Important Solanaceae Diseases
Quick Guide

On the next pages you will find a quick guide to the major diseases of the Solanaceae. The guide concentrates on diseases which occur when growing tomatoes, potatoes, and peppers in Ohio. Here is a list of the diseases which are included. This Quick Guide is based on the fact sheets from Ohio State University found at http://ohioline.osu.edu/hyg-fact/3000/index.html

1. Late Blight
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Late Blight

Late blight is a devastating disease of potato and tomato crops worldwide. Late blight was responsible for the Irish potato famine of the 1840's. A century and a half later, it is still an important disease. This disease can result in complete destruction of potato or tomato crops.
Late blight only affects potato, tomato, and a few close relatives. Peppers and eggplants can be mildly affected. Some Solanaceae weeds can also be affected.

Late blight is a fungal disease. It is caused by *Phytophthora infestans*. Unlike most pathogenic fungi, the late blight fungus cannot survive in soil or dead plant debris. The fungus survives the winter in potato tubers. It is introduced to fields and gardens on seed potatoes or tomato transplants. Sometimes live spores blow to a field.

The disease develops best when it is cool and moist (nights in the 50's, days in the 70's, and rain). Lesions appear on leaves within 3-5 days of infection. A white mold soon grows. The white mold forms spores which are spread by irrigation, rain, wind and equipment.

The best management is prevention.

Because the fungus can not over-winter in the soil, late blight has to be introduced to a field. The best way to limit introduction is to always use certified seed potatoes. Certified means that they do not have any late blight lesions. If you have 'volunteers', remove them right away. Make sure you destroy the 'volunteer' plants.

All photos from Ohio State University Extension Plant Pathology Fact Sheets.

Irregular, purplish-black late blight lesions on leaves of potato.

On leaves, late blight looks like pale green wet looking spots. These begin at the tip or edge of the leaves. These spots or lesions rapidly become bigger and turn dark brown or purplish-black.

Close-up of underside of lesion showing cottony, white mold growth of the late blight fungus on potato leaf.

If the weather is wet, a white mold will grow on the bottom side of the leaf. If it is dry, infected leaves quickly dry up and the white mold growth disappears. Infected areas on stems appear brown to black. The entire vine may die in a short time.

Tomato fruit with late blight has large, firm, brown, leathery appearing lesions and may show a cottony, white mold growth.

Lesions on tubers are coppery-brown. Bacteria enter the lesions and the entire tuber breaks down slimy and uneatable.

Potato tuber tissues infected with late blight are firm and appear tan to copper-brown with a granular texture.

Lesions on tomato fruits are large and brown. Soft rot bacteria invade and rot the entire fruit.

Anthracnose Fruit Anthracnose affects many vegetables and fruits, including tomato. The disease can attack pepper and tomato fruits at any stage. It can severely affect the quality of the crop and its profitability. It can destroy an entire crop.	This fruit rot is caused by several different species of fungi in the genus *Colletotrichum*. The fungi survive on plant debris left from infected plants. It is not soil-borne. It can be introduced on infected seeds. Spores spread by rain and irrigation water, especially from diseased fruit.	**Prevention is the best management.** Plant only disease free seeds and seedlings. Some cultivars are moderately resistant to this fruit rot. Rotate crops, growing pepper or other Solanaceae only every three years. Water early in the day so the plants can dry.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
	Lesions can appear on stems and leaves. They are irregular in shape and brown with dark brown edges.		On the fruit, sunken lesions form. Often there are many lesions on one fruit. These lesions can join, becoming very large areas. Pink or orange rings form at the edge of the lesions. These are masses of fungal spores.

Bacterial Spot of Pepper Bacterial spot is especially destructive during seasons with high temperatures and rainfall. It is a serious disease of pepper and tomato.	On pepper, bacterial spot is caused by *Xanthomonas capestris* pv *vesicatoria*. This bacterium can over winter on plant debris and seeds. The debris can be in or on the soil. The bacteria can survive for 10 years on a dry seed. The bacteria enter the stomata of the leaves and any break in the epidermis. The bacteria are spread during all aspects of cultivation, in the air and water.	**Prevention is the best management.** Plant only disease free seeds and seedlings. Bleach treatment of seeds may be useful. Rotate crops, growing Solanaceae only every three to four years. Water early in the day so the plants can dry. Plow all plant debris deep into the soil.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
	Small yellow-green spots appear on leaves. The spots are surrounded by a yellow halo. The yellow halo expands and the centers of the spots become brown to black and sunken. Spots may join together, destroying large parts of the leaf. The diseased parts of the leaf break off. The leaves look ragged and full of holes. Eventually badly infected leaves will fall off.		Spots on fruits are at first green and circular. The lesions are raised. Eventually the spots become brown, about 1/8 inch in diameter. They are like cork.

Fusarium and Verticillium Wilts

These wilts affect tomato, pepper, potato, and egg plant.

The fungi responsible for the wilts attack plants at all stages of development. The fungi usually enter through the roots and grow into the vessels in the roots and then into the stem. The vessels become plugged and water can not reach the stems and leaves. Leaves begin to wilt and eventually die. The entire plant can die.

These wilts are caused by fungi. Fusarium wilt is caused by *Fusarium oxysporum.* Different types cause diseases on different types of plants. They are warm weather organisms. They are soil borne.

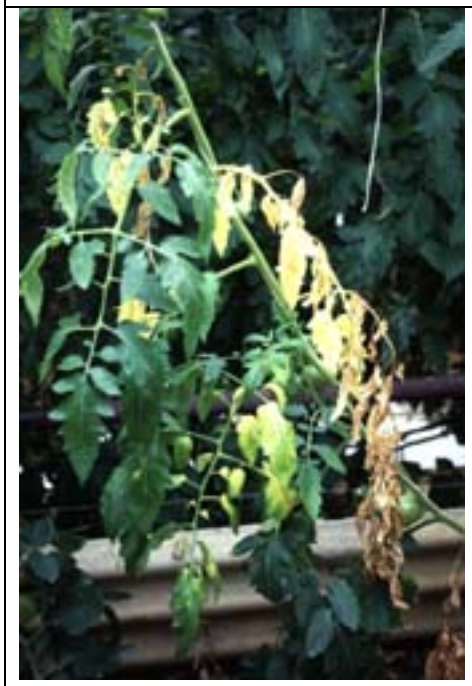
Verticillium wilt is caused by *Verticillium albo-atrum* and *V. dahliae.* Some types of the fungus are active in cool weather, others when it is warm or hot.

The best management is the use of resistant cultivars. There are many pepper and tomato cultivars which are resistant to both types of wilt. Remember to consider this when growing 'heirloom' tomatoes. There are also new strains of the wilts which will infect even resistant varieties. Rotate Solanaceae out for 4 to 6 years. Remove all infected plant debris.

All photos from Ohio State University Extension Plant Pathology Fact Sheets

Fusarium wilt begins with clearings on leaflets. The leaves will droop. Lower leaves will start to wilt, turning yellow. These leaves will die, eventually the entire plant will die.

If you cut a stem and pull away the tissue, you might see dark brown streaks.



Sometimes only one shoot may be affected as in the tomato with Fusarium wilt. However, the entire plant will usually wilt soon after you see the first signs.

Fusarium wilt will cause the vascular ring to turn brown. Parts of the underground root and stem system may decay and fall off.

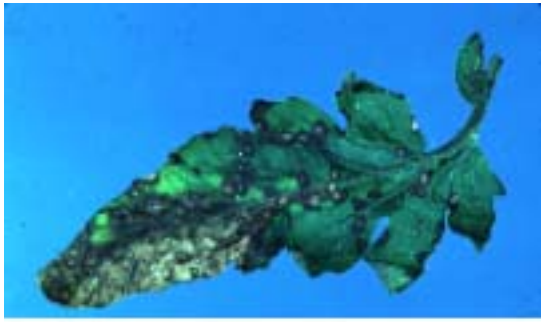
Verticillium wilt looks similar to Fusarium wilt. Sometimes there are no symptoms until the plant is heavily infected. The bottom leaves are pale and die. Tomatoes often survive, but the plants are small and do not have many fruit. Tubers from Verticilllium infected plants may show some vascular ring discoloration.

As with Fusarium wilt, Verticillium wilt can start on one side. This is shown in the potato leaf above.

Bacterial Spot, Speck, Canker of Tomato These bacterial diseases can cause considerable damage to tomatoes. *Xanthomonas campestris* pv. vesicatoria, causes bacterial spot. Bacterial speck is caused by *Pseudomonas syringae* pv. tomato. Bacterial canker is caused by *Clavibacter michiganensis* subsp. *michiganensis*	All of these bacteria are found on seeds and on plant debris in soil where they over-winter. Bacteria are spread rapidly by rain. These bacteria can survive on leaves. They infect the plants through natural openings or wounds. The bacterial spot and canker bacteria thrive during weather with high moisture and temperature. Bacterial speck occurs during cool and moist weather.	Management includes planting tomatoes and other Solanaceae only every 2 to 3 years. Use only disease free seeds. Seeds can be treated (for example with bleach) prior to planting. On leaves, these diseases look like small greasy water soaked spots. A yellow halo surrounds the spots and the center of the spot dries out. Spots may combine into larger spots. Leaves may fall off.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
			On fruit, water soaked spots are raised. Centers become brown and scabby. Eventually a white halo appears.

Blossom-End Rot of Tomato, Pepper, and Eggplant Blossom-end rot is a serious disease. 50% of a crop can be lost.	Blossom-end rot is an abiotic disease. It is caused by calcium deficiency. Large amounts of calcium are required for cell growth. Without enough calcium, tissues break down. Blossom-end rot happens when there is not enough calcium to allow for the rapid growth of the fruit.	Management includes having the soil pH at 6.5. Calcium can be added to the soil using lime.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
		On tomato and eggplant, blossom-end rot begins as a small water soaked spot at the blossom end of the fruit. This can happen any time. The lesion enlarges and sinks. Eventually it turns black. Often other bacteria invade. On peppers the spots are tan. Bacteria and fungi may start to grow at the spots. Blossom-end rot can occur on the side of peppers.	

Phytophthora Blight of Pepper Phytophthora blight is a very destructive disease of pepper and cucurbits. It can lead to severe crop loss.	The soil fungus *Phytophthora capsici* causes Phytophthora blight. The fungus needs free water to infect plants. It usually occurs in poorly drained soils. The fungus survives in the soil and on plant debris. It is spread on seeds and transplants. It can be carried by rain. Fruits are especially susceptible to infection. Warm and wet weather favor infection.	Management includes using disease free seeds and transplants. Grow peppers and cucurbits only every 3 to 4 years in the same area.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
		*Phytopthora* affects seedlings and mature plants. Water soaked brown lesions develop on the lower stem. Water can not move up the stem to the leaves. Roots can also be infected. The plant again will wilt. Leaves can also have tan spots. Fruit develop lesions which are water soaked. The areas eventually shrivel up. The fungus grows into a white mass.	

Septoria Leaf Spot of Tomatoes *Septoria* affects leaves and stems. It does not affect fruit. It can defoliate a plant rapidly in warm and moist weather.	The fungus *Septoria lycopersici* causes Septoria leaf spot. It lives in the soil and on plant debris. The spores are splashed by rain or irrigation onto the leaves and stems. Wind can also spread the spores. The disease spreads rapidly when it is moist and between 60 and 80 F.	Management includes not planting tomatoes for 4 years. Deep plowing of plant debris also helps. The Solanaceae weeds are also a source of the fungus.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
 Leaf blight resulting from severe infection of Septoria leaf spot on tomato leaf	 Septoria leaf spot on tomato leaf	The disease attacks plants at all states. The spots are small, circular and water soaked. The spots become larger with dark margins and tan centers. You can see the fungal fruiting bodies in the middle of the spots.	Heavily infected leaves will drop off. The fruit is then exposed to the sun and may develop sun scald.

Rhizoctonia Stem and Stolon Canker of Potato

Rhizoctonia is a common potato disease. It can cause tubers to sprout late, reduce the number of potato plants and the quality of the tubers.

The fungus *Rhizoctonia solani* causes Rhizoctonia canker. This fungus survives in the soil for many years, especially on plant debris. The fungus grows on tuber surfaces in cool and moist conditions.

Management includes rotating crops, not growing potatoes for 3 to 5 years. Use certified seed potatoes. Plant seed potatoes in soils that are at least 60 F. Plant them only 2 inches deep. Harvest potatoes as soon as the vines are dead. (above 60 F). Cover seed tubers with no more than 2 inches of soil.

All photos from Ohio State University Extension Plant Pathology Fact Sheets

Plants are often small and spindly when they emerge. The first sprouts may die before emerging. Lesions may develop at the bottom of the stem. These lesions may not allow nutrients to go to the roots from the leaves. The vines become yellow to reddish purple and the leaves curl. The stalks may swell. Small tubers may even form at nodes
Sometimes the fungus forms a white powdery mold on stems.

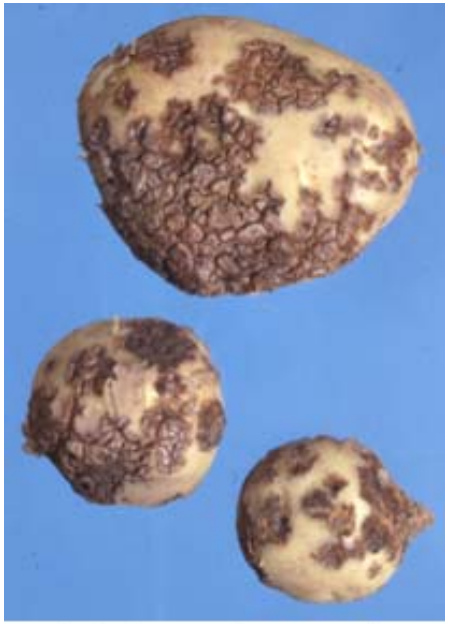
Potato tuber covered with small brownish-black fungal bodies (sclerotia) of the Rhizoctonia fungus- "the dirt that won't wash off."

Brown, sunken Rhizoctonia stem cankers on newly sprouted seed tuber (black line represents the soil surface).

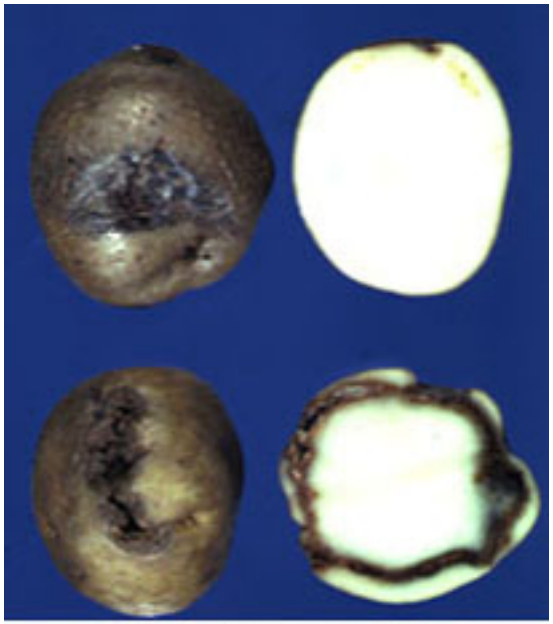
Rhizoctonia cankers on stolons pruning off young, developing tubers.

Fusarium Dry Rot and Seed Piece Decay of Potato Fusarium dry rot is an important post harvest disease. It affects the quality of tubers used for table consumption. It is also a major problem in seed potatoes. It causes losses in the amount of seed potatoes making it through storage and can affect how many seed potatoes sprout.	Fusarium dry rot is caused by several species of the fungus *Fusarium*. *Fusarium* lives in the soil. The fungus survives as resistant spores in the soil and in plant debris. Most infections occur because *Fusarium* enters the tubers through wounds resulting from harvesting.	Prevention is the best management. Harvest tubers only after the plants are completely dead. By this time the epidermis of the tuber will be mature. Try to limit injuries to the tubers during harvest. Store harvest potatoes at 55 to 60 F with 90 to 95% humidity for 1 to 2 weeks. This will allow healing of any harvest wounds. After this store the tubers at 38 to 40 F. Plant only certified seed potatoes.	All photos from Ohio State University Extension Plant Pathology Fact Sheets .
 **Tubers with Fusarium dry rot have wrinkled, sunken, brown to black lesions. When cut, infected tissues are dry and crusty.**	 **Infected areas of tubers with Fusarium dry rot often have internal cavities containing white or pink molds.**	Small brown lesions appear 3 to 4 weeks after harvest. The lesions continue to grow, especially if the temperature is above 50 F. Often bacteria also invade and cause the tuber to completely rot away.	Lesions are sunken areas that are gray or black. White, yellow, pink molds may be present inside the tubers. Seed pieces may completely rot away.

Blackleg, Aerial Stem Rot, and Tuber Soft Rot of Potato These are similar diseases caused by soft rot bacteria.	These soft rots are caused by different species of the bacterium *Erwinia*. These bacteria survive in the soil and in plant debris.	For management, plant only certified seed potatoes. If possible plant whole seed tubers so no cutting is required. If you do cut the seed potatoes, make sure you use clean instruments in a clean area. . Harvest tubers only after the plants are completely dead. By this time the epidermis of the tuber will be mature. Try to limit injuries to the tubers during harvest. Store harvested potatoes at 55 to 60 F with 90 to 95% humidity for 1 to 2 weeks. This will allow healing of any harvest wounds. After this store the tubers at 38 to 40 F.	All photos from Ohio State University Extension Plant Pathology Fact Sheets Blackleg starts from a contaminated seed potato. Sometimes the entire seed piece will rot away. Blackleg can also develop later. Stems become infected through wounds. The lesions are brown to black. The lesions become a mushy rot. Eventually the entire stem dies.
 **Inky black to light-brown stem decay of blackleg originating from the potato seed piece and extending above ground up the stem. Note wilting leaves of infected plant.**	 **Potato tuber mostly consumed by soft rot bacteria resulting in a soft, watery, cream to tan-colored decay.**	 **Irregular, brownish black, soft, mushy stem lesions characteristic of aerial stem rot**	Leaves roll up at the margins, turn yellow, and wilt. Tubers become soft and watery. The entire tuber can rot away, leaving only a shell. The rotting tubers can smell very badly. The smell comes from other bacteria invading the rotting tuber.

Scab of Potato Tubers Tubers with potato scab are low in quality because of surface lesions. There are no above ground symptoms.	Scab is caused by two different bacteria. A group called Actinomycetes can cause scab. These bacteria are found in soils with pH's above 5.5. *Streptomyces* can also cause scab. Most often they come on seed potatoes. These bacteria will survive on plant debris and the soil will remain contaminated. These bacteria can also survive going through the digestive system of animals. They are often spread by animals.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
 Raised, tan to brown, corky lesions of potato scab.	Scabs are roughly circular. They are raised and tan to brown in color. Scabs can cover the entire tuber. Some scabs are sunken and can be up to ½ inch deep.	We notice scab when the tubers are harvested, but scab can be present when tubers are young. These lesions will continue to grow as the tubers mature.

Potato Pink Rot, Pythium Leak and Seed Piece Decay Pink rot and Pythium leak are sometimes called water rot. They are problems of mature tubers during harvest and storage. They are serious during warm and wet weather. Seed potatoes can also suffer if weather is warm and wet.	The fungus *Phytophthora* (NOT the species that causes late blight) causes pink rot. *Pythium* causes seed-piece decay. Both are soil borne fungi. They survive in the soil on plant debris or as spores. These fungi infect tubers through wounds. Roots can be infected at any state. Seed pieces can become infected by *Pythium* soon after they are planted.	Management includes rotating crops for at least 4 years. Delay planting until 2 weeks after plowing down vegetation. The plowed plants may stimulate the *Pythium* populations. Do not plant when soils are below 45 F or over 70 F. Plant in well drained soils. Do not harvest if soil temperatures are below 50 F or above 65. Do not harvest when soils are very wet. Avoid harvesting infested fields when soils are especially wet or soil temperatures are below 50 F or above 65 F. Try not to injure tubers. Store the tubers in a cool and dry place. Take out any infected tubers.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
 **Potato tubers with pink rot showing the advancing rot, sharply defined by a dark line visible on the outer surface (above). When cut, infected tissues first appear slightly discolored (left), then turn salmon pink in about 15 minutes (center) and brown to black in half an hour (right).**	Pink rot in mature plants shows up as brown or black roots. Plants can be stunted and die. Sometimes leaves turn pale. Eyes of infected tubers are often dark brown. Decayed tubers may look whole but when squeezed will produce a clear liquid. The inside of potatoes will turn pink in about 20 min. after being cut.	*Pythium* decayed seed potatoes result in fewer plants and plants which sprout late. Some seed pieces never sprout. *Pythium* begins as a discolored water soaked area. The tissues are very watery. The tubers eventually become a soft watery paste.	

Bacterial Ring Rot of Potato Bacterial ring rot is an important disease of potato. Seed potatoes can not be certified if this disease is present. It can spread quickly and result in a significant crop lose.	The bacterium *Clavibacter michiganense* subsp. *Sepedonicus* causes ring rot. The bacteria survive on infected tubers. They can survive up to 5 years on surfaces of crates, bins and machinery. However, the bacteria can not survive in the soil unless potato plant debris is present. The bacteria enter through wounds. They are easily transmitted during seed potato preparation. A knife can spread the bacteria from an infected tuber to the other seed potatoes. Ring-rot bacteria can move in water and by chewing insects The bacteria increase in the plant and spread through the water conducting vessels	Management includes planting only certified seed potatoes. Throw away any seed potatoes that have ring rot. Before handling seed potatoes, make sure everything is clean. If you find ring rot, get rid of all plant debris and disinfect all equipment and storage areas.	All photos from Ohio State University Extension Plant Pathology Fact Sheets
 Ring rot symptoms of the vascular ring often appear only as a broken, sporadically appearing dark line or a continuous, yellowish discoloration.	 Brown, cheesy decay of the vascular ring of a potato tuber characteristic of ring rot. Severely diseased tubers may show slightly sunken, dry, cracked areas on outer surface.	Severe ring rot can cause leaves to turn yellow and die. First the lower leaves become pale, roll up at the edges and die. Often only one or two stems are affected. In the tuber, the vascular ring breaks down. The outside of the tuber may have sunken, dry, and cracked areas.	

Early Blight of Potato and Tomato Early blight occurs commonly on tomato and potato. Spots occur on leaves and stems of tomato. Fruit also rot. Potato leaves and tubers are affected. It can be very destructive. Whole plants can be defoliated. Although called early blight, it usually develops on mature leaves and stems.	The fungus *Alternaria solani* causes early blight. The fungus survives on infected plant debris in the soil. It is present in all soils where tomatoes and potatoes have been grown. It is transmitted on infected seed and tubers. Spores are carried on the wind and water. Infection is common during warm and humid weather. It can develop any time during the plant's life cycle. Tubers are infected through wounds and natural openings. Lesions can continue to develop during tuber storage.	Management includes planting varieties less susceptible to early blight. Potatoes and tomatoes should be rotated out, and only planted every 3 to 4 years. Bury all plant debris by deep tilling. Use certified seeds, plants, and seed potatoes. Water early in the day so plants can dry before dark.	All photos from Ohio State University Extension Plant Pathology Fact Sheets Symptoms first appear on older leaves. Small brown or black dead spots appear. Spots are very small to ½ inch. The spots enlarge. Sometimes rings form, making the spots look like a "bull's eye". The spots may grow together. The leaves turn yellow and die. Early blight moves up the plant. Infected stems look similar to the leaves.
 Dark brown, angular early blight lesions on a potato leaf.	 "Target-spot" or "Bull's eye" appearance characteristic of early blight lesions.	 Figure 3. Dark, leathery, sunken early blight lesions on tomato fruit at the point of stem attachment.	If the fungus attacks during flowering, flowers drop and fruit stems have spots and break. Spots can form on the fruits as well. Lesions are darker sunken spots about ¾ inch in size.