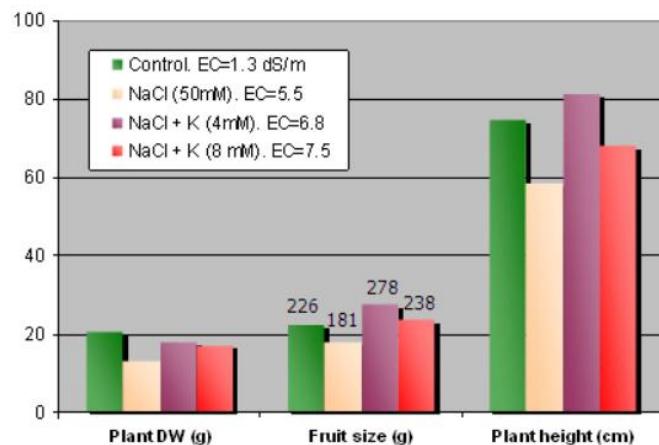
- Abundant application of potassium, as this specific cation can successfully compete with the sodium, and considerably reduce its uptake and the resulting negative effects. (Fig. 3)
- Abundant application of nitrate, as this specific anion successfully competes with chloride, and markedly reduces its uptake and adverse effects.
- Also, calcium helps suppressing the uptake of sodium. When sufficient calcium is available, the roots prefer uptake of potassium to sodium, and sodium uptake will be suppressed.

**Figure 3:** Multi-K® potassium nitrate reverses the adverse effects of salinity in greenhouse tomatoes  
(Source: Satti et Al. 1994)



Salination of the nutrient solution markedly decreased dry weight of the plant, fruit size and plant height. The addition of 4 or 8 mM Multi-K® potassium nitrate to the salinized nutrient solution markedly increased EC values of the nutrient solution but reversed the said adverse effects caused by the NaCl. Several parameters were improved even over the control as a direct result of the treatment with Multi-K®, i.e., fruit size and plant height

**Figure 4:** The effect of salinity and Multi-K® potassium nitrate on vegetative parameters and fruit size in 'Pusa ruby' greenhouse tomatoes.



### Zinc improves tolerance to salt stress

Zinc nutrition in plants seems to play a major role in the resistance to salt in tomato and other species. Adequate zinc (Zn) nutritional status improves salt stress tolerance, possibly, by affecting the structural integrity and controlling the permeability of root cell membranes. Adequate Zn nutrition reduces excessive uptake of Na by roots in saline conditions.

### Sensitivity to calcium deficiency

Tomatoes are highly sensitive to calcium deficiency, which is manifested in the Blossom-End Rot (BER) symptom on the fruits. Salinity conditions severely enhance BER intensity. Recently, it was found that manganese (Mn) serves as antioxidant in tomato fruit, hence its application to tomatoes grown under salinity can alleviate BER symptoms in the fruits. Special care must be taken to avoid growing conditions, which enhance BER phenomenon.

**Water quality: Tomatoes tolerate brackish water up to conductivity of about 2-3 mmho/cm.**

### Tomato nutrient needs

Tomatoes have consistent needs for nitrogen and potassium throughout their growth cycle. However, the ideal ratio between these two elements changes depending on the plant's stage of development. Supplying the correct ratio is crucial for proper growth and fruit development. For optimal fruit quality and to prevent the common problem of Blossom End Rot (BER), calcium is another essential nutrient in a tomato's nutritional program.

### **Nitrogen (N)**

The form of nitrogen plays a significant role in tomato yield. It's recommended to use fertilizers with a high percentage of nitrate-nitrogen, such as potassium nitrate. Plants grown with ammonium-based fertilizers tend to have lower yields and experience more stress compared to those receiving only nitrate. Additionally, ammonium competes with calcium uptake, so using fertilizers low in ammonium helps prevent calcium deficiencies.



### **Nitrogen deficiency in tomato**

### **Potassium (K)**

Potassium is essential for optimal tomato growth and quality. Potassium nitrate is the recommended source because the nitrate form facilitates easy potassium uptake by the plant. Adequate potassium levels are crucial for various vital processes, including balancing

electrical charges within the plant, regulating cell metabolism, and controlling osmotic pressure. These functions contribute to several benefits:

- Improved drought tolerance and reduced wilting
- Better disease resistance
- Promotion of vibrant red color development and reduced fruit color disorders
- Higher dry matter content in fruits



### Potassium deficiency in tomato

#### Calcium (Ca)

Calcium plays a critical role in building strong cell walls, leading to firmer and better-shaped fruits. The calcium ion is immobile in the plant, which means that it moves from the roots to the upper organs only in the xylem.

Several factors can hinder calcium uptake and lead to Blossom End Rot (BER):

- Water stress
- Salt stress in the root zone
- High temperatures in dry conditions
- Limited root system

Careful calcium management is crucial under these conditions, including combined application of calcium fertilizers by Nutriigation™ (fertigation) and foliar sprays. It is also important to maintain an optimal Ca:Mg:K ratio of 3:1:3 to prevent competition between these elements and ensure sufficient calcium uptake.

Here are some additional strategies to enhance calcium uptake and prevent BER:

- Proper irrigation, especially when the weather is hot and dry.
- Night irrigations: calcium is absorbed by the plant during the day and transferred to the leaves. At night, when transpiration is low, calcium is transferred to the fruits.
- Select resistant varieties: some tomato varieties are more susceptible to blossom-end rot than others.



- **BER – a common disorder associated with calcium deficiency**

### **Magnesium (Mg)**

Magnesium is essential for healthy tomatoes, although only severe deficiencies will impact fruit size and yield. These deficiencies typically occur under low soil temperatures or inadequate irrigation, hindering magnesium uptake from the soil. If such conditions arise, applying magnesium foliar sprays with magnesium nitrate can prevent severe deficiencies.

While magnesium uptake competes with calcium and potassium, maintaining a balanced nutrient program prevents deficiencies and ensures optimal plant health.



**Magnesium deficiency in tomato**

### **Salinity**

High salinity levels in the soil can hinder tomato plant growth. Soil electrical conductivity (EC) above 2.5 dS/m (saturated paste) can lead to decreased yields.

Under saline conditions, sodium competes with potassium uptake, and high chloride levels can also hinder the uptake of nitrate, both of which reduce plant development and fruit production. In such cases, corrective actions include applying ample potassium, nitrate-nitrogen, and calcium.

It should be noted that some tomato varieties, like cherry tomatoes, can tolerate higher salinity (EC above 4 dS/m). In these varieties, salinity can even improve sugar concentration and extend shelf life.

### **General guidelines for tomato nutrition at different growth stages**



#### **Establishment**

The developing root requires high levels of phosphorus (P). N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ratio of 1:1:1 is recommended at this stage.



#### **Vegetative growth**

The recommended N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ratio at this stage is 1:1:1.



#### **From initial flowering till fruit-set**

**When reproductive processes take place, the plant requires larger quantities of potassium while phosphorus requirements drop. The recommended N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ratio now is 2-1-3.**



#### **Fruit development and maturation**

**The growing fruits create a significant sink for potassium, and potassium absorption increases accordingly.**

**To right N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O balance at this stage shifts to 5-3-10.**

### **Supplementary foliar nutrition**

Foliar application of nutrients at specific stages of crop development boosts yields and improves quality. To boost vegetative growth, it is advised to supplement root nutrition with foliar application of fertilizers with N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ratio of 1:1:1.

At the reproductive stages, it is recommended to ensure adequate calcium levels by foliar application of readily available calcium preparations. This will help to prevent the development of BER.

Insecticide Crop Common name of the pest Dosage / ha a.i (gm) Formulation (gm/ml) Spray fluid

Azadirachtin 1 (10000 PPM) :Tomato Fruit borer \_ 1000-1500 500

#### **Tomato - Fertigation**

The nutrient requirement for hybrids is 200:250:250 kg of NPK per ha. 75 % of P (187.5 kg P which comes to 1172 kg of superphosphate) is applied as basal. The remaining quantity of 200:62.5:250 kg of NPK per ha is applied through fertigation. Every day irrigation should be given for one hour. Along with this, water soluble fertilizers have to be given. This dose is split and given once in 3 days for the entire crop period through fertigation as detailed below.

Stage	Crop stage	Duration in days	Fertilizer grade	Total Fertilizer (kg/ha)	Nutrient applied			% of requirement		
					N	P	K	N	P	K
1	Transplanting to plant establishment stage	10	19:19:19	65.78	12.50	12.50	12.50	10.00	5.00	10.00
			13:0:45	27.77	3.61	-	12.50			
			Urea (46%N)	8.44	3.88	-	-			
					19.99	12.50	25.00			
2	Flower initiation to flowering	30	12:61:0	40.98	4.92	25.00	-			
			13:0:45	222.22	28.89	-	100.00	40.00	10.00	40.00
			Urea (46%N)	100.27	46.12	-	-			
					79.93	25.00	100.00			
3	Flowering to fruit set	30	19:19:19	65.78	12.50	12.50	12.50			
			13:0:45	138.88	18.05	-	62.50	30.00	5.00	30.00
			Urea (46%N)	63.90	29.39	-	-			
					59.94	12.50	75.00			
4	Alternate day from picking	80	12:61:0	20.49	2.46	12.50	-			
			13:0:45	111.11	14.44	-	50.00	20.00	5.00	20.00
			Urea (46%N)	50.14	23.06	-	-			
					39.96	12.50	50.00			
					<b>199.82 or 200.00</b>	<b>62.50</b>	<b>250.00</b>	<b>100</b>	<b>25</b>	<b>100</b>

The total quantity of the requirement of 19:19:19 is 132 kg, 12:61:0 is 62 kg, 13:0:45 is 500 kg and Urea is 223 kg per ha.

#### **Introduction:**

Tomatoes are a versatile and widely enjoyed fruit that can be grown in gardens or even in containers on balconies and patios. If you're eager to cultivate your delicious tomatoes, this comprehensive guide will take you through the step-by-step process, from selecting the right tomato varieties to harvesting your juicy, sun-ripened crop. Let's dive into the complete steps involved in tomato production.

#### **Climate and Soil Requirements**

Tomatoes are incredibly adaptable and can thrive in diverse soil types, including sandy to heavy clay. However, for optimal growth, it's recommended to cultivate tomatoes in well-drained soils such as sandy or red loam, enriched with ample organic matter and maintaining a pH level between 6.0 and 7.0.

#### **Variety Selection:**

Choose tomato varieties that suit your growing conditions and culinary preferences. Consider factors such as fruit size, color, taste, disease resistance, and intended use (e.g., slicing, canning, or cherry tomatoes).

State	Most sold Tomato seeds
Telangana	<a href="#">Heemsohna Tomato</a> , <a href="#">Saaho Tomato seeds (To 3251)</a> , <a href="#">Lakshmi Tomato</a> , <a href="#">Abhilash Tomato</a>
Andhra Pradesh	<a href="#">Abhilash Tomato</a> , <a href="#">Heemshikhar Tomato</a> , <a href="#">US 440 Tomato</a> , <a href="#">Sikinder Tomato</a> , <a href="#">Saaho Tomato</a>
Karnataka	<a href="#">Heemsohna Tomato</a> , <a href="#">Abhilash Tomato</a> , <a href="#">US 440 Tomato</a> , <a href="#">Saaho Tomato seeds (To 3251)</a>
Maharashtra	<a href="#">SW 1508</a> , <a href="#">Abhilash Tomato</a> , <a href="#">Saaho Tomato seeds (To 3251)</a> , <a href="#">US 440 Tomato</a> , <a href="#">Heemsohna Tomato</a>
Madhya Pradesh	<a href="#">US 440 Tomato</a> , <a href="#">Saaho Tomato seeds (To 3251)</a> , <a href="#">Abhilash Tomato</a> , <a href="#">Heemsohna Tomato</a>
Tamil Nadu	<a href="#">Abhilash Tomato</a> , <a href="#">Saaho Tomato seeds (To 3251)</a> , <a href="#">US 440 Tomato</a> , <a href="#">Heemsohna Tomato</a>
Rajasthan	<a href="#">Saaho Tomato seeds (To 3251)</a> , <a href="#">TO-3150</a> , <a href="#">Abhilash Tomato</a> , <a href="#">NS 4266</a> , <a href="#">Heemshikhar Tomato</a>
Odisha	<a href="#">Heemsohna Tomato</a> , <a href="#">Saaho Tomato seeds (To 3251)</a> , <a href="#">Abhilash Tomato</a> , <a href="#">NS 4266</a> , <a href="#">Heemsohna Tomato</a>

To find more Tomato seeds [Click Here](#)

#### ***Seed Starting:***

Start tomato seeds indoors, 6-8 weeks before the last expected frost date in your area. Fill seed trays or small pots with a well-draining seed starting mix. Plant the seeds at a depth of  $\frac{1}{4}$  to  $\frac{1}{2}$  inch and moisten the soil. Place the trays/pots in a warm area with ample sunlight or use artificial grow lights for germination.

#### ***Transplanting***

Once the tomato seedlings have developed several sets of true leaves and the risk of frost has passed, it's time to transplant them into larger containers or directly into the garden soil. Choose a sunny location with fertile, well-drained soil. If transplanting into containers, ensure they have sufficient drainage holes and are large enough to accommodate root growth.

### ***Soil Preparation:***

Prepare the soil before transplanting by removing weeds, loosening the soil, and incorporating organic matter, such as compost or well-rotted manure. Tomatoes prefer slightly acidic soil with a pH level between 6 and 7. Conduct a soil test to adjust the pH if necessary. Adequate soil preparation ensures optimal nutrient availability and drainage.

### ***Planting and Spacing:***

When planting your tomato seedlings, dig holes that are deep enough to bury the lower part of the stem, including the cotyledon leaves. Remove the lower leaves, leaving only the top few sets. Space the plants according to the specific variety's recommended spacing guidelines, typically around 18-24 inches apart. Firmly press the soil around the base of each plant for stability.

### ***Watering and Fertilization:***

Tomatoes require consistent moisture throughout their growing period. Water the plants deeply, providing about 1-1.5 inches of water per week, depending on weather conditions. Avoid overhead watering to minimize the risk of disease. Apply organic mulch around the plants to help retain moisture and reduce weed growth. Additionally, feed the tomatoes regularly with a balanced fertilizer, following package instructions, to ensure healthy growth and fruit production.

### ***Nutrient Management in Tomato Crop***

By implementing effective nutrient management practices, you can provide your tomato crops with the essential elements they need for optimal growth, health, and high yields.

The nutrient requirement for hybrids is 200:250:250 kg of NPK per ha. 75 % of P (187.5 kg P which comes to 1172 kg of superphosphate) is applied as basal. The remaining quantity of 200:62.5:250 kg of NPK per ha is applied through fertigation. Every day irrigation should be given for one hour. Along with this, water-soluble fertilizers have to be given. This dose is split and given once in 3 days for the entire crop period through fertigation as detailed below.

### ***Use of Plant Growth Regulators (PGR) for Good Yield***

PGR product	Technical content	Dosage	Time of application
<a href="#"><u>Syngenta Isabion</u></a>	Amino acids and Nutrients	2 ml per lit of water	Flowering, Fruiting, Ripening stage
<a href="#"><u>Multiplex Samras</u></a>	Amino Acids	2-3 ml per lit of water	Flowering, Fruiting stage
<a href="#"><u>Bayer Ambition</u></a>	Amino acids & Fulvic acids and Micro Elements,	2-3 ml per lit of water	Transplanting, Flowering, Fruiting stage
<a href="#"><u>Sumitomo Progibb &amp; Indofil Indolizer</u></a>	Gibberellic acid	2.5 gm / 100-lit water	Fruiting stage
<a href="#"><u>Syngenta Cultar</u></a>	2-3 ml per lit of water	5 ml/15 lit of water	Flowering stage, Fruiting stage

### **Pest and Insect Management in tomato crop:**

Pest	Symptoms	Control Measures
<b>Whitefly</b>	Whitefly attack on tomatoes can result in chlorotic spots, yellowing, downward curling, drying of leaves, and serve as a vector for tomato leaf curl disease.	Install 4 - 6 yellow <a href="#">sticky traps</a> per acre. Spray <a href="#">Verticillium lecanii</a> at 5 ml/L of water. Spray <a href="#">Actara Insecticide</a> at 0.5 gm/L of water. Spray <a href="#">Confidor Insecticide</a> at 0.8 - 1 ml/L of water.
<b>Fruit Borer</b>	The borer larvae consume the inner content of the fruit by making circular holes on the surface and partially penetrating fruits to consume the inner contents.	Use Tapas Helic-O-lure with <a href="#">funnel trap</a> at 6 per acre. Spray 2 ml of <a href="#">Plethora</a> Insecticide mixed in 1 L of water. Spray <a href="#">Cigna</a> Insecticide at 1.5 - 2 ml/L of water.
<b>Pinworm (Tuta absoluta)</b>	Tuta absoluta infestation in tomatoes can cause leaf and stem mining, along with the presence of pinholes on fruits.	Install 4 - 6 yellow <a href="#">sticky traps</a> per acre. Spray <a href="#">Verticillium lecanii</a> at 5 ml/L of water. Spray <a href="#">Actara Insecticide</a> at 0.5 gm/L of water. Spray <a href="#">Confidor Insecticide</a> at 0.8 - 1 ml/L of water.
<b>Leaf Miner</b>	The presence of serpentine mines on leaves and subsequent drying and dropping of leaves are common symptoms of damage caused by the Serpentine leaf miner ( <i>Liriomyza trifolii</i> ) in tomato plants.	Install 4 - 6 yellow sticky traps per acre. Spray <a href="#">Verticillium lecanii</a> at 5 ml/L of water. Spray <a href="#">Actara Insecticide</a> at 0.5 gm/L of water. Spray <a href="#">Confidor Insecticide</a> at 0.8 - 1 ml/L of water.
<b>Mealybug</b>	Mealybug infestation on tomatoes causes the presence of white, cottony masses on leaves, stems, and fruit, as well as stunted growth and yellowing of leaves.	<a href="#">Neem oil 1500 ppm</a> - 2-3 ml per litre of water  <a href="#">Beauveria bassiana / Verticillium lecanii</a> - 5 gm per litre of water  <a href="#">Acephate 75 SP-</a> 1.5 gm per litre of water  <a href="#">Imidacloprid 17.8 %SL</a> - 0.4 ml per litre of water  <a href="#">Imidacloprid - 17.8 % SL</a> 0.4 ml

<b>Thrips</b>	Thrips feeding on tomato plants result in crinkling and curling of leaves due to sap extraction, giving a silvery or bronze appearance. Additionally, affected flower buds become brittle and eventually drop off.	<a href="#">Acetamiprid -20 %SP</a> - 0.4 gm per litre of water  <a href="#">Blue sticky traps</a> - 6 traps per acre  <a href="#">Neem oil -1500 ppm</a> - 2-3 ml per litre of water
<b>Red Spider Mite</b>	Red spider mite infestation on tomato plants leads to affected leaves turning reddish brown and bronzy. In severe cases, the presence of larvae results in silken webbing on the leaves, causing them to wither and dry. The infestation can also impact flower and fruit formation	<a href="#">Neem oil - 1500 ppm</a> - 5 ml per litre of water  <a href="#">EPN Army</a> - 1-2 kg per acre  <a href="#">Bayer Oberon</a> - 0.4 ml per litre of water  <a href="#">Dhanuka o</a> mit - 2.5 ml per litre of water  Crystal Abacin - 1ml per litre of water
<b>Root Rot</b>	Infected plants may show signs of yellowing of the leaves or chlorosis and wilting.	<a href="#">Trichoderma viride</a> - 1ml or 3 gm per litre of water
<b>Nematode</b>	Presence of small galls on the roots.	<a href="#">Pseudomonas fluorescence</a> - 1ml or 3 gm per litre of water  <a href="#">Paecilomyces lilacinus</a> - (Drenching) - 4 ml per litre of water

## Common Disease in Tomato

Disease	Symptoms	Control Measures
<b>Damping Off</b>	Damping off in tomatoes occurs in two stages: pre-emergence and post-emergence. In the pre-emergence phase, seedlings are killed just before they reach the soil surface, resulting in the complete rotting of the seedlings. In the post-emergence phase, the infection targets the young tissues at the collar level, causing them to become soft, and water-soaked, and leading to seedling collapse or toppling over.	<a href="#">copper oxychloride</a> - 3 gm per litre of water  <a href="#">Trichoderma viride</a> - 1ml / 3gm per litre of water
<b>Bacterial stem and fruit canker</b>	Spots on leaves, stems, and fruits Wilting of leaves and shoots, cracks and cankers with slimy bacterial ooze, and small water-soaked spots with white halos on fruits that become raised, tan-colored, and rough in the center.	<a href="#">Blue copper</a> / Blitox ( copper oxychloride)- 3 gm per litre of water+ <a href="#">streptocycline</a> - 0.1 gm per litre of water  <a href="#">Mancozeb</a> - 2.5 gm per litre of water

<b>Early Blight</b>	Small, black lesions on older foliage, which enlarge and develop concentric rings in a bull's eye pattern. Yellowing of surrounding tissue and potential foliage loss in high temperature and humidity conditions.	<a href="#">Chlorothalonil</a> - 2gm per litre of water  <a href="#">Propiconazole</a> - 2ml per litre of water
<b>Bacterial Leaf Spot</b>	Small, brown, water-soaked circular spots with a yellowish halo on infected leaves, potentially leading to defoliation on older plants. Water-soaked spots on green fruits that enlarge into raised, irregular, light brown lesions with a rough, scabby surface; ripe fruits are unaffected.	<a href="#">Blue copper</a> / Blitox ( copper oxychloride)- 3 gm per litre of water+ <a href="#">streptocycline</a> - 0.1 gm per litre of water
<b>Bacterial Wilt</b>	Rapid and complete wilting of mature plants, with lower leaves potentially dropping before wilting occurs. The presence of bacterial ooze appears as a white streak when infected plant parts are cut and immersed in clear water.	<a href="#">Pseudomonas</a> - 1 ml/ 3gm per litre of water  <a href="#">Copper oxychloride</a> -3gm per litre of water
<b>Fusarium wilt</b>	Veinlet clearing and leaf chlorosis, leading to wilting and death of younger leaves, progressing to complete plant wilting within days. Yellowing of lower leaves, subsequent leaf wilting, browning of the vascular system, stunted growth, and plant death.	<a href="#">Trichoderma viride</a> - 1ml / 3 gm per litre of water  <a href="#">Copper oxychloride</a> -3gm per litre of water

## Harvesting:

The ideal time to harvest tomatoes varies depending on the specific variety and intended use. Tomato plants generally start producing fruits around two to three months after planting, and it takes another four to six weeks for the fruits to ripen fully.

The yielding starts after 50 to 60 days of sowing. The picking can be done every 10 to 15 days intervals from the date of first picking. A farmer can go for picking about five times until the last harvest.

## Yield

- **Varieties: 30 - 40 t / ha**
- **Hybrids: 80 - 95 t / ha**

## Tags

Agriculture	Aphids	Blogs Gallery	Boron	Calcium
Chewing Pests	Diseases	Downy Mildew	Early Blight	Fall Armyworm
Farming	Fruit Borers	Fruit Flies	Insecticides	Iron
Late Blight	Leaf Hopper	Leaf Spots	Magnesium	Mealy Bugs
Mites	Mosaic Virus	Nitrogen	Nutrient Deficiency	Nutrients
Pink Bollworm	Powdery Mildew	Soil Testing	Stem Borer	Sucking Pest
Sulphur	Thrips	Tomato	Trichoderma Viride	Tuta Absoluta
Wilting				

## Important Natural Enemies of Tomato Insect Pests

### Parasitoids



*Trichogramma spp.*



*Campoletis spp.*



*Chrysocharis pentheus*



*Bracon spp.*



*Chelonus spp.*



*Encarsia formosa*

### Predators



Lacewing



Ladybird beetle



Spider



Reduviid bug



Praying mantis



Common mynah

## Introduction

Tomatoes are grown in abundance both in the summer and winter seasons in India. The crop grown in the winter is of superior quality because they contain more total solids. The [tomato paste](#) retains all of the flavour, sweetness, and

nutrients in the fresh fruits. The tomato processing industry in India is equipped with state of the art manufacturing facilities and advanced technology.

Around 80% of the tomatoes are consumed fresh and 20% are employed in the processing to make tomato paste, puree, ketchup, pickles, juices and sauces. Tomato paste is a smooth thick substance manufactured by processing fresh and ripened tomatoes. Tomato paste is a raw material for manufacturing tomato processed products. The sauce and ketchup sector is the major user of tomato paste.

### **Global Tomato availability**

There are more than 1500 varieties of tomatoes cultivated in India. Only a few varieties are commercially cultivated. India is the second-largest producer of tomatoes, producing 20 million tomatoes every year. India contributes to 11% of the world's total tomato production. However, India processes only 150000 tonnes of tomatoes annually. India's demand for **tomato processed products** has surged by 40%. India's annual ketchup consumption is estimated to be 150000 tonnes with a valuation of 1.8 billion.

Though many countries produce tomato paste, the ten largest producing countries account for 83% of the world's yearly production. China is the largest producer of tomatoes followed by India, Turkey, and the United States. The tomato is also cultivated in the Northern hemisphere and processed in the months of July and December. The southern hemisphere region's production is between January and June. Brazil is the only country in the Southern hemisphere that processes one million tons per year at the same season as the Northern hemisphere.

### **Tomato processing industry in India – Production capacities**

Unlike guava and mango processing industries, The number of tomato processing industries is limited. Most of the processing industries are located in the Krishnagiri and Chittoor districts of India. Most of the varieties cultivated in India are used as a table variety and only a few varieties are used for processing.

In the year 2019-20, the main production and exchange countries exported 6.8 million tonnes of tomato paste, which is 35% higher than the previous year. The global tomato paste export market generated a revenue of USD 3.1billion of the USD 6.4billion generated by the global trade of tomato products. The demand for tomato paste has been steadily increasing and China has dedicated capital investment to overtake the dominant position of the USA and Italy.

The **tomato processing industries** are located mostly in the southern regions of India. Tomato paste production is viable for the tomato processing industries in South India because of their close proximity to tomato growing areas. The World Processing Tomato council estimated that 41.37 million tonnes of tomatoes were processed into value-added products around the globe. Thus represent 26% of the total fresh tomato production. In comparison, just about 1% of tomato production is being processed to produce value-added products.

### **Usage of tomato processed products**

The primary tomato processed products are Tomato puree and tomato paste. The primary tomato processed products pave a way for secondary processed products. The ketchup and sauce industry is the major consumer of tomato puree and paste. Additionally, the beverage and culinary product industries are the second major consumers of tomato paste and puree.

Tomato is an essential product in the B2B sector since it is used as a raw material to produce other **processed tomato products**. Tomato juice, paste, puree, diced/peeled tomatoes, ketchup, pickles, sauces, tomato-based powder products, and ready to eat curries. Processed tomato products have a wide range of applications in the food industry, snacks, culinary, motels, restaurants, and fast food retail chains.

### **Processing varieties of tomato**

Abhinav and Namdari are the most popular varieties of **tomato processed in India**. Rashmi, Vaishali, and Rupali are processed in small quantities. Southern varieties are mostly used for processing. Northern varieties are used for table purposes. These two varieties contribute to 90% of processing and the remaining market share is taken by other varieties. Tomatoes are processed at the beginning of the year from (Jan-April) and from August-October.

## **Tomato paste**

The Abhinav variety is grown in the region of Karnataka and is most suited for processing. Namdhari is grown across all the states in India. These two are the most preferred commercial varieties by the **tomato paste processors**. This tomato paste has a great demand in the domestic ketchup and sauce market.

- Brix: 28-30 Deg (hot break)
- Packing: tomato is packed aseptically in pre-sterilized aseptic bags placed with poly-liner in food-grade epoxy painted (inside) open-top MS drum.
- Product Net weight: 228kg / Drum.
- Gross weight: 18MT (80 drums in 20 FCL)
- Shelf life: 24 months from the date of manufacturing.

## **• Tomato paste processing method – How are tomatoes processed?**

- The ripened tomatoes are unloaded in the factory and it undergoes the first stage of quality control. The fruits are then sorted to remove mechanically injured or spoiled fruits. The fruits are unloaded and filled in the crates. The **tomato paste processing** begins by washing tomatoes with chlorinated water at 5-10ppm and then with plain water to remove dust particles.
- The tomatoes are crushed in the fruit miller and the pulp is collected in the pulp storage tank. The puree is preheated at 85-95 Deg Celcius and refined to remove seed/ tomato waste. The product is passed through the evaporator to remove the water content. The tomato paste is then passed through a strainer and metal detector to remove impurities. Eventually, the product is sterilized and filled in aseptic bags. The tomato paste with aseptic bags is packed in MS drums and stored in the warehouses.

## **• Tomato paste processing flow chart**

- Here is the **process flowchart** for the extraction of tomato paste. The tomato paste is further processed into ketchup, sauce, and other **processed tomato products**.

## **• Future trends in the tomato processing Industry**

- Because of the rapid urbanization, consumers in emerging and developed countries are lured to eat readymade foods and **tomato processed products**. To meet the growing demand, processed food manufacturers and tomato paste processors are focusing on ready to eat products. In 2021, the global tomato processing market was valued at 43.4 million tonnes. The global processing industry is expected to see a CAGR of 3.8% from 2022 to 2027. The Indian tomato processing industry witnessed moderate growth during the year 2015-to 2020. However, the market is expected to grow at a CAGR of 4.2% in the year 2021-2026. The advances in seed research and breeding procedures make tomatoes available all around the year. This is one of the key factors driving the global tomato processing industry.

### **Key opportunities for the tomato processing industry**

In India, over the last three years, the demand for **tomato processed products** has increased at a rate of 30% each year. Additionally, the range of tomato processed foods is expanding with the introduction of various tomato products including powder-based products. ICAR-IIHR Bengaluru has observed that there are plenty of opportunities to breed dual purpose opportunities with processing quality attributes. This will pave the way for the tomato processing industry to produce more puree/paste in India.

### **Challenges for the Tomato processors**

- Most tomato varieties currently cultivated by the farmers are suitable only for table purposes. They are not suitable for the **tomato processing industry**. The tomatoes cultivated in India are acidic with large locules and thin walls. Thus, it requires more fruit to produce tomato paste.
- For tomato paste processors, product perishability is a critical quality factor. Tomatoes have less shelf life. Physical losses up to 25-30% can occur during transportation and storage, comprising the quality of the processed paste.

A constant supply of economical tomatoes is non-viable as off-season tomatoes are expensive

## LIST OF COMPANIES & ORGANIZATIONS IN INDIA

### **Tomato processors**

	<b>Website</b>
Nestle India	<a href="http://www.maggi.in">www.maggi.in</a>
Hindustan Unilever Ltd.	<a href="http://www.hul.co.in">www.hul.co.in</a>
Field Fresh Foods/ Del Monte	<a href="http://www.fieldfreshfoods.in">www.fieldfreshfoods.in</a>
Kagome Foods India	<a href="http://www.kagomeindia.com">www.kagomeindia.com</a>
Cremica Food Industries	<a href="http://www.cremica.com">www.cremica.com</a>
Indira Foods	<a href="http://www.indirafoods.in">www.indirafoods.in</a>
Dabur India	<a href="http://www.dabur.com">www.dabur.com</a>
Capricorn Food Products India Ltd	<a href="http://www.capricorngroup.com">www.capricorngroup.com</a>
Valcore Foods	<a href="http://www.valcorefoods.com">www.valcorefoods.com</a>
G. D. Foods MFG. (India) Pvt. Ltd.	<a href="http://www.tops.in">www.tops.in</a>
Mother Dairy Fruit & Vegetable Pvt Ltd	<a href="http://www.motherdairy.com">www.motherdairy.com</a>
GRG Fine Foods	<a href="http://www.grgfinefoods.com">www.grgfinefoods.com</a>
Sun-sip Agro Processors	<a href="http://www.sunslipagro.com">www.sunslipagro.com</a>
Sunrise Naturals	<a href="http://www.sunrisenaturals.in">www.sunrisenaturals.in</a>
Adinath Agro Processed Foods Pvt Ltd	<a href="http://www.adinathagro.com">www.adinathagro.com</a>
Jadli Foods	<a href="http://www.jadlifoods.com">www.jadlifoods.com</a>
Arora Foods India- Fun Top Brand	<a href="http://www.funtopindia.com">www.funtopindia.com</a>
Sri Varsha Food Products India Ltd	<a href="http://www.srivarsha.com">www.srivarsha.com</a>
Aditi Foods India Pvt Ltd	<a href="http://www.aditifoods.com">www.aditifoods.com</a>
Cropotto Foods International LLP	<a href="http://www.cropottofoods.com">www.cropottofoods.com</a>
Nexxeen Foods Pvt Ltd	<a href="http://www.nexxeenfoods.com">www.nexxeenfoods.com</a>
Capital Foods	<a href="http://www.capitalfoods.co.in">www.capitalfoods.co.in</a>
Malabar Fruit Products	<a href="http://www.fruitomans.co.in">www.fruitomans.co.in</a>
Morton	<a href="http://www.mortonindia.com">www.mortonindia.com</a>
Tajir Pvt Ltd- Habit Brand	<a href="http://www.tajir.com">www.tajir.com</a>
Testo India	<a href="http://www.testoindia.co.in">www.testoindia.co.in</a>
Veeba Foods	<a href="http://www.bonafiderpl.com">www.bonafiderpl.com</a>
Dr.Oetker	<a href="http://www.oetker.in">www.oetker.in</a>
Solazta Agro Processing- Tomezza Brand	<a href="http://www.tomezza.com">www.tomezza.com</a>
Jain Farm Fresh Foods Ltd	<a href="http://www.jainfarmfresh.com">www.jainfarmfresh.com</a>
Varadharaja Foods Private Limited	<a href="http://www.vfoods.in">www.vfoods.in</a>
Vision Agro Foods	<a href="http://www.visionagrofoods.com">www.visionagrofoods.com</a>
Galla Foods	<a href="http://www.gallafoods.com">www.gallafoods.com</a>
Everest Beverages & Food Industries	<a href="http://www.everestfood.in">www.everestfood.in</a>
Sensa Foods	<a href="http://www.sensafoods.in">www.sensafoods.in</a>

### **Tomato processors & growers**

Varun Agro Processing Foods Pvt Ltd	<a href="http://www.varunagro.com">www.varunagro.com</a>
Global Green Company Limited	<a href="http://www.globalgreengroup.com">www.globalgreengroup.com</a>
Sahyadri Food Processing	<a href="http://www.sahyadrifarms.com">www.sahyadrifarms.com</a>

### **Seed companies**

Bayer Crop Science	<a href="http://www.bayer.in">www.bayer.in</a>
Orbi Seeds International	<a href="http://www.orbisseeds.com">www.orbisseeds.com</a>
United Genetics India	<a href="http://www.unitedgeneticsindia.com">www.unitedgeneticsindia.com</a>
Namdhari Seeds Pvt Ltd	<a href="http://www.namdhari-seeds.com">www.namdhari-seeds.com</a>
TierraSeed Science Pvt. Ltd	<a href="http://www.tierraseedscience.com">www.tierraseedscience.com</a>
Nuziveedu Seeds	<a href="http://www.nuziveedu-seeds.com">www.nuziveedu-seeds.com</a>

### **NGOs or Government bodies**

All India Food Processors' Association	<a href="http://www.alfpa.net">www.alfpa.net</a>
Kisan Network Pvt Ltd	<a href="http://www.kisanetwork.com">www.kisanetwork.com</a>
Ministry of Food Processing Industries	<a href="http://www.mofpi.nic.in">www.mofpi.nic.in</a>
Agricultural and Processed Food Products Export Development Authority	<a href="http://www.apeda.gov.in">www.apeda.gov.in</a>
India Brand Equity Foundation	<a href="http://www.ibef.org">www.ibef.org</a>
Directorate General of Commercial Intelligence and Statistics	<a href="http://www.dgcis.doi.gov.in">www.dgcis.doi.gov.in</a>
National Horticulture Board, Ministry of Agriculture	<a href="http://www.nhb.gov.in">www.nhb.gov.in</a>
Tomato Paste Manufacturers Association of India	<a href="http://www.tomatopaste.in">www.tomatopaste.in</a>
Food Safety and Standards Authority of India (FSSAI)	<a href="http://www.fssai.gov.in">www.fssai.gov.in</a>

