



- ❖ Tomatoes is one of the crops that many farmers have ignore for decades because of the myths of being affected by many pest and diseases.
- ❖ Having realized that many tomatoes farmers lack adequate knowlege on how to control and prevent pest and diseases in their tomatoes farms we developed a comprehensive tomatoes manual that will assist deal with this problem.
- ❖ Farmers should embrace new farming practices so that they can achived good yield in their farming.

In the manual the following topic have been discussed in details

- ❖ Land preparations
- ❖ Agronomic practices
- ❖ Disease and pest control
- ❖ Utilization



TOMATOES PRODUCTION (*solanum lycopersicum*)

Land Preparation

Field Selection

- Consider previous planted crop. As general rule, farmers should observe at least a 3-season break from tomato, pepper, potato or any other crop from the solanaceous family. This is done to avoid disease cycles and ensure less cost in disease management.
- Check the irrigation water quality. Excess sodium and fluoride may affect proper plant growth.
- Check water availability particularly if you intend to use irrigation.
- The land should be gentle sloping to facilitate drainage.

Soil environment

- Tomatoes can grow in a variety of soil types; they do best in well-drained, deep soils.
- Uniform clay or silty loams. The soil should be loose, deep and of correct structure.

- Because tomato has a root system of more than 60 cm depth.
- The optimum pH for tomato production is 6-7.5.
- In coming up with a fertilizer program the grower can carry out a soil analysis.

Land preparation

- Proper land preparation is necessary to loosen soil and break hard pans or compacted fields.
- During land preparation, 8 tons of farm yard manure per acre can be incorporated into the soil to improve its structure; this will in turn improve soil aeration and water percolation.
- In nematode infested areas, fumigation can be done with registered products.
- In soils whose pH is low; lime can be applied to raise the pH. For alkaline soils, gypsum can be used to reduce soil pH; it is also handy in sodium-level reduction.
- Planting on beds is recommended for low-lying, areas with high run-off; Raise the soil 15cm high with walkways of 30cm between the beds.
- Lay drip lines with the nozzles facing up.

Seed requirement

- Tomato varieties are sold in seed counts and are available in leading stockists in all the regions of the country.
- In calculating seed requirement, the amount of seed will be determined by the spacing that will be used. A plant density of 3 plants per metre squared is recommended for most regions.
- The grower should plant about 15 percent more seeds in their nursery to cater for the seedlings that will be used for gapping.

Nursery management

- Soil nursery method is the most recommended method for growing seedlings. In the soil nursery method, a fine tilth is recommended because of small sized seeds. The nursery should be raised 15 cm above the ground.



Figure showing tomatoes seedlings in trays

- Seeds should be planted at a depth of 1cm and a spacing of 15cm between the rows.
- The seeds are arranged along a furrow, and then covered lightly with soil.
- The nursery can be covered with hay or dry grass. This is done to increase moisture on the surface and prevent splash during irrigation.
- Watering will be done lightly using a watering can and timed in the morning to avoid conditions conducive for the development of diseases.
- The seeds will sprout within 7-10days. It will take about 21-30 days before the seedlings are ready for transplanting.
- Harden-off seedlings a week or two before transplanting by reducing irrigation.
- The farmer will be required to monitor the seedlings for pests, diseases and weeds using appropriate control methods when need arises.
- Farmers can also use trays for raising the seedlings. Plants raised in trays generally have a better survival rate.

Agronomic practices.

They include

- nutrient management
- irrigation
- Pruning
- Weeding
- pest
- Support
- disease management
- harvesting
- Marketing

Nutrient Management

- Nutritional programs enhance proper plant performance. Crop nutrient requirements change with each stage of growth.
- Always use Phosphate fertilizer as basal dressing for root development, DAP or TSP can be used at the rate of 150Kg/ha.
- After transplanting, either Urea or CAN can be used for leaf establishment. Apply Urea after 2-3 weeks or CAN in the 5th week; both are applied at the rate of 200Kg/ha.
- At the onset of flowering, top dress with NPK at 200Kg/ha; a compound fertilizer is necessary for the supply of N, P and especially K that is needed for flowering. Top dress NPK after the first harvest.

- To correct micro-nutrient deficiencies, foliar feeds can be applied alongside the regular pesticide applications.
- Avoid excessive Nitrogen; it leads to excess vegetative growth, poor fruit set, smaller fruits, hollow fruits and poor keeping quality.
- Inadequate calcium can lead to blossom end rot disease; this disease can be corrected by applying calcium fertilizers.

Irrigation

- The amount and frequency of irrigation depends on prevailing weather conditions and the stage of growth. Avoid irrigation in the evening to prevent disease development.
- For a standard greenhouse of 240 square metres install a 500 litre tank, this will serve the plants for a single day - i.e. half a litre per plant per day.
- Apply water regularly during dry spells to reduce physiological problems. Irrigation should also be done after each harvest.
- Avoid excessing watering this may cause dumping off, leaching of nutrients and waterlogging.
- Seedlings can also be sourced from a certified seedling raiser or nursery.

Transplanting

- The seedlings are ready for transplanting within 21-30 days depending on weather and varieties.
- When moving plants from the nursery bed, ensure that their roots are protected with a ball of soil - this lessens transplant shock.
- Transplanting is best done in the evening when the weather is cool.
- Transplant directly into already prepared holes. Spacing ranges from 60x45 cm, or
- 60x60 cm depending on soil fertility, water availability and varieties

Support

- Plant support is done by trellising the tomato on poles and wires. This is usually done early – 2-3 weeks after transplanting - to avoid plant damage.



- Tie a string lightly on the tomato and then gently twine the string around the plant to avoid snapping the stem.
- Alternatively, a peg can be inserted in soil just adjacent to the tomato and a trellis or string tied on to it and then tied on the barbed wire above, the tomato is then made to wind on the string.
- Supporting the crop allows free air movement and reduces moisture accumulation thus reducing disease incidences.

Pruning

- To avoid the spread of diseases from plant to plant, do not use secateurs or a knife, pinch out instead using your thumb and forefinger.
- A weekly scouting is done for side shoots before they develop into big shoots.
- Remove side shoots, laterals, old leaves, diseased leaves & branches and overshadowed lower leaves by hand.



Figure showing how to prune

- After formation of the first fruit cluster of mature green tomatoes remove all the lower older leaves to allow for ventilation and disperse food to the fruits.

- Flowers should be pruned to 5-6 per cluster for medium- large sized fruits.

Weed management.

- The crop stand should be kept free of weeds at all time, because weeds compete for nutrients and are also vectors for disease.
- Hand weeding is recommended both for the greenhouse and outdoor tomatoes.

Pests and Diseases

- Always scout for pests and diseases in the morning because this is the best time to get all the pests on the plant.

Major Tomato Pests

Greenhouse Whitefly (*Trialeurodes vaporariorum*)

The pest is known to transmit viruses.



Figure showing whiteflies on tomatoes

Control of whiteflies

- Physical control –use of nets and double doors, sticky traps and destruction of infested debris, registered pesticide products can also be used.

Leaf miner (*Liriomyza huidobrensis*)

- The adult leaf miner causes damage on the leaves with the feeding marks. The larvae tunnel the leaf reducing the photosynthesis area and often destroying the leaf.
- Heavy infestation can lead to loss of leaves and even death of the plant. When leaves are damaged the yield for that plant will be direct affected.



Figure of a life miner

Control of Leaf miners

- Biological control using Diglyphus, disease and cultural control such as burying plant residues.

Diseases in Tomatoes

Blossom End-rot

Symptoms

- An early sign of the disorder are a water soaked spot near the blossom end of the fruit.
- This turns brown and enlarges to cover almost half of the fruit.



Possible causes

- Too fast growth during the early stages followed by sudden drought especially when the fruits are small.
- Excessive nitrogen and infrequent watering.

- Calcium deficiency especially in young fruits.
- Low application of nitrogen to calcium deficiency soils

Control

- Application of CAN
- Apply calcium chloride foliar feed at 15kg/1000 liters (Higher concentration will damage leaves).
- Lime calcium deficient soils

Late Blight

Symptoms

- Occurs under cool and high humidity conditions especially wet season.
- It is characterized by rapid drying of leaves and brownish dry rot of fruits often destroying the whole crop.



Figure showing late blight

Control

- Spray with recommended curative fungicides.

Early Blight

Symptoms

- It occurs during hot weather. It causes stem cankers on seedlings and small irregular dark brown spots on the leaves. As they enlarge they show a concentric pattern. The result is partial defoliation of the crop.

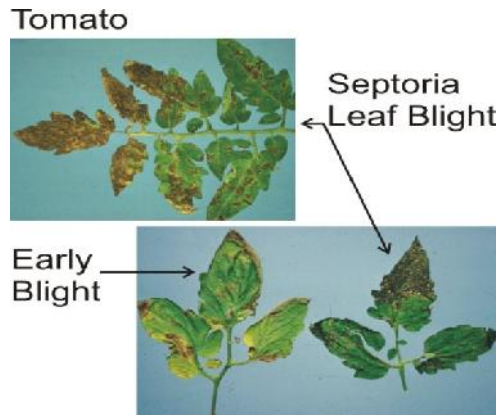


Figure showing early blight

- It causes premature fruit drop and low quality fruits.
- It is soil borne and the fungus usually survives on plant debris.

Control

- Field sanitation.
- Crop rotation.
- Spray with recommended curative fungicides.

Bacterial wilt –*bacterium Ralstonia Solaceanum*



- Bacterial wilt is one of the major diseases of tomato.
- The disease is known to occur in the wet tropics, subtropics and some temperate regions of the world.
- The pathogen can also cause the bacterial wilt in several major crops such as eggplant, pepper, potato, tobacco and tomato.
- This disease is one of the major challenges tomato farmers face.

Symptoms

- Symptoms consist of a non-yellowing wilting of the youngest leaves at the ends of the branches during the hottest part of the day.
- During its early stages, only one or half a leaflet may wilt and plants may appear to recover at night, when the temperatures are cooler.
- As the disease develops under favorable conditions, the entire plant may wilt quickly and desiccate although dried leaves remain green, leading to general wilting and yellowing of foliage and eventually the plant dies.
- Rapid wilting
- Drops of white or yellowish bacterial ooze may be visible when the stem is cut.

Control

- Crop rotation
 - Plant resistant varieties
 - Remove and burn all infected plants.
 - Field sanitation
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- No chemical control available
 - Cultural practices such as crop rotation field hygiene and irrigation water management can help
 - Growing resistant root stock



Fusarium wilt – *Fusarium oxysporum f.sp. lycopersici*



Figure 2 showing a tomato affected by fusarium wilt

- Tomatoes may be infected at any age by the fungi.
- The wilt organisms usually enter the plant through young roots and then grow into and up the water conducting vessels of the roots and stem.

Symptoms

- Yellowing of the foliage beginning with the lower leaves and working upward.
- Curling of the leafs followed by browning and drying.

- The top of the vine wilts during the day and recovers at night, but wilting becomes progressively worse until the entire vine is permanently wilted.
- Vascular browning can be seen in infected stems and large leaf petioles.
- If the main stem is cut, dark, chocolate-brown streaks may be seen running lengthwise through the stem.
- Development is favoured by high temperature, low humidity and nutrient deficiency. It is soil borne and survives in plant debris.
- The symptoms include yellowing and wilting of the lower leaves, slightly drooping at high temperatures.
- The vascular vessels appear brown. In cool conditions it affects the root area only causing tomato root rot wilt.
- Browning of the vascular vessels is restricted to the stem near the soil level but roots show a severe browning and decay.

Control

- Use of resistant varieties.
- Liming.
- Crop rotation
- Crop rotation is key in managing the disease.
- Infected crop debris should be disposed off well to avoid re-infection but also not act as source of inoculums.
- Use of certified disease free seeds as well as tolerant varieties can also help.
- Fungicide use can also help to reduce spread and also cure disease plants.
- Some of the effective chemicals available include Chlorothalonil, Mancozeb, Propineb, Cymoxanil, Azoxystrobin and Propamocarb.

Bacterial Canker –*Clavibacter michiganensis*

Symptoms

- May be noted on leaves, stems, and inside fruits.
- Areas of leaves above the second or third cluster may show dull green and water-soaked areas, which later appear desiccated and become necrotic.
- Wilting progresses until the entire leaflet dies.
- Close examination of stems reveals open cankers.
- Splitting of the stem lengthwise reveals reddish brown discoloration.

- The pith becomes granular to mealy and filled with cavities.
- On fruits there is formation of yellow brown spots, slightly raised and surrounded by a white birds eye like halo spot.



Figure showing bacterial canker

Control of the disease

Cultural control methods

- tolerant varieties
- certified disease-free seeds
- practicing crop rotation
- Proper disposal of infected plant material
- Managing watering by reducing overhead irrigation.
- Use of tools such as pruning knives can also spread the disease from one plant to another hence, they should be sanitized.
- Affected plants can be uprooted to reduce spread.

Chemical control

- Fungicides that can be effectively used include Copper based fungicides.

Powdery Mildew – *Leveillula taurica*



Symptoms

- A white, powdery mold grows on the upper surface of the leaves
- The growth forms circular to irregular areas, 6mm or more in diameter
- Lesions are often associated with some leaf yellowing
- Affected tissue may turn brown and die, usually starting on the leaves and progressing up the plant
- initially appear as light green to yellow blotches or spots
- A white, powdery growth of the fungal mycelium is found on the top of leaves.
- The fungus produces specialized feeding structures called haustoria that invade host cells to extract nutrients.
- And is especially evident at the point where the petiole joins the stem.
- Affected plants and their root systems are stunted.
- The degree of stunting depends upon time of root infection.
- Plants infected when they are young will be more severely stunted than plants infected at a later stage.

Control

- Plant raised beds to promote soil water drainage away from roots
- Thoroughly disinfect equipment before moving from infested to clean field.
- Greenhouses typically provide ideal conditions for disease development and spread. An integrated approach should be used to control powdery mildew in the greenhouse. Practices that maintain high relative humidity should be utilized.
- Infected plants should be removed from the house, which should be sanitized after production.

- Registered fungicides should be applied to plants as soon as symptoms are observed.
- control measures scouting, rouging of infected plants, use of resistant varieties, and spraying preventative chemicals. Azoxystrobin, Myclobutanil, Triforine, Thiophanate, Tebuconazole, and Sulfur based fungicides .

General Management of pest and diseases

The general principles in pests and disease management include;

- Practicing crop rotation. Observe minimum 2 year rotation program
- Planting resistant /tolerant varieties - Use certified disease-free seed treated with an approved fungicide to control seed rots and post emergence damping off
- Field hygiene-old crop should be removed from the fields, control weeds and crop debris since these are source of pests and diseases. Staking and pruning are also key to disease incidence reduction
- Using proper crop production practices that provide the right growing conditions for plants (sufficient water and balanced fertilization), particularly when crops are young.

Strong healthy plants are more likely to withstand pests and diseases.

- Irrigation management; poor irrigation timing and scheduling may lead to disease, overhead irrigation in the evenings can encourage early blight.
- Ensure regular crop scouting for pest and disease as well as weed and nutrient deficiencies. Proper pest and diseases identification is the first and critical step in their management.

Harvesting

- Tomatoes are ready for harvesting in 70 to 120 days depending on weather and varieties.
- Usually the very first cluster bears the first ready fruits.
- Pick fruits at intervals as they ripen depending on your market demand. The very first harvest is usually less compared to the later harvests. Hand pick and place fruits in crate• Harvesting continues for up to 6-8 months.
- Once the plant reaches the top, (approximately 2 m long or the height of a normal person standing with arms stretched upwards), laying is to be done. Bring the tomato down, bending it on the ground and trellising it on a string as done initially.
- Observe the pre-harvest period incase any chemical was sprayed. Watering must be done immediately after every harvest.

Marketing

- Plant varieties which are accepted in the local market, supermarkets, export and other consumption institutions because of their quality.
- When targeting specific markets, grade before selling by sorting out according to size, colour, or weights when the weather is cool. helps to detect problems early and take control measures on time.

Value addition

- Making tomato juice
- Puree
- Tomato paste
- Pickle
- Chutney
- Ketchup
- Sauce
- Canned tomato products