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FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

Tomato

Botanical name: *Solanum lycopersicum. Mill*

Family: *Solanaceae*

Chromosome No.: *2n = 24*

Origin: *Peru or Mexico*

Area and production

- The estimated world production of tomato is about 127.92 million tones and area of about 47.19 lakh ha. China ranks first with production of 33.64 million tones leaving USA to second place. The area and production of tomato in our country was about 6.34 lakh ha and 124.33 lakh tones respectively in 2009-10. The leading tomato growing states are UP, Karnataka, Maharashtra, Haryana, Punjab and Bihar.
- A large number of tomato determinate and indeterminate varieties have been evolved by various organizations of the country. According to the growth habit, tomato is characterized by two types of plant.

Determinate type:

- Inflorescence occurs more frequently in almost every internode until terminal ones are formed and elongation ceases at this point, in otherwords, it may be defined as self topping and the main stem terminates with a flower cluster.

Indeterminate type:

- Inflorescence cluster occurs at every third internode and main axis continues to grow indefinitely.

Important varieties/hybrids

Arka Saurabh:

- This variety was developed in IIHR Bangalore by selection from the breeding line V 685 introduced from Canada. Plants are semi determinate in growth; fruits are thick fleshed, firm round, medium large in size, deep red colour. Fruits have good transport quality, which is good for both fresh market and processing. The average yield is 30.8 tonnes per ha.

Arka Vikash:

- An improved variety developed through selection from a variable population of American variety “Tip Top” introduced at IIHR Bangalore. Plants are indeterminate; fruits are medium size with uniform deep red colour. It is recommended for cultivation in both hills and plains. The variety does well in moisture stress conditions and gives an average yield of 30.3t/ha.

Sioux:

- Plants are indeterminate, medium to large round fruits with yellow stem end, sub acidic in flavour, suitable for short distance market. This variety was released by IARI.

Pusa Ruby:

- A very popular variety developed at IARI, New Delhi through hybridization of Sioux X Improved Meeruti. Plants are indeterminate, spreading, less branched, hardy with an height of 80-85 cm. fruits are flattish- round, small to medium sized uniform red, slightly lobed and mild acidic. This is an early variety having 25-30 fruits per plant.

Pusa Early Dwarf:

- It was developed by NBPGR, New Delhi through hybridization of Improved Meeruti X Red Cloud. Plants having determinate growth habit are typical dwarf with compact fruiting. Fruits are medium large in size, uniform red, ribbed, obscure furrow with 5-6 locules. It is suitable for rainy season.

Pusa Uphar:

- The variety developed at IARI, plants are indeterminate, erect thick stemmed with dark green foliage, 2-3 fruits per cluster, fruits are medium size, round shaped with deep red skin colour. Average yield is 35-40t/ha and this variety is suitable for processing.

CO 3:

- Plant habit is determinate, which is a mutant variety of CO1 developed by TNAU, Coimbatore. Plants are erect, thick and main stem has strong primary branches with dark green foliage. Fruits are round globular in shape, medium in

size, bright red colour and possess high Vitamin C and gives an average yield of 38.1 t/ha.

Hissar Anmol:

- Developed at HAU, Hisar through hybridization of Hissar Arun X Lycopersicon hirsutum f. glabratum. It is resistant to leaf curl virus. Plants are determinate, flattish round, medium in size with red colour.

Hisar Lalit:

- This variety has been developed through hybridization of HS 101 X Resistant Bangalore at HAU, Hisar. It is a semi determinate, which bears fruits in medium to large in size, round in shape. This variety is resistant to root knot nematode.

Pant Bahar:

- Developed at Pantnagar from AC 238 line. Plants are bushy with light green foliage with relatively thin stem, fruits are ready for harvest in 78 days. Fruits are flattish round medium in size and red in colour. This is resistant to verticillium and fussarium wilt and has good storage and processing quality.

Pant T3:

- Developed at Pantnagar through pure line selection. Plants are semi determinate, round hairy stem. Fruits ripen in 60 days, uniform red in colour and suitable for processing. Its average yield is 19.2 t/ha

Punjab Chhuhara:

- This variety was developed at PAU, Ludhiana through hybridization of EC 55055 215 X Punjab Tropic. Plants are dwarf, bushy, determinate and uniform red colour at maturity. This variety is suitable for long transportation.

Punjab Kesari:

- Developed through hybridization followed by pedigree selection at PAU, Ludhiana. It is recommended for cultivation in both plains and hills. Plants are determinate bushy and this variety is susceptible to late blight fruit borer and root knot nematode.

Pusa Sheetal:

- It is developed through hybridization of two low temperature fruiting type introductions, Balka (Introduced from Bulgaria) X Jeemnoroshnese (Introduction from USSR). Plants are determinate growth habit. Fruits are flattish, round in shape, uniform red colour. The average yield is 36.3t/ha.

VC 48-1:

- This is a bacterial wilt resistant variety developed at Assam Agricultural University. Plants are determinate, very vigorous and possess good foliage.

NTDR-1:

- This variety is developed at UAS, Bangalore. It is a nematode resistant variety.

Maega (L-15):

- This variety released through hybridization between NTDR1 X AVRDC at UAS Dharwad. Fruits are medium in size, flattish round and it can grow in high temperature conditions. Average yield is 25-30t/ha.

Arka Alok (BWR-5):

- A pure line selection from IIHR 719-1-6(CL-114-5-1-0) from AVRDC, Taiwan Plants determinate Fruits on the lower clusters square round, large(120g) and in later cluster oblong, medium (80g) firm fruits with light green shoulder. Resistant to bacterial wilt. Bred for fresh market Suitable for kharif and Rabi seasons. Duration 130 days. Yield 46 t/ha.

Arka Abha (BWR-1):

- A pure line selection from IIHR 663-12-3-SB-SB (VC-8-1-2-1) from AVRDC, Taiwan. Plants semi determinate. Fruits oblate, with light green shoulder Fruits have stylar end scar with average fruit weight of 75g. Develops deep red color on ripening. Resistant to bacterial wilt caused by Rastonia solanacearum. Bred for fresh market Suitable for both kharif and rabi Duration 140 days Yield 43 t/ha.

Arka Ahuti (Sel-11):

- A pure line selection from IHR 143-3-7-SB-1(Ottawa 60 from Canada) Plants semi- determinate. Fruits oblong with 2-3 locules. Thick fleshed fruits have light green shoulder, ripens to dark attractive red, TSS 5.2% Bred for processing-tomato puree. Suitable for kharif and rabi seasons. Duration 140 days Yield 42 t/ha.

Arka Meghali:

- A pedigree selection (F8) of the cross Arka Vikas x IIHR 554 Plants semi-determinate. Narrow dark green leaves with good canopy. Fruits medium (65g.), oblate with light green shoulder. Deep red fruits. Suitable for fresh market. Bred for rainfed cultivation Suitable for kharif season. Duration 125 days. Yield 18 t/ha

Arka Ashish:

- It is ready for harvesting in 130 days. Fruits are egg shaped red in colour and all fruits can be harvested at once. Suitable for processing. It is resistant to powdery mildew and crop can be grown both in rainy and winter season. Average yield is 38 t/ha.

Arka Abhijit:

- A F1 hybrid of the cross 15 SBSB x IIHR 1334 Plants semi-determinate. Dark green leaves with good canopy. Fruits medium (65-70g.), round with green shoulder. Deep red, firm fruits. Suitable for fresh market Highly resistant to bacterial wilt. Duration 140 days Yield 65 t/ha.

Arka Ananya:

- It is a high yielding F1 hybrid with combined resistance to ToLCV and BW Plants semi-determinate with good foliar cover. Foliage dark green. Fruits round, firm (5.0 kg/cm2), medium (50-65g) with light green shoulder. First fruit maturity 55-60 days. Develops deep red color on ripening Yields 76 tons/ha. in 140 days. Suitable for summer and rainy seasons.

Arka Rakshak:

- High yielding F1 hybrid with triple disease resistance to ToLCV, BW and early blight. Fruits square round, large (90-100g), Deep red, firm fruits Suitable for fresh market and processing. Yield 75-80 t/ha.in 140 days.

Arka Samrat :

- High yielding F1 hybrid with triple disease resistance to ToLCV, BW and early blight. Fruits oblate to high round, large (90-110g), Deep red, firm fruits Suitable for fresh market. Yields 80-85 t/ha. in 140 days

Arka shreshta:

- A F1 hybrid of the cross 15 SBSB x IIHR 1614 Plants semi-determinate.Light green leaves with good canopy. Fruits medium large(70-75g.), round with light green shoulder. Deep red firm fruits. Suitable for both fresh market and processing. High yielding F1 hybrid with bacterial wilt resistance. Suitable for rabi season Duration 140 days Yield 76 t/ha.

Arka Vikas (Sel.22):

- A pure line selection from an American variety Tip-Top. Plants semi-determinate. Narrow dark green leaves with good canopy. Fruits medium large (80-90 g), oblate with light green shoulder which develop deep red on ripening. Bred for fresh market Adapted to both rain fed and irrigated conditions. Suitable for both kharif and rabi seasons Duration 140 days. Yield 35-40 t/ha.

Pusa Gaurav:

- Developed through hybridization of GlamourXWatch, Determinate with light green foliage, oblong, yellowish red fruits, Yield 40 t/ha.

Azad T-2, Azad T-3, Azad T-5:

- Developed at CSAUAT, Kanpur, determinate, red round fruits, resistant against fruit borer and nematodes and leaf curl.

Pusa Sadabahar:

- Determinate, plants dwarf, accommodating more number of plants per unit area and prolific bearer. Suitable for growing under wide temperature range of 80 C to 30 C.

Pusa Rohini:

- Determinate, suitable for summer season, sowing in plains of North India, Fruits are round, medium. Yield 40-43 t/ha.

Narendra Tomato (NDT-5):

- Indeterminate, medium large, round, red at maturity, suitable for processing.

Sakthi:

- Developed at KAU Kerala, semi determinate, resistance against bacterial wilt.

Mukthi:

- Developed at KAU Kerala, determinate, resistance against bacterial wilt and fruit cracking and heat tolerant variety.

Kashi Amrit:

- Developed at IIVR, Varanasi, determinate, attractive red, round. Yield 62 t/ha.

Varieties resistant to leaf curl

- Three varieties such as Sankranthi, Nandhi and Vybhav are released at UAS Bangalore which are resistant to leaf curl virus and suitable for growing in summer season.

Sankranthi:

- Fruits are medium, round, medium duration (95-105 days). Yield is 40-45 t/ha.

Nandhi:

- Fruits are medium size, high yielding variety. Yield is 40-45 t/ha.

Vybhav:

- Suitable for distant transport. It is resistant to both leaf curl and bacterial wiltdisease.Yield is about 40-50 t/ha.

Arka Vishal:

- plants are tall; duration of the crop is 165 days. Fruits are large, red in colour and suitable to grow in rainy and winter season. Staking is required for growth and better development of plants. Average yield is 75 t/ha.

Arka Varadhan:

- Crop is harvested in 160 days after transplanting. Fruits are large deep red in colour, resistant to root knot nematodes and grown both in rainy and winter season. Staking is necessary for the plants. Average yield is 75 t/ha.

Pusa Hybrid-1:

- Developed at IARI New Delhi, determinate, round, medium size, suitable for long distance transportation. Fruit setting at high night temperature. Yields 32.5 t/ha.

Pusa Hybrid-2:

- Determinate, round, medium, field resistant to nematode, yields 55 t/ha.

Pusa Hybrid 4:

- Determinate, round, medium, yields 55 t/ha.

Pusa Divya :

- Indeterminate F1 hybrid, profusely branched, round, yield 35 t/ha.

Varieties suitable for different purposes

Varieties for fresh market: Pusa Early, Dwarf, Pusa Ruby, Pusa 120, Pant T-3, Arka Vikas, Arka Saurabh, CO-3, Punjab Kesari, Pant Bahar

Varieties for distant market: Pusa Gaurav, Roma, Punjab Chhuhara, Pusa Uphar.

Varieties for processing: Pusa Gaurav, Rousa, Punjab Chhuhara, Pusa Uphar, Arka Saurabh.

Varieties resistant to abiotic stresses: Pusa Sheetal-low temperature; Pusa hybrid 1-High temperature; Pusa Sadabahar- high and low temperature regime.

Climate and soil

- Temperature affects growth and development of tomato plants primarily by controlling biochemical processes. Temperature emerges as the major growth factor through its control on plant development including morphogenesis and product quality and induction of flowering stimuli. Temperature also determines climatic zones and controls plant distribution, growth cycles, and growth rates and ultimately yield.
- Tomato is a warm season crop. It is neither tolerant to frost nor to water logged condition. The optimum ranges of temperature is 20-24C, mean temperature below 16C and above 27C are not desirable. Lycopene content is highest at 21-24C while the production of this pigment drops off rapidly above 27C. Tomato can be grown on variety of soils but better yield is obtained in well drained soil, fairly fertile, rich in organic matter with fair water holding capacity. For early crop, a sandy loam soil is the best, however, for higher yield heavy soils rich in organic matter are preferred. The best soil pH is 6-7.

Seasons

Seed sowing in the plains is done thrice during the year.

1) For rainy-autumn crop: The seeds are sown in the month of June and July.

2) For autumn-winter crop: Seeds are sown in the month of Sep-Oct.

3) For spring-summer crop: Seeds are sown in the month of Jan-Feb.

- In hills the seeds sowing depend upon the elevation of the place. On lower hills, seeds are sown at Feb-March while on the higher hills in the months of March and April.

Seed rate

- The seed rate depends upon the germination percentage of seed. Normally 300-400 g and 100-150 g seeds for open pollinated varieties and hybrids respectively are required for planting one hectare land.

Irrigation

- Tomato plants require adequate moisture throughout their growth period. First irrigation is required soon after transplanting. Too much of water at the time of transplanting and before fruit set have been found detrimental causing blossoms off. Irrigate the crops at an interval of 3-4 days during summer and 10-15 days during winter to maintain the soil moderately wet. During winter, the plants are not irrigated at the time of ripening of fruit. A long spell of drought followed by sudden heavy irrigation may cause cracking of fruits.

Furrow irrigation is most widely used to irrigate tomato crop in India. Drip irrigation of tomato crop increases the yield by 50 per cent and saved water by 30 per cent as compared to furrow method. Nowadays sprinkler irrigation is also being popularized which is found to be more economical. Irrigation following a period of moisture stress during fruit development leads to blossom end rot. Development of moisture stress in foliage results different physiological consequences. Viz. (1) Decrease in stomata opening (2) Reduction in photosynthesis and transpiration. (3) Dehydration of protoplasm (4) Reduction of cell division and cell enlargement. (6) Decrease in total dry matter production and growth.

Weed control

- The normal method of weed control is to give two hand hoeing in the first and third fortnight after transplanting and an earthing up operation during the seasonal fortnight. The application of pre emergence herbicides like metribuzin at 0.35kg/ha, fluchloraline 1.25kg/ha controls the weed population and increases the yield of tomato. Recently the use of pendimethalin @1.0kg/ha as pre emergence application at three days after transplanting was found very effective in suppressing the weeds.

Staking

- In case of indeterminate varieties, the yield and quality of fruit is improved by staking the plants with wooden sticks/polythene threads. Staking not only increases the yield and improve its quality but also reduces the infection by fungal diseases.

Harvesting and yield

- In indeterminate cultivars, fruit are harvested in 70-100 days after planting. In determinate cultivar fruits are harvested at 70 days depending upon the environmental condition. According to the use of fruits they are harvested in following stages.

Green stage:

- About a fortnight before turning (Development of a trace of redness at the stylar end of the fruit), the fruits will develop normal colour of the vine though they are still green yet they may be fully developed. These fruits are picked and sent to distant markets.

Pink stage:

- At this stage, pink colour on the fruits varies from the trace at the bottom end to a considerable extent covering the surface. Though at this stage most of the fruits are red, yet they are not fully ripe. They are picked for local markets.

Ripe stage:

- At this stage the surface of most of the fruits is red and softening of the fruits begins. They may be picked for home or table use.

Full ripe stage:

- At this stage the fruits have maximum colour development and may feel soft to touch. They are ordinarily used within 24 hours of picking and are consumed or used for canning and pickling.
- Fruits are normally picked at an interval of 4-5 days in summer whereas for winter crop picking should be at weekly interval. The yield varies greatly according to varieties or season. On an average yield of open pollinated varieties ranges from 20-25 t/ha. Hybrid varieties may yield up to 50t/ha or more under normal conditions.