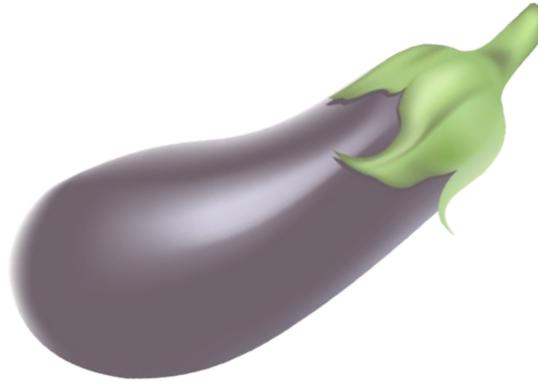


INTEGRATED PEST MANAGEMENT INNOVATION LAB

eggplant package



eggplant

The eggplant, also called **aubergine** or **brinjal**, is one of the top ten vegetables grown in the world. The vegetable originated in India and China, and Arabic traders introduced it to southern Europe and the Mediterranean. China is the world's leading eggplant producer with over half of all eggplant acreage, and India is second, accounting for roughly one quarter of total world production. Indonesia, Egypt, Turkey, Iraq, and the Philippines are the other major eggplant producing countries. Overall, Asia accounts for about 94 percent of the world eggplant area, with about 92 percent of world output (FAO 2007). African eggplant, *Solanum aethiopicum*, also referred to as scarlet eggplant, bitter tomato, mock tomato, garden egg, or Ethiopian nightshade, is native to Africa and is domesticated from a related wild spp., *S. anguivi*.

The eggplant is a tropical/ semitropical plant belonging to family Solanaceae and is closely related to tomato, pepper, and potato. The eggplant is well adapted to grow under high rainfall and high temperatures, as well under dry conditions with irrigation. Eggplant has small/moderate amounts of dietary fiber, vitamins, and micronutrients. It contributes to the diet of people in developing countries when other vegetables are in short supply.

Eggplant production in the tropics is challenged by different pests: insects, diseases, nematodes, mites, and weeds, leading to heavy yield losses. This situation continues despite indiscriminate and intensive use of pesticides to manage these pests.

This brochure details successful IPM Innovation Lab (IPM IL) approaches that have been tested by scientists, extension agents, and farmers to manage eggplant pests. The techniques and recommendations, pictures and descriptions of key plant pests are provided in the following pages.

WHAT IS IPM?

Integrated pest management (IPM), an environmentally-sound and economical approach to pest control, developed in response to pesticide misuse in the 1960s. Pesticide misuse has led to pesticide resistance among prevailing pests, a resurgence of non-target pests, loss of biodiversity, and environmental and human health hazards.

WHAT ARE IPM PACKAGES?

The **IPM Innovation Lab** has developed and tested robust IPM packages, holistic suites of IPM recommendations and practices for the production of vegetables and other crops. Farmers who use IPM packages in planting and production see enhanced profitability in their crops. The recommended practices in IPM packages cover economically significant pest species over a wide range of cropping systems across the tropical world, with resulting benefits to human health and the environment.

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Integrated Pest Management Innovation Lab (IPM IL)
IPM PACKAGES FOR CROP HEALTH

eggplant pests and diseases

identification, descriptions, and images



Photos

(Clockwise from left):

- *Leucinodes orbonalis* feeding damage on eggplant fruit
- Adult Thrip
- Adult *Mylabris pustulata*
- Adult Epilachna beetle
- Eggs of the Epilachna beetle

Diseases

Bacterial wilt

(Caused by the bacterium *Ralstonia solanacearum*) | Worldwide

This economically devastating disease is often lethal to eggplant and other crops such as tomato and pepper. Symptoms first appear as flaccidity on young leaves and, when conditions are favorable, quickly develop into complete wilt. Other symptoms include brown discoloration of the vascular system, especially near the soil line, and adventitious roots on the lower stems. Infected plants often die, resulting in a serious crop losses.

Fusarium wilt

(Caused by the fungus *Fusarium oxysporum f. sp. melongenae*) | Worldwide

The fungus survives in the soil a long time and spreads by farm equipment, irrigation water, and plant debris. The fungus and disease development are favored by a combination of warm soil temperatures and high soil moisture. Symptoms appear as slight yellowing of foliage and wilting of upper leaves, which later turn dull-green to brown and remain attached to the plant. When the stem and roots are cut diagonally, reddish-brown streaks are visible in the vascular tissues.

Early blight

(Caused by fungus *Alternaria solani*) | Worldwide

The fungus survives in soil, infested crop, and weed residues. The pathogen can spread by wind, water, insects, and farm equipment. The disease development is favored by high temperature and prolonged periods of wetness. Major symptoms include dark brown spots with dark concentric rings that develop first on the oldest leaves and progress upward on the plant.

Cucumber mosaic virus

(Transmitted by aphids) | Worldwide

Infected leaves show puckering and mosaic coloring can form. Vein necrosis is followed by leaf wilt or deformation. Sometimes fruits are also deformed with yellow streaks.

Little leaf disease

(Caused by phytoplasma/mycoplasma-like organisms) | Worldwide

The disease, which occurs late in the season, is transmitted by grafting as well as by the plant hopper, *Hishimonus phycitis*. The infected plants have small clusters of yellowish leaves, which are soft and narrow. The diseased plants neither produce any flowers nor set fruit. The root system is also stunted.

Tomato yellow leaf curl virus *Kanchanaburi* (TYLCV)

(Primarily transmitted by whitefly) | Worldwide

Infected plants show leaf yellowing, cupping, and stunting. TYLCV can cause reduction in leaf size, flower and/or fruit drop, and can wipe out fruit production if plants are infected at an early age.

Insects

Eggplant fruit and shoot borer (EFSB)

Leucinodes orbonalis (Lepidoptera: Pyralidae) | Worldwide

Responsible for extensive yield losses, it is one of the major constraints in eggplant production throughout the tropics in Asia and Africa. The most serious damage is caused by larval feeding inside the fruit, while boring inside the shoot leads to shoots wilting and dying and slows plant growth. The pest has developed resistance to commonly used pesticides due to farmers' indiscriminate use for its control.

Spotted beetles

Epilachna vigintioctopunctata and *E. dodecastigma* (Coleoptera: Coccinellidae) | Worldwide

Feeds on solanaceous crops like tomato and potato, and cucurbits. Adults and larvae feed on leaves, leading to skeletonization of the leaves.

Cotton aphid

Aphis gossypii (Hemiptera: Aphididae)

A cosmopolitan and polyphagous pest that feeds on crops like cucurbits, eggplant, okra, cotton, etc. Aphids suck the sap from plants, which results in yellowing, curling, and deformation of leaves. Honey dew secretion leads to development of sooty mold.

Flea beetles

Epitrix fuscula (Coleoptera: Chrysomelidae) | Worldwide

The flea beetle feeds on the undersides of leaves, leaving numerous small round, or irregularly shaped holes, giving leaves a "shot hole" appearance.

Spider mites

Tetranychus spp. (Acarina: Tetranychidae) | Worldwide

Mites are cosmopolitan and polyphagous and feed on various vegetable crops and reduce yields. Mites cause yellow specks and webs on leaves. Mites move to other plants using web strands.

Root knot nematode

Meloidogyne spp. | Worldwide

Nematodes have a wide host range and are most severe in warm areas with long growing seasons. Infected plants are generally less vigorous and healthy. Symptoms of nutrient deficiency and diurnal wilting are visible on leaves due to reduced efficiency of the root system. Presence of bead-like galls on roots is a characteristic of nematode presence.

Insects (continued)

Leafhopper

Amrasca bigutata bigutata
(Hemiptera: Cicadellidae)

Favored by hot and humid weather conditions, this pest causes yellow spots and “hopper burns” on leaves.

Thrips

Thrips palmi (Thysanoptera: Thripidae)| Worldwide

A polyphagous pest that infests eggplant mostly during the dry season, thrips prefer to feed on foliage but also feed on fruit.

Whitefly

Bemisia tabaci (Hemiptera: Aleyrodidae)| Worldwide

The whitefly is a polyphagous pest responsible for crop losses worldwide with no records of virus transmission in eggplant.

Broad mites

Polyphagotarsonemus latus
(Acarina: Tarsonemidae)| Worldwide

Serious pest of eggplants, pepper, tomato, etc. Affects tender leaves in the growing shoots. Affected shoots become elongated, while leaves become curled and distorted. Fruits are malformed and scarified.

South American Tomato Leafminer

Tuta absoluta (Lepidoptera: Gelechiidae)| Worldwide

The South American tomato leafminer causes damage primarily to tomato but also affects eggplant, potato, and tobacco.

eggplant ipm techniques



Photos from left to right: Tomato yellow leaf curl virus Kanchanaburi on eggplant leaves | Little leaf disease caused by phytoplasma and vectored by *Hishimonus phycitis* | Eggplant seedling production using trays under net house

Soil preparation

Preparing the soil before planting results in healthy plants with minimal pest problems. Soil solarization and fertilization combined with compost inoculated with *Trichoderma* spp., neem cake, and Vesicular Arbuscular Mycorrhiza (VAM) fungus improve the nutrients available to the crop, priming the plant's own defenses and reducing the incidence of nematodes and plant diseases.

Seed selection

Select a high-yielding, locally-preferred eggplant variety that is resistant or moderately resistant to diseases such as bacterial wilt.

Sanitation

Proper sanitation i.e., removing plant debris from field, helps in reducing EFSB, spotted beetles, and aphid populations in the field and prevents or delays crop infestation.

Seed treatment

Treating seeds with the *Trichoderma viride* or *T. harzianum* fungi, and *Pseudomonas fluorescens* and *Bacillus subtilis* bacteria protects seedlings from fungal, bacterial, and nematode attacks, increases seedling vigor, and induces plant defense against pests.

Seedling nursery

Good seedbed preparation is fundamental to the production of healthy plants. The use of seedling trays reduces contamination. Irrigation should be monitored to prevent excess moisture, which increases the incidence of fungal diseases. Avoid planting near cucurbits and cotton field if thrips, whiteflies, and aphids are a problem in the area. Avoid planting over-age seedlings in the field.

Clipping

Removing and destroying the EFSB infested shoots from plants helps in reducing EFSB population build up in the field.

Grafting

By grafting high-yielding eggplant scions on disease-resistant rootstock of wild solanums, a healthy crop could be grown in soil known to be infected with *Ralstonia solanacearum* that causes bacterial wilt disease. Grafting increases robustness of plants and yield.

Fertilization

Neem cake or mustard oil cake alone or in combination with compost-inoculated with *Trichoderma* spp., is effective against soilborne diseases. Using neem and mustard oil cakes reduces the incidence of nematodes and contribute to the build-up of beneficial soil microbes that assist in nutrient absorption by the plants.

eggplant ipm techniques



Photos from left: A farmer in Bangladesh holding an eggplant | A pheromone trap to catch pests

Biological Control

Inundative release of parasitoids such as *Trichogramma* spp. helps control EFSB while inundative release of lady bird beetles helps to reduce aphid populations. Use of neem-based biopesticides helps in managing leaf hopper, aphids, whiteflies, and mites. Sprinkler irrigation reduces mite population.

Microbial biological control agents

Formulations of the fungi *Verticillium*, *Paecilomyces*, *Metarhizium*, and *Beauveria* species and formulations of beneficial nematodes such as *Heterorhabditis* sp. and *Steinernema* sp. may be used for the control of whiteflies, thrips, and *T. absoluta*. Microbial control agents have little or no impact on parasitoids and predators of pests. For this reason, natural enemies will continue to serve as effective regulators of a variety of pests. By using these biopesticides, one may reduce/ eliminate the use of synthetic pesticides.

Bt Eggplant

The government of Bangladesh has approved cultivation of genetically modified eggplant, which controls EFSB.

Pheromone traps

Sex pheromone traps for the EFSB should be set up in the field either at the canopy level or slightly above the canopy level for effectiveness. Once pests are found in the traps, the field should be monitored, and infested shoots, fruits, and fallen leaves should be removed and destroyed.

Sticky traps

Setting up large, yellow sticky sheets in fields helps to reduce pest populations such as aphids, thrips, and whiteflies.

Mulching

Mulching conserves moisture, harbors natural enemies, and reduces insect pest, mite, and disease incidence. Use of reflective mulches or straw mulch reduces the leafhopper, whitefly, and thrip population.

FOR MORE INFORMATION

The **Integrated Pest Management Innovation Lab** (IPM IL, formerly the IPM CRSP) develops sustainable and economical pest control methods to improve livelihoods for farmers worldwide. Our eight projects in seven countries work with scientists, extension agents, students, and farmers in the tropical and subtropical world.

We are funded by USAID and housed at Virginia Tech in Blacksburg, Virginia.

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