

## IPM PACKAGE: TOMATO

The IPM Innovation lab (IPM IL) has developed and tested practical IPM packages in vegetables. The IPM packages are holistic suites of IPM recommendations and practices from planting to market chain with an aim to enhance profitability from vegetable farming. These packages are economically and environmentally viable.



Grading in tomatoes



Seedlings grown in plastic tray



Grafted seedlings of tomato



Bio-pesticide (*Bacillus thuringiensis*) produced in Nepal

### VARIETY SELECTION:

Select high-yielding, locally-preferred Tomato variety that is tolerant to insect transmitted virus diseases (Tomato yellow leaf curl virus and others). Seeds should be free from seed-borne viruses like the Tomato mosaic virus and the Cucumber mosaic virus. Experience show that in the present context this factor should be critically seen in raising a healthy crop. Farmer should consult with local agricultural research and extension institutions, district agriculture development offices, universities, and experts from other non-governmental organizations and for technical advice while selecting the varieties. Make sure of the variety and its suitability in the production area.

### SEED BED PREPARATION:

Preparing the seed bed (raised) using solarized soil and fertilizers combined with *Trichoderma spp*, and neem cake that reduces the incidence of seedling diseases, weeds and nematodes. Similarly, using coco-peat and plastic trays to grow seedlings will provide an ideal medium resulting in disease free seedling, which will result in much more healthier and robust plants in the field, ultimately leading to a to a good harvest.

### SEED TREATMENT:

Treating seeds with fungus *Trichoderma viride* and the bacteria *Pseudomonas fluorescens* protects seedlings from fungal, bacterial and nematode attacks, increases seedling vigor, and induces plant defense against pests. Mix 10g of Trichoderma formulation per litre of cow dung slurry for treatment of 1kg of seed before sowing.

### SEEDLINGS IN NURSERY:

Using screens or nets against aphids and thrips vector can prevent or delay early virus infection. Carefully examining seedlings before transplantation will reduce disease incidence. Seedlings are usually ready to transplant in 3-4 weeks' time. Drench nursery beds with 5 gm of Trichoderma formulation per liter of water. Or, Apply 10 - 25 g of Trichoderma powder per 100 m<sup>2</sup> of nursery bed.

### ROUGING:

Monitoring and removing any disease or virus infected plants within 45 days of transplanting will prevent disease spread by insect vectors.

### GRAFTING:

Grafting preferred tomato scions on wild eggplant (*Solanum sisymbriifolium*) will significantly reduce the bacterial wilt (*Ralstonia solanacearum*) and Root Knot Nematode (RKN) infection, increasing the yield.

### FERTILIZATION:

Well decomposed compost inoculated with *Trichoderma spp* and other bio-fertilizers (N, P, K) will reduce the disease incidence along with building-up of beneficial soil microbes. This will further improve the nutrient absorption by the plants. Apply 5 Kg of Trichoderma powder per ha after turning of sun hemp or dhaincha into the soil for green manuring Or Mix 1kg of Trichoderma formulation in 100kg of farmyard manure and cover it for 7 days with polythene. Sprinkle the heap with water intermittently. Turn the mixture in every 3-4 days interval and then broadcast in the field.



Funnel Trap



Staking in Tomato



Marigold used as a trap crop in tomato field



Damage by larvae of Tomato Fruit Borer



Aphids

### INSECT TRAPS:

a) Setting up yellow sticky traps in the field will support the monitoring of aphid, whiteflies, and thrips as well as support reduce their population, b) Pheromone traps should be installed in the field for *Helicoverpa armigera* and *Spodoptera litura* early in the season. And once they are found in the traps, the field should be monitored, and a specific bio-pesticide (NPV/BT) should be used.

### STAKING:

To ensure proper aeration and enough sunlight, staking of tomatoes is important. It prevents shoots and fruits from touching the soil, which reduces late blight infection and fruit rot.

### IRRIGATION:

Using drip irrigation in hills will reduce the weeds, which harbors several insects, thus significantly reducing the insect infestation. Irrigation should be properly monitored to prevent excess moisture, which increases the incidence of fungal infection.

### SANITATION AND ROTATION:

Keeping area free of any tomato residues from the earlier years and other weeds (such as *Ageratum*) before planting tomatoes in the same field or area, it will reduce the incidence of insects (such as borers), and Tomato yellow leaf curl virus transmitted by the whitefly (*Bemisia tabaci*). Similarly, rotating plant families (Solanacea- Leguminacea) from one season to the next, so that Tomatoes are not planted in the same spot more often than every three years or so. The purpose of crop rotation is to help maintain the balance of nutrients, organic matter, and microorganisms' necessary for healthy soil.

### TRAP CROPS:

Trap crops are usually grown to attract insects or other pests that destroy the main crops. In tomato, Marigold is commonly used for every 15 rows of the main crop (or as a border) to attract tomato fruit borer. Additionally, marigold are best known for their ability to suppress plant-parasitic nematodes such as *Meloidogyne spp.*

### BIO-CONTROL AGENTS:

Nuclear polyhedrosis viruses (NPV)/ *Bacillus thuringiensis var kurstaki* can be used against Tomato fruit borer (*H. armigera*). Similarly, formulations of fungi *Verticillium*, *Paecilomyces*, *Metarhizium*, and *Beauveria* species are found effective against whiteflies, thrips, and leafminers.

## MAJOR INSECTS PESTS AND THEIR MANAGEMENT

### 1. TOMATO FRUIT BORER

Most of the damage is caused by larval feeding on leaves, flowers, flower buds, and fruits. A larva bores into the fruits with the body hanging outside.

- Summer ploughing to destroy the eggs and larvae.
- Use of pheromone traps (1/ropani) for monitoring.
- Plant Marigold as a trap crop in between the rows or as a border crop.
- Avoid planting near maize or cotton.
- Use of neem and other botanicals extract at a weekly interval.
- Use Bt based pesticides @2gm/liter water.
- Contact insecticides as last resort such as Chlorocyper.

### 2. APHIDS

High population can result in yellowing of leaves and stunted plants. They also secrete a large amount of honeydew that promotes development of sooty mold on foliage and fruits.

- Conserve NE's such as Lady Bird Beetle (LBB).
- Use of yellow sticky traps to monitor.
- Use of insecticidal soap along with Neem or Tobacco ( 100gm soap+100gm tobacco/neem powder + 20L water).
- Spray fermented cattle urine in ratio of 1:5 at a weekly interval.
- Use of bio-pesticide such as *Verticillium lecanii*.
- As a last resort use Systemic insecticides: Imidacloprid. @ 3-5 ml per lit of water.



White Flies



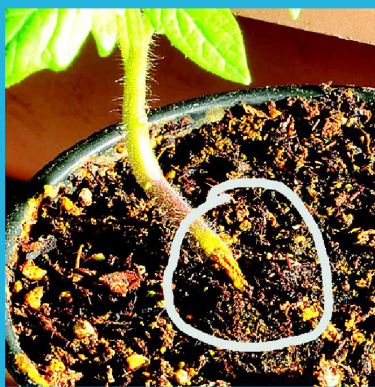
Leaf miner damage in tomato



Adult Tobacco Caterpillar



Late Blight infestation in tomato



Damping Off

### 3. WHITE FLY

Flies suck the cell sap resulting in yellowing of leaves; plant looks diseased and finally wilts. Results in heavy crop loss, often related to its role in transmitting virus disease such as TYLCV.

- Use of yellow sticky traps to monitor.
- Caging of plants with nylon nets.
- Use of bio-pesticide such as *Verticillium lecanii*, along with neem extract or neem based pesticides.
- Using insecticidal soaps.
- Practice trap cropping (Beans or Soybean).
- Spray *Verticillium lecanii* or Azadirachtin on the lower surface of leaves at 15 days interval.
- Using chemicals like acetamide as a last resort.

### 4. LEAF MINER

Adults are small yellow-and-black flies which lay their eggs inside the leaves of tomatoes, where the larvae hatch and proceed to consume the nutrient-rich, chlorophyll-filled cells. Eventually, they meander to the edge of the leaf, where they drop to the ground and pupate.

- Keeping surrounding field clean.
- Collecting and destroying affected leaf parts.
- Neem product like Margosom @5ml /Ltr water.
- Systemic insecticides: Acetamide.
- Avoid unnecessary pesticide applications.

### 5. MYRID BUG

Adults suck the sap from pedicel of leaves, flower and twigs, making a ring. Affected part breaks after a few days.

- Management as indicated for white fly after appearance of symptoms.

### 6. TOBACCO CATERPILLAR (*Spodoptera litura*)

Early larval instars and caterpillars feed in clusters skeletonizing the leaves.

- Management as indicated for tomato fruit worm.

## DISEASES AND THEIR MANAGEMENT

### 1. LATE BLIGHT

Dark brown, water soaked patches appear on the leaves and stems. Infected fruits develop brown lesions that cover most part of the fruits.

- Drenching seedbed with Trichoderma and dipping seedlings before transplanting.
- Use solarized soil to raise seedlings.
- Promote air circulation with adequate spacing, and pruning.
- Raise ridges up to 15-20cm height.
- Destroy voluntary potato plants and related solanaceous weeds.
- Avoid heavy irrigation and water logged condition.
- Regularly pruning and destroying affected tissues and plant parts.
- Copper based pesticides: metalaxyl at an interval of 7-10 days as a last resort.

### 2. DAMPING OFF

This disease mostly attacks seedling stage. In transplanted seedlings they attack in ring form in the stem and stem nodes and then the plants rots and fall down to ground.

- Nursery should be always established in south facing plot.
- Make raised nursery bed and drenching bed with Trichoderma solution.
- Manage irrigation water. Apply required amount and in time. There should be good drainage system.
- Treat the soil with Trichoderma.
- In heavy invasion apply Bavistin@2gm per sq. m area.

### 3. EARLY BLIGHT

It produces a wide range of symptoms at all stages of plant growth. It can cause damping-off, collar rot, stem cankers, leaf blight, and fruit rot. The classic symptoms occur on the leaves where circular lesions up to 1/2" in diameter are produced.

- Remove and destroy affected tissue, plant parts.
- Use Diseases free seedlings.



Early Blight infestation in tomato



Bacterial Wilt infested field



Root Knot nematode



Pith necrosis



Viral disease

- Seed treatment with Trichoderma @10gm/kg seed.
- Use Chlorothalonil/ mancozeb/ ziram /copper products on 7-10 days interval.

#### 4. BACTERIAL WILT

Bacterial wilt affected plants suddenly starts wilting after morning time passes and the sun heat / day temperature is raised. Very easy to diagnosis with a sharp knife slice the stem and dip it in a clean glass of water and whitish fluid starts oozing out.

- Grow tolerant variety such as Srijana.
- Promote air circulation providing adequate spacing, pruning.
- Maintain pH of 6.2-6.5.
- Avoid water logged condition.
- Raised ridges upto 15-20 cm.
- Use of Pseudomonas in compost.
- Use of Chlorothalonil at an interval of 7-10 days after disease occurrence.
- Use of seedlings grafted with wild egg plant.

#### 5. ROOT KNOT NEMATODES

Stunted growth, small leaf, small nodules in roots are some of the major symptoms.

- Use tolerant variety.
- Use solarized soil to raise seedlings.
- Crop rotation with non-host crops like crucifers, brassicae and intercropping with mustard.
- Use of mustard cake mixed with compost.
- Use of seedlings grafted with wild egg plant (*Solanum sisymbriifolium*).
- Grow Marigold in between rows or as a border crop.

#### 6. BACTERIAL SOFT ROT

Soft rot develops in the inner stem, which becomes brown and slimy, then disintegrates and becomes hollow. Similarly, the infected fruit develops a thin outer skin and becomes filled with a slimy mass.

- Remove and destroy affected tissues and plant parts.
- Balance dose of fertilizers and avoid crop injury and overwatering.

#### 7. PITH NECROSIS

Caused by *Pseudomonas corrugata* and other soil-borne species. When stems are cut longitudinally, the center of the stem (pith) may be extensively discolored, hollow, and/or degraded. Initial symptoms are also seen in fruits and leaves.

- Adequate ventilation to avoid high humidity levels (especially during cloudy weather).
- Avoiding excessive nitrogen levels to prevent vigorous plant growth.
- Incorporation of crop debris to speed decomposition of residue and associated bacteria, and crop rotation.
- Use of copper oxychloride paste in affected stems.

#### 8. VIRAL DISEASES

One of the most devastating diseases. Majority transmitted through whiteflies and aphids. Infected tomato plants show leaf yellowing, mosaic, cupping, and stunting. They can cause reduction in leaf size, can cause flower and/or fruit drop, and can wipe out fruit production if plants are infected at an early age.

- Use Diseases free seeds and seedlings.
- Remove and destroy affected plant as early as possible.
- Use resistant varieties if available.
- Using nylon net to grow seedlings.
- Managing insect vectors such as whiteflies and aphids.
- Destroying old plants immediately after harvest.



Contact  
Information

**Integrated Pest Management Innovation Lab - Nepal**  
International Development Enterprises (iDE) | Nepal | 01-5520943, [www.idenepal.org](http://www.idenepal.org)  
[www.oired.vt.edu/ipmcrsp](http://www.oired.vt.edu/ipmcrsp) @IPMCRSP [ipmcrsp@vt.edu](mailto:ipmcrsp@vt.edu)

Funding

The Integrated Pest Management Innovation Lab (IPM IL) is supported by a grant from USAID and managed by Virginia Tech's Office of International Research, Education, and Development (OIREd).