The chill pepper, *(Capsicum sp.)*, originated in Mesoamerica and is now widely cultivated throughout the tropics and subtropics. Peppers grow well in warm climates and have a relatively long growing season. China, Bangladesh, India, Indonesia, Korea, Pakistan, and Thailand are the world’s leading producers of pepper. In 2014, over 400,000 tons of pepper was grown globally. In recent years, there has been an increase in pepper production worldwide, possibly due to the high nutritional value of pepper. Pepper contains significant amounts of vitamins A, C, and B, calcium and iron. Peppers belong to the Solanaceae family, which includes eggplant, potato, tobacco, and tomato. Pepper production in the tropics is challenged by insects, diseases, nematodes, mites and weeds, leading to heavy yield losses. This brochure details successful IPM Innovation Lab (IPM IL) approaches that have been tested by scientists, extension agents, and farmers to manage pepper pests. Pictures, descriptions of key pests, and recommendations for management are provided.

**WHAT IS IPM?**
Integrated pest management (IPM), an environmentally-sound and economical approach to pest control, was 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.
pepper pests and diseases
identification, descriptions, and images

Insects

**Broad mite**
*(Polyphagotarsonemus latus)*
*Acarina: Tarsonemidae | Worldwide*

A serious pest of pepper, eggplant, tomato, etc. It affects tender leaves in the growing shoots. The affected shoots become elongated, and the leaves become curled and distorted. Fruits are malformed and scarified.

**Spider mites**
*(Tetranychus spp.)*
*Acarina: Tetranychidae | Worldwide*

Spider mites are cosmopolitan and polyphagous pests that feed on various vegetable crops and cause yield loss. They cause yellow specks on leaves and produce webs on the leaf surface. They use web strands to disperse from one plant to another.

**Chili thrips**
*(Scirtothrips dorsalis)*
*Thysanoptera: Thripidae | Worldwide*

Thrips feeding leads to curling and dropping of leaves, and buds drop if fed upon. Feeding also scars the fruit. Thrips can also damage peppers by transmitting viruses such as the *Tomato spotted wilt virus*.

**Silver leaf whitefly**
*(Bemisia tabaci)*
*Hemiptera: Aleyrodidae | Worldwide*

Responsible for heavy crop losses worldwide, whiteflies damage peppers by sucking and secreting sticky honeydew, which grows black sooty mold. Extensive feeding may result in stunting, poor growth, defoliation, and reduced yields.

**Pepper gallfly**
*(Asphondylia capsici)*
*Diptera: Cecidomyiidae | Worldwide*

Larvae feed inside the fruits and young fruits become small and deformed. When older fruits are attacked, the fruits become twisted and deformed.

**Tomato fruit worm/Corn earworm**
*(Helicoverpa armigera)*
*Lepidoptera: Noctuidae | Worldwide*

This major pest of food and fiber crops has a wide host range, including pepper, tomato, corn, eggplant, crucifers, melons, beans, and others. Most of the damage is caused by fruitworm larvae feeding on flowers, buds, and fruits.

**Aphids**
*(Aphis gossypii)*
*Hemiptera: Aphididae | Worldwide*

A cosmopolitan and polyphagous pest that feeds on various crop hosts like cucurbits, peppers, eggplant, okra, cotton, and others. Aphids suck the sap from plants, which results in yellowing, curling, and deformation of leaves. Honeydew secretion leads to development of sooty mold and thus affects the normal growth of plants.

**Spiraling whitefly**
*(Aleurodicus dispersus)*
*Hemiptera: Aleyrodidae | Worldwide*

Feeding by large populations can cause desiccation of plants. Honeydew secreted by whiteflies also promotes growth of sooty mold and thus affects the normal growth of plants.

Photos
(Clockwise from left):
- Bell pepper fruitworm
- Chili thrips
- Aphids on pepper plant
- Spider mites (bottom)
Diseases

**Bacterial**

**Bacterial Leaf Spot**  
( *Xanthomonas campestris pv. vesicatoria* )

Water soaked lesions are observed on the leaves, fruits, and stem. These lesions gradually become necrotic and brown in the center. These necrotic spots can coalesce and cause chlorosis.

**Bacterial Wilt**  
( *Ralstonia solanacearum* )

This economically devastating disease of tomato is often lethal to pepper and other crops like eggplant, potato, and tobacco. 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 severe reduction in yield.

**Viral**

**Tomato Spotted Wilt Virus**

This virus, transmitted by thrips, can affect pepper at any stage of development. It causes stunting, rosette leaves, ringspots, mottling, mosaic, bronzing, and necrosis on infected plants. Fruits are distorted with small black specks.

**Cucumber Mosaic Virus**

A very common and devastating viral disease transmitted by aphids. Symptoms are variable and may range from no symptoms to severe stunting, mottling, and necrosis of foliage. Fruits are distorted and may break down on distal end.

**Pepper Veinal Mottle Virus**

Infected leaves show chlorotic vein banding, mottling, mosaic, and puckering. Plants may be stunted with a reduced and distorted fruit set. It is transmitted by aphids.

**Potato Virus Y**

It is common worldwide, especially under warm climatic conditions. Symptoms appear as vein clearing and progresses into a mosaic, dark green veinbanding of leaves. Stem necrosis and defoliation also occurs in some cases. Infection at an early stage of plant development could lead to a 100% yield loss.

**Fungal**

**Gray Mold**  
( *Botrytis cinerea* )

The fungus can affect young seedlings, flower petals, injured fruit, or senescing leaves. Initially, the symptoms appear as a dark, water-soaked, slimy lesion. The affected areas turn brownish-gray and powdery-looking as sporulation develops. Young seedlings may show damping off near the soil line.

**Powdery Mildew**  
( *Leveillula taurica* (Imperfect stage = *Oidiopsis taurica*) )

This fungus usually occurs on older leaves just before fruit sets. A patchy white growth occurs on leaves, which later covers the entire lower leaf surface. The upper surface of leaves may show yellowish or brownish patches. Infected leaves roll upward and later drop off.

**Damping Off and Root Rot**  
( *Pythium spp.*, *Rhizoctonia solani*, *Fusarium spp.* )

It can occur before or after plant emergence and can damage seedlings after transplanting. In pre-emergence damping off, seedlings fail to emerge. While in post-emergence, seedlings are stunted, wilted, and topple over.

**Cercospora Leaf Spot**  
( *Cercospora capsici* )

Small, round to oblong lesions occur on leaves, which later turn brownish-gray. Infected leaves often drop off.

**Anthracnose**  
( *Colletotrichum acutatum* and *C. gloeosporioides* )

Primarily the fruits are affected. Lesions are round and sunken. The center of lesion is covered by pink colored sporulation.

**Phytophthora rot**  
( *Phytophthora capsici* )

This is a very common fungal disease, which causes dead and wilted plants, especially in poorly drained soils. The crown region near the base is usually dark, sunken, and necrotic. Sometimes, vascular discoloration is observed.

**Choanephora Blight**  
( *Choanephora cucurbitarum* )

Pepper plants are susceptible from seedling to early flowering stage, but extensive damage occurs in the rainy season. Infected tissue turns brown or black and infected young fruits drop off. Other symptoms include wilting of leaves, and stems that appear wet and green, with bark that peels off and shreds easily.

**Verticillium Wilt**  
( *Verticillium albo-atrum*, *V. dahlia* )

In the beginning, the leaves roll inwards with some foliar wilting. As the disease progresses, yellowing of leaves, premature leaf fall, wilting and stunting of plants occur. Dark brown discoloration is seen in the vascular tissue that extends from the soil line to lower branches of the plant.

**Root Knot Nematode**  
( *Meloidogyne spp.* )

Nematodes have a wide host range and are most severe in warm areas with long growing seasons. Plants infected by root-knot nematodes 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.
Soil Preparation
Light, well-drained, and well-prepared fertile soil 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 other plant diseases.

Seed Selection
Select a high-yielding, locally preferred pepper variety that is resistant or moderately resistant to diseases such as bacterial wilt and Phytophthora blight. Grow transplants in covered seedbeds to prevent aphids, whiteflies, and transmission of viral diseases. Discard diseased seedlings or infected plants.

Seed Treatment
Treating seeds with the *Trichoderma viride* or *T. harzianum* fungi, *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.

Sanitation
Before sowing, remove and destroy plant debris or infested plant material from the field to avoid fungal diseases. Remove weeds, which may serve as a reservoir for disease.

Crop Rotation
Crop rotation with non-host crops also helps in reducing incidence of soil-borne diseases.

Grafting
Grafting is expensive but grafted plants are very beneficial when there is a risk of flooding or soil-borne diseases such as bacterial wilt and Phytophthora blight. AVRDC (The World Vegetable Center) recommends PP0237-7502, 0242-62 and Lee B chili accessions for grafting.

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

Mulching
Mulching conserves moisture, harbors natural enemies, and reduces insect pest, mite, and disease incidence. Use reflective mulches or straw mulch to reduce the aphid, whitefly, and thrip populations.

Sticky Traps
Setting up large, yellow sticky sheets in fields helps to reduce populations of pests such as aphids, thrips, and whiteflies. Use of water troughs may be effective in reducing aphid populations.

Biological Control
Inundative release of ladybird beetles helps to reduce aphid populations. Use of neem-based biopesticides helps in managing aphids, whiteflies, and mites. Sprinkler irrigation reduces mite populations.

Microbial Biological Control Agents
Formulations of the fungi *Verticillium*, *Paecilomyces*, *Metarhizium*, and *Beauveria* species and beneficial nematodes such as *Heterorhabditis* sp. and *Steinernema* sp. may be used for the control of whiteflies and thrips. Using *Bacillus thuringiensis* is also effective against lepidopteran pests. 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.

Prepared by Dr. Jaspreet Sidhu, IPM Innovation Lab

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.

Contact us:
Office of International Research Education and Development (OIRED)
Virginia Tech
526 Prices Fork Road
Blacksburg, VA 24061
540-231-3516 | rmuni@vt.edu
www.oired.vt.edu/IPMIL