

IPM Series: Potatoes

Symptoms	Possible Causes	Notes
PLANTING/EARLY GROWTH		
Sprouts fail to emerge	Cool soil temperature; seed pieces planted too deeply; soil compacted or waterlogged Table-stock potatoes	Cover seed pieces with 3 inches of soil once soil tempera- tures are above 50°F. Plant in loose, well-drained soil or a deep raised bed. Table-stock potatoes treated with growth inhibitors. Plant only certified seed potatoes.
Sprouts with reddish-brown, sunken lesions	Rhizoctonia canker (black scurf)	Endemic fungal pathogen occurring naturally in soils, or seed borne.
Seed pieces rot or are eaten	Various soil borne decay organisms. Especially in cold, wet soil Seed corn maggot	Allow seed pieces to cure at 70°F. for a day before planting. Place seed pieces in paper bag with 2 Tbs. of elemental sulfur and shake to coat thoroughly prior to planting. Avoid poorly drained soil.
Foliage off-color / plants growing slowly	Cool soil temperatures Low soil fertility	Plant on mounded soil or in raised beds. Fertilize with balanced soluble fertilizer or seaweed extract. Foliar sprays can also help alleviate early season nutrient stress.
New shoot tips and leaves are tan or blackened	Frost damage	Protect emerging plants with floating row cover.
Small holes in seed pieces and developing shoots	Potato wireworm	Insect-damaged plants are often invaded by pathogens resulting in weak plants.
FOLIAGE		
Leaf yellowing	Nutrient deficiency	Interveinal yellowing- potassium, iron, magnesium. Older leaves first, followed by younger leaves- nitrogen.
	Spider mites	Small yellow pin-point dots (stippling); leaves may appear dirty on undersides or be covered with webbing. Leaves become dry and brittle.
	Aphids	Small, soft, pink or green insects on young growth. The green peach aphid spreads the leaf roll virus.
	Glyphosate herbicide Nematodes	Younger leaves turn yellow and turn downward. Plant becomes yellow and stunted under severe water stress.

White stippling on upper leaf surface	Leafhoppers	Leaf tips and margins turn yellow or brown. Plants may be stunted. Leafhoppers vector several diseases.
Leaves mined	Potato tuberworm	Small, hollowed out blotches in leaves. May fold leaves over for shelter and bore into petioles and stems.
Leaf spots and blotches	Early blight	Small, brown lesions with yellow halos that rapidly enlarge; “bull’s-eye” pattern within lesions. Older leaves and stressed plants are more susceptible.
	Late blight	Small, water soaked spots at leaf tips and margins. Enlarge to brown to purplish lesions. Under wet conditions white fungal growth may be observed on leaf undersides. Greasy, dark lesions may appear on stems.
	Freeze damage	Water-soaked blotches that turn black.
	Air pollution	Ozone injury produces black speckling or patches of dead leaf tissue and bronzing on lower leaf surface depending on varietal susceptibility.
Stem and stolon cankers	Rhizoctonia canker (black scurf)	Reddish brown lesions. Can cause plant wilting.
	Early blight	Dark, sunken lesions.
	Late blight	Dry or wet brown to purplish lesions.
Leaf and stem distortion	Mosaic viruses	Mottled, deformed leaves; stunted plants.
Leaf curling/distortion	Aphids 2,4-D, dicamba Viruses	Small, soft, pink or green insects on young growth. Leaf curling and distortion. Leaves rough and crinkled. Leaves may be small, crinkled or mottled. Leaf roll virus causes rolling and thickening of lower leaves.
	Rhizoctonia canker (black scurf)	Cupped, pinkish upper leaves.
Leaf scorch	Drought Stress	Leaf margins are affected first.
Entire plant wilted/stunted	Root-knot nematode	Entire plant wilts under water stress. Galls on roots.
	Rhizoctonia canker (black scurf)	Small, black spots on stems that won’t rub off.
	Fusarium, Verticillium	Soil-borne fungal diseases. One stem or one side of plant wilts first. Brown streaking or discoloration of vascular tissue.
	Drought stress Excessive water	Newer growth wilts
Plants cut off at soil line	Cutworm Slugs and snails	Damage may occur throughout summer on young plants. Feed on the stems of small plants. Night feeders; slimy trails may be seen.
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; may feed on young or mature plants.
	Hornworm	Mid to late summer pest; very large, green caterpillars with red or black “horn”; may strip foliage.
	Colorado potato beetle	Adults and larvae chew entire leaves.
	Blister beetles	Cluster on plant tops; feed on leaves and flowers.

TUBERS Small holes in tubers	Wireworm	Round, 1/8 inch entry holes. Look like nail punctures. Tunnels deep or shallow
	Tuberworm	Tunnels deep, black and filled with excrement.
	Cutworms Slugs	Gray or black caterpillars. May notice ragged holes in leaves. Occasional pest.
Raised bumps	Flea beetle larvae Root-knot nematodes	Shallow winding trails on tuber surface. Small bumps or pimple on tubers. May also see brown spots on skin. Galls on roots.
	Scab	Rough, brown patches that may be raised and warty, level with the surface or sunken. Strongly associated with alkaline soil and raw, un-decomposed organic matter, like fresh animal manure. Resistant varieties are available.
	Rhizoctonia canker (black scurf) Late blight	Small black spots or specks on surface. Brown to purple spots on tubers with granular rotted tissue extending into the tuber.
Roughened surface	Scab	Rough, brown patches that may be raised and warty, level with the surface or sunken. Strongly associated with alkaline soil and raw un-decomposed organic matter, like fresh animal manure. Resistant varieties are available.
	Glyphosate herbicide damage	May also see creasing or folds in tubers.
Internal discoloration	Black heart	Tubers develop black centers that begin dry and latter become wet. Occurs in storage when potatoes are packed closely and ventilation is poor. Occurs occasionally in the garden in waterlogged soil.
	Root-knot nematodes Low temperature damage Bacterial soft rot and fungal tuber rot	Brown spots in outer tuber flesh. In storage or when tubers are dug after a fall frost. Tubers become soft and smelly. Severe after very wet conditions or harvesting during hot weather, 90°F. and above.
One or more internal cavities	Hollow heart	Occurs during rapid plant growth. More pronounced with long-tuber varieties. Maintain even and adequate moisture and fertility. Plant large seed pieces and closer plant spacing.
	Exposure to sunlight (chlorophyll production)	Keep loose soil hilled up over developing tubers. Solanine, an alkaloid compound poisonous to people, is more concentrated in green skin and pith. Remove all green parts before cooking and eating.
Cracks / knobby or misshapen tubers	Secondary growth of tubers 2,4-D or dicamba herbicide damage Rhizoctonia	Prolonged dry soil conditions followed by rainfall or irrigation. Soil borne fungus.
	Plants over-crowded, seed pieces too large, low fertility, lack of water, planted too late	See text "Cultural/Environmental Problems".
Excessive foliage / no tubers	Over-fertilization with nitrogen	Avoid using high nitrogen fertilizers, like ammonium nitrate and urea.

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

1. **Correctly identify the problem; if insect or disease, learn the life cycle and habits.**
2. **Learn to anticipate and prevent problems; 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

The potato, *Solanum tuberosum*, is a warm-season perennial grown as an annual in Maryland. The species probably originated in the Peruvian highlands over 6,000 years ago. Potatoes grow best in a full-sun location, in well-drained soil high in organic matter with a pH of 6.0 to 6.5. Where **scab disease** is a persistent problem, a soil pH of 4.8 to 5.8 is recommended. The potato plant remains upright and tender through the growing season and may reach 3 ft. in height.

Tubers are enlarged, modified stems (not roots) that develop from the growing stem. Potato plants produce flowers and sometimes small potato-like fruits with seeds inside. However, the seed is extremely small and, if planted, will not come true to the desired variety. **Purchase certified, disease-free seed potatoes** from a reputable company. Last season’s garden tubers and store-bought potatoes may be symptomless carriers of numerous virus diseases and should be avoided.

Potato plants are reproduced vegetatively by planting seed pieces with 1 to 3 buds (“eyes”) or small, whole seed potatoes in the spring, up to 6 to 8 weeks prior to the last expected frost. Plant the seed pieces (cut side down) or whole seed potatoes 8 to 12 inches apart and cover with 3 inches of soil. Raised beds or mounded soil warms up earlier in the spring and allow for deeper root growth.

Water the bed with a starter fertilizer and keep potato plants well-watered throughout the season. Since the potatoes form above the planted seed potato it is important to keep loose soil pulled up around the main stem. This will increase yield and reduce the problem of **tubers greening upon exposure to sunlight**. Potatoes can also be planted mid-July for a fall harvest. Apply a thick straw mulch to summer plantings to keep the soil cool and moist and to deter **Colorado potato beetles**.

Nutritional

- 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**.
- Avoid using fresh animal manure before or after planting.



Leaf scorch

Water / Temperature

Potatoes will not easily root or produce top growth unless soil temperature exceeds 50°F. Ambient temperatures below freezing may damage new foliage. If planting in cool soil, allow cut seed pieces to cure at 70°F for a day before planting. This will lessen the danger of insects and diseases attacking seed pieces. Place seed pieces in paper bag with 2 Tbs. of elemental sulfur and shake to coat thoroughly prior to planting.

Too much or too little water is associated with many tuber disorders, including blackheart and cracks. **Secondary growth (knobby, deformed potatoes)** occurs when normal tuber growth is halted by high soil temperature, drought, frost on foliage, hail or a combination of these factors. When growth resumes, the tuber may become knobby, dumbbell-shaped or pointed at the ends. Well-drained soil and continuous moisture, especially during tuber formation, are essential to successful potato growing.



Blackheart

Harvesting/Storage

Small, tender “new” potatoes can be harvested 6 to 8 weeks after planting, usually once the plants have flowered. Gently dig the soil around the young potatoes to avoid damaging the plant and bruising the remaining tubers. Tubers will continue to grow through the summer until plants are killed by frost,

mowing or insects and diseases. If you plan to store potatoes, leave tubers in the ground for 2 weeks after plants die back. This will allow them to develop a thickened skin.

Dig potatoes very gently with a spading fork. Bruises and cuts sustained during the harvest will allow entry of soil borne fungi and bacteria that cause storage rots. Storage potatoes are cured for 10 to 14 days at 50° to 60°F and high humidity to heal over wounds and cuts. Potatoes are best stored at low temperatures (40° to 50°F) and high humidity. Carefully place tubers in storage containers using straw or newspaper to separate layers.

Diseases

Early blight (*Alternaria solani*)

Early blight is a widespread and often damaging fungal disease that overwinters on potato tubers and vine debris and is splashed 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 may appear as dark, sunken lesions on tubers. Early blight is more often a problem on the older leaves of older plants. Under very favorable conditions it may defoliate entire plants.

Control: Avoid overhead watering and lay down a thick organic mulch to prevent soil splashing onto lower leaves. Remove infected leaves during the growing season and discard all badly infected potato plant debris at the end of each season to limit overwintering of spores. Chlorothalonil, mancozeb and fixed copper fungicides can be used to prevent or slow infection.



*Early blight
on leaf*

S. A. Johnston, Rutgers U.



*Late blight
on stem*

S. A. Johnston, Rutgers U.

Late Blight (*Phytophthora infestans*)

Late blight is a widespread fungal disease that caused the Irish potato famine of 1845-1846. It affects leaves, stems and tubers. The disease originates from diseased seed potatoes. Fungal spores are spread by air from garden to garden.

Symptoms appear during prolonged cool, wet weather. Small, light green spots on leaves are first observed. These lesions may rapidly enlarge, turn purple to black in color and kill entire leaves. A layer of white mold may appear on leaf undersides during severe infections. The often quick death of foliage leads to an unpleasant smell of decomposing plant tissue. The disease slows down during dry periods but will continue to defoliate plants when favorable conditions reoccur. The disease produces sunken lesions, brown to purple in color, on tubers.

Control: Select only certified, disease-free seed potatoes and never plant table-stock potatoes. Do not leave potato tubers in the garden. Pull up and discard infected plants. Keep foliage dry (avoid overhead watering) and plant potatoes in sunny, well-drained locations. Protectant fungicides, including chlorothalonil, mancozeb and fixed copper, are effective if applied prior to infection. Select varieties that are less susceptible.

Rhizoctonia Canker/Black Scurf

Rhizoctonia solani



S. A. Johnston, Rutgers U.

Black Scurf

This soil-borne disease girdles emerging plants causing collapse of young plants. Other symptoms include plant stunting, purple leaves, aerial tubers, leaf rolling and sometimes plant death. Red to brown lesions can be seen on stems and stolons (the underground, horizontal stems). Dark colored sclerotia (the tough, resting structure of the fungus) may be observed on stems and tubers and are a diagnostic sign of this disease. The sclerotia resemble soil particles but are not easily rubbed off. Tuber infection can lead to malformation and cracking. This disease can be common, but is not very destructive. It usually slows growth but plants recover somewhat if conditions are good.

Control: Buy certified, disease-free seed potatoes and rotate crops where possible. The disease can overwinter on plant debris so always remove and discard infected plants and tubers.

Common Scab (*Streptomyces scabies*)

Common scab is widespread in Maryland. This bacterial pathogen infects only the underground plant parts, producing raised scabs or a corky russetting on tubers. The lesions are circular or irregular and vary in color from tan to brown. This disease also



Common scab

affects beets, turnips and carrots.

In some instances the lesions will extend into the pith or flesh of the tuber. When conditions are dry, the infected tubers may be edible.

Control: Select resistant varieties, buy certified, disease-free seed stock, plant on well-drained soils and lower the soil pH to 5.5 to 6.0 where scab is a problem (apply 14 lbs. of iron sulfate/1,000 sq. ft. of garden area to lower the soil pH by ½ unit.) Place seed pieces in paper bag with 2 Tbs. of elemental sulfur and shake to coat thoroughly prior to planting. Keep plants well-watered during tuber formation. Rotate potatoes to different parts of the garden.

Insects and Other Pests

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 potato plant. 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 use an insecticide.

Cutworms

Black cutworm (*Agrotis ipsilon*)

The primary cutworm that causes damage to potato 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 1½ 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 potato plants at or just below the soil level and are active at night. Look for cut plants and dig around the base of the plant for the caterpillars.

Control: To protect plants from cutworm damage, wrap them with cardboard collars. 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.



Hornworm

*Black
Cutworm*



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 curling and wilting of the leaves. 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 potatoes.

Control: Aphids are generally more of a problem May through June and again in the fall. Control is often not necessary because predators and parasites usually take care of them. Common predators are green lacewing larvae, lady beetles, hover fly larvae and predatory bugs. Aphids are parasitized by several small wasps. Parasitized aphids turn brown and remain on the leaves.

Flea Beetles (*Epitrix* spp.)

Flea beetles are small, beetles with enlarged back legs that enable them to jump. The most common species on potato 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 tubers, producing narrow, straight tunnels, about 0.8 mm in diameter. Tunnels may extend 2 inch into the tuber. Fungi may grow in the tunnels, turning them black or brown. Larvae may also cause small bumps and shallow winding trails on the surface of tubers.



Flea beetles

Control: To manage flea beetle problems, 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 and can be a serious pest in Maryland gardens. The adult beetle is stout, about 1/2 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. There are up to 3 generations of this beetle in Maryland each year.

Control: It is important to monitor plants from the time they are set out in the garden, for signs of larvae and adults. If only a few are present, hand pick and destroy them. Prevent potato beetle problems by protecting transplants as soon as they are set out with floating row cover. *Bacillus thuringiensis* var *tenebrionis* (M-TRAK®) may be used to control young larvae in heavy infestations. There are up to 3 generations of this beetle in Maryland.



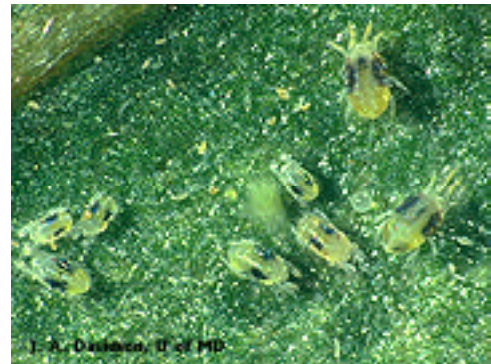
Colorado potato beetle larvae

Colorado potato beetle and eggs



Spider Mites

Spider mites can be a very serious problem on potato 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. If they are not controlled, spider mites can kill potato plants. 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.



Spider mites

Control: Because spider mites feed on lower leaf surfaces, they are difficult to control by spraying insecticides/miticides. All lower leaf surfaces must be contacted with the spray to kill the mites. Plants that have had heavy mites feeding are also easily damaged by insecticide sprays. This is especially true of insecticidal soap during hot, dry weather. 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.

Potato Leafhopper (*Empoasca fabae*)

Leafhoppers start appearing in June. Potato leafhopper adults are about 1/2 inch long, pale green and wedge-shaped. Immature leafhoppers, or nymphs, are smaller than the adults with reduced wings. Leafhoppers are very active and move rapidly when disturbed by jumping, flying or running. The leafhoppers suck plant sap from the leaves causing white stippling. Heavy feeding may cause drying and yellowing or browning of the leaf margins or the entire leaf. This is often referred to as "hopper burn". Check the undersides of leaves for the leafhoppers and their cast skins. Their excrement appears as tiny dark spots on the leaves where they have been feeding.

Control: Leafhoppers are very mobile and can be abundant making them difficult to control. The damage can be tolerated in most garden situations. Insecticidal soap may give some

control if applied when leafhoppers are small. Many predators such as lacewings, damsel bugs, lady bird beetles, minute pirate bugs and spiders feed on leafhoppers.



Leafhopper damage

Potato Tuberworm (*Pthorimaea operculella*)

Potato tuberworm caterpillars create tunnels in stem, leaves and tubers of potatoes. The caterpillars are pinkish-white, with brown heads and up to **2** inch long. The adult moth is small and gray with mottled wings of black and brown. The moth lays eggs on foliage, plant debris or exposed tubers. Young larvae mine the leaves and later may fold sections of leaves into shelters. They may also bore into stems and petioles. Generally there is little foliage feeding and larvae move from foliage to the tubers by crawling or dropping to the soil. (They do not reach tubers by boring through stems and roots.) They bore deep tunnels (**C** inch in diameter) into the tubers. The tunnels are usually black because they are filled with excrement and often infected with fungi.

Control: Reduce exposure of tubers to egg-laying moths. Moths usually cannot reach tubers covered with 2 inches or more of soil unless the soil has deep cracks. Keep soil moisture adequate to prevent cracking. Use floating row cover.

Wireworms (*Elateridae* spp.)

Wireworms are the larvae of click beetles. They live in the soil and bore into potato seed pieces and tubers. Larvae are hard, cylindrical, yellowish to reddish brown and about 1 inch long. (They resemble mealworms that are sold as pet food.) They have a long life cycle and take 3 to 4 years to mature into adult beetles. During the spring the larvae bore into seed pieces and developing shoots. The damaged areas often become infected with fungi or bacteria which results in weak plants. In the summer, wireworms bore into the tubers. Holes are round and about **C** inch in diameter. The tubers look like they have been punctured with a nail. The tunnels are straight and shallow to deep. They are usually lined with potato skin (periderm).

Control: Avoid planting potatoes in areas that have been in grass or grassy weeds (primary food plants of larvae). Prior to planting, check the soil for the presence of wireworms. Carrots are very attractive to wireworms and can be used to trap wireworms in the garden. Plant carrots (with tops) every **22** - 3 feet throughout the garden. Pull up the carrots every 2 to 3

days and remove the wireworms. Replace the carrots to trap more wireworms.

Seedcorn Maggot (*Delia platura*)

The seedcorn maggot attacks the sprouting seeds of several vegetables and occasionally the seed pieces of potatoes in cool, wet soil. The maggot is whitish, legless and about **3** inch long when mature. The adult is a gray fly that resembles a housefly. The fly lays eggs in moist soil. The maggots hatch and burrow into seed pieces and underground stems where they feed for 2 to 3 weeks.

Control: Damage is more likely to occur in soil with a lot of decaying vegetation. Well cured potato seed pieces are seldom damaged.

Blister Beetles (*Epicauta* spp.)

Blister beetles are occasional pests of potatoes. Adults are **2** inch long, solid black or black with stripes or light margins on wings (elytra), or yellow with black stripes. The adults have a narrow first segment on the thorax (body), resembling a neck. Larvae are parasites on the eggs of grasshoppers or ground-nesting bees. Large numbers of adult beetles cluster on plants and feed on the foliage and flowers. They may defoliate individual plants and then move on to others to continue feeding. They are generally a problem later in the summer.

Control: Control is rarely necessary.

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 potatoes. This nematode causes swellings or galls on the roots of potato plants. Nematodes reduce the plant's ability to take up water and nutrients. Symptoms include wilting, reduced vigor, smaller leaves, galls on roots and bumps on tubers. 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: If nematodes have been a problem, move potatoes or other susceptible plants to another part of the garden. Organic soil amendments such as aged manure and compost can be added to the soil to help reduce the impact of nematodes on vegetable plants. They may contain substances that inhibit nematodes but are most useful for their ability to increase the nutrient availability and water-holding capacity of the soil.

Lesion Nematode (*Pratylenchus* spp)

The most common nematode pest of white potatoes is the lesion nematode, *Pratylenchus* spp. This nematode will feed in

the roots of potato and cause black decayed regions called lesions. This reduction of the root system results in stunted plants in areas of the garden. When the *Verticillium* fungus is present, the two pathogens together can cause a disease of potato called "early dying".

Control: Same as for root knot: rotation.

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

Insect Pests of Vegetables (color photo plates), PMA11 available for \$3.00 from Home and Garden Information Center, 12005 Homewood Rd., Ellicott City, MD 21042. Make check payable to the University of Maryland for \$3.00.

References:

Carr, A. 1979. *Color Handbook of Garden Insects*. Emmaus, PA.: Rodale Press. 241pp.

Flint, M.L. 1990. *Pests of the Garden and Small Farm*, University of California Publication 3332. 286pp. Division of Agriculture and Natural Resources, University of California, 6701 San Pablo Ave., Oakland, CA 94608-1239, (415) 642-2431. \$30.00.

Gilberg, L. ed. 1993. *Garden Pests and Diseases*. Menlo Park, CA.: Sunset Publishing Corporation. 112pp.

MacNab, A.A., A.F. Sherf, and J.K. Springer. 1983. *Identifying Diseases of Vegetables*. Pennsylvania State University, College of Agriculture. University Park, PA. 62pp.

Reviewed By:

Charles McClurg, Ph.D., Extension Vegetable Specialist, University of Maryland, College Park, MD.

Robert Mulrooney M.S., Extension Plant Pathologist, University of Delaware, Newark, DE

Mention of trade names does not constitute an endorsement by the Maryland Cooperative Extension, University of Maryland, College Park, MD.

ALWAYS READ THE PESTICIDE LABEL AND FOLLOW ALL DIRECTIONS AND SAFETY PRECAUTIONS.

**Protect the Bay
Use Pesticides and Fertilizers**

Wisely

**Have a home, garden or pest question?
Call the Home and Garden Information Center
1-800-342-2507**

www.agnr.umd.edu/users/hgic

**Check out our plant diagnostic site
<http://www.agnr.umd.edu/users/hgic/diagn/>**