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HOME & GARDEN

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Home & Garden Mimeo # HG 56

IPM Series: Tomatoes

Symptoms	Possible Causes	Notes
LEAVES/STEMS		
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	Plant becomes yellow and stunted. Small nodules cover roots
	Air pollution	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 leafs spot	Small, round gray spots with dark margins on lower leaves
	Gray leaf spot	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	Tiny, dark brown circular spots that develop yellow rings
	Bacterial spot	Same as above
	Freeze damage	Water-soaked blotches that turn black
	Edema	Dark, raised spots on upper surfaces coused 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	Damage on new growth. Leaves become finely divided and narrow.
	Mosaic viruses	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)

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

BLOSSOMS/FRUITS

Blossom drop	High or low temp.	Temps. above 95°F. and below 50°F.
	Air pollution	
	Excessive nitrogen	Lush, dark green plant growth
	Limited sunlight	
	Initial heavy flower set	
	Botrytis (gray mold)	Pedicels (blossom stems) look pinched or withered
Failure to flower or fruit	Excessive nitrogen	Unusually tall, lush plants
	High or low temp.	Poor pollination/aborted fruits with temperature extremes
	Limited sunlight	Plants receive less than 5 hrs. of sun and/or spaced too close
Large holes chewed in fruit	Hornworms	Chew or scrape green fruit
	Tomato fruit worm	Bore deeply into young, green fruit; fruits ripen prematurely and secondary rots often develop
	Armyworms	Drier, more shallow feeding hole than above
	Cutworms	Variegated form climbs onto mature plants to feed on green fruit
	Colorado potato beetle	May feed on fruits if present in large numbers, (adults & larvae).
	Slugs	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	Small dark spots; may be raised or sunken and have a ring or halo
	Bacterial spot	Small raised brown spots; larger than bacterial speck lesions
	Stink bug	Hard, yellow, white or green spot beneath fruit skin
Spots on fruit	Early blight	Dark, leathery lesions, may be shrunken; "bull's eye" pattern may be visible
	Late blight	Olive green to black, oily looking lesions; wet rots develop under favorable conditions
	Buckeye rot	Smooth, dark brown spots in a concentric ring pattern; enlarge to cover half or more of fruit; generally starts at blossom end
	Rhizoctonia fruit rot	Affects fruits in contact with soil
	Anthracnose	Soft rot; circular, brown, shrunken lesions on ripening fruit
	Blossom-end rot	Dark, leathery lesions on fruit bottom. Most prevalent on enlarging fruit
	Stink bug	See section above
Large discolored areas	Sunscald	Light colored; becomes soft. Typically on surfaces exposed to full sunlight due to defoliation
	Green shoulder	Varietal characteristic; often affects large-fruited varieties.
	Late blight	see "Spots on Fruit"
	Blossom-end rot	see "Spots on Fruit"
	Buckeye rot	see "Spots on Fruit"
	Graywall	Blotchy ripening; brown, irregular lesions inside and outside fruit; develops on mature, green fruit (physiologic disorder)
Soft rots	Gray mold	Small, white halos on green or ripe fruit; may cause decay of flowers and fruit
	Freeze damage	Fruit become soft and discolored
	Fruit flies	Soft rot in stem-end of ripe or damaged fruit
	Soil rots: pythium and rhizoctonia	Rot damage on fruits that contact the soil
	Anthracnose	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	Late season problem; short days, low sunlight, plant crowding
	Excessive nitrogen	Avoid overfertilization, particularly after fruits form
Uneven ripening	Cold temp.	Late season problem
	Varietal characteristic	Especially on large-fruited and plum-type varieties
	Weak, unthrifty plants	Poor soil; plants too crowded or neglected
Distortion/malformed fruit	Cool temperatures	Temperatures below 50°F. at or before flowering cause "cat-facing" and "zippering"; damage most common on first cluster
	Exposure of plants to phenolic type herbicides	

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
Pale green leaves	Lack of nitrogen Lack of sunlight	Cool soils, immature root systems reduce nutrient uptake Tomato plants require a minimum of 6-8 hours sunlight
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

Blossom-end Rot

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.

Catfaced Tomato

Fusarium wilt

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 (see photo). 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.

Advanced early blight symptoms

Closeup of lesion on leaf

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

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.

Anthracnose

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 hormworms. 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*)

Cut worm damage

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*)

Greenhouse Whitefly

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 bug damage

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 ºf½ 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 mite damage

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.

Authors: Jon H. Traunfeld and Mary Kay Malinoski, Regional Specialists, Home and Garden Information Center, Maryland Cooperative Extension, University of Maryland, Ellicott City, MD.

Reviewed By:

Charles McClurg, Ph.D., Dept. of Horticulture, University of Maryland, College Park, MD.

Michael Orzolek, Ph.D., Dept. of Horticulture, University of Pennsylvania, University Park, PA.

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