Tomatoes

Introduction

Tomatoes belong to the Solanacae (nightshade family) along with potatoes, peppers and eggplants. *Lycopersicon esculentum* is a perennial plant in the tropics in northern climates it is grown as an annual. Botanically this is vegetable is a fruit (a berry). Flowers are generally born in clusters of 4 to 8 but small fruited types may have 30 to 50 flowers per cluster. The flowers are mainly self-pollinated by the wind. The fruit has 2 to 18 locules (chambers or sections).

The tomato is a native of the Peru, Bolivia, and Ecuador area of the Andes Mountains. Its antiquity is uncertain in regard to cultivation but it was being cultivated when America was discovered by Europeans. It was not until 1835 that the tomato was considered as a food crop in the northeastern U.S.

Tomatoes respond well to high temperatures. The minimum temperature for seed germination is 10° C with a maximum temperature of 35° C and an optimum range of 17 to 20° C. Most field transplants not be set out until the danger of frost is past. An optimum growth rate is obtained at 22 C with reductions occurring above 30°C and below 12°C. Fruit setting is inhibited above 30° and below 16°C. Root growth does not occur below 16°C. Tomatoes require adequate, even moisture, particularly at flowering and during fruit set.

Tomatoes grow best in well drained soils that are applied with organic matter. Sandy soils are for early production, loam and clay loam soils ted for later production. Shelter from wind is important for early production. This crop also benefits from the use of plastics such as ground mulches, row covers, and tunnel houses.

Tunnel house tomato harvest begins about mid-July and field harvest about August 1st. Production continues as long as economically viable, usually up to late October. Marketable yields of ripe tomatoes vary dramatically with the weather. This range is 10,000 to 30 000 kg per hectare. Tomatoes for green chow may yield as much as 40,000 kg per hectare.

There is a large market for red tomatoes in the Atlantic area within our growing season, especially on the wholesale market. There is still price competition from other areas of North America and in good growing seasons, market "gluts". There is also interest in extending our season with the use of tunnel houses for July and August production. There is a limited market for fresh green tomatoes and a limited processing market. At the present time yields of red processing tomatoes are not high enough to be economically viable.

Crop Establishment

Seeding/Planting – Since tomatoes require a relatively long growing season, they should be started in a greenhouse or hotbed. Approximately 75 to I50 grams of seed are required to produce enough plants for one hectare. Sow seeds eight weeks before plants are to be set in the field or tunnel. A temperature of 2rc for 1 to 2 weeks is required for good seed emergence.

Plants for early crops can be pricked off (when the first true leaves appear) into 5 to 10 cm pots and plants for late production can be pricked off into a module transplant tray, peat block, paper pots or peat pots 4 to 5 weeks before transplanting. Plants should be grown firm and stocky by good light, moderate temperatures and appropriate fertilization. Plants should be developed to the budding stage by the time of transplanting. Tomato plants can also be raised by sowing raw seed directly into peat pots, module trays, or peat blocks. Under such a planting system a superior plant can be raised in a shorter time. This system is less labor intensive and reduces transplant shock.

Tomato plants should be hardened for about one week before transplanting to the field. This can be accomplished by reducing the soil moisture supply and reducing the air temperature to 13 to 16°C. This will improve the survival ability of the plants to adverse weather conditions when field set.

Tomatoes are normally field set at 11,000 to 18,000 plants per hectare depending on the type of tomato and its field spacing:

(1) Determinate (small-vined) cultivars- plants 45 to 60 cm apart, rows 1 to 1.5 m apart.
(2) Indeterminate (large vined) cultivars – plants 50 to 90 cm apart, rows 1.5 to 2 m apart.
(3) Staked Tomatoes -plants 45 cm apart, rows 1 to 1.5 m apart.

Nutrient Content: An excellent source of Vitamin C. They are also a source of many minerals including potassium, calcium and folate. One medium raw tomato provides 35 kilocalories.

Crop Management

Transplanting – Set in the field after the danger of frost is past. Set out only relatively young, tender and blossom free plants. Severe hardening reduces yields. To obtain good yields and fruit size, the plants should become established in the field before the first fruits are set. This is important with early determinate cultivars. Use a starter fertilizer solution.

Mulching – Black plastic mulch can be used for weed control and higher yields of marketable fruit. Clear plastic mulch is the most effective for early growth and yields. However, weeds must be con· trolled with the use of herbicides.

Hot caps, row covers or tunnels – These are used by growers to foster early growth and production. Ventilation is critical on warm sunny days. Do not allow temperatures around plants to exceed 35"C. Grow cultivars suited to this method of culture. Staking Tomatoes - advantages in staking, or otherwise training tomato plants off the ground include a frequent increase in the percentage of marketable fruit, easier harvesting, and reduced injury to both plants and fruit in harvesting. It is doubtful that staked yields will differ from un-staked plant yields or that fruits on staked plants are firmer. Staking procedures that require little pruning seem best because pruning is costly; since removing laterals means removing potential flower clusters, both early and total yields per plant are often reduced. The practices of staking and pruning most are likely to be profitable when a long harvest season is possible and fairly uniform production over the season is desired. (Only staking greenhouse cultivars should be used in tunnel houses and a limited number of trusses should be allowed to set depending on the intended market and season)

Irrigation – The soil moisture should be kept at a reasonable level to reduce the incidence of cracking and blossom end rot from wide fluctuations in soil moisture. A fixed irrigation system may be used for frost control at planting time or late in the full. Trickle irrigation may be used in the field or in tunnel houses with or without soil mulches.

Nutrition

All ADDITIONS OF LIME AND FERTILIZER OR MANURES SHOULD BE BASED ON RECOMMENDATIONS FROM A SOIL TEST.

Manures – Often they are used in tomato production but one has to be careful of excessive nitro· gen since delayed maturity and excessive vegetative growth may result.
Lime – Lime should be applied to maintain the soil pH in the range 6.0 to 6.5.
Nitrogen – Nitrogen is best applied at the time of planting and broadcast at an appropriate level, since an excess will delay maturity of ripe tomatoes. If a side dressing is applied, apply only after fruit has developed on the second truss. Where plastic mulches are used the nitrogen application should be reduced since the nitrogen does not leach. Approximately 50 kg per hectare or less of nitrogen may be enough for vigorous cultivars on plastic mulch. Maturity may be delayed two to three weeks by an excessive application of nitrogen. Total yields of green plus ripe fruit are usually larger but early ripe yields are drastically reduced. For green chow tomatoes heavier rates of nitrogen should be used.

Phosphorus – It is most effectively used when banded at the time of transplanting especially when small quantities of fertilizer are being applied. Band at least 50 kg of phosphorus per hectare. Use a transplant solution if possible especially on low phosphorus soils.
Potash – Broadcast potash requirements before planting and incorporate it into the soil along with the nitrogen.
Magnesium – On sandy soils low in organic matter and in magnesium content, foliar applications of Epsom salts should be considered.
Calcium – On sandy soils low in calcium apply foliar sprays of calcium chloride to prevent blossom end rot.
Micronutrients – *Boron* – Tomatoes have a high boron requirement. Apply a boronated fertilizer and apply at least one foliar spray of soluble boron.
Application Method – Nitrogen and potash should be broadcast prior to planting and incorporated into the soil. Phosphorus would be best banded and starter solutions should always be used. Fertilizer ratios of N to P to K of 1-2-1 have been the most effective on this crop. More fertilizer may be needed on staked cultivars.

Pests and Pest Control

Weeds

Control perennial weeds prior to planting. Many growers use black plastic mulch for weed control, especially when the crop is grown under plastic row tunnels. Most herbicides recommended for use on tomatoes will not provide complete control of annual weeds and supplemental cultivation is usually necessary.

Diseases

Damping Off (fungi)

Characteristics – Seed may decay, fail to emerge or once emerged develop water soaked discolored areas on the stem which withers and causes the plant to fall over. Disease incidence and severity is increased by cold temperatures, over watering, high humidity and overcrowding.
Control – Hot water treat seed and apply a fungicide seed protectant. Plant seeds at the recommended rate into sterilized seeding mix and flats. Supply adequate moisture but do not overwater and maintain night temperatures above 16°C. Drench immediately after seeding with a fungicide and if damping off occurs continue to apply fungicides at weekly intervals.

Septoria Leaf Spot (fungus)

Characteristics – Causes numerous small grayish circular leaf Spots with dark borders. Survives in crop residue and on seed. Wet weather favors disease development.
Control – Hot water treat seed. Apply protective fungicide sprays on a regular basis. Plow down crop residue immediately following harvest.

Botrytis Blight (fungus)

Characteristics – Leaf spots are dark brown to black concentric rings or zones within the spot. On fruit, large, dark, sunken areas develop particularly at the calyx end or on growth cracks.
Control – Apply fungicide sprays if required. Healthy which are not stressed can tolerate some leaf spotting.

Late Blight (fungus)

Characteristics – Irregular greenish black water soaked areas appear on older leaves. Infected fruit remains firm but becomes rough with greasy greenish brown patches. This disease is more common under cool moist conditions and is the same fungus which late blight of potatoes.
Control – Apply fungicide sprays.

Anthracnose (fungus)

Characteristics – Common rot of ripe fruit causing r sunken spots which develop dark centers. Infection· by other secondary organisms may cause complete-rotting of fruit. Fruit becomes more susceptible as it ripens.
Control – Apply fungicide sprays. Follow a 3 year rotation.

Botrytis Rot (fungus)

Characteristics – Gray mold rot of foliage, stem and occurs. Pale green silvery ring marks with a brownish puncture in the center, known as ghost spot, on the green fruit. The same rings are generally yellow on ripe fruit. This disease is associated with wet, humid weather.
Control – Use fungicides for control in tunnel house or field.

Bacterial Speck and Spot (bacterium)

Characteristics – These two bacterial diseases are spread by seed and transplants and can overwinter from previous year's diseased crop. Most spread takes place during transplant production and is increased by high humidity. Symptoms include black spots on the leaves with a yellow border and small dark spots on the fruit.
Control – Hot water treat the seed and apply a fungicide seed protectant. Use sterilized soil in the green· and disinfect flats. If these diseases appear in the greenhouse or field, apply appropriate fungicide plus copper sprays. Premixing the spray for 90 minutes or longer (overnight) increases efficacy. If tomatoes are staked use a disinfectant on used stakes. Follow at least a two year rotation.

Bacterial Canker (bacterium)

Characteristics – This bacterial disease is seed borne and can overwinter for one year in infected plant debris. Leaves wilt, die and brown cankers develop on the stem. White spots develop on the fruit with dark corky centers.
Control – Hot water treat the seed and apply a fungicide seed protectant. Use sterilized seeding mix and disinfect flats and tools. Do not plant into fields which have been infested for at least two years.

Virus Diseases

Tomato Mosaic – Leaves and occasionally green fruit are mottled with light and dark green patches. Fruit may ripen unevenly and have internal brown streaks. This highly infectious virus can be spread simply by touching infected plants.
Cucumber Mosaic – Infected plants are stunted with distorted (shoestring) leaves. Most disease spread is by aphids feeding first on diseased plants and then on healthy.
Double Virus Streak – This disease is caused by infection of the plant by both tomato mosaic and PYX virus. Infected plants have mottled leaves, brown streaks on the stems and petioles and brown greasy blotches on the fruit.
Control – Keep young plants virus-free by sanitation measures and aphid control. Avoid unnecessary handling of plants. Infections of older, well developed plants do not affect yield appreciably.
Grow seedlings away from mature tomato plants. Eradicate weed hosts in or near the greenhouse. Do not keep ornamentals in the same greenhouse with tomato seedlings. Do not smoke or chew tobacco when handling plants. Wash hands with soap (trisodium phosphate, a detergent, is best) and water before handling tomato plants. Do not harden transplants by leaving them in headlands or other weedy places. Do not use cultivators in an infected crop and then in a healthy one.

Non-Parasitic Disorders

Blossom-end Rot

Characteristics – A physiological disorder. Lack of adequate soil moisture and insufficient calcium uptake from the soil to the fruits during dry weather have been shown to cause this disorder. Excessive magnesium, potassium, sodium, or ammonium salts, or a deficiency of soluble calcium salts, all tend to decrease calcium uptake.

Control – Timely irrigation will reduce or prevent this disorder. If drought occurs, and irrigation is not possible, cultivation should be very shallow to reduce water loss. Hoeing or cultivating should be done no closer than 30cm from the plants to avoid root pruning. Maintain a high organic matter content in the soil and a high soil pH. A spray application of calcium chloride or calcium nitrate (or a trial pre-plant application of gypsum) may help control this disorder.

Blotchy Ripening

Characteristics – Blotchy Ripening is a disorder which involves irregular fruit ripening. Slow growth due to plant stress seems to be the cause.
Control – Eliminate heat or moisture stress wherever possible.

Yellow Shoulder

Characteristics – Climatic conditions prevent the red pigment from developing in the wall tissue near the stem. The shoulders of the tomato then became deep yellow in color. Cultivars with green shoulders are more susceptible and high temperatures during the growing season aggravate this problem. Fruits exposed to direct sunlight appear to be the most susceptible.
Control – Avoid susceptible cultivars and protect crops from high temperatures where possible.

Insects

Cutworm

Characteristics – Sometimes a serious problem especially near grassy margins of fields.
Control – Control couch grass and then perennial weeds in the year prior to planting. Apply chemical sprays as necessary.

Flea Beetles

Characteristics – Adults are 1.5 to 3 mm long, black or bronze beetles. Their hind legs are well developed for jumping. The white larvae are in the soil, and therefore seldom seen. Depending on species, there are one or two generations a year. Adults over- winter in the soil. Eggs are laid on or near the roots where larvae feed. Mature larvae pupate in the soil near the host plant. Adults emerge in early August for single-generation species. Last-generation adults feed on foliage until full, when they return to the soil to overwinter.
Control – Before transplanting, lightly spray the plants in the flats with a field spray insecticide. Watch closely in the field as damage may occur suddenly and an insecticide may be needed.

Tomato Fruit Worm (Corn earworm)

Characteristics – This pest is usually not a serious problem. Larvae feed on the fruit. See Corn section for description.
Control – The insecticides applied for flea beetles will control this pest.

The Colorado Potato Beetle

Characteristics – The Colorado Potato Beetle is an occasional pest. Larvae feed on leaves.
Control – Insecticides applied for the flea beetle will control this pest.

SPECIFIC CHEMICAL CONTROLS FOR THE VARIOUS CROP PESTS DISCUSSED MAY BE FOUND IN THE APPLICABLE PEST MANAGEMENT GUIDES ON THE PERENNIA WEBSITE

Harvesting and Handling

Pick fruit at the ripe, pink or mature-green stage depending on its use and distance to market. At about 21°C, pink fruits ripen in 1 to 2 days and mature-green fruits in 4 to 5 days. Exposure of green fruit to ethylene supplied as a gas to harvested fruit, or as a field spray of ethephon, accelerates ripening. Prolonged exposure to temperatures above 30°C can inhibit red pigment formation.

Storage and Conditioning

Mature-green tomatoes should be stored at 13 to 21°C while firm ripe fruit can be held as low as 10°C (pink fruit are stored at intermediate temperatures, 10-15°C). Relative humidity in all cases should be 85- 90%. Mature green fruit can be held 2-6 weeks while ripe fruit can only be held 1 week in conventional storage. Controlled atmosphere storage may be used to delay ripening and extend storage life. Botrytis and Alternaria rots may be a problem.

Bibliography

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