Tomato

High-tech Cultivation Practices



Jain Drip®

Tomato *(Lycopersicum esculentum)* is edible, belongs to the family Solanaceae. It is a herbaceous annual plant with bisexual flowers. The fruit is a true berry. It is a self-pollinated crop but in some cases as high as 30% cross-pollination has been reported. Depending upon the growth habit, the tomato plants have been categorized into two-indeterminate and determinate types. The plant of former type terminates in a vegetative bud, whereas that of the determinate type terminates in a flower-bud and is appropriately called 'self topping' or 'self pruning' type. Many varieties of determinate type tomato plants do not have adequate foliage to protect their fruit. Some of them fruit very early. The determinate varieties can be harvested in 2-3 harvests while the fruiting period of indeterminate type is prolonged.

Climate

Tomato is a warm season crop, it requires warm and cool climate. The plants cannot withstand frost and high humidity. Also light intensity affects pigmentation, fruit colour, fruit set. The plant is highly affected by adverse climatic conditions. It requires different climatic range for seed germination, seedling growth, flower and fruit set, and fruit quality. Temperature below 10ºC and above 38ºC adversely affects plant tissues thereby slow down physiological activities. It thrives well in temperature 10ºC to 30ºC with optimum range of temperature is 21-24ºC. The mean temperature below 16ºC and above 27ºC are not desirable. The plant doesn't withstand frost, it requires low to medium rainfall, and does well under average monthly temperature of 21 to 23ºC. Avoid water stress and long dry period as it causes cracking of fruits. Bright sunshine at the time of fruit set helps to develop dark red coloured fruits.

Soil

Tomatoes do very well on most mineral soils, but they prefer deep, well drained sandy loams. Upper layer of soil should be porous with little sand and good clay in the subsoil. Soil depth 15 to 20cm proves to be good for healthy crop. Deep tillage can allow for adequate root penetration in heavy clay type soils, which allows for production in these soil types.

Tomato is a moderately tolerant crop to a wide pH range. A pH of 5.5- 6.8 is preferred. Though tomato plants will do well in more acidic soils with adequate nutrient supply and availability. The soils with proper water holding capacity, aeration, free from salts are selected for cultivation.

Soils extremely high in organic matter are not recommended due to the high moisture content of this media and nutrient deficiencies. But addition of organic matter to mineral soils and soils depleted of continuous cultivation will increase yield.

Varieties

Selection of tomato varieties have been in plenty suitable almost all parts of the country. Some of the sought after varieties are given below.

Sioux- Highyielding dwarf, spreading

Pusa red plum- Table variety, determinate (IARI)

Pusa early dwarf- Suitable for kharif and rabi (IARI)

Co-1- Semi spreading dwar, fruits in cluster (TNAU)

Co-2- Mutant of Co-1.

S-12- High yielding, variety from PAU

PKM-1- Round fruits with green shoulder

Pusa Ruby- Indeterminate, flat fruits (IARI)

Pusa Gaurav- Good for processing (IARI)

Paiyur 1- Suitable for rainfed cultutre

Arka Saurabh- Semideterminate, round fruits; good keeping quality (IIHR)

Arka Vikas- High yielding table variety

Arka Ahuti- Oblong fruits, TSS 5.4% (IIHR)

Arka Ashish- Determinate oval fruits; tolerant to DM (IIHR)

Arka Abha- Determinate; bacterial wilt resistant (IIHR)

Arka Meghali- Rainfed' thick flesh.(IIHR)

Sakthi- Resistant to Bacterial wilt (KAU)

HS 101- Determinate; dwarf spreading, good for winter season. (HAU)

HS 102- Early variety (HAU)

HS 110- Late, table purpose variety, (HAU)

Hisar Arun- Extremely early, large fruits (HAU)

Hisar Lalima- Determinate, early, ;large fruit (HAU)

Hisar Lalit- Semi determinate, root-knot nematode tolerant (HAU)

Hisar Anmol- Tolerant to leaf curl virus, determinate (HAU)

SL-120- Semideterminate, root-knot nematode tolerant (IARI)

S-12- Dwarf bushy plants (PAU)

Pant Bahar- Bushy and much branched (GBPU)

NDT-1- Indeterminate, large fruits.

NDT-120- Determinate, good for processing.

Solan gola- From Himachal (YSPU)

F1 Hybrids

Apart from the above Varieties with yield potential only 25-30 t/ha a series of Hybrids are developed by Research Institutions, Universities, and Private Seed companies. The main thrust is for very high yields (75-120t/ha) and long shelf life apart from other qualities like TSS etc. Tomato hybrids are made available for both salad and puree end use.

Early and high yield, uniform fruiting, and resistance to adverse environmental conditions are some of the advantages of using F1 hybrid seeds. A combination of Pusa Ruby and Best of All is preferred as the F1.It not only yields 50 per cent more than Pusa Ruby but its fruit quality is also very attractive. The other combination recommended is Pusa 120 x Pusa Ruby.The F1 not only gives a high yield of attractive fruits but is also resistant to root-knot nematodes. Pusa Hybrid-2 has also performed well. The main drawback is the high cost of production of these seeds.

Some of the other Hybrids available in the country are; Arka Vishal, Arka Vardan, COTH hybrid 1, BRH 1 and 2, .Rashmi, Vaishali, Rupali, Naveen, Avinash2, MTH 4, Sada Bahar, Gulmohar, Sonali etc.



Nursery practices

- Tomato seeds are sown on raised beds or seed boxes.
- Raised beds of 1 m width and 10 m long in one or more bits according to the availability of space surrounded by drainage channels of 30 cm width are to be formed. The height of the bed should be 15 to 30 cm.
- Incorporate 8 t/ha of organic manure (FYM) before firming up the surface of the bed.
- Sow seeds uniformly using 36,000 seeds (plus 10%) for 1 ha transplanting.
- Seeds are sown at a depth of 1-2 cm and 5 cm x 4 cm or 5 cm x 3 cm spacing.
- Consolidate the beds after sowing with a light roller.
- Provide light mulch on the surface with dry leaves or dry grass.
- Two beds of 40 m2 area are required for producing for seedlings for 1 ha.
- Application of 200g of Furadan granules per 80 m2 of bed area.
- Seed treatment with Thiram or Dithane M-45 is done at the rate of 3 g/kg seed.
- Spraying copper fungicide on 12th day and 19th day of sowing to prevent damping off disease.
- Only organic manures are to be applied. If the soil is very low in fertility, apply phosphate at 75 kg/ha and potash at 200 kg/ha rates.
- Install micro sprinkler system for irrigation. Sprinklers and sprinkler lateral at 2.3 m spacing.
- Apply irrigation water in the form of a fine spray every evening.
- Six weeks old seedlings are to be used for transplantation.
- Harden the seedlings before transplanting. This is done by suspending irrigation to the nursery beds for 4 days prior to transplanting.

Land preparation

The field is ploughed three or four times and leveled properly. At the last ploughing 20-25 tonnes of farmyard manure, 10 kg carbofuran granules or 200 kg neem cake has to be applied.Ridges and furrows are formed at a spacing of 60 cm.

Transplanting to Main Field

- Condition the seedlings for 1-2 days before transplanting by slightly reducing the moisture and maintaining approximate outdoor temperatures.
- Thoroughly water plants l2 to l4 hours before transplanting to the field. Plants should be dug or cut loose from the soil when being transplanted; ensure the roots are not exposed to sun or drying wind.

Spacing Spacing varies with the varieties

- Generally Tomato can be planted on 1.0 m wide raised broad beds (furrow between beds is 30 cm wide).
- Plant two rows of Tomato on each bed on either side of 60 cm space at the centre of the bed.
- Plant to plant spacing in both cases can be 45 cm or 30 cm based on varieties.
- Some hybrids with large canopies are planted at 120 cm x 45 cm (18,500 plants/ha).
- Plant Population36000 (60 cm x 45 cm) plants per hectare based on varieties.
- Irrigation Inline drip line with 4 lph emitters spaced at 40 or 60 cm is found suitable for Tomato. The lateral spacing of 1.3 m would suit for a number of other row crops- Brinja, Okra, Potato, flower, Cabbage, Cauli flower , Leaf vegetables etc.
- Tomato Root system is mainly (70 % or more) spread in the top 20 cm soil layer. Irrigate daily as per the schedule for the season.



Water requirement of Tomato

Water requirement is depended upon Evaporation of the place and crop factor (Kc) at different stages of the crop.

October Planting

Month	Water requirement	
	Mm/day	Lt/ha/day
October	1.02-1.22	10200-12200
November	2.62-3.0	526200 - 30500
December	3.48-4.38	34800-43800
January	5.32-6.07	53200-60700
February	5.31-6.00	53100-60000

November planting

Month	Water requirement	
	Mm/day	Lt/ha/day
November	1.00-1.16	10000-11600
December	2.26-2.84	22600-28400
January	3.92-4.47	39200-44700
February	6.49-7.33	64900-73300
March	6.42-7.03	64200-70300

December planting

Month	Water requirement	
	Mm/day	Lt/ha/day
December	0.86-1.08	8600-10800
January	2.54-2.90	25400-29000
February	4.78-5.40	47800-54000
March	7.84-8.59	78400-85900
April	7.03-7.96	70300-79600

January planting

Month	Water requirement	
	Mm/day	Lt/ha/day
January	0.97-1.10	9700-11000
February	3.10-3.41	31000-34100
March	5.78-6.33	57800-63300
April	8.59-9.74	85900-97400
May	7.16-8.48	71600-84800

Fertilizer Management

Tomato removes 2.8, 1.3,and 3.8 kg/ton yield of N,P and K from the soil. Therefore the fertilizer recommendation has to depend on the variety and target yield.

Apply organic manure (FYM, Cattle dung, poultry manure, or Compost) 20 t/ha rate at the last plough and incorporate with top soil.

A generalized fertigation schedule is given below. Contact Jain Irrigation Expert for guidance on specific variety and target yield and location.

Jain® Drip



Fertigation Schedule for Tomato				
Part by water Soluble Fertilizers				
		80:100:100 kg/ac NPK		
Stge of crop	duration	fert grade	total kg/ac	quantity Sch. (every 3 days)
Plant establishment	10 days	19:19:19 13:00:46 Urea	26.5 11 3.5	8.8 kg 3.7kg 1.2 kg
Flower initiation stage	30 days	12:61:0 13:00:46 Urea	16.4 89 40	1.6 kg 8.9 kg 4 kg
Flower to fruit set	30 days	19:19:19 13:00:46 Urea	26.5 55.5 25.5	2.6 kg 5.5 kg 2.5 kg
fruit set and maturity	70 days plus	12:61:0 13:00:46 Urea	8 44.5 20	1 kg 3.2 kg 3 kg

75 % of P is given as basal at land preparation 469kg SSP/ac

Micronutrients

- Iron deficiency is visible in highly calcareous soils or when water containing high carbonates are used for irrigation. Its deficiency can be corrected by spraying 0.25 per cent ferrous sulphate till the chlorotic symptoms do not appear on young leaves.
- Spraying 0.25 per cent Zinc sulphate twice at weekly intervals corrects Zinc deficiency and for prevention soil application of zinc sulphate @ 50 kg/ha is recommended.
- Mg deficiency can be corrected by spraying 0.5 per cent magnesium sulphate twice at weakly intervals.
- Weeding and interculture are essential for high yield performance.

Pest management ; Diseases of Tomato

Damping off *(Rhizoctinia solani):*

Seedling appear pale green with brownish water soaked lesions at basal portion of the stem.The lesion girdle the stem,affected tissue rot and seedling collapse and killed.

Partial sterlization of the soil by burning trash on the surface, proper drainage,forming raised seed bed.seed treatment with 3g thiram/kg or drenching the soil with 1% Bodeaux mixture or captan 2gm/ litre.

Early blight *(Alternaria solani):*

Small, isolated, scattered spots on the leaves, fully developed spots are irregular, brown to dark brown in colour & with concentric rings inside the spot. Often several spots coalesce to form large patches resulting in blight



Timely spray of captan or zineb or mancozeb @3g/l of water is effective.

Late Blight *(Phytophthora infestans):*



Irregular water soaked patches on leaves. White fungal sporulation on undersurface of leaves. Later lesions dry and turn brown. Lesions on stem and petioles. firm olive brown irregular shaped areas on fruits.

Fungicides like Bravo or Mancozeb

3g/l of water. Ridomil gold as spray. Do not plant near or after a potato crop.

Anthracnose *(C. gloeosporioides):*



Small.slightly depressed,circular lesion appear on the ripe fruits, lesion may enlarge and become sunken,with concentric rings

Crop rotation, weed control, spraying mancozeb @2.5g/l gives effective control.

Grey Leaf spot *(Stemphylium solani)*



Leaf spots appear on under side of leaves as small brown small specks,later it develop on both surfaces into greyish brown, glazed lesion. On older leaves lesions dry up, crack and centre drop out leaving a hole appearance, leaves defoliate.

Foliar application of mancozeb at 2.5g/l proves effective.

Powdery mildew *(Leveillula taurica):*



Light green to bright yellow lesion otic spots with concentric rings may develop,powdery covering can be seen on the leave which later on moves to upper suface also,leaves die.

Apply tridemorph or dinocarp at 1ml/l or hexaconazole 2ml per litre for effective control.

Wilt *(Fusarium oxysporium):*



Clearing of the veinlets and chlorosis of the leaf, soon the petiole and leaves drop and wilt. Younger leaves may die in succession and entire plant may wilt and die. Black discoulration of the vascular tissue may be seen.

Crop rotation, summer plouhging, seed treatment with 4 g *Trichoderma viride* formulation or 2.5 g carbendazim per kg of seed is effective.

Bacterial spot *(X. compestris):*



Small circular to irregular water soaked areas on lower surface of the leaves. These spots become depressed with a bulge on the lower surface. This bulging surface first smooth but become tough later,a narrow yellow halo may surround the spot, leaf dies, hon green fruits water soaked border can be seen.

Spraying of crop with mixture of streptocycline 200 mg/l & copper oxychloride 3g/l of water gives good control.

Bacterial canker *(C.michiganensis):*

Unilateral leaves, wilted leaflets, water-soaked spots on fruits.

extraction of seeds through fermentation, 3-year crop rotation.

Bacterial wilt *(P.solanacearum)*



Wilting, stunting, yellowing of the foliage and finally collapse of the entire plant, lower leaves may drop before wilting occur. Vascular system become brown and ooze from it can be observed.

crop rotation with cruciferous plants is recommended.

Tomato spotted wilt *(Virus):*



Young leaves usually turn bronze and later develop numerous dark spots, growing tip may die-back, plant may have one sided growth habit or stunted and have drooping leaves, produces no fruits or with chlorotic ring spots, green fruits have slightly raised area with concentric rings.

rouging, control of thrips with insecticides like carbofuran granules (100g/m2) in the nursery & in the main field 6kg/acre 10 days after transplantation gives good protection

Tomato mosaic *(Tomato mosaic virus):*



Mottling of the leaves, dicolouration of leaves, sunken or cup like patches on leaf, edges of the leaf is downward, chloroticring appear on the fruit.

use of virus free seedlings and hot water treatment of seed or seed treatment with 20% trisodium orthophosphate is affective.

Leaf curl *(Tomato leaf curl virus):*



Severe stunting of the plants with downward rolling and crinkling of leaves, chlorosis of the leaves, curl leaves become hairy and leathery plants become pale and bushy.

Use of systemic insecticides such as dimethioate 0.05%/ carbofuran or phorate granules20kg/acre as soil application is effective.

Blossom end disorder *(Physiological disorder Ca-deficiency):*



Begins with light tan, water soakedspot which enlarge, turn black and leathery.

Liming with high calcium limestone 2-4 months proir to planting.

Insect pests of Tomato

Aphids *(Aphis gossypii):*



Leaves are stunted and distorted and curl under. The upper surface is sticky and a black moldy growth appears

Aphids are virus vectors. Spray often to control with systemic insecticid.

Fruit borer *(H. armigera):*



Leaves and flowers are attacked. sometimes young fruits are also attacked.

Transplant 2 rows of marigold for every 16 row of tomato as trap crop,spray 5% neemseed kernel extract,spray NPV @250LE/ac. spray 2ml endosulphan or chloropyriphos or Quinolphos/lwater.

Tobacco caterpillar:

Leaves and fruits are attacked specially at night.

Plant castor as trap crop, collec & destroy the eggs, pheromone trap@10/ha,poison(bate-10kg bran+ 1kg jaggery + 1l cabaryl) with little water.

Leaf minor *(Liriomyza spp.):*

Mesophyll of the leaves are fed.

Root knot nematode

Galls are visible on the root.

Deep summer ploughing, crop rotation with mustard, use of carbofuran 3g at 65g/m2 in nursery & 3.8kg/ha in the main field.

Harvesting

Harvesting stage differs depending upon the end use of the fruits

Green stage

The fruits are fully developed but are green and suitable for sending to distant markets.

Pink stage

Some of the portion is red or pink and the fruit is not fully ripe. It is most suited for local markets.

Ripe stage

The major portion of the fruit is red and the softening begins. It may be picked up for home or table use.

Full ripe stage

- The fruit develops maximum colour and turns soft.
- It is suited for processing purposes.
- After picking the fruits are graded and sorted out into cracked, bruised, injured fruits and well-matured ripe fruits.
- For marketing purpose ISI standard is advocated.
- On an average yield of 25t/ha is expected from the improved tomato varieties but an excellent hybrid crop can produce as high as 40 t/ha.
- It is strongly recommended to transport harvested fruits in Plastic crates to reduce damage to fruits.
- Best storage temperature for tomato fruit is 12-15° C.

Dos

- Ensure good drainage in the field.
- Adopt drip irrigation.
- Compulsorily apply organic manure as per recommendation
- Select high yielding, disease and pest tolerant variety suitable for each location.
- Practice drip irrigation from the beginning.
- Strictly follow the irrigation schedule given.
- Follow the drip system maintenance schedule given.
- Compulsorily weed/ inter-cultivate, timely operation helps in crop growth.
- Follow fertigation schedule as given.
- Follow the precautions while operating the drip system as explained.
- Follow disease and pest control measures timely and effectively.
- Apply sprays in the evening or early morning only.

Don'ts

- Don't over irrigate the crop at anytime.
- For fertigation don't mix solid fertilizers and dissolve them together. Prepare individual solutions and mix them for application.
- Don't spray the crop under hot sunlight.
- Don't make a fire in the field with Drip system.
- Don't use the fertigation unit for bulky organic manure and fertilizers that are not soluble in water.
- Don't add solid fertilizer from the bag directly to the fertilizer tank. Prepare solution separately and pour the solution to the fertilizer tank. Prepare solution only in plastic buckets. Don't use metal container.

Crop yields depend on climate, soil and management and therefore can't be guaranteed by the company.

Government Subsidy Available



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