# ORGANIC INSECT AND DISEASE CONTROL FOR SOLANACEOUS CROPS

## INTRODUCTION

The botanical family Solanaceae includes several important vegetable crops such as tomatoes, potatoes, eggplants, and peppers. These crops share a number of insect and disease pests, so any crop rotation plan should consider all crops grown from this family.

## I. INSECT CONTROL

**APHIDS** (Primarily the **GREEN PEACH APHID**, *Myzus persicae*, and the **POTATO APHID**, *Macrosiphum euphorbiae*)

Aphids are small, soft-bodied insects **(Photo 4.1)** that suck nutrients from plant tissues and form colonies on the undersides of leaves and often in or around flowers. Several different species of aphids attack potato, tomato, eggplant and pepper. In hot dry weather, populations can increase rapidly causing leaves to wilt and twist. In most organic systems, aphids are rarely a lasting problem because predator and parasite populations keep the aphid population in check. However, there is often a lag period between when aphid populations first arrive and when their natural enemies build up, so regular examination of the plants is needed. Some aphids transmit viruses, which are particularly devastating in seed potato production.

Cultural Control:

1) Encourage beneficial insects. It is most important to limit use of broad spectrum insecticides such as rotenone or pyrethrum because these kill predators and parasites, and may cause the aphid populations to flare up. Leaving or creating beneficial insect habitat and food sources will help.

2) Use virus resistant cultivars.

3) Control overwintering weeds and inspect overwintered and imported plants in greenhouses since they are often the source of initial infestation of spring transplants.

Materials Approved for Organic Production:

1) Soap: If aphid populations are high, control may be needed. Ensure coverage of the parts of the plant where aphids live, especially the undersides of leaves. In recent studies, soaps have been ineffective against green peach aphid. Other studies we examined indicated 5 good, 1 fair, and 2 poor results against other aphid species.

2) Rotenone is recommended in the older literature (check with certifier on approval status of formulated products, as none are currently OMRI listed).

3) Neem products can provide some control. Based on a limited number of studies, neem products gave good control of turnip aphid (2 studies); fair (4) to poor (3) control of green peach aphid; and mostly good control of other aphids (2 good, 2 fair, 1 poor). Please see the neem chapter for a discussion of the different types of neem products.

4) Summer oils (2 fair and 3 poor results) will provide some control.

5) Kaolin clay (currently not labeled for aphids on these crops) and plant and mineral oils may be effective.

**COLORADO POTATO BEETLE** (*Leptinotarsa decemlineata*)
Colorado potato beetles (CPB) overwinter as adults **(Photo 4.2)**, hibernating in the soil near where previous host crops were grown. They emerge in the spring and primarily crawl to new hosts where they feed and lay eggs **(Photo 4.3)**. The resulting larvae **(Photo 4.4)** and successive generations can quickly defoliate a crop. The CPB prefers potatoes and eggplants but can also be a problem on tomatoes and peppers.

Cultural Control:

1) Crop rotation out of susceptible crops is the first line of defense since CPB only feeds on solanaceous plants. Control of solanaceous weeds such as horse nettle is important.

2) A barrier trench lined with plastic between the old field and new field of host crops will catch many crawling adults and trap them. This will reduce the overall population, but supplemental control may still be required.

3) If young potato plants are infested, rapidly moving a flame from a propane torch over the top of the plant has been shown to kill the overwintered adult CPB that tend to feed at the top of the plant. Although this may singe the plant tissue, if done carefully there will be no long-term damage to the plant. Suction devices can also be used.

4) Mulch crops with straw or hay before adults arrive. This will significantly reduce and delay CPB pressure.

5) For plantings less than two acres, hand-picking may be practical if the CPB pressure is low.

6) Trap cropping is effective, using a potato variety such as 'Superior' that grows well in cool weather. Plant the trap crop between last year's and this year's fields (near CPB overwintering sites), and destroy by flaming when adult CPB numbers on the trap crop are high.

Materials Approved for Organic Production:

1) Spinosad: Recent studies showed 12 good and 2 fair results.

2) Neem products: Recent studies showed 1 good and 2 fair results. Generally, neem is slow-acting, but it reduces overall damage and numbers of large larvae. Please see the neem chapter for a discussion of the different types of neem products.

3) *Beauveria bassiana*: Recent studies showed 1 good, 1 fair, and 5 poor results.

4) *Bt tenebrionis* (also called *Bt san diego*) - currently there are no approved formulations

**EUROPEAN CORN BORER** (*Ostrinia nubilalis*)

The European corn borer has over 200 host plants and is primarily a pest of corn, but pepper and eggplant are also relatively common hosts and tomato and potato somewhat less so. In the spring adults lay their eggs on plants and the emerging larvae bore into stalks **(Photo 4.5)** or fruits. The larvae usually enter the fruit under the calyx or sometimes directly through the side and feed inside. Secondary rotting of infested fruit is common.

Cultural Control:

1) Crop rotation is only of limited value because the adults can easily fly between fields.

2) Some pepper varieties differ in their susceptibility, but there are no truly resistant varieties.

3) Effectiveness of spray materials can be increased by timing sprays using information from pheromone traps regarding peak activity periods. Check with county extension for any available IPM forecasting services.

Materials Approved for Organic Production:

1) *Bt kurstaki*: No recent studies on peppers; however, Bt can be effective but has a very short residual protection.

2) Spinosad: Recent studies: 3 good, 1 poor result on this crop.

**FLEA BEETLES** (**POTATO FLEA BEETLE-** *Epitrix cucumeris*, **TOBACCO FLEA BEETLE-** *Epitrix hirtipennis*, **PALESTRIPED FLEA BEETLE-***Systena blanda*, and **EGGPLANT FLEA BEETLE-** *Epitrix fuscula*)

Flea beetles **(Photo 4.6)** are common pests of potatoes, tomatoes and eggplants when the crops are young. Their feeding causes small holes in the leaves. Under light insect pressure and good growing conditions, seedlings and transplants will grow out of the damage. Eggplant is especially attractive to flea beetles and small transplants may need protection. The species of flea beetles that attack the Solanaceae are not the same as those that attack brassica crops or sweet corn. This is important when considering your crop rotation.

Cultural Control:

Row covers work well but can be expensive. Crops under row covers usually produce earlier yields.

Materials Approved for Organic Production:

The studies below were mostly conducted on flea beetle pests of other crops, particularly brassicas. Results may be different on flea beetle pests of solanaceous crops.

1) Rotenone: Growers have noted good control with rotenone (currently, no rotenone products are on the OMRI approved list).

2) Spinosad: Research trials have indicated that spinosad can be effective, though results are variable. (3 fair and 2 poor results).

3) Neem products are similarly effective (2 fair, 2 poor results). Please see the neem chapter for a discussion of the different types of neem products.

4) Capsaicin gives some control (45% in one study). The product, Miller's Hot Sauce™ is OMRI-approved and labeled for use on crop plants as a mammal repellant. If so used, it will also reduce flea beetle damage.

5) Pyrethrum: Pyganic™ has shown variable results (4 fair, 2 poor) even with high rates.

6) Kaolin clay (Surround™). Recent trials have shown three poor results.

**Note:** Since flea beetles can re-colonize rapidly, especially on sunny days, frequent treatment with any material may be required. It is advisable to treat all susceptible plants in the field to reduce influx from untreated areas.

**HORNWORM** (**TOBACCO**, *Manduca sexta*, and **TOMATO**, *Manduca quinquemaculata*)
These large green caterpillars **(Photo 4.7)** are more common in warmer climates but do turn up sometimes, including in hoophouses and greenhouses. They can consume considerable leaf tissue.

Cultural Control:

Scouting and hand picking the larvae works well because they are usually in small numbers. The caterpillars are well camouflaged; look for the large droppings beneath plants.

Materials Approved for Organic Production:

*Bt kurstaki*: There is a lack of research data, however growers report successful use.

Spinosad: One recent study showed good control.

**POTATO LEAFHOPPER** (*Empoasca fabae*)
Potato leafhoppers **(Photo 4.8)** do not overwinter in the Northeast but "leap frog" their way up from southern areas each summer, arriving in very large numbers some years, and small numbers in others.

The potato leafhopper favors alfalfa, beans, strawberries and potatoes. It is a serious pest of potatoes, as both adults and larvae suck plant juices. Their feeding causes curling, stunting and dwarfing accompanied by a yellowing, browning or blighting of the foliage known as "hopperburn" or tipburn because the damage is first seen at the leaf tips working inwards. When significant "hopperburn" is seen, your crop has already lost yield, so be sure to scout your field early.

Cultural Control:

1) Crop rotation will not help control leafhoppers since they do not overwinter in the Northeast and because the pest can move large distances.

2) Some varieties are more tolerant and these include 'Elba', 'Green Mountain', some russets, 'Snowden', 'Ontario', and 'Katahdin'. 'Red Norland' is very susceptible. More information may be found in seed catalogues or through your local extension office.

3) Scouting and early detection are important because population levels vary greatly from year to year, and successful control must start early.

Materials Approved for Organic Production:

1) Pyrethrum (recent trials have shown 1 good result).

2) Neem products: One recent study showed fair control. Please see the neem chapter for a discussion of the different types of neem products.

3) Spinosad: Entrust® is not effective against this pest.

**TARNISHED PLANT BUG** (*Lygus lineolaris*)
The tarnished plant bug (TPB) is a sucking insect **(Photo 4.9)** that feeds on flowers and buds of eggplant, pepper and tomato causing flower drop, which greatly reduces yield in some years.

Cultural Control:

1) Do not mow legume hay fields surrounding crops just prior to or during flowering of solanaceous crops because that will drive the TPB into the crops.

2) Floating row covers work well to protect buds and flowers on young plants and can greatly increase early yield but may not be practical for mid-summer use.

3) Practice good weed control, since TPB seems to be more of a problem in weedy areas.

Materials Approved for Organic Production:

There are no proven effective organic insecticides for TPB, although pyrethrums will reduce the overall populations. Neem products are recommended for trial.

## II. DISEASE CONTROL

### DISEASES CAUSED BY BACTERIA

**BACTERIAL CANKER** (*Clavibacter michiganensis* subsp. *michiganensis*), **BACTERIAL SPECK** (*Pseudomonas syringae* pv. tomato) and **BACTERIAL SPOT** (*Xanthomonas campestris* pv. *vesicatoria*) are all quite common and are all managed the same way.

Canker is most common on tomato but can occur on pepper as well. The first symptoms may include wilting, browning at the margin of the leaflet, and leaflet curling. Later symptoms include brown stem cankers that frequently crack open, and spots on the fruit. The fruit lesions have a dark brown center surrounded by a white ring, with a characteristic "birds-eye" appearance **(Photo 4.10)**.

Speck is found only on tomato. Small black lesions (1/8 inch) with a yellow halo appear on leaves, and black raised lesions or dots appear on fruit **(Photo 4.11)**.

Spot occurs on both tomato and pepper. Symptoms can appear on leaves, stems, and fruit **(Photo 4.12)**. Lesions begin as water-soaked spots that become brown and may have an irregular shape **(Photo 4.13)**. Infected leaves eventually turn yellow and drop off the plant.

Cultural Control:

1) Plant disease-free seed. Hot water seed treatment at 122°F for 25 minutes is recommended for tomato seed. For pepper seed, hot water treatment at 125°F for 30 minutes is recommended. Strictly

follow time and temperature recommendations to minimize damage to seed germination and vigor. Hot water treatment can also eliminate fungal pathogens on the seed. Chlorine treatment of seed is also effective and may be permitted, check with the certification agent. Use one part household bleach to 4 parts water plus a half teaspoon of surfactant per gallon of solution, agitate seed for one minute, then rinse in running water for 5 minutes. Dry seed thoroughly.

2) Pepper varieties that are resistant to bacterial spot are available (see Cornell 2004) .

3) If growing and using transplants, all greenhouse materials should be cleaned and sterilized prior to use. The spread of bacterial diseases in the greenhouse is common.

4) If trellising or caging tomatoes, stakes and cages should either be new or cleaned and disinfected. Sodium hypochlorite at 0.5% (12x dilution of household bleach) is effective, and must be followed by rinsing, and proper disposal of solution. Hydrogen peroxide is also permitted.

5) If pruning tomatoes, disinfect tools or gloves regularly to minimize spread of bacteria from infected plants.

6) Use a 3-year crop rotation away from tomato and pepper.

7) Because bacterial diseases can spread by splashing water, avoid overhead irrigation.

8) Avoid working in the crop when it is wet.

9) Compost may contain organisms that are antagonistic to the pathogen.

### Materials Approved for Organic Production:

Copper compounds. Recent studies showed 2 fair and 1 poor result.

**COMMON SCAB** (potato)

Common scab is a disease of potatoes that results in corky lesions on the surface of the tuber **(Photo 4.14)**. It is caused by the filamentous bacterium *Streptomyces scabies*. The pathogen can survive in the soil for many years.

### Cultural Control:

1) Plant scab free potato seed.

2) Rotate with crops that are not hosts (hosts include beets, carrots, turnip, radish and parsnip). Good rotation crops are sweet corn and green manures such as rye, millet and oats. Avoid plow down crops of legumes, especially red clover immediately before potatoes.

3) Use resistant cultivars (see Cornell 2004).

4) Maintain pH below 5.5, although this is usually not suited for diversified vegetable growers since it is detrimental to the other crops in the rotation.

5) Maintain good soil moisture, especially at tuber initiation.

Materials Approved for Organic Production:

1) Applying sulfur in the row when planting is suggested, but unproven.

2) Biologicals such as Trichoderma are recommended for grower testing.

## DISEASES CAUSED BY FUNGI AND FUNGAL-LIKE ORGANISMS

### **ANTHRACNOSE** (tomato)

Anthracnose is a common disease of ripe tomato fruit, caused by the fungal pathogen *Colletotrichum coccodes*. Symptoms begin as small, sunken, water saturated lesions. Black fungal structures develop and are visible within the lesion **(Photo 4.15)**. While symptoms appear only on ripe fruit, infection can occur on both green and ripe fruit.

Cultural Control:

1) Use a 3-year crop rotation away from potato, tomato and pepper.

2) Mulching can reduce the severity of infection.

3) Avoid overhead irrigation or use it such that fruit wetness is minimized.

4) Plant disease-free seed. Hot water seed treatment at 122°F for 25 minutes is recommended for tomato seed.

5) Stake or cage plants so fruit is not in contact with the soil.

6) Compost may contain organisms that are antagonistic to the pathogen.

Materials Approved for Organic Production:

Copper products showed 1 poor result in recent studies.

### **BLACK SCURF** (potato)

Black scurf is a fungal disease (*Rhizoctonia solani*) of potato that can delay emergence and reduce yield. More commonly, however, the disease results in a high percentage of tubers with black rough structures on the surface that reduce marketability **(Photo 4.16)**. These are asexual reproductive structures called sclerotia. These sclerotia can survive for years in the soil and infect susceptible crops in future seasons. While *R. solani* is uncommon on tomato, pepper and eggplant, the pathogen has a very broad host range including many vegetables.

Cultural Control:

1) Use seed tubers free of sclerotia.

2) Use a 3-year or longer crop rotation including a grass or cereal green manure such as sudex (sorghum-sudan grass hybrid) or Japanese millet the year before potatoes.

3) Promote quick emergence by planting in warm soil, covering seed pieces with no more than 2 inches of soil and hilling up later. Also, avoid wet soil at planting time.

4) Plow down Brassica green manures that contain high levels of glucosinolates, e.g., 'Pacific gold' oriental mustard and 'Idagold' mustard.

Materials Approved for Organic Production:

Trichoderma (RootShield®) has shown variable results.

**EARLY BLIGHT** (potato, tomato)

Early blight is caused by two fungi (*Alternaria solani* and *Alternaria tomatophila*) that are a serious problem in tomatoes and potatoes but rarely effects peppers and eggplants. All of the above-ground portions of the plant can be affected throughout the growing season. The disease starts on the lower leaves with small circular spots that have a target appearance of concentric rings **(Photo 4.17)**. Leaves develop yellow blighted areas and later the tomato fruit may rot on the stem end. Potato tubers can also become infected, but this is quite rare. The pathogen can overwinter in the soil on diseased plant residues.

Cultural Control:

1) Use crop rotations of at least 3 years to non-hosts (away from tomato, potato and eggplant).

2) Provide optimum growing conditions and fertility. Stressed plants (including drought) are more susceptible to early blight.

3) Stake or cage plants to keep fruit and foliage away from soil.

4) Drip irrigation is preferred, or overhead irrigation starting before dawn, so that the plants are dry early in the day. The key is to keep the period of leaf wetness to a minimum.

5) Mulching helps to prevent splashing of spores from soil up to lower leaves.

6) Indeterminate tomato and late-maturing potato varieties are usually more resistant/tolerant to early blight.

7) Early blight can be seed-borne, so buy from a reliable supplier. Hot water seed treatment at 122°F for 25 minutes is recommended to control early blight on tomato seed. See chlorine treatment proce-

dures under bacterial diseases.

8) Disinfect stakes or cages with an approved product each season before using. Sodium hypochlorite at 0.5% (12x dilution of household bleach) is effective, and must be followed by rinsing, and proper disposal of solution. Hydrogen peroxide is also permitted.

### Materials Approved for Organic Production:

1) Copper products showed one good and one poor result in recent studies.

2) A *Trichoderma harzanium* product, PlantShield HC®, used as a drench at planting, showed fair to good results in NYS on tomatoes over three seasons.

**GRAY MOLD** (greenhouse tomato)

Gray mold, caused by the fungus *Botrytis cinerea*, can occur wherever tomatoes are grown but is primarily a problem in greenhouse production. The disease can affect all aboveground parts of the tomato. Lesions can form on leaves, stem, petiole and senescent petals frequently causing blossom drop or infected fruit **(Photo 4.18)**. Lesions on leaflets progressively expand to include the petiole and eventually the whole leaf is killed. Infected tissue develops a gray fuzzy mold growth, which can give off clouds of spores when shaken.

### Cultural Control:

Since gray mold has a very wide range of hosts, the spores are difficult to avoid. Controlling the disease involves managing the environment in the greenhouse to make it less favorable for disease spread. Reduce leaf wetness to a minimum and maximize ventilation. High calcium levels in the soil that result in a calcium to phosphorus ratio of 2 or higher in the leaf petiole aids in reducing susceptibility of tomato plants.

### Materials Approved for Organic Production:

Copper may be effective. Begin application before the canopy becomes dense.

**LATE BLIGHT** (potato, tomato)

Late blight **(Photo 4.19)** is caused by a fungus-like pathogen (*Phytophthora infestans*) and is a serious disease of both potato and tomato, and is infamous as the cause of the Irish potato famine. It can quickly defoliate plants and cause fruit rot in tomato and tuber rot in potato. Spores are carried long distances in the wind and the disease can spread rapidly. The pathogen overwinters only in living plant debris, most commonly on seed potatoes or unharvested and cull potatoes in the Northeast. Imported solanaceous transplants including tomato and petunia may harbor late blight.

### Cultural Control:

1) Destroy cull potatoes and control potato volunteers in all fields.

2) Use drip irrigation rather than overhead in order to keep the foliage

dry. Alternatively, overhead irrigate early in the morning before dawn so the plants are dry early in the day. The key factor is to keep the period of leaf wetness to a minimum.

Materials Approved for Organic Production:

Copper products give fair to good control but must be applied often and thoroughly.

**LEAF MOLD** (greenhouse tomato)

Leaf mold, caused by *Fulvia fulva*, is primarily a disease in greenhouse production in the northeast. It is a disease that is usually only a problem under highly humid conditions. The initial symptoms are light green to yellowish spots on the upper surface of the leaf **(Photo 4.20)** with a dark green mold on the undersurface of each spot **(Photo 4.21)**. Later the spots coalesce and the leaves wither and drop from the plant. Usually, only the foliage is affected. The older leaves are affected first and so if the disease comes in late in the season it does not affect yield. If it strikes early the loss of foliage will reduce yield. In severe outbreaks blossoms, petioles and fruit may be affected.

Cultural Control:

1) Sanitation is important. After harvest remove all crop residue. Once the crop residue is removed the production area should be steamed for at least six hours. Minimizing periods of leaf wetness reduces the severity of leaf mold. Avoid wetting leaves by overhead irrigation or dripping condensation. Maintain good ventilation.

Materials Approved for Organic Production:

None known.

**PHYTOPHTHORA BLIGHT** (pepper)

Phytophthora blight, caused by *Phytophthora capsici*, is a serious problem of peppers in warmer parts of the Northeast. Plants collapse and fruit will rot where they touch the ground **(Photo 4.22)**. Fruit lesions develop as dark, water-soaked areas that spread and become coated with the white spores of the pathogen. *P. capsici* overwinters in the soil.

Cultural Control:

1) Crop rotation away from a host plant for 4-5 years. Note that peppers, tomatoes, eggplants, cucurbits, lima beans and snap beans are all hosts for this pathogen.

2) Use raised beds and ensure good soil drainage.

3) Maintain good soil structure to avoid poor drainage and standing water in the field.

Materials Approved for Organic Production:

No control materials are effective against Phytophthora blight.

**SEPTORIA LEAF SPOT** (tomato)
Septoria leaf spot is a fungal disease (*Septoria lycopersici*) of tomato that behaves in a manner similar to early blight. Initial symptoms include peppering of lower leaves first with small circular spots with a dark brown margin **(Photo 4.23)**. Rapid defoliation can occur under optimal conditions **(Photo 4.24)**. The fungus is spread by splashing water, insects, equipment or field workers.

Cultural Control:

1) Since this is often seed-borne, be sure to buy seed and/or transplants from reputable sources.

2) Space plants to promote air circulation, which will help keep leaves dry.

Materials Approved for Organic Production:

Copper products showed one good and one poor result in recent trials.

**VERTICILLIUM WILT** (eggplant, tomato)
Verticillium wilt can be a serious problem in eggplant and some tomato varieties. This disease can be caused by either of two fungal pathogens, *Verticillium albo-atrum* or *Verticillium dahliae*. Infected plants exhibit leaves that turn yellowish and portions of the plant collapse **(Photo 4.25)**. Most modern tomato varieties are resistant, but many heirlooms are not. On potatoes the disease is called "early dying."

Cultural Control:

1) Avoid other host crops before eggplant or tomatoes in the rotation including; tomatoes, eggplant, potatoes, peppers and strawberries.

2) Plant resistant varieties (see Cornell 2004).

3) Compost may contain organisms that are antagonistic to the pathogen.

Materials Approved for Organic Production:

No control materials are effective against Verticillium wilt

**WHITE MOLD** (tomato, pepper, eggplant)
White mold is a fungal disease caused by *Sclerotina sclerotiorum*, which has a very wide host range including tomatoes, eggplants, peppers, beans, carrots, lettuce, cole crops and many weeds. Early symptoms are water-soaked lesions and a firm rotting of stem tissue. Later these lesions become covered with a pure white fungal growth and black sclerotia can be found on and in the diseased tissue **(Photo 4.26)**. All of the tissue above the lesion dies, so entire branches of the plant will wilt and then die. This disease is most common on heavy soils with poor drainage.

Cultural Control:

1) Use raised beds and tiles to improve drainage if necessary.

2) Rotation is difficult because so many crops and weeds are hosts and the sclerotia are very long-lived in the soil. Four years of sweet corn or other cereal is recommended for infested fields.

3) Avoid excessive irrigation.

4) Avoid overcrowding and weeds that maintain moisture in the crop canopy. Good airflow is essential to control white mold.

### Materials Approved for Organic Production:

*Coniothyrium minitans* (Contans®) is a beneficial fungus that can be applied to the soil to reduce survival of sclerotia. It should be applied after a crop infected with white mold or before a susceptible crop is planted in an infested field.

## REFERENCES

Cornell 2004. Reiners, S., Petzoldt, C. H., and Hoffmann, M. P. eds. Cornell Pest Management Guidelines for Vegetables 2004. Cornell Cooperative Extension Publication. Chapter 19, Eggplant; Chapter 23, Peppers;Chapter 24, Potatoes; Chapter 27, Tomatoes.http://www.nysaes.cornell.edu/recommends/

# CHAPTER 4 - SOLANACEAE

**Photo 4.1** Potato aphids.

**Photo 4.2** Colorado potato beetle adult.

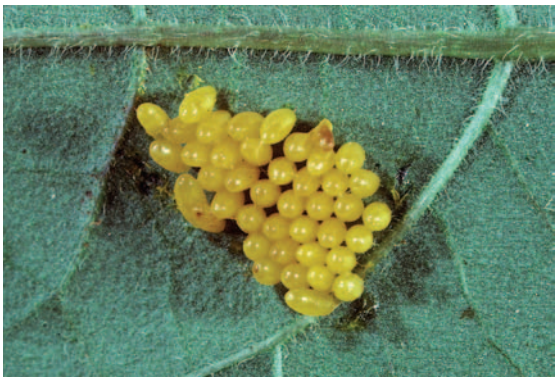

**Photo 4.3** Colorado potato beetle eggs.

**Photo 4.4** Colorado potato beetle larva.

**Photo 4.5** European corn borer in a potato plant.

**Photo 4.6** Potato flea beetle adult.

**Photo 4.7** Hornworm larva.

**Photo 4.8** Potato leafhopper and its damage.

**Photo 4.9** Tarnished plant bug (courtesy Purdue University).

**Photo 4.10** Bacterial canker symptoms on tomato fruit and leaflet.

**Photo 4.11** Bacterial speck symptoms on tomato fruit.

**Photo 4.12** Bacterial spot lesions on pepper fruit.

**Photo 4.13** Bacterial spot symptoms on pepper leaves.

**Photo 4.15** Tomato anthracnose symptoms.

**Photo 4.17** Early blight symptoms on tomato.

**Photo 4.19** Potato late blight symptoms.

**Photo 4.14** Common scab of potato (courtesy K.L. Perry).

**Photo 4.16** Black scurf of potato (right) and healthy tuber (left) (courtesy K.L. Perry).

**Photo 4.18** Grey mold symptoms on tomato fruit.

**Photo 4.20** Tomato leaf mold symptoms on upper leaf surface.

**Photo 4.21** Tomato leaf mold symptoms on lower leaf surface.

**Photo 4.23** Septoria leaf spot of tomato, young lesions.

**Photo 4.25** Verticillium wilt symptom on eggplant.

**Photo 4.22** Phytophthora blight symptoms on pepper.

**Photo 4.24** Septoria leaf spot of tomato, severe symptoms.

**Photo 4.26** White mold symptoms on pepper.