SUBSECTOR

“TOMATO”

SUBMITTED BY

ANUSHA M

SAHITHI K

NIROSHA B

NEMI C

PREETHI

PALAK

ANJALI

SUBSECTOR – TOMATO

Botanical name: *Licopersicon esculentum*

Family: Solanaceae

Chromosome no 2n = 24

Origin: Peru, Ecuador – Bolivia

Origin and distribution

Cultivated tomato originated from Peru, Ecuador, Bolivia. Domesticated place of tomato lies in Mexico. The ancestor of cultivated tomato is cherry type (*Licopersicon esculenta var cerasiformae* - cherry tomato).From Mexico is distributed to Spain, Europe, Britain, France etc.

Species:

Tomato belongs to the family solanaceae. The genus Lycopersicon differs from Solanum by the absence of spines and anther tips are narrow and exhibit longitudinal divisions. The genus Lycopersicon was divided into two sub genera.

1. Eu lycopersicon. 2. Erio persicon.

Eu lycopersicon is characterized by red fruited edible species with carotenoid pigmentation and they are annuals. Cultivated tomato is included in this. The species included are

1. Cultivated tomato - *Licopersicon esculentum* and.

2. Small fruited tomato- *Licopersicon pimpinellifolium*

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

Growth habit:

Tomato can also be classified depending on the growth habbit.

1. Indeterminate: terminal buds ends with a leafy bud and continue it vegetative growth. Ex: Pusa ruby.

2. 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. Ex. Pusa Early Dwarf

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

Importance and Nutrition value:

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 and sweet potato, but it tops the list of canned vegetables. 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. 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 Mallic acid. Glutamic acid is an amino acid mostly present in tomato.

Tomato contains many important minerals like Na, K, Ca, Mg, P, K, Fe, Zn, Boron. The alkaloid present in tomato is called tamatin and the coloured pigment is called Lycopene. Lycopene content is high at 700 F or 210 C.

Varieties:

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, HS – 10, sweet 72, S-12, Co I 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 chuharra are suitable for processing.

Varieties released by IIHR Arka Abha, Arka Abhizit, Arka Ahuthi, Arka Aloukik, Arka Meghali, Arka Sourab, 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

SL – 120 : resistant to nematode and released by IARI, New Delhi.

S-12: Evolved by PAU, Luthiana, fruit round to flatish with persistant pedicel suitable for summer crop all over the India.

Sioux: American variety, resistant to growth cracks.

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	L. esculentum X L. Pimpinellifolium	

Co 1, Co -2 – released from TNAU, Coimbatore. Co3 it is a mutant of Co1 Gulmohar (MTH 6) – released from Maharastra hybrid Seed Company Punjab chuharra, Ox heart, Punjab kesari, Pusa early dwarf, Pusa rubi, Pusa red plum, Pusa sada bahar, Sweet – 72, Roma, Yasvanth 2 are other hybrids.

Climate:

Tomato is a warm season vegetable require a long season optimum temperature is 21 to 240 C. Temperature and light intensity effect the fruit set pigmentation and nutritive value. Optimum temperature for seed germination is 300 C. Maximum fruit set occurs at a night temperature of 15 to 200 C. High temperature (380 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 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. 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 6 to 7. If the soil is acidic i.e., pH 5.0 or lower liming is advocated.

Seed sowing:

It is grown almost the year round. In north India seed sowing is done in November and transplanting during the month of January. In case of South India sowing is done in the month of August. In case of summer sowing is done in the month of March; it is transplanted in the month of April- May.

Seed rate:

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

Nursery practices:

Tomato is a transplanted crop. Seeds are sown in the area of 225 sq.m. A raised bed prepared by well decomposed FYM is mixed @ 3 kg FYM per sq.m. 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 and 40% formalin solution at 500 ml / sq.m. area of nursery bed sterilisation. 10% formaldehyde is also used for fumigation. 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 7.5 cm 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. The seedlings should be hardened before setting them into field.

Transplanting:

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. Direct sowing reduces the infestation of root knot the 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:

Nitrogen is the most important nutrient. Deficiency of nitrogen reduces endogenous auxins and blossom end rot disease increase with increased levels of nitrogen. Phosphorus is essential for rapid root development. Deficiency of phosphorus leads to the development of purple colour on the underside of leaflets. Potassium is involved in the synthesis of proteins and organic acids. Deficiency leads to yellowing at the margins of leaf. A high level of potassium improves the shape of fruit.

In general NPK @ 75 to 150 kg: 60 kg: 60 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.

Nitrogen is the best applied in the form of NH4SO4, Urea, CAN and Ammonium chloride. Besides the above inorganic fertilizers combination of well decomposed FYM and groundnut cake is recommended. FYM is to be added @ 20-25 tons per ha at the time of last ploughing and incorporated into soil. Regarding the inorganic chemical fertilizers 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 to 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 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 hoeing’s 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:

Stage maturity 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.

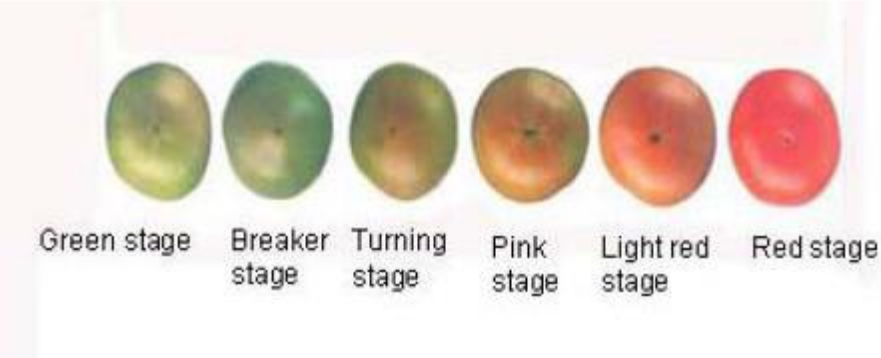
2. Mature green: fully grown fruit shows a brown ring at stem scar. It has light green colour at blossom end and seeds are surrounded by jelly like substance.

3. Turning or 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.



JUDGING MATURITY OF TOMATO BY COLOURS

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.

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 300 to 500 Q per ha. Hybrids can give up to 1000 Q per ha.

Storage:

Tomato can be stored either in mature green or breaker stage of maturity. Fruit remain firm up to 21 days when kept at 200 C for the cultivars like Florida MH and Floradade. Temperature of 100 C cause moderate chilling injury and Alternaria root rot.

Production:

Andhra Pradesh is the largest producer of tomatoes in India. Tomato is one of the major horticulture crop of the country. With an estimated production of 18735.91 thousand metric tonnes in 2013-14, India is one of the largest producer of tomatoes in the world, second only to China. Around 11 % of the total world produce of tomatoes is cultivated in India.

Andhra Pradesh still holds the top position in tomato production, even after creation of Telangana. With an estimated production of 3354.47 thousand metric tonnes in the year 2013-14, Andhra Pradesh shares 18% of all India produce. Kurnool, Chittoor, Visakhapatnam and Prakasam districts are the major producers of tomatoes.

Karnataka is the second largest producer of tomatoes with an estimated production of 2068.38 thousand metric tonnes in the year 2013-14. Districts of Kolar, Chikkaballapur, Belgaum, Tumkur, Hasan are major producers of tomatoes.

Recently, Madhya Pradesh has shown remarkable growth in tomato production and now occupies third position in the list of largest tomato producing states with an estimated production of 1937.37 thousand metric tonnes in the year 2013-14. Districts of Shahdol, Jhabua, Ratlam, Sagar are the major producers of tomatoes in the state.

Cost of cultivation:

Field preparation	**Nursery and planting / sowing**	**weeding**	**Plant protection**	**Fertilizers**	**Wages**	**Staking, transport & other expenses**	**Total**
6000	7000	10000	12000	8000	13000	5000	61000

Benefits:

Cost of cultivation	**Yield (MT/ha)**	**Net income (Rs.) (at the lowest price)**	**Market price range (Rs.)**
61000	50	39000 (@ Rs. 2/kg)	2-30 per kg

Value Addition:

Chutney:

It is a pungent relish of Indian origin made of fruit, spices and herbs. Although originally intended to be eaten soon after production, modern chutneys are often made to be sold and so require preservatives - often sugar and vinegar - to ensure it has a suitable shelf life. Chutney of good quality should be palatable and appetizing.

Tomato is cut into slices of suitable size and softened by boiling in water. Slow cooking at low temperature yields better product. Onion and garlic are added at the start to mellow their strong flavours. Spices are coarsely powdered and added to the product. Spices as well as vinegar extract should be added just a little before the final stage of boiling to avoid the loss of essential oils of these spices and vinegar.

Pickles:

The process of preservation of food in common salt or in vinegar is called pickling. Spices and edible oils may be added to the product .Pickles are good appetizers and add to the palatability of a meal. They aid in digestion by stimulating the flow of gastric juice. The pickles contain nutrients of varying amounts. The food value of cucumber pickle exceeds that of eggs, rice, fresh onions and tomatoes.

Pickling process: Pickling is done in two stages.

1. By curing or fermentation with dry salting or fermentation in brine, or salting without fermentation.

2. By finishing and packing.

Dry salting: The vegetable is treated with dry salt. The salt extracts the juice from the vegetable and forms the brine, which is fermented by lactic acid forming bacteria. The method is as follows:

The vegetable is prepared .For every 100 kg prepared vegetable, three kg of salt is used. The vegetable is placed about 2.5cm deep in the keg or barrel and is sprinkled with salt. Another layer of vegetable is added and again sprinkled with salt. Like this salt and vegetable are added layer by layer till the keg is 3/4 th full Then one or two fold cheese cloth is spread over the salted vegetable. Place a wooden board on the top of it. A clean stone or weight is placed on the wooden board to press the vegetable. The brine is formed in 24 hours generally.

The keg is placed in a warm and dry place and fermentation is allowed to proceed. As soon as the brine is formed, the fermentation starts and bubbles of CO2 begin to rise. Fermentation is usually completed in 8 to 10 days under favourable conditions of 30OC.The product is now ready for preserving by excluding air ,which can be done by three ways.

(1) Pouring edible oil (2) Pouring brine and (3) Placing hot molten paraffin wax.

Fermentation in brine: Steeping of vegetable in a salt solution of predetermined concentration for a certain length of time is called brining.

Raw materials used in Pickling

Salt: Free from impurities and salts such as lime (Cao), iron (blackening), magnesium (results in bitter taste) and carbonated (makes the product soft in nature).

Vinegar: Vinegar of good quality should contain at least 4% acetic acid. Synthetic low quality vinegar is not suitable for pickle preparations. Usually maleic and citric vinegar is used. In order to ensure good keeping quality pickle, the final concentration of citric acid in the pickle should not be less than 2%. Citric acid (Commercial) is used because it is highly concentrated.

Spices: Spices are added to all the pickles. The quality added depends upon the type of fruit or vegetable taken and the kind of flavour desired. The spices generally used are bay leaves, cardamom, chillies, cinnamon, clove, coriander, dill herb, ginger, mace, mustard, black pepper, cumin, turmeric, garlic, mint, fenugreek, asafetida etc.

Water: Only potable water should be used for the preparation of brine. Hard water contains the salts of Ca, Mg, Na etc,. These interfere with the normal salt curing of vegetable. If hard water is to be used, a small quantity of vinegar should also be added to the brine to neutralize its alkalinity. Iron should not be present in the water in appreciable quantity as it causes the blackening of the pickle.

Cooking utensils: Metallic vessels should not be corrodible. Vessels made of iron and copper are not suitable. Glass lined vessels and stainless steel vessels are preferred. The ladles, spoons and measuring vessels should also be made of non-corrodible materials.

Sauces:

Sauce is a product similar to ketchup, prepared from pulps of tomato or other fruits or vegetables having TSS not less than 15% and cooked to a suitable consistency with added sugar, salt, spices and vinegar (acetic acid). Sugar, salt, spices, acetic acid all act as partial preservatives.

According to the FPO fruit should have a minimum of 15% TSS and 1.2% acidity. To ensure its keeping quality the sauces should contain 3% acetic acid. The sugar content may vary from 15-30% according to the kind of sauce made. Preservative and colours may also be added in sauces for increasing storability. Sauces may or may not be prepared from tomato, but ketchups are essentially prepared from tomato.

Sauces are of two kinds and they are the thin and thick sauces. Thin sauces mainly consist of vinegar extract of various flavouring materials like spices and herbs. A sauce which doesn't flow freely and which is highly viscous is called a thick sauce.

Ketchup:

It is a product made by concentrating tomato juice or pulp without seeds and skin, with added spices, salt, vinegar, onion, garlic etc.so that it contains not less than 12% tomato solids and generally 28% or more total solids (not less than 25% TSS as per FPO specifications)

Procedure: For preparing 1 kg of tomato pulp, the following ingredients are required.

Sugar	75g	Red Chilli Powder	5g
Salt	10g	Cinnamon, cardamom, Anil seed, Black Pepper,(all powdered)	10g each
Onion(Chopped)	50g	Clove(Headless)	5g
Ginger(Chopped)	10g	Vinegar	25ml
Sodium Benzoate	0.25g/kg of final product		

1. Selection of fruits: Select sound ripe tomatoes having deep red colour. Remove all green and yellow portions. Green fruits make the ketchup inferior in colour and flavour.

2. Preparation of pulp: Take the selected tomatoes in an aluminium or stainless steel vessel and crush thoroughly with a wooden handle. Cook the crushed mass for 5 minutes and mash

it well while cooking. While it is sufficiently soft. Strain through the fine mosquito net cloth or 1mm mesh stainless steel sieve. Discard the sheds and skins.

3. Cooking: To the pulp add about 1/3rd of sugar given in the receipe. Place the spices (onion, garlic, cloves, cardamom, black pepper, jeera, mace, cinnamon and chili powder) in a muslin cloth bag (Jelly bag) and immerse it into the pulp. Heat the pulp till it thickens and is reduced to about 1/3rd of its volume. Remove the bag and squeeze it well to extract the aroma and flavour of the spices. Add vinegar, salt and the remaining sugar .Heat the mass for a few minutes so that the volume of the finished product is about 1/3rd of the original pulp.

4. Addition of preservatives: To a small quantity of finished product, add the preservative sodium benzoate, at the rate of 295mg/kg of finished product and mix thoroughly. This can be increased up to 885mg/kg as per specifications of FPO, 1955.Transfer the dissolved preservatives to the rest of the product and mix thoroughly.

5. Cooling and Mixing: Pour the finished product into a medium size sterilized bottles, seal them air tight with crown cork and pasteurize in boiling water for 30 minutes. Cool the bottle in air and store in a cool dry place.

Judging end point: End point is determined by hand refractometer. When TSS reaches desired level (28-30%) sauce or ketchup is considered ready. Judging end point by volume is very simple and common in practice. The volume is measured by stick. If the volume of the produce remains 1/3rd of its original volume sauce/ketchup is considered ready.

Key points:

1) Chilli powder, spices, onion, ginger and garlic should be tied loosely in a muslin cloth bag.

2) Vinegar and colour may be added towards the end of boiling.

3) 1/3rd of sugar may be added in the beginning to preserve the red colour of pulp.

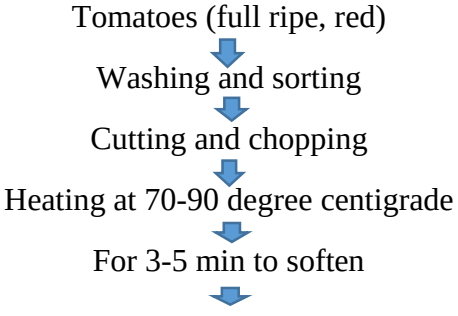
4) Instead of clove, cinnamon and cardamom, their essences may be added more conveniently.

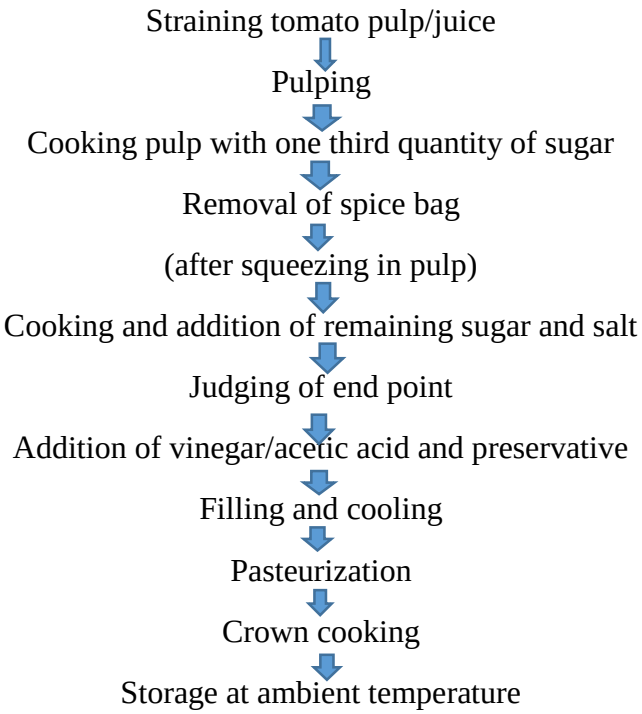
5) Garlic may or may not be added, depending upon consumer’s acceptance.

6) Acid magenta II colour is avoided. Choose other red colours or orange colours such as erythrosine, carmoisines, sunset yellow etc.

Bottling: Ketchup is filled in bottles at 88OC and is pasteurized for 30 minutes in hot water at 85OC-90OC after cooking. It is preferable to add 250ppm sodium benzoate and then pasteurize the product.

FLOW CHART FOR TOMATO SAUCE/KETCHUP:





Tomato Puree: Tomato pulp without skin and seeds, containing not less than 8.37% of salt free from tomato solids is called as “medium tomato puree”. It is further concentrated to 12% solids to form heavy tomato puree. Pulp is extracted and concentrated in open cookers or vacuum pans and packing is done in glass bottles or cans.

Flow Chart: Tomato fruits ---Washing---Sorting---Cutting into 4-8 pieces—Heating in SS pan for 4-5 minutes---pulping---Juice---(Discard seeds and skin)---Heating or boiling till end point(9-12OBrix)---Hot filling at 85OC---Sealing/Crown corking--- Sterilization in boiling water for 25-30 minutes---Cooling---Labelling and storage.