

Tomato

- **Botanical name:** *Lycopersicon esculentum*
- **Family:** Solanaceae
- **Chromosome no. (2n) :** 24
- **Origin:** Peru, Ecuador – Bolivia
- **Common Name:** Love Apple , Poor Man Orange

Importance and Uses

- The tomato is one of the most important "**protective foods**" both because of its special nutritive value and also because of its widespread production.
- It is the world's largest vegetable crop after potato. Tomatoes are used for soup, salad, pickles, ketchup, puree, sauces and in many other ways. Tomato is a major source of vitamins and minerals. It is widely used as salad vegetable.
- Tomato contains many important minerals like Na, Ca, Mg, P, K, Fe, Zn, Boron.
- The steroidal glycoalkaloid present in tomato is called **tomatin** and the coloured pigment is called **lycopene (red colour)**. Lycopene content is high at 21°C.

Climate

- Tomato is a warm season vegetable, is grown extensively in cool season also. It requires a long season optimum temperature is 15 to 27°C.
- Temperature and light intensity effect the fruit set, pigmentation and nutritive value. Mild winter condition in northern plains is ideal for seed germination, plant growth, fruit set, fruit development and ripening.
- At low and high temperatures, there is low germination of seeds, poor plant growth, flower drop, poor fruit set, and ripening. At high temperatures, generally the quality of fruits is poor and there is high incidence of sun scald.
- 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. Excessive rains adversely affect its fruit set causing flower drop.
- Tomato has a yellow pigment 'Carotene' and red pigment (at ripened stage) called 'Lycopene' and at very high temperature formation of lycopene is inhibited.

Soil

- Tomato can be grown in a wide range of soils from sandy to heavy soils. However, sandy loam, rich in organic matter ideal for its cultivation.
- A well drained, fairly fertile loam with fair moisture holding capacity is ideal for growing a good crop of tomato.
- Tomato is highly susceptible to water logging. Well drained soils are highly necessary. The preferable pH range is 7 to 8.5.

Origin, taxonomy and botany: Cultivated tomato originated from Peru, Ecuador, Bolivia. Domesticated place of tomato lies in Mexico. The ancestor of cultivated tomato is cherry type (*Lycopersicon esculenta* var. *cerasiformae* - cherry tomato). Tomato belongs to the family Solanaceae.

Cultivated tomato is an annual herb, 0.7 to 2m tall, erect with thick solid stems or spreading, coarsely hairy with strong characteristic odour. Strong tap root with dense fibrous and adventitious roots are formed. Tomato can be classified depending on the growth habit.

Indeterminate: terminal buds ends with a leafy bud and continue it vegetative growth. (Inflorescence cluster occurs at every third internode and the main axis continues to grow indefinitely.) **Ex:** Pusa ruby.

Determinate fruits: terminal buds ends with floral bud and further its vegetative growth is checked and are called as Self topping or self pruning types. (Inflorescence occurs more frequently in almost every internode until terminal ones are formed and elongation ceases at this point) **Ex.** Pusa Early Dwarf

Semi-determinate: have semi dwarf growth and it is between determinate and indeterminate. Number of nodes between two consecutive inflorescences will be around one. **Ex:** S-12, Roma.

The leaves are compound pinnatifid with small leaflet. Flowers are borne in small forked raceme cyme. They vary in numbers from 5 to 12. Flowers are pendent, perfect, hypogynous. Stamens 6 in number and inserted on throat of corolla tube, filament bright yellow. Carpels 6, united and basal ovary typically 6 celled with a central fleshy placenta. Dehiscence of anther is longitudinal, 1-2 days after opening of corolla. If the pollen is shed as the style grows up through anther tube, self-fertilization occurs and when the stigma protrudes, chances of cross pollination through bees increase. The optimum temperature for pollination as around 21°C.

Varieties & Hybrids: In certain varieties of tomato, the vegetative growth automatically stops, giving rise to bushy growth. They are called self pruning varieties.

- Certain varieties like Pusa rubi, Pusa early dwarf, Marutham, Arka vital, Pusa 120, sweet 72, S-12, Co-1 are suitable for cultivation in **plains**.
- Varieties like Sioux, Best of all, Pusa early dwarf are suitable for **hilly areas**.
- Varieties like Roma and Punjab chuhara are suitable for **processing**.
- Varieties released by IIHR Bangalore are Arka Abha, Arka Abhijit, Arka Ahuthi, Arka Aloukik, Arka Meghali, Arka Sourab, Arka Srasika, Arka Vartnan, Arka Vikas, Arka Visal.
- **Pusa Sheetal:** cold resistant variety
- **Best of all:** Mid season variety
- **IVRI-2 :** variety developed from IVRI, Varanasi
- **Floradade:** It is a variety brought from Florida
- **PUSA-120:** resistant to nematode and released by IARI, New Delhi.
- **S-12:** Evolved by PAU, Ludhiana, fruit round to flattish with persistent pedicel suitable for summer crop all over the India.
- **Sioux:** American variety, resistant to growth cracks
- HS-101, HS-102, HS-110, Hisar Anmol, Hisar Arun, Hisar Lalima, Hisar Lalit etc. are developed by HAU Haryana.

S. No	Hybrid	Parentage	Characters
1	Pusa rubi	Sioux X Improved meeruti	Indeterminate
2	Pusa Early Dwarf	Improved meeruti X Red cloud	Determinate and slightly furrowed
3	Pusa Red Plum	<i>L. esculentum</i> X <i>L. Pimpinellifolium</i>	

Co-1, Co-2 – released from TNAU, Coimbatore. Co-3 it is a mutant of Co1. Gulmohar (MTH 6) – released from Maharashtra hybrid Seed Company. Punjab chuharra, Ox heart, Punjab kesari, Pusa early dwarf, Pusa rubi, Pusa red plum, Pusa sadabahar, Sweet – 72, Roma, Yasvanth-2 are other hybrids.

A high yielding tomato F₁ hybrid “**Arka Rakshak**” triple disease resistance, Tomato leaf curl virus (ToLCV), bacterial wilt (BW) and early blight (EB), developed by Indian Institute of Horticultural Research (IIHR), Bangalore. This is the first multiple disease resistant public bred tomato F₁ hybrid released for commercial cultivation in the country. Plants are semi-determinate.

Seed sowing: It is grown almost the year round. In north India, generally autumn and spring summer crops are taken. Therefore, seed sowing is done in November and transplanting during the month of January. In case of South India, 3 crops are taken which are sown during June-July, October-November and January- February.

Seed rate: Seeds are very light in weight. 400 to 500g of seed sufficient to raise nursery and transplant in one hectare.

Nursery bed preparation: Tomato is a transplanting crop. Seeds are sown in the area of 250 m². A raised bed prepared by well decomposed FYM is mixed @ 4kg FYM per m² of nursery bed. A fertilizer dose of 0.5 kg N, P, K per bed is also mixed in the soil. Seeds are treated with fungicides (Thiram or Bavistin @ 2g/kg) and 40% formalin solution at 500ml/m² area of nursery bed sterilisation. During summer and rainy season, there is very heavy incidence of damping off. To protect seeds and seedlings, the beds should be treated with 10% formaldehyde. After fumigation the beds are covered with polythene for 24 hours. Seeds are sown 4 to 5 days after removal of polythene sheets. In line sowing 7.5cm distance is kept between the rows. The beds are covered with straw or polythene till the seeds germinate. Seedlings are protected against wind, exposure to sun and excess rainfall. Fungicides are sprayed weekly to avoid of damping off. Nursery can also be grown in poly house. Hardening is done by withholding water 4-5 days before uprooting seedlings. Adding 4,000ppm sodium chloride or spraying of 2,000ppm CCC is effective for hardening of seedlings.

Transplanting of seedlings: Seedlings are transplanted at 25 to 30 days and 10-15cm height, on the evening of sunny day. Whole day transplanting is done in a cloudy day. In some of the areas tomato is directly sown. Seeds should be sown 1.25 to 2.5mm deep. Direct sowing is reduce the infestation of root knot nematode, bacterial wilt and damping off. The seedlings are transplanted at the side of ridge. Later, earthing up is done to keep the plant in the middle of the ridge. 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.

Nutritional management: Well decomposed FYM is recommended, added @ 20-25 tons per ha at the time of last ploughing and incorporated into soil. In general, NPK @ 120 kg: 60 kg: 50 kg per ha has been recommended for various tomato varieties. The quantity of Nitrogen to be applied varies greatly depending on the variety as well as soil conditions. However, for hybrids, higher quantity of N is applied. A high level of N at seedling stage and moderate level at flowering and fruiting stage is required. However, high level of N in plant reduces the C/N ratio resulting in unfruitfulness. Half N, entire P and K should be applied as basal dose, half N is given in 2 to 3 splits. 30, 45, 60 days after sowing. Micro nutrients like B, Zn also need to be applied and lime is essential under acidic soil. Availability of Boron is considered to be essential for production of large size fruit with high vitamin content and prevent fruit cracking, while Zinc for higher ascorbic acid content and tolerances to diseases.

Irrigation: Tomato is a deep rooted crop. Roots will grow to a depth of 120 to 150 cm and it has some drought tolerance. They require adequate moisture for their fair growth. Excess as well as insufficient moisture is harmful. First irrigation is given immediately after transplanting afterwards care should be taken not to apply too much water as it makes the plant to run and drops the blossom. However, light irrigation should be given at 3 to 4 days interval in summer and 10 to 15 day interval in winter. Furrow irrigation is the most widely used. Drip irrigation is fairly recommended as it can save more water compared to furrow irrigations.

Intercultural operations: Tomato is subjected to **pinching**, the lateral shoots are pinched to improve more bushy growth but little foliage is to be kept. Frequently shallow hoeings are necessary to improve the yield, it also reduce the weed growth. **Mulching** should be done 15 to 20 days after planting. 2 to 3 **weeding** before flowering encourages good crop growth. Application of a weedicide, basalin or pendimethalin @ 1 kg a.i./ha plus one hand weeding at 45 days after transplanting was recommended. **Staking** is very essential for indeterminate group of varieties because it improves yield and quality protection of fruits. In pest and diseases, easy harvesting and easy spraying of chemicals.

Harvesting: The stage of maturity at which tomato should be harvested depends upon the purpose for which they are used and the distance of transportation. The following stages of maturity for harvesting are recognized.

- **Immature:** Before the seeds have fully developed and before the jelly like substance around the seeds are fully formed.
- **Mature green:** The 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.
- **Turning or breaker stage:** 1/4 th of the surface at blossom end shows pink.
- **Pink stage:** 3/4th of the surface shows pink.
- **Hard ripe:** all the surface turn to pink or red but flesh is firm.
- **Over ripe:** fully coloured and flesh is also soft.

For distant market mature green stage fruit can be harvested and for a local market, they can be harvested at hard ripe stage. Fruits at fully ripe or over ripe stages are utilized within 24 hours for processing. For seed production, red ripe tomatoes are ideal.

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

Yield: Depends on various factors on an average an open pollinated variety will give 250 to 500 quintals per ha. Hybrids can give up to 1000 q per ha.

Post harvest management & Storage: Tomato can be stored either in mature green or breaker stage of maturity. Fruit remain firm up to 21 days when kept at 20°C for the cultivars like Florida MH and Floradade. Temperature of 10°C cause moderate chilling injury and Alternaria root rot.

Physiological disorders in Tomato:

1. Blossom end rot: It is more serious, ground discoloration starts. In blossom end of the fruit. Black spot develops to encompass 1/2 to 2/3 rd portion of the fruit. Later the tissues shrink and skin becomes dark grey to black. It may lead to secondary infection by fungus and unfit for consumption.

Causes: use of Ammonium sulphate, imbalance of Mg & K; deficiency of calcium

Remedies: cultural practices that concern soil moisture and maintain uniform moisture supply. Transplanting in early April instead of early June. Foliar spray of 0.5% CaCl₂. Apply Nitrogen in the form of Urea.

2. Fruit cracking: occurs for middle of the May. Reduced transpiration has increased cell turgidity and contributed to tomato fruit cracking. Reduced transpiration occurs even in summer when fruit are grown in green house. Cracking also occurs in rainy season when rains fall in long dry spell. Presence of water on the surface of fruit is more conducive in cracking than high soil moisture.

Boron deficiency in the soil also causes fruit cracking.

They are two types of cracking.

i. radial cracking: occurs mostly at ripe stage.

ii. Concentric cracking: it is common in mature green stage.

Remedies: use of resistant cultivars like Sioux, Punjab chuhara. Picking of the fruit before the full ripe stage. Soil application of Borax @ 10- 15 kg per ha. Regulation of soil moisture. Misting (spray of cool water).

3. Puffiness: commonly known as hallowness. Tomato puffs, puffy tomatoes, puffs and pockets. As the fruit reaches about 2/3rd normal size outer wall continues to develop normally but remaining internal tissue growth is retarded. Fruit become lighter in weight and partially filled. Very high or vary low temperature and low soil moisture conditions will lead to puffiness.

4. Cat facing: a large scar is formed at the blossom end portion of the fruit. Such fruits have ridges and furrows and blotches at blossom end.

Reasons: low temperature, faulty pollination, application of nitrogen during transition from vegetative to reproductive phase.

Remedies: balanced fertilizer application; regulation of temperature.

5. Sunscald: when fruits and leaves are exposed to the sun, there is appearance of yellow, white patches on green and ripen fruits. These patches may have secondary infection of fungus and start rotting varieties with sparse foliage will suffer more sunscald especially in the month of May and June.

Remedies: prefer the varieties having more foliage and follow appropriate cultural practices.

6. Flower and fruit drop: higher incidence of flower and fruit drop is resulted because of fluctuations in temperature poor water management and soil moisture.

Remedies: good package of practices should be followed. Moisture stress should be avoided. Spraying of planofix or NAA @ 1 ml in 4.5 lt of water. Control of fluctuations in temperature.

7. Blotchy ripening: greenish yellow; maintain balance between Nitrogen and Potassic fertilizers.

8. Bronzing or internal browning: also known as grey wall. Characterized by death of tissues within the fruits associated by vascular browning variety EL 235673 is found resistant to this disorder.

9. Green back: stem and portion of the fruit turns green. At high temperature ripening is inhibited and green band is expected. Reduce temperature by artificial means.

Plant protection measures

Diseases: Damping off and root rot, Late blight, Buckeye rot (fruit rot), Early blight, Fusarium blight, Powdery mildew, Verticillium wilt, Anthracnose fruit rot, Fruit rot, Black leaf mould, Bacterial wilt, Bacterial canker, Leaf curl virus, Spotted wilt virus

Pests: Tomato fruit worm, Epilachna beetles, Jassids, Tobacco caterpillar, White fly, Thrips, Leaf miner, Fruit borer, Aphids, Tomato worm, Mites, Fruit fly, Nematodes, Root-knot nematodes