



# Recent Advances in Production of Tomato (*Solanum lycopersicum* L.)



# Tomato

- Botanical name : *Solanum lycopersicum* L.
- Family : Solanaceae
- Origin : Mexico
- Chromosome no :  $2n=2x=24$
- Breeding system : Self-pollinated

# SYSTEMATIC CLASSIFICATION

**KINGDOM:** Plantae

**PHYLLUM:** Angiosperms

**DIVISION:** Eudicots

**CLASS:** Asterids

**ORDER:** Solanales

**FAMILY:** Solanaceae

**GENUS:** *Solanum*

**SPECIES:** *lycopersicum*

# ORIGIN

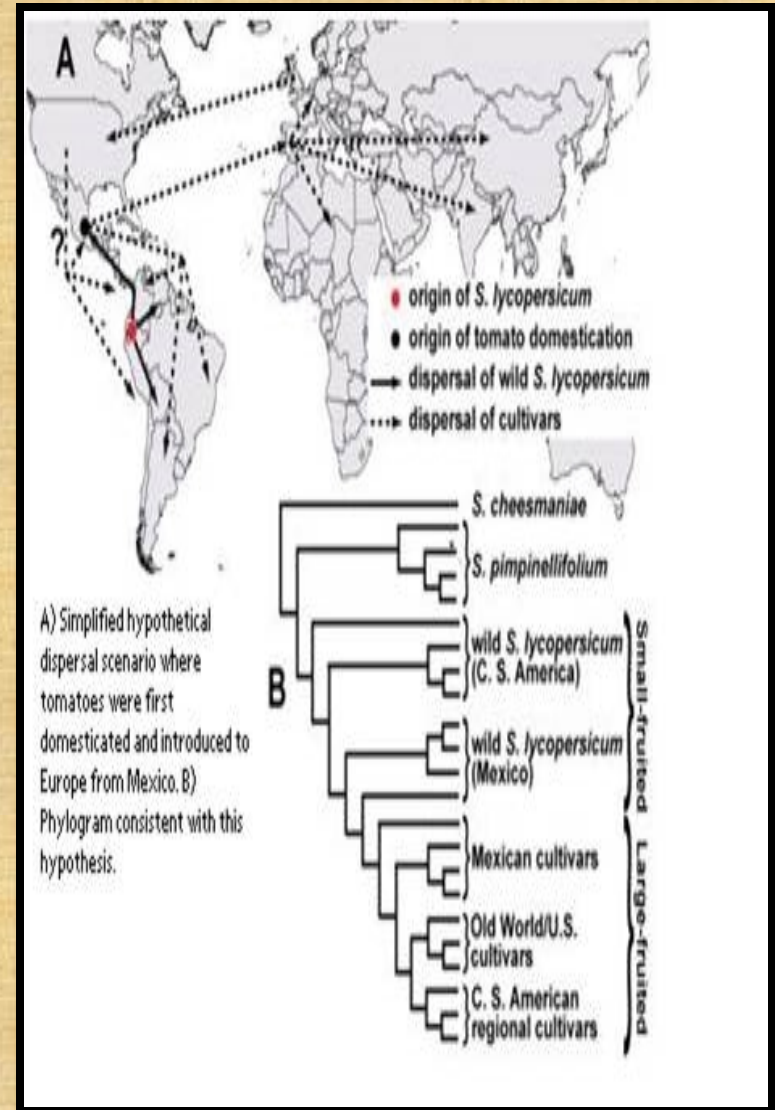
➤ Originated in the Andes mountain region of South America (Peru, Ecuador and Bolivia) on the basis of availability of numerous wild and cultivated relatives (Vavilov, 1951).

➤ From its centre of origin, it was first domesticated in Mexico.

➤ From Mexico, it arrived in Europe somewhere around in 1554.

➤ First introduced in America in 1710. By 1830, tomato became popular in the USA.

➤ Britishers believed to have introduced tomato in India in 1828 through the Royal Agri-Horticultural Society, Calcutta and afterwards it spreads to other parts of the country.



# EVOLUTION OF TOMATO

- Was considered poisonous until 1700s.
- In 1820, farmer R. G. Johansson was the first to eat tomato.



Ancestor of Tomato  
(*Solanum lycopersicum* var.  
*cerasiforme*)



Cultivated form of tomato  
(*Solanum lycopersicum* L.)

# CLASSIFICATION

**Miller(1788)** -*Solanum lycopersicum* (cultivated form)

*Solanum pimpinellifolium* (wild form)

**Muller (1940) & Luckwill (1943)** - two sub-genera

i. *Eulycopersicon* (true lycopersicon)

ii. *Eriopersicon*

## *Eulycopersicon*

- annual, edible fruit and red coloured with carotenoid pigment and self compatible.
- *Solanum lycopersicum* L.(cultivated tomato)
- *Solanum pimpinellifolium*. (Wild form)

## *Eriopersicon*

- Green fruited, self incompatible.
- *S. peruvianum*, *S. hirsutum*, *S. glandulosum*, *S. cheesmani*, *S. chilense*, *S. pennellii*, *S. parviflorum*, *S. chmielewskii*

## Bailey,1949: Classified tomato (*Solanum lycopersicum* L.) according to their fruit shape and plant spread.

BOTANICAL VARIETY	COMMON NAME
<i>Var. commune</i>	Common Tomato
<i>Var. grandifolium</i>	Large Leafed Tomato
<i>Var. validium</i>	Upright Tomato
<i>Var. cerasiformae</i>	Cherry Tomato
<i>Var. pyriformae</i>	Pear tomato

Based on growth habit, tomato plant is characterized into :

- i. **Determinate type** – Inflorescence occurs at almost every internode. Terminal bud ends in floral bud and vegetative growth is checked.
- ii. **Indeterminate type**- Inflorescence cluster occurs at every third internode and the main axis continues to grow indefinitely. Terminal bud ends in leafy bud and there is continuous vegetative growth.

# AREA AND PRODUCTION

IN INDIA BY NHB, NEW DELHI(2012-13)

AREA : 0.884 MILLION HECTARE

PRODUCTION : 1.78 MILLION TONNES

IN H.P. BY NHB, NEW DELHI(2012-13)

AREA : 10,000 HA

PRODUCTION : 0.4 MILLION TONNES



# BOTANICAL FEATURES

**Habit** : Herbaceous perennial but cultivated as annual. Tap root system with numerous lateral roots.

**Stem** : Green coloured, highly pubescent, round in cross section

**Leaf** : Leaves are pinnate green in colour, petiole-pubescent and long, Tip is blunt.

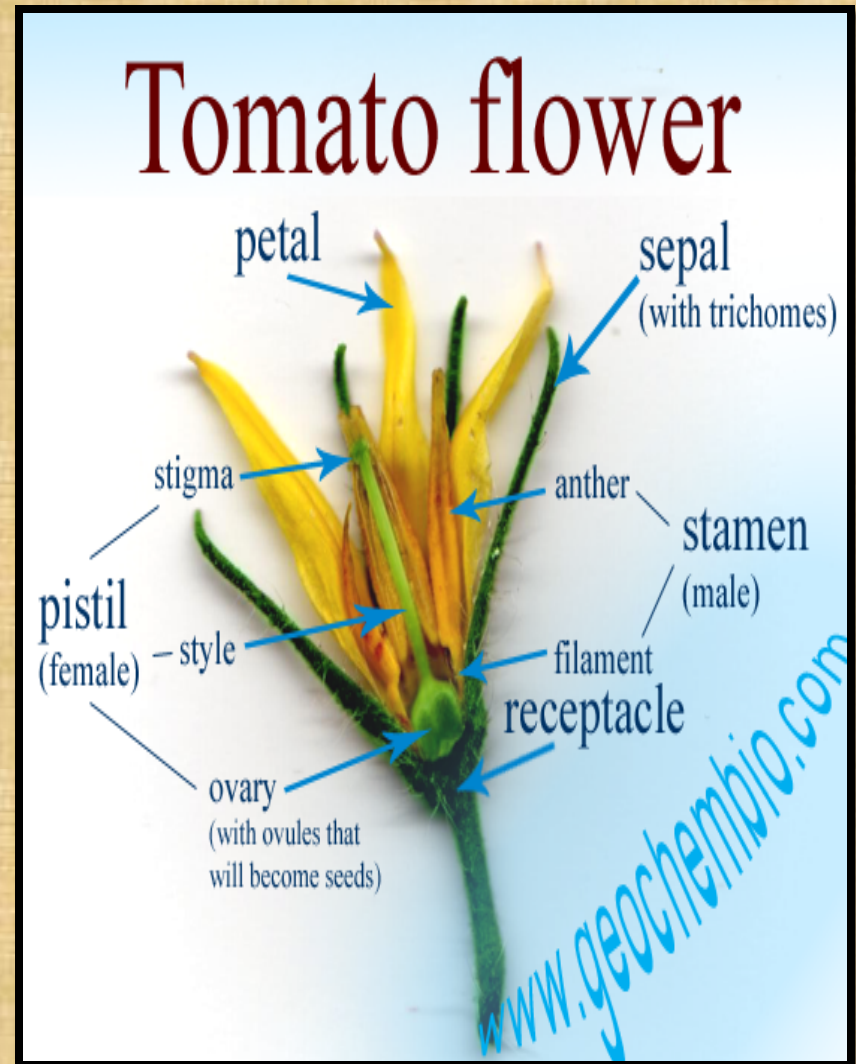
**Flowers:** Yellow in colour, borne in cluster, extra axillary in position, the flower cluster appears like racemose cyme . The flower cluster is called a truss.

**Calyx:** Grey in colour, 5-7 sepals, alternate with petals, persistent, valvate aestivation.

**Corolla:** Bright yellow in colour with 5-7 petals, alternate sepals, valvate aestivation.

**Androecium:** Stamens 5, greenish yellow, free at the base and united at the top. The anthers dehisce longitudinally.

**Gynoecium:** Multicolored, syncarpous with numerous ovules in each locules; style pale green and present within the anthredial cone.



# NUTRITIONAL AND MEDICINAL VALUE

- ❖ Rich source of mineral particularly potassium, vitamins and organic acids particularly citric and maleic acid.
- ❖ Ascorbic acid content ranges from 16-75 mg/100 g of fruit weight
- ❖ Tomato is also rich in medicinal value.
- ❖ The pulp and juice are digestible, mild aperient is parameter of gastric secretion and blood purifier.
- ❖ It is said to be useful in mouth cancer and sore mouth etc.
- ❖ It is one of the richest vegetables, which keeps our stomach and intestine in good condition.

# NUTRITION

## RED TOMATOES, RAW

### NUTRITIONAL VALUE PER 100 G (3.5 OZ)

<u>Energy</u>	74 kJ (18 kcal)
<u>Carbohydrates</u>	3.9 g
- <u>Sugars</u>	2.6 g
- <u>Dietary fiber</u>	1.2 g
<u>Fat</u>	0.2 g
<u>Protein</u>	0.9 g
<u>Water</u>	94.5 g

<a href="#">Vitamin A</a> equiv.	42 µg (5%)
- <a href="#">beta-carotene</a>	449 µg (4%)
- <a href="#">lutein</a> and <a href="#">zeaxanthin</a>	123 µg
<a href="#">Thiamine (vit. B<sub>1</sub>)</a>	0.037 mg (3%)
<a href="#">Niacin (vit. B<sub>3</sub>)</a>	0.594 mg (4%)
<a href="#">Vitamin B<sub>6</sub></a>	0.08 mg (6%)
<a href="#">Vitamin C</a>	14 mg (17%)
<a href="#">Vitamin E</a>	0.54 mg (4%)
<a href="#">Vitamin K</a>	7.9 µg (8%)
<a href="#">Magnesium</a>	11 mg (3%)
<a href="#">Manganese</a>	0.114 mg (5%)
<a href="#">Phosphorus</a>	24 mg (3%)
<a href="#">Potassium</a>	237 mg (5%)
<a href="#">Lycopene</a>	2573 µg

# IMPORTANCE AND USES

- Rank 2<sup>nd</sup> most important vegetable.(Potato being 1<sup>st</sup>)
- Tomato is basically a warm season crop and has the potential to grow all the year round in mild climate condition.
- It is a day neutral plant and mainly self pollinated but cross pollination may occur to some extent.
- It is universally treated as ‘protective food’ and provide almost all types of Vitamins and Minerals.
- Fruit is consumed as fresh or in processed form.
- Its ripe fruits are utilized on a large scale in the preparation of variety of products such as puree, paste, powder, ketchup, sauce, syrup, juice and canned whole peeled fruits.
- Red colour is due to the presence of ‘lycopene’(20-50mg/100g of edible portion) which is regarded as the powerful antioxidant.

# CLIMATIC REQUIREMENT

- Warm season crop
- Optimum daily mean temperature 21-24°C.
- Lycopene development is highest at 21-24°C and drops off rapidly above 27°C.
- Night temperature is critical for fruit set. Optimum range 15-20°C. Do not set fruit when night temperature is either below 13°C or above 20°C.
- Seed germination occurs maximum at 24°C.
- Tomato is susceptible to cold winds, frost and highly water logging conditions.

# SOIL REQUIREMENT

- Well drained fertile organic matter rich soils are ideal.
- For early crop:- Sandy loam soil.
- For higher yield:-Clay loam soil.
- **Ideal soil pH:- 6-7**
- Can tolerate little soil acidity upto pH- 5.5, not below it.



# LAND PREPARATION

- 4-5 repeated ploughings
- All stubbles, weeds etc. are removed & levelling of land.
- Addition of well rotten FYM or compost @ 20 -25 tonnes/ha
- Level the land properly



# NURSERY RAISING

- Tomato is a transplanted crop.
- Seeds sown on raised nursery beds of 1.0 m width and 15-20 cm height and convenient length.
- **SEED RATE:**
- **Hybrids: 125-175g/ha**
- **Open Pollinated Varieties: 400-500 g/ha**
- After sowing beds are covered with straw or long dry grass till seed germination.
- Sprinkle water regularly.  
Hardening of seedling by withholding water at least 4-6 days before transplanting



Nursery of Tomato can also be raised in plug trays under protected conditions.



# Nursery of Tomato can also be raised under protected conditions in poly tunnels.

- Polytunnels can be used to provide a higher temperature and/or humidity than that which is available in the environment but can also protect crops from intense heat, bright sunlight, strong winds, hailstones and cold waves. Every factor influencing a crop can be controlled in a polytunnel. Polytunnels are often used for nursery raising.



# SOWING TIME

It can be grown almost throughout the year in the country. However the number of crops grown varies from region to region. In Northern plains, generally two crops, autumn and spring crop are grown.

State/Region	Sowing	Transplanting	Harvesting
<b>Northern plains:</b> <ul style="list-style-type: none"><li>• Autumn Crop</li><li>• Spring-Summer Crop</li></ul>	July-August November	August– September 2 <sup>nd</sup> fortnight of January	October-December April-May
<b>Hills of H.P. and Uttaranchal</b>	March-April	April-May	July-August
<b>Karnataka &amp; Maharashtra</b>	May-June October- December	July-August November-January	September-October March-May

## **SPACING:**

- Indeterminate – 90 x 30 cm
- Determinate – 60 x 45 cm

# TRANSPLANTING

- About 28-35 days old healthy seedlings of 12-15 cm height having 3-4 leaves are ideal for transplanting.
- Transplanted in the evening.
- Irrigated immediately after
- transplanting.



# MANURES AND FERTILIZER

- Apply 15-20 tonnes of FYM , 100-125 kg N, 50-60 kg  $P_2O_5$  , 50-60 kg  $K_2O$  /ha.
- For Hybrid:- 200 kg N, 100 kg  $P_2O_5$  and 100 kg  $K_2O$  /ha
- Excess N may delay maturity and decrease fruit size.
- $\frac{1}{2}$  of N and full dose of P and K is applied as basal and remaining dose of N is top dressed into two equal parts i.e. 30 and 45 days after transplanting.

# IRRIGATION

- 1<sup>st</sup> irrigation is applied as soon as transplanting.
- Subsequent irrigations are made at 8-10 days intervals or as per the requirement of the crop.
- In winter, plants are not irrigated during ripening of fruits to retard the process but they are irrigated during summer to promote the process of ripening.

Methods of Irrigation commonly practiced in tomato cultivation

Most adopted method : Furrow irrigation



Furrow Method



Drip Irrigation



Sprinkler Irrigation



# INTERCULTURE OPERATIONS & WEED CONTROL

- For raising a successful crop, gap filling, hoeing, earthing up, staking, pruning and mulching are required.



Earthing up



Plastic Mulch



Straw mulch

# WEED CONTROL

- Critical period for checking weeds is 35-40 days after transplanting.
- Two hand hoeings at 1<sup>st</sup> and 3<sup>rd</sup> fortnight after transplanting and earthing up at 2<sup>nd</sup> fortnight after transplanting.
- Chemical control:-
- Pre-transplant surface application of Alachlor (1-1.25 kg/ha) or Oxadiazon (1.0 kg/ha) or Fluchloralin (1.25 kg/ha) and post-transplant spraying of Metribuzin (0.5 kg/ha) control the weeds very effectively.



# STAKING AND TRAINING



Stake and weaved  
tomato plants

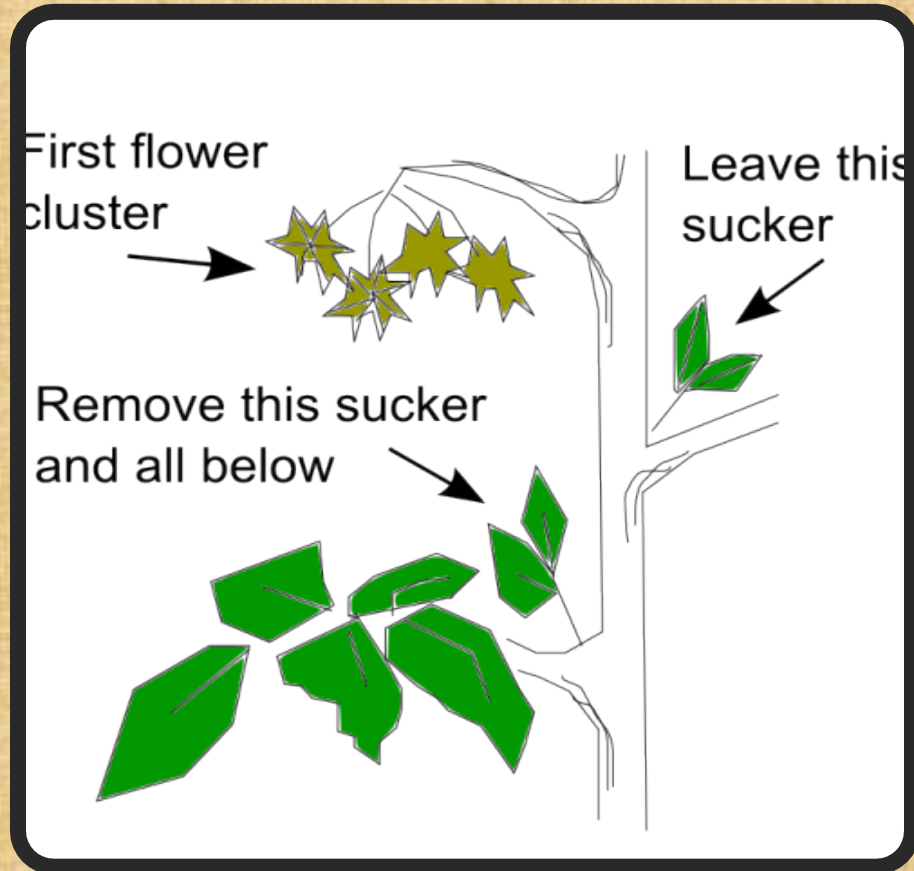


cage



Trellis

# PRUNING



# USE OF PGR

Beneficial for early yield, increased fruit set at extreme temperature

PURPOSE	GROWTH REGULATOR	MODE OF APPLICATION
High Yield	GA @ 5-25 ppm	Seed treatment
	PCPA @ 10-20 ppm	Seed treatment
Increased Fruit Set	NAA @ .1ppm	Seed soaking for 24 hours
Increased Fruit Set during summer	IAA @ 50 ppm	Seed soaking for 24 hours
Increased fruit set at lower temperature	PCPA @ 50-100 ppm	Foliar spray at flower cluster
Ripening of fruits	Etherel @ 1000 ppm	Whole plant spray at the initiation of fruit ripening

# HARVESTING

- Crop start yielding 70 days after transplanting.
- Tomato fruits are harvested at different stages of maturity depending on the distance of market and purpose.
- Harvested
- Twice in : Summer
- Weekly: Winter and Rainy season.

# HARVESTING STAGES



## **Green / Stage 1**

“Green” means that the surface of the tomato is completely green in color. The shade of green may vary from light to dark.



## **Breakers / Stage 2**

“Breakers” means there is a definite “break” in color from green to tannish-yellow, pink or red on not more than 10% of the surface.



## **Turning / Stage 3**

“Turning” means that more than 10%, but not more than 30%, of the surface, in the aggregate, shows a definite change in color from green to tannish-yellow, pink, red, or a combination thereof.



## **Pink / Stage 4**

“Pink” means that more than 30%, but not more than 60%, of the surface, in the aggregate, shows pink or red in color.



## **Light Red / Stage 5**

“Light red” means that more than 60% of the surface, in the aggregate, shows pinkish-red or red, provided that not



## **Red / Stage 6**

“Red” means that more than 90% of the surface, in the aggregate, is red.

- Pink stage - Suitable for distant marketing.
- Little Red stage - Suitable for local marketing and processing.
- Red Stage - Suitable for processing purpose



# YIELD




- Yield of tomato depends on many factors like soil, variety, season and management practices followed.
- However an average open pollinated varieties yields 300 – 500 q/ha and hybrids yields 500 – 600 q/ha.







# DISEASES OF TOMATO (Fungal Diseases)

Name of the Disease	Symptoms	Control Measures	Image
<p>Buckeye rot <i>Phytophthora nicotianae</i> var. <i>parasitica</i></p>	<p>Pale brown, concentric rings resembling slightly the markings on a buckeye, usually appear on young and green fruits</p>	<p>Spray metalaxyl + mancozeb (.25 %) Followed by spray of either mancozeb (.25%) or copper oxychloride (.3%) @ 7-10 days interval</p>	
<p>Alternaria Leaf Spots <i>Alternaria solani</i> <i>A. Alternata</i> <i>A.a.f.sp.lycopersici</i></p>	<p><i>A.solani</i>- Dark Brown Spot with concentric rings, target board effect. <i>A.Alternata</i>- small, circular, dark brown. <i>A.a.f.sp.lycopersici</i> Small, angular, light brown not surrounded by hallow</p>	<p>Treat seed with captan (.3%), Copper oxychloride (.3%) or mancogeb (.25%) @ 10-14 days interval</p>	

<p><b>Septoria leaf spot</b> <i>Septoria lycopersici</i></p>	<p>Small, water soaked, more or less circular spots in outline and show brown margins with grey centers</p>	<p>Spray carbendazim (.1%) or mancozeb (.25%) or copper oxychloride (.3%) repeat at 10-14 days interval.</p>	
<p>Powdery mildew <i>Leveillula taurica</i> <i>Erysiphe cichoracearum</i></p>	<p>L.taurica- white talcum like covering on lower surface of leaves upper surface turns yellow E. cichoracearum- white lesions on upper surface of leaves</p>	<p>Spray wettable sulphur (.2%) or dinocap(0.05) or carbendazim (0.05) or hexaconazole (0.05) or difenoconazole (0.05%)</p>	
<p>Fusarium wilt <i>Fusarium oxysporum</i> f sp. <i>lycopersici</i>.</p>	<p>Clearing of vein lets and drooping of the petioles. Browning of vascular bundles, entire plant wilt</p>	<p>Resistant varieties - Marglobe . Treat seed with T. viride , Streptomyces griseus or Bacillus subtilis or with Carbendazim (.2%)</p>	

<p><b>Bacterial Diseases</b>  <b>Bacterial spot</b>  <i>Xanthomonas campestris</i> p.v. <i>vesicatoria</i></p>	<p>Spots on leaves and stems are water soaked ,dark, not surrounded by hallow, later give scorched appearance</p>	<p>Dip seed in streptocycline (100ppm) for 30 min. Spray Streptocycline (100ppm) followed by copper oxy chloride(.3%)</p>	
<p><b>Bacterial Wilt</b>  <i>Ralstonia solanacearum</i></p>	<p>Sudden drooping of leaves without yellowing accompanied by rotting of the stem</p>	<p>Soil solarization, apply bleaching powder 15 kg/ha before transplanting Use resistant hybrids like Sun seed 7711.</p>	
<p><b>Bacterial Canker</b>  <i>Clavibacter michiganensis</i> sub sp. <i>michiganensis</i></p>	<p>Lower leaves wilts, on stem brown streaks and canker develop, on fruit scaby lesions surrounded by white hallow</p>	<p>Spray Streptocycline (100ppm) followed by copper oxy chloride(.3%) Dip seed in streptocycline (100ppm) for 1 hrs.</p>	

## Tomato mosaic

Virus causes a light and dark green mosaic mottled with raised dark green areas and distorted and crinkled younger leaves. The virus is seed borne

Volunteer plants and weeds should be removed and diseased plants rogued and destroyed



## Tomato spotted wilt virus

Pale red or yellow areas of 1.2 cm diameter with concentric circular markings in the normal red skin of the ripe tomato are formed

For the control of insect vector spray dimethoate @ 0.03% at 10 days interval



## Root Knot

Knots are formed first in lateral roots followed by primary root

Apply DBCP at 20-40 litre per ha in soil



# INSECT PESTS OF TOMATO



Fruit borer: *Helicoverpa armigera*



Serpentine leaf miner: *Liriomyza trifolii*



Leaf eating caterpillar: *Spodoptera litura*



Whitefly: *Bemisia tabaci*

# POST HARVEST HANDLING AND STORAGE

- Precooling of tomato after harvest at 12-13°C on the farm prolongs their storage life.
- Store well at 4-5°C and 85-90 % RH for 7 days in cold storage.

# PHYSIOLOGICAL DISORDERS/PRODUCTION CONSTRAINTS

## BLOSSOM END ROT:

- Caused due to high soil moisture, high temperature, deficiency of Ca, increase in N application.
- Controlled by growing resistant varieties, light and frequent irrigations and recommended dose of N. Spray  $\text{CaCl}_2$  at fruit development stage.

## CRACKING

- Caused due to moisture stress conditions because of irregular irrigations, fluctuation between temperatures, Bo deficiency.
- Controlled by growing resistant varieties, maintaining optimum soil moisture and spray borax 2-3 times.



Blossom End Rot



Cracking

## Puffiness

- Caused due to abortion of embryo after fertilization, necrosis in tissues of fruits, high temperature and soil moisture, high dose of N.
- Controlled by avoiding over watering to the resistant varietic crop, growing es and recommended dose of N.

## Cat Face

- Caused by high or low temperature during fruit setting, faulty pollination and fertilization, time of N application.
- Controlled by delaying pruning, balancing nutrient application, regulating temperature and use of PGR's



Puffiness



Cat Face



## Sun Scald

- Caused by exposure to intense sunlight especially during hot/dry weather.
- Controlled by growing varieties with abundant foliage, avoiding training and pruning during summer months.

## Green Shoulder

- This disorder is mainly genetic but brought specially in condition of high light and temperature.
- Controlled by growing varieties free from this disorder and cultivating tomato in normal growing conditions.



Sun Scald



Green shoulder

# PROTECTED CULTIVATION OF TOMATO



- Average temperature requirement for cultivation under protected environment is 18-24° C
- Main Varieties Grown are :-Naveen 2000+, Amisha, BSS-366.
- Spacing : 70 × 30 cm
- Training and Pruning
- Single stem
- Double stem



*Single Stem System*



*Double Stem System*

# **TOMATO IN MODIFIED NATURALLY VENTILATED MEDIUM TECH POLYHOUSE**



# FERTIGATION

- Fertigation in polyhouse is usually done with the help of drip and the rate of fertilizer application is controlled by venturii system.
- Water soluble fertilizers like Samadhan (N:P:K ::19:19:19) are used in drip based fertigation system to prevent choking of drip lines.
- Urea 21.5 gram, SSP 62.5 gram and MOP 16.5 g per meter square for soil application.

# ENHANCING OUT-OF-SEASON PRODUCTION OF TOMATOES USING HIGH TUNNELS

Low cost structure for high-value crops.

Wind (and sun) protection.

Water control.

Season extension (early and late crops possible).

## Case Study: Yield and Soil Quality under Transitional Organic High Tunnel Tomatoes

Yields, fruit quality, and soil quality in transition organic and conventional tomatoes were measured over the course of three growing seasons. N was applied at 112, 168, and 224 kg total N/ha in the form of chicken manure (for organic treatment) and a polymer-coated slow release urea fertilizer in the conventional treatments. Study revealed that a combination of compost and high N, low P organic fertilizers are needed for optimum maintenance fertility strategy for organic tunnel house production.





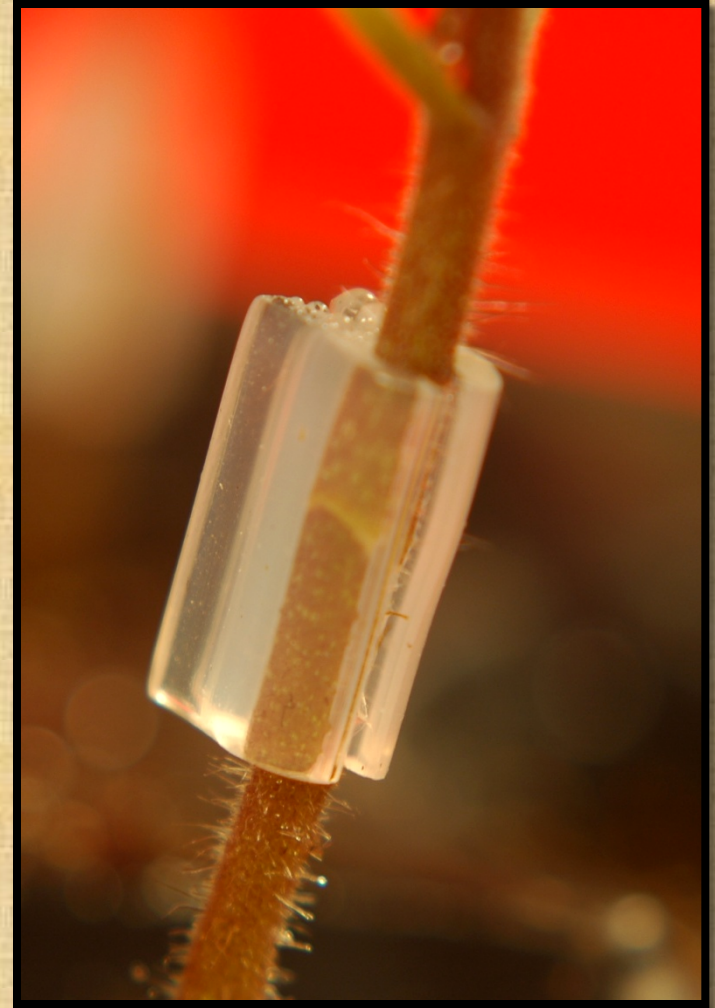
# TOMATO GRAFTING



- First reports of vegetable grafting occurred in Asia in the 1920's.
  - Fusarium wilt of melon
- Popularized in Japan and Korea
  - Tunnel and Greenhouse production

# TUBE GRAFTING

- The advent of “tube-grafting” or “Japanese top-grafting” has become the most popular for tomato.
  - Seedlings are grafted at 2-4 leaf stage.



## **Case study: Evaluation of Grafting Using Hybrid Rootstocks for Management of Bacterial Wilt in Field Tomato Production**

- Seven hybrid tomato rootstock with possible resistance to Bacterial Wilt and a known resistant cultivar were tested as grafting rootstocks to impart resistance to bacterial wilt susceptible cultivar, BHN 602. Grafted entries consistently exhibited the least bacterial wilt incidence compared with the control; the self-graft and non-grafted entries. Over all the trials, tomato plants grafted onto 'Cheong Gang', 'BHN 1054' and 'BHN 998' displayed the least incidence. Fields studies show that grafting holds promise for decreasing the impact of bacterial wilt as well as increasing the overall productivity of tomato cultivars.

**Theodore McAvoy, Joshua H. Freeman, and Steven L. Rideout. 2012**

# Important hybrids available in tomato in public and private sector

## Public Sector

IARI (New Delhi)	KT-4, Pusa Hybrid-1, Pusa Hybrid-2, Pusa Hybrid-4, Pusa Divya
IIHR (Bangalore)	Arka Vardhan, Arka Vishal, Arka Shreshtha, Arka Abhijit
GBPUAT (Pantnagar)	Pant Hybrid-1, Pant Hybrid-2
NDUAT (Faizabad)	NDTH-1, NDTH-2, NDTH-6
UHF (Solan)	Solan Shagun, Solan Garima, Solan Sindhur

# Private Sector

Ankur	ARTH-3, ARTH-4
Century	Century-12, Maitri, Rishi
Indo American	Karnataka, Mangla, Vaishali, Rupali, Naveen, Rashmi, Sheetal
Mahyco	MTH-1, MTH-2, MTH-6, MTH-15, MTH-16, S-28, Sonali
Namdhari	NS-386, NS-815, Summerset, Cross B, Gotya
Nath	NA-501, NA-601
Nijjar	NH-15, NH-25, NH-38
Pioneer	LIHB-230
Sandoz	Learika, Rasika, Avinash 11
Sungrow	Arjuna, Krishna, Bhim
Sutton	Sutton Grom, Prolific
Beejo Sheetal	BSS-39, BSS-20, BSS-40, BSS-90

# IARI ACHIEVEMENTS IN TOMATO BREEDING

Achievement for specific purpose	Varieties/hybrids
Varieties for fresh market	Pusa Early Dwarf, Pusa Ruby
Varieties for long distance transport	Pusa Gaurav
Varieties for processing industry	Pusa Gaurav, Pusa Uphar
Low temperature tolerance	Pusa Sheetal (8°C)
High temperature tolerance	Pusa Hybrid-1 (28-30°C)
High and low temperature tolerance	Pusa Sadabahar (8-30°C)

# IIHR achievements in tomato breeding

Achievement for specific purpose	Varieties/hybrids
Specific purpose	
Fresh market hybrid	Arka Ananya
Fresh market and processing	Arka Samrat, Arka Rakshak
Biotic and Abiotic stress	
Bacterial wilt resistant hybrid	Arka Alok, Arka Abha, Arka Abhijit, Arka Shreshta
Nematode resistant hybrids	Arka Vardhan, Arka Vishal
Moisture stress tolerance varieties	Arka Meghali
Multiple disease resistant hybrids (TLCV and BW)	Arka Ananya
Multiple disease resistant hybrids (TLCV BW and Early blight )	Arka Samrat, Arka Rakshak

## Kashi Hemant

This has been developed through pedigree selection from a cross Sel-18 x Flora Dade. The plants are determinate, yield 400-420 q/ha



## Kashi Abhiman

Kashi Abhiman is a determinate tomato hybrid. High yield potential of 87 t/ha and 93 t/ha has been recorded at HARP, Ranchi and CITH, Srinagar, ideal for long distance transportation





# RESISTANCE BREEDING IN TOMATO

DISEASE	RESISTANCE SOURCE	RESISTANT VARIETIES
Buckeye rot	<i>S. pimpinellifolium</i>	Early Selection,KT-10,KT-15, Flat Large Red, Red Cherry
Fusarium Wilt	<i>S. hirsutum</i> f. <i>glabratum</i> , <i>S. hirsutum</i> , <i>S. peruvianum</i> , <i>S. pimpinellifolium</i>	Pant Bahar, BSS-20, Roma, Meenakshi, Roza, HS-110, Pan American for race1 and Walter for race2
Leaf Curl Virus	<i>S. hirsutum</i> f. <i>glabratum</i> , , <i>S. peruvianum</i> , <i>S. pimpinellifolium</i> , <i>S. glandulosum</i>	H-24, H-36,Hissar Gaurav, Hissar Anmol
Spotted Wilt Virus	<i>S. hirsutum</i> f. <i>glabratum</i> , , <i>S. peruvianum</i> , <i>S. pimpinellifolium</i>	Pearl Harbour, Red Currant
Early Blight	<i>S. hirsutum</i> f. <i>glabratum</i> , <i>S.hirsutum</i> , <i>S. peruvianum</i> , <i>S. pimpinellifolium</i>	H-22, H-25, Kalyanpur No.1
Late Blight	<i>S. pimpinellifolium</i> , <i>S. esculentum</i> var. <i>cerasifolrme</i>	Ottawa 30, Ottawa 31, Red Cherry, Early Market

Cont'd...

Verticillium Blight	<i>S. pimpinellifolium</i>	Pant Bahar
Fruit Borer	<i>S. hirsutum f. glabratum</i> , <i>S. hirsutum</i>	Pusa Uphar
Bacterial Wilt	<i>S. pimpinellifolium</i>	BT-1, BT-10, Arka Abhijit, Arka Shresha, BWR-1, BWR-5, Arka Alok, Arka Abha, Arka Vardhan
Root Knot Nematode	<i>S. peruvianum</i>	Hissar Lalit, Pusa 120 (Sel 120), Nematex, Arka Vardhan

# BREEDING FOR ABIOTIC STRESSES

- Include environmental conditions such as:
  - Low and high temperature
  - Drought conditions
  - Flooding
  - moisture stress
  - Soil salinity
  - Water logging conditions etc.

<i>Solanum</i> species	Environmental stress tolerance
<i>S. Cheesamanii</i>	Salt tolerance, heat tolerance for fruit set
<i>S. Pimpinellifolium</i>	Heat tolerance for fruit set, drought tolerance
<i>S. Chilense</i>	Drought tolerance, cold resistance
<i>S. Hirsutum</i>	Cold tolerance, chilling tolerance, salt tolerance
<i>S. Pennelii</i>	Drought tolerance, salt tolerance
<i>Solanum lycopersicoides</i>	Cold tolerance

Tomato varieties resistant to abiotic stresses	
Variety	Abiotic stress tolerance
Pusa Sheetal	Fruit set upto 8°C (Low) night temperature
Pusa hybrid-1	Fruit set upto 28°C (high) night temperature
Pusa Sadabahar	Fruit set at both low (6°C) and high (30°C) night temperature
Sabour Suphala	Salt tolerant at seed germination stage
Arka Vikas	Tolerant to moisture stress
Solan Vajr	Tolerant to drought
HS-101 , HS-102	Resistant to high temperature
Pusa Ruby	Resistant to salinity

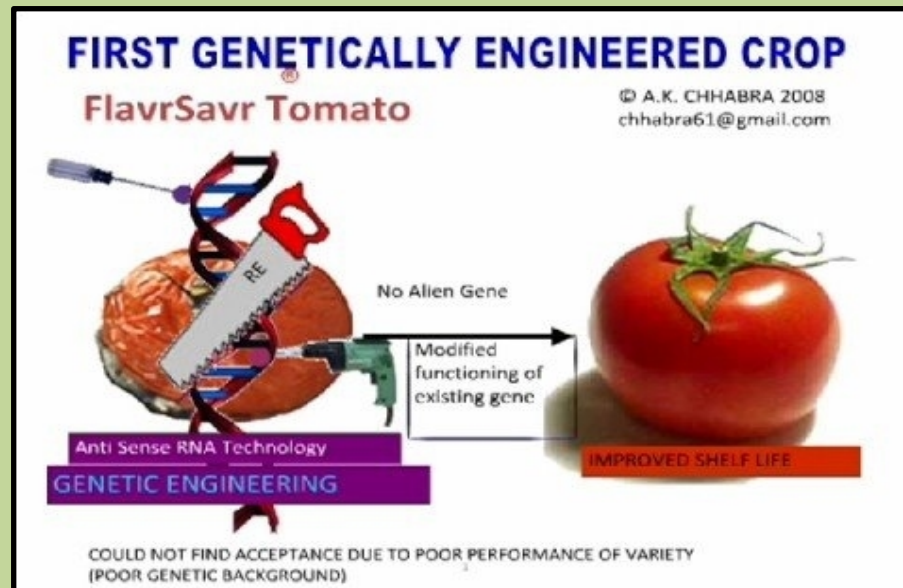
# **STATUS OF TOMATO BREEDING AT UHF NAUNI**

- Solan Gola - oldest variety, single plant selection.
- Solan Vajr - Selection from Solan Gola released in 2001.
- Yashwant –An open pollinated variety.
- Solan Sagun- Hybrid variety.
- Solan Garima – Hybrid variety developed by crossing UHF-55 (Female) and UHF-22 (Male) in 2007.
- Solan Sindhur- Hybrid variety developed by crossing UHF-55 (Female) and UHF-40(Male) in 2007.

Variety	Characteristic Features
Solan Gola	Indeterminate, fruit medium round, suitable for long transportation, first harvesting after 75 days, average yield 375 q/ hac
Yashwant	Indeterminate, fruit flat with uniform ripening, resistant to Buckeye rot (5%), average yield 500 q/ hac
Solan Vajr	High yielding and drought resistant ,fruit wt. 70gm, ready in 70-75 days, average yield 425-475 q/ hac
Solan Sagun	Suitable for long transportation, average fruit wt. 65gm, resistant to Alternaria and Buckeye incidence , Average yield 500 q/ hac
Solan Garima	Plant indeterminate, 3-4 fruits/ cluster, average fruit wt. 85 gm, round, long distance transportable, average yield 660 q/ hac
Solan Sindhur	Plant indeterminate, 3-4 fruits / cluster, average fruit wt. 60 gm, round, long distance transportable, average yield 650 q/ hac.

# FLAvrSavr (Longer Lasting Tomato)

- In tomato, enzymes poly galacturonase degrades pectin which is the major component of fruit cell wall. This leads to the softening of fruit and a deterioration in fruit quality. Transgenic tomatoes have been produced , which contain antisense construct of the gene encoding PG. These transgenics shows a drastically reduced expression of PG and markedly slower fruit softening; these tomatoes have about 2 weeks longer shelf-life than normal tomatoes. Such tomatoes were approved for marketing in U.S.A. under the name FlavrSavr. Slow Fruit Softening Tomato(1994).



**THANK YOU**

