

## IPM Series: Tomatoes

Possible Causes		Notes	
<b>LEAVES/STEMS</b>			
Leaf yellowing	Older leaf drop	Normal for bottom leaves to yellow and drop as plant ages	
	Nutrient deficiency	Interveinal yellowing- potassium, iron, magnesium Older leaves first, followed by younger leaves- nitrogen Leaf tips- boron	
	Spider mites	Yellow stippling; leaves may appear dirty on undersides	
	Whitefly	Small, transparent oval insects on leaf undersides. Tiny, white insects fly up when plant is disturbed	
	Leafhoppers	Leaf margins look scorched; leaves curl upward. Small, wedge-shaped insects fly up when plant is disturbed.	
	Fusarium wilt	Lower leaves yellow and wilt	
	Bacterial wilt	Upper leaves yellow and wilt	
	Verticillium wilt	Lower leaves yellow and wilt	
	Root knot nematodes Air pollution	Plant becomes yellow and stunted. Small nodules cover roots Speckled upper leaf surfaces; undersides may appear silver	
Leaf spots and blotches	Early blight	Small, brown lesions with yellow halos that rapidly enlarge; "bull's-eye" pattern within lesions. Lower leaves affected first.	
	Septorial leaf spot Gray leaf spot	Small, round gray spots with dark margins on lower leaves Numerous small, dark brown lesions on lower leaves Leaf centers dry out and crack	
	Late blight	Dark brown blotches on leaf tips and margins that quickly enlarge; water soaked appearance	
	Bacterial speck Bacterial spot	Tiny, dark brown circular spots that develop yellow rings Same as above	
	Freeze damage Edema	Water-soaked blotches that turn black Dark, raised spots on upper surfaces caused by excessive moisture	
	Purplish leaves	Tomato spotted wilt virus	Flecking or irregular lesions on upper leaf surface
		Phosphorous deficiency	Primarily on young transplants
Cold damage		Primarily on young transplants	
Leaf and stem distortion	2,4-D herbicide damage Mosaic viruses	Damage on new growth. Leaves become finely divided and narrow. Mottled, deformed leaves; stunted plants	
	Leaf curling	Aphids	Small, soft, pink or green insects on young growth; downward curling
Water stress		Lower leaves curl upward first	
Varietal characteristic		Lower leaf curling upward during hot weather	
Heat stress		Lower leaf curling upward during hot weather	
Herbicide drift		Especially with phenolic type herbicides (2,4-D)	

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Leaf scorch	Drought stress Pesticide burn Fertilizer burn	Leaf margins are affected first Random, irregular spots up to entire leaf burn Leaf margin burn from roots contacting excessive salts; grayish spots from direct foliar contact with fertilizer
Leaf and stem browning	Early blight Late blight Fusarium wilt Bacterial wilt Southern blight	Leaves brown and die; lesions extend to stems Wet or dry browning and rotting of leaves and stems Wilting precedes browning Rapid browning from top down Lower stem turns dark brown
Stems/entire plant wilts	Fusarium wilt Bacterial wilt Verticillium wilt Root knot nematode Walnut wilt Southern blight Drought stress Standing water	Wilting of lower branches first; plants recover at night; discolored stem tissue Rapid wilting from top down without recovery; discolored stem tissue Similar to fusarium; uncommon in Maryland Entire plant wilts Planted in vicinity of walnut tree; roots exude an inhibitory chemical - (juglone) Dark canker forms at soil line followed by plant collapse Newer growth wilts Roots deprived of oxygen
Leaves mined	Pin worm	Irregular leaf blotches; leaves folded, webbed and mined. Small, dark caterpillars may be found inside
Leaves with holes	Flea beetle	Tiny holes in shotgun pattern. Small, shiny dark insects that jump when disturbed
Leaves chewed	Cut worms Hornworm Armyworms Colorado potato beetle	Gray or black caterpillar; several generations; feed on young or mature plants at night. Mid to late summer pest; very large with red or black "horn"; strip foliage off branches Late season caterpillar Adults and larvae chew entire leaves
Nubby growths on stems	Varietal characteristic; aerial roots	

## BLOSSOMS/FRUITS

Blossom drop	High or low temp. Air pollution Excessive nitrogen Limited sunlight Initial heavy flower set Botrytis (gray mold)	Temps. above 95°F. and below 50°F.  Lush, dark green plant growth  Pedicels (blossom stems) look pinched or withered
Failure to flower or fruit	Excessive nitrogen High or low temp. Limited sunlight	Unusually tall, lush plants Poor pollination/aborted fruits with temperature extremes Plants receive less than 5 hrs. of sun and/or spaced too close
Large holes chewed in fruit	Hornworms Tomato fruit worm  Armyworms Cutworms Colorado potato beetle Slugs	Chew or scrape green fruit Bore deeply into young, green fruit; fruits ripen prematurely and secondary rots often develop Drier, more shallow feeding hole than above Variegated form climbs onto mature plants to feed on green fruit May feed on fruits if present in large numbers, (adults & larvae). Rasping type of damage on bottom of fruits resting on or near the ground

	Animals (turtles, squirrels deer, ground hogs, birds)	Pecked, torn or chewed fruits; often one “strike” per fruit on fruits closest to the ground; more noticeable during drought
Small holes chewed in fruit	Pin worm	Bore into stem-end of green or ripe fruit; several generations per season
Tiny spots or flecks fruit	Bacterial speck Bacterial spot Stink bug	Small dark spots; may be raised or sunken and have a ring or halo Small raised brown spots; larger than bacterial speck lesions Hard, yellow, white or green spot beneath fruit skin
Spots on fruit	Early blight Late blight Buckeye rot Rhizoctonia fruit rot Anthracnose Blossom-end rot Stink bug	Dark, leathery lesions, may be shrunken; “bull’s eye” pattern may be visible Olive green to black, oily looking lesions; wet rots develop under favorable conditions Smooth, dark brown spots in a concentric ring pattern; enlarge to cover half or more of fruit; generally starts at blossom end Affects fruits in contact with soil Soft rot; circular, brown, shrunken lesions on ripening fruit Dark, leathery lesions on fruit bottom. Most prevalent on enlarging fruit See section above
Large discolored areas	Sunscald Green shoulder Late blight Blossom-end rot Buckeye rot Graywall	Light colored; becomes soft. Typically on surfaces exposed to full sunlight due to defoliation Varietal characteristic; often affects large-fruited varieties. see “Spots on Fruit” see “Spots on Fruit” see “Spots on Fruit” Blotchy ripening; brown, irregular lesions inside and outside fruit; develops on mature, green fruit (physiologic disorder)
Soft rots	Gray mold Freeze damage Fruit flies Soil rots: pythium and rhizoctonia Anthracnose	Small, white halos on green or ripe fruit; may cause decay of flowers and fruit Fruit become soft and discolored Soft rot in stem-end of ripe or damaged fruit Rot damage on fruits that contact the soil See “Spots on Fruit”
Large, pithy core	Varietal characteristic	May also be encouraged by hot, dry weather
White pithiness	Drought and high temperature	Speculation is that stressed plants produce extra conductive tissue to bring moisture into fruit
Seeds germinate inside fruit	Late season ripening	The chemical that inhibits premature sprouting breaks down under cool, low light conditions
Failure to ripen	Insufficient ripening time Excessive nitrogen	Late season problem; short days, low sunlight, plant crowding Avoid overfertilization, particularly after fruits form
Uneven ripening	Cold temp. Varietal characteristic Weak, unthrifty plants	Late season problem Especially on large-fruited and plum-type varieties Poor soil; plants too crowded or neglected
Distortion/malformed fruit	Cool temperatures Exposure of plants to phenolic type herbicides	Temperatures below 50°F. at or before flowering cause “cat-facing” and “zippering”; damage most common on first cluster

Cracking	Excessive nitrogen Excessive moisture  Varietal characteristic	Avoid overfertilization, particularly after fruits form Concentric and radial cracks on ripe fruit; avoid overwatering (Cracking is more severe with high temperatures); use raised beds
Splitting of stem	Normal growth response	Occurs late in season along main stems
Broken branches	Excessive fruit load	Inadequate support for high-yielding plants

## TRANSPLANTS AND SEEDLINGS

Symptoms	Possible Causes	Notes
White-tipped leaves	Frost damage	Tomatoes insufficiently hardened; planted too early
Purple leaves	Cold damage Phosphorous deficiency	Low temperatures prevent phosphorous uptake
Wilted	Desiccation Water stress	Leaves may become pale and dry with high winds Lack of adequate water; related to wind burn
Plants fall over and die	Damping-off Cutworms	Tap root and lower stem shrivel and darken Night feeders; plants cut off at soil line
Leaves and stems chewed	Slugs and snails	Night feeders; slimy trails may be seen
Plants cut off at soil line	Cutworm  Slugs and snails	Plants sometimes “disappear”; dragged into underground burrow by cutworm; damage generally occurs under cool conditions, May-June Night feeders; slimy trails may be seen
Small holes	Flea beetles	Small, dark, shiny beetles that jump when disturbed; “shotgun” feeding pattern
Leaf yellowing	Spider mites Whitefly	Fine stippling, especially in warm weather Tiny, white insects fly up when plant is disturbed; usually from greenhouse where plants were grown

The tomato is the most commonly grown vegetable in Maryland home gardens. It is cultivated here as a tender, warm-season annual. Tomatoes are a reliable garden crop although the fruits and foliage are subject to damage each season by numerous insects and diseases. Some, like early blight, can be quite serious from year to year. However, a large number of the tomato problems observed each season by gardeners are cultural and environmental. These include, insufficient water, nutrients, space, sunlight and support; poor soil, low pH, temperature extremes, root damage from cultivation, planting too late or early, plants not “hardened-off” properly, and setting out poor transplants.

The **integrated pest management** approach to preventing or managing tomato problems is recommended and can be summarized as follows:

1. **Correctly identify the problem; if insect or disease, learn the life cycle, symptoms and behavior.**
2. **Learn to anticipate and prevent problems (e.g. reduce plant stress).**
3. **Monitor the problem for worsening symptoms.**
4. **If level of damage becomes unacceptable choose a “least toxic” control.**

The severity of some common problems is closely related to the weather (some diseases are worse in “wet” years) and to your gardening decisions (selected varieties, spacing, etc.).

## Cultural/Environmental Problems

### Nutritional

#### Early Season

Tomato plants are deep-rooted, heavy feeders that perform best in deep, fertile soils amended with organic matter. Early season **leaf yellowing** can be caused by a lack of nitrogen or potassium while **purplish leaves** indicate a phosphorous deficiency. Cool soil will limit the uptake of plant nutrients. Do not plant tomatoes deeply in cool soils (less than 60°F). Watering-in your transplants with a balanced soluble fertilizer, especially those high in phosphorous, will help alleviate these problems. Foliar sprays of kelp (seaweed extract), “manure tea” or other soluble fertilizers can also help plants overcome early season nutrient stress.

#### Side-Dressing

Avoid side-dressing with high nitrogen fertilizers such as ammonium nitrate (33% N) and urea (46% N). Keep soluble and granular fertilizers off foliage to prevent **leaf scorch**.

#### Boron Deficiency

If you have light, sandy soil (Southern Maryland and the Eastern Shore), broadcast and incorporate 6-7 level tablespoons of borax per 1,000 sq. ft. of gardening area. These soils tend to be deficient in boron and will produce poor tomato crops unless boron is added each year.

#### Blossom-End Rot

This physiologic disorder results from a lack of calcium in enlarging fruits. The fruit tissue disintegrates on the blossom or bottom end of the fruit leaving dark brown lesions that are sunken and leathery. During periods of rapid plant growth calcium is taken up and deposited in the expanding leaves. If there is insufficient calcium in the soil or if the plant can't take up calcium due to lack of water, the fruits will begin to show symptoms. Affected fruits should be immediately pulled and discarded because they use up nutrients and water.

Plants tend to “grow out of the problem”. Calcium chloride may be sprayed on affected plants but this will not reverse existing damage. **You can reduce blossom-end rot by:**

- Using calcitic or dolomitic lime in the fall to maintain a proper pH (6.3-6.8)
- Mixing in a handful of ground limestone with the soil from each planting hole in the spring
- Mulching your plants to conserve soil moisture
- Avoiding high nitrogen fertilizers
- Deep, regular watering; a mature, fruiting plant requires 1-2 gals. of water twice a week during dry periods.

## Wind, Water, Temperature

Lack of available water or wind whipping of un-protected plants can cause early season leaf scorch. Lower **leaf curling** may be caused by water and temperature stress. Many fruit and flower problems are related to environmental stressors. Temperatures below 55° F. or above 95° F. and water stress may interfere with pollination and fertilization and lead to **blossom and fruit drop**. Flower buds exposed to night temperatures below 55° F. may produce fruits that are “**catfaced**” or **deformed**. Remove these fruits immediately.

### Sunlight and Spacing

Tomatoes need 4-6 sq. ft. of growing area and a minimum of 6 hours of direct, daily sunlight (they are more productive with 8-10 hours). Plants receiving insufficient sunlight may become weak and spindly and produce fewer blossoms and fruits. Furthermore, the fruits may **ripen unevenly** and fail to develop good flavor.

### Air Pollution/Pesticide Injury

Ozone and PAN cause white and yellow or purple flecking and lower leaf silvering over the entire plant when air pollution indices are high. Leaf burn from chemical sprays (soaps, oils, fungicides) may cause random leaf spotting or scorching of leaf margins or entire leaves. This is more likely to occur under high humidity and temperature conditions. Tomatoes are very susceptible to herbicide drift injury from phenoxy herbicides (including 2,4-D, especially the volatile ester form, and dicamba). They cause crinkling, cupping and twisting of foliage. Young leaves may also be abnormally small and finely divided. Glyphosate (Roundup) causes leaves to become strappy and twisted and may delay blooming and fruiting. Plants often “grow out” of the damage.

## Foliar Diseases

### Plant Wilts

**Fusarium, verticillium and bacterial wilt** are soil borne diseases that can survive in soil for many years with or without host plants. **Fusarium wilt** is by far the most prevalent of these wilt diseases in Maryland. Symptoms first appear early-mid summer when first fruits enlarge. Wilting and browning of shoots and leaves occurs first on lower branches. Leaves may wilt on only one side of a branch. Eventually the entire plant shrivels and dies. When you slice an infected stem lengthwise you'll notice a brown streak between the outer green skin and inner pith. **Verticillium wilt** of tomatoes is very similar to fusarium wilt but is uncommon in Maryland. **Bacterial wilt** produces a rapid, top-down wilt with no recovery at night.

Severe **water stress** caused by a lack of water, poorly developed root system or poorly drained soil, will produce wilt symptoms.

**Control:** Rotation within a small garden is not likely to reduce the incidence of this disease. Replacing or solarizing infected soil can be costly and may not solve the problem. **Many popular hybrid varieties have resistance to Race 1 of Fusarium Wilt. If this disease is a problem in your garden select only those varieties with resistance to Races 1 and 2.**

## Leaf Spots

Many fungal and bacterial diseases affect tomato foliage. **Septoria leaf spot** and **gray leaf spot** are early season diseases that produce small lesions on lower leaves. They often come into the garden from infected transplants but are rarely devastating. Other minor diseases include bacterial spot and speck and powdery mildew.

### Early blight (*Alternaria solani*)

Early blight is a widespread and often damaging fungal disease that overwinters on tomato vine debris and is splashed from soil onto lower leaves. This disease spreads rapidly during wet or dry weather. Upon close examination you will see brown, circular lesions with a defined “bull’s-eye” pattern. The fungus can move to shoots and the stem-end of fruits. Infected leaves turn yellow and then brown. Under very favorable conditions early blight may defoliate entire plants.

**Control:** Select varieties with purported resistance. Remove and discard all infected tomato plant debris at the end of each season to limit overwintering of spores. Provide adequate spacing between plants, remove “suckers” merging from the base of plants and lay down a thick organic mulch to prevent soil splashing onto lower leaves, or plant on plastic mulch. Carefully inspect transplants for signs of this disease prior to planting. Chlorothalonil and fixed copper fungicides can be used to prevent or slow infection.

### Late Blight (*Phytophthora infestans*)

Late blight affects leaves, stems and fruits. The disease comes in on diseased transplants and seed potatoes. Fungal spores are spread by air from garden to garden. New strains of late blight have been found in recent years in Maryland, which may have the ability to overwinter in the soil. This could greatly increase the prevalence of this disease. Symptoms appear during prolonged cool, wet weather. Rapid browning of leaf tips and margins and plant stems is followed by the development of oily-looking, olive to black lesions that spread over the fruits. The disease slows down during dry periods but will continue to defoliate plants with a return to wet conditions.

**Control:** Purchase disease free transplants. Select only certified, disease-free seed potatoes and never plant potatoes from a supermarket. Do not leave potato tubers in the garden. Pull up and discard infected plants. Keep foliage dry (avoid overhead watering) and plant tomatoes in sunny, well-drained locations. Protectant fungicides, including chlorothalonil and fixed copper are effective if applied prior to infection.

## Fruit Diseases

**Soft rots** invade ground-grown fruit, particularly when no mulch is placed under plants. Some soft rot diseases, such as **anthracnose**, may appear on staked tomatoes under wet conditions. The development of certain foliar diseases (e.g. early and late blight develop) may produce damaging symptoms on green or ripening fruits. Affected fruits should be removed and discarded. **Graywall** or **blotchy ripening** causes deterioration of the outer walls and crosswalls of affected fruits. It appears most frequently in compacted soils under cool, wet, low-light conditions.

## Caterpillars

### Hornworms (*Manduca* spp.).

Hornworms grow up to 4 inches long, are green with diagonal stripes or chevrons, and have a horn at the rear end. They may strip individual branches of a tomato plant. They may also chew large areas from green fruit. To find the hornworms look in areas of the plant that are being defoliated and on the ground for the presence of large, black droppings. Remove the caterpillars by hand-picking. It is not necessary to spray for them. Braconid wasps often parasitize hornworms. You may see their small white cocoons attached to very slow moving hornworms. Do not destroy these parasitized hornworms. The beneficial wasps will emerge from the cocoons to parasitize other hornworms.

### Armyworms (*Spodoptera* spp.)

Armyworms have distinct lengthwise stripes, are smooth, and can reach up to 1½ inches long. They primarily damage the fruit and are best controlled by hand picking and removing damage fruit.

### Tomato Fruitworm (*Heliothis zea*)

Tomato fruitworms are primarily pests of tomato fruit. The caterpillars vary in color from greenish-yellow, reddish or brown, have yellowish heads, distinct stripes along the sides, and short, whisker like spines over the body. They may reach 1 5/8 inches when mature. Fruitworms normally begin feeding near the stem end and eventually enter the fruit. To control hand-pick the caterpillars and remove infested fruit.

## Cutworms

### Black cutworm (*Agrotis ipsilon*)

The primary cutworm that causes damage to tomato plants is the black cutworm. The caterpillar is gray to black, with a lighter stripe down the middle of its back. Other species are a dull brownish color. Mature caterpillars can reach 1 3/4 inches in length and curl up into a C-shape when disturbed. Cutworms are generally a problem during May and June. The caterpillars clip off tomato transplants at or just below the soil level and are active at night. Look for cutoff seedlings and dig around the base of the plant to expose the caterpillars.

**Control:** Wrap seedlings and transplants with cardboard collars to protect them from cutworm damage. A simple collar can be made from a paper cup with the bottom removed. Push the cup into the soil to hold it in place. Cardboard tubes from paper towels or toilet tissue can be cut to size for collars.

### **Tomato Pinworm (*Keiferia lycopersicella*)**

The tomato pinworm is an occasional pest in tomatoes in home gardens. Pinworms are small caterpillars. When mature they are about 1/4 of an inch long, and purplish-black in color. Pinworm caterpillars damage the foliage and fruit of tomato plants. On fruit, they bore into the stem ends, and create narrow, blackened tunnels. This boring activity exposes the fruit to decay. Often the fruit must be cut open to see the damage. Pinworms also mine tomato foliage and construct folded shelters that are held together by webbing.

To monitor for pinworm, search plants for mined leaves and folded leaf shelters that contain the larvae. In fruit, look under the green calyx of fruit for larvae, entry holes or frass.

**Control:** Pinworm is very difficult to control. Destroy any larvae that are discovered in mines and dispose of infested fruit. Dispose of plant residue at the end of the season. Do not compost it.

## **Aphids**

### **Potato Aphid (*Macrosiphum euphorbiae*)**

#### **Green Peach Aphid (*Myzus persicae*)**

Aphids are small, soft-bodied insects, usually green or pink, with long, slender mouthparts used to suck out plant fluids. This feeding causes leaves to wilt and curl downward. They excrete honeydew, which makes the leaves sticky and supports the growth of sooty mold. Two species of aphids attack solanaceous vegetables in Maryland, the green peach aphid and the potato aphid. The potato aphid is most common on tomatoes.

**Control:** Aphids are generally more of a problem May through June and again in the fall. Insecticide applications are generally not necessary because predators and parasites usually control the aphids. Common predators are green lacewing larvae, lady beetles, hover fly larvae and predatory bugs. Several small wasps parasitize aphids. Parasitized aphids turn brown and remain on the leaves.

### **Greenhouse Whitefly (*Trialeurodes vaporariorum*)**

Whiteflies infest many vegetables during the summer. Adults are small, white moth-like insects that may fly from the plants when disturbed. The immature whiteflies are tiny, scale-like insects that feed on the undersides of leaves. Both the adults and nymphs (immatures) suck the sap from leaves. Heavy infestations cause leaves to turn yellow or appear dry. Whiteflies secrete honeydew, which causes the leaves to become sticky and supports the growth of black sooty mold.

**Control:** Parasites and predators normally keep whiteflies under control. If additional measures are needed, insecticidal soap, pyrethrum or commercial blends of both are effective. These materials are contact insecticides and must be sprayed on the undersides of the leaves to kill the whiteflies. Insecticidal soaps and other insecticides can burn plants when temperatures are above the low 80's. Check container labels for precautions.

### **Flea Beetles (*Epitrix* spp.)**

Flea beetles are small, beetles with enlarged back legs that enable them to jump. The most common species on tomato is the potato flea beetle, which is 2 mm long, black, and has yellow rear legs. The adult beetles chew small, round holes or pitted areas in leaves. The larvae feed on roots, but cause no damage.

**Control:** To manage flea beetles, protect young plants with floating row cover. Older plants can usually tolerate heavy feeding. Flea beetles overwinter in plant debris and weeds. Remove these refuges by removing or rototilling the weeds and debris in the fall.

### **Colorado Potato Beetle (*Leptinotarsa decimlineata*)**

The Colorado potato beetle prefers potato and eggplant but will attack tomatoes if its favorite hosts are not available. The adult beetle is stout, about 3/8 of an inch long, and has yellow wing covers with black stripes. The larvae are red to orange, stout, with 2 rows of black spots along their sides. Both adults and larvae feed on the leaves, leaving only veins and stems.

**Control:** If only a few are present, hand pick and destroy them. *Bacillus thuringiensis*, (San Diego strain) may be used to control young larvae in heavy infestations. There are up to 3 generations of this beetle in Maryland.

## **Stink Bugs**

### **Southern Green Stink Bug (*Nezara viridula*)**

#### **Brown Stink Bug (*Euschistus servus*)**

Stink bugs are shield-shaped insects with long, sucking mouth parts and long jointed antennae. Their name comes from the fact that they give off an offensive odor when disturbed. The most common species that cause damage to tomatoes in Maryland are the brown and southern green stink bugs. Stink bug damage on tomato fruit is called cloudy spot. On green tomato fruit it appears as dark pinpricks surrounded by light discolored areas that may reach  $\frac{1}{2}$  inch in diameter. The spots become white and pithy, but remain firm as the fruit ripens. Damage is superficial and can be removed with a sharp knife.

**Control:** Stink bugs are attacked by parasitic wasps and flies and several predatory beetles and bugs. In the vegetable garden look for stink bug egg masses and remove them. The eggs are barrel or keg shaped with distinct circular lids and laid in groups

of 10 or more on leaf surfaces. Remove or rototill crop debris at the end of the season and control weeds to help reduce hibernating sites of adults.

### **Fruit flies (*Drosophila* spp.)**

Fruit flies are tiny, 1/8 inch, tan to brown, with red eyes. They breed in ripe tomato fruit. The adult flies lay eggs in cracks or damaged areas in ripe tomatoes. The maggots hatch and live in the fruit. Fruit flies can complete a generation in a matter of days in the summer. The best control is to keep ripe fruit picked and dispose of damaged or fallen fruit.

### **Spider Mites**

Spider mites can be a very serious problem on tomato plants during hot, dry weather. Spider mites are very tiny with 8 legs. They vary in color from light green (with two dark spots) to red. To the unaided eye they look like tiny moving dots. The mites feed on the undersides of leaves and damage appears as fine stippling on the upper surfaces. Lower leaf surfaces appear dirty and may or may not have webbing. Heavy mite infestations cause leaves to turn yellow and eventually brown. Spider mites can kill tomato plants if not controlled. To monitor for spider mites, examine the leaves closely, with a hand lens if necessary. If damage is seen, but no mites are found, check leaves higher up on the plant. A simple technique for sampling is to tap a few terminal leaves over a piece of white paper. Wait a few seconds and watch for movement.

**Control:** Because spider mites feed on lower leaf surfaces, they are difficult to control by spraying. All lower leaf surfaces must be contacted with the spray to kill the mites. Insecticide sprays easily damage plants that have had heavy mites feeding. This is especially true of insecticidal soap during hot weather. (Hose plants down with water on hot days to reduce dusty conditions, which are favorable to spider mites.)

Predatory mites are an excellent option. They will hunt down and kill the spider mites and provide long-term control. They are available through mail-order sources.

### **Slugs**

Slugs feed on tomato fruit that is in contact with the ground and on the leaves of transplants. Most slug feeding is done at night,

and the only evidence of their presence during the day may be slime trails. Keep ripening fruit picked, especially those near the ground. Dispose of any damaged fruit. Transplants can be protected from slugs with cardboard collars as for cutworms. Keep mulch away from seedlings until they are well established. Slugs like to hide in cool, moist, dark areas during the day. Remove debris, boards, etc. from gardens to help eliminate shelter areas for slugs. Barriers of diatomaceous earth, sharp sand, or ground oyster or crab shells placed around vulnerable plants can prevent damage. These barriers may lose effectiveness after becoming wet.

### **Nematodes**

#### **Root Knot Nematodes (*Meloidogyne* spp.)**

Nematodes are microscopic worms that feed on plant roots. The root knot nematode is the most common nematode that is a problem on tomatoes. This nematode causes swellings or galls on the roots of tomato plants. Nematodes reduce the plants ability to take up water and nutrients. Symptoms include wilting, reduced vigor, smaller fruit and leaves. The only sure way to check if a plant has root knot nematodes is to dig it up and check the root system for the galls. Root knot tends to be more of a problem in sandy soils.

**Control:** Use nematode resistant varieties of tomatoes in the garden. They will have an "N" on the label or seed packet indicating nematode resistance. Also, if nematodes have been a problem, move tomatoes or other susceptible plants to another part of the garden. Organic soil amendments such as peat, manure and compost can be added to the soil to help reduce the impact of nematodes to vegetable plants. They may contain substances that inhibit nematodes but are most useful for their ability to increase the water-holding capacity and nutrient availability of the soil.

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## **Protect the Bay - Use Pesticides and Fertilizers Wisely**

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