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BOTANY AND PLANT PATHOLOGY
ag.purdue.edu/btny
BP-204-W

Managing Phytophthora Blight of Cucurbits

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Introduction

Phytophthora blight is perhaps the most serious disease of cucurbits in Indiana. It has characteristics of a foliar disease, spreading rapidly from plant to plant under appropriate weather conditions, much like anthracnose. However, the fungus-like organism that causes Phytophthora blight may also survive in soil for indefinite periods, much like Fusarium wilt. This bulletin will describe the disease cycle, symptoms and management of Phytophthora blight of cucurbits.

What's in a name?

When naming a disease, plant pathologists sometimes use the official designation of the pathogen. This is the case with Phytophthora blight, so named for the pathogen *Phytophthora capsici*. Phytophthora is pronounced fahy-**tof**-ther-uh. The word comes from the Greek *phytón* (plant) and *phthorá* (destroyer). Specialists sometimes abbreviate *Phytophthora capsici* to the shorter, easier-to-use Pcap. The term Pcap is sometimes used as shorthand for Phytophthora blight as well.

Phytophthora Blight Symptoms

Phytophthora blight symptoms may be observed on all above-ground parts of a cucurbit plant. On pumpkins and squash, lesions readily form on foliage and fruit. While perhaps less sensitive to Phytophthora blight, cantaloupe may also exhibit symptoms on foliage and fruit. However, cucumbers and watermelons generally display symptoms only on fruit rather than foliage. (Under extremely conducive conditions such as high amounts of rain, watermelon foliage may exhibit symptoms.)

Lesions on pumpkin and squash leaves often start out light green and sunken, changing to brown and irregularly shaped (Figure 1). Stem lesions may cause the vine to wilt from the constricted area out toward the end of the vine (Figure 2). Lesions on fruit can vary. Lesions on watermelon fruit are often round and water-soaked, and may appear as a bruise (Figure 3). Under moist conditions, white mold caused by the growth of *P. capsici* covers these lesions. Lesions on fruit may be more common on undersides where moisture accumulates (Figure 4). Fruit lesions on pumpkin may be large and of no particular shape.

Symptoms caused by Phytophthora blight may appear similar to other diseases. For example, Pythium may also cause damping-off that appears similar to that caused by Phytophthora blight; often it is not possible to tell the difference between damping-off caused by Pythium and Phytophthora blight without a laboratory analysis. Fusarium fruit rot of pumpkin may cause a white growth on pumpkin fruit similar to Phytophthora blight. Fusarium fruit rot lesions on pumpkin tend to appear drier compared to lesions caused by Phytophthora blight. The disease white mold of pumpkin may be mistaken for Phytophthora blight; however, the former disease is accompanied by irregularly shaped, dark fungal bodies. While experienced growers may learn to recognize symptoms of Phytophthora blight, if there is any doubt, it is always good to send lesions to the Purdue Plant and Pest Diagnostic Laboratory.

Figure 1. *Phytophthora blight has caused a light-brown, wedge-shaped lesion on this pumpkin leaf.*

Figure 2. *The stem lesion on this pumpkin vine, caused by Phytophthora blight, will result in the death of the vine from this point.*

Figure 3. *Phytophthora blight caused the round lesions on this watermelon. Note the Phytophthora blight fungus-like organism sporulating on the lesion.*

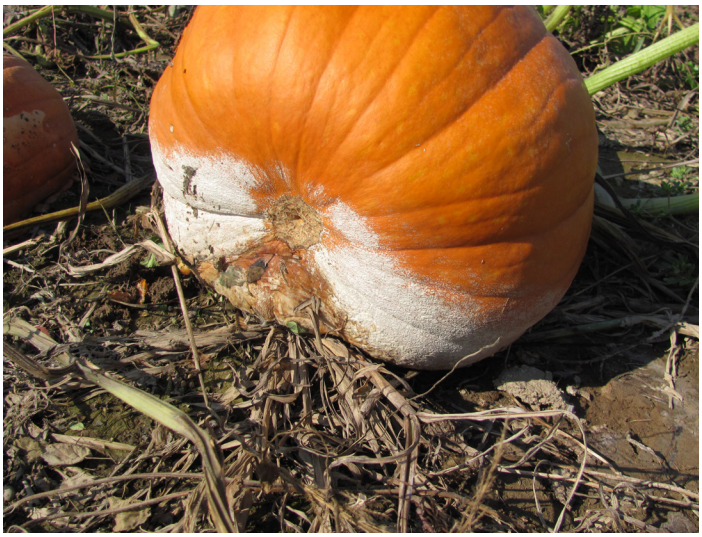

Figure 4. The Phytophthora blight fungus-like organism sporulates on a lesion on the underside of a pumpkin fruit.

Disease Cycle and Symptoms

Although understanding a pathogen's taxonomy is usually not critical to disease management, it is useful to understand that the organism that causes Phytophthora blight is more closely related to brown algae than to fungi (thus the reference of a "fungus-like" organism).

Below are three points that follow from knowing *Phytophthora capsici* is more closely related to brown algae than fungi.

1. Brown algae is an organism that lives in water. Therefore, heavy rains, standing water and poorly drained fields favor Phytophthora blight more than most diseases. Phytophthora and related organisms — like the pathogens that cause downy mildew and Pythium diseases — are sometimes called "water molds."
2. *Phytophthora capsici* can survive in water for substantial periods of time. If the pathogen washes off into a river or pond — and that water is then used for irrigation — it can carry *Phytophthora capsici.* Even farms downriver can end up getting Phytophthora blight from water.
3. Fungicides that are most effective against Phytophthora blight are often not the same as those most effective against, for example, anthracnose and powdery mildew. Anthracnose and powdery mildew are caused by fungi; the organism that causes Phytophthora blight is not a fungus, but a fungus-like organism more related to a brown alga.

Phytophthora capsici has a rather large range of hosts. In addition to causing disease on all cucurbits, Phytophthora blight can affect peppers, tomatoes, eggplants, snap beans and lima beans. Pepper plants are particularly susceptible. While tomato plants do not usually exhibit symptoms with the severity of cucurbits or pepper, *Phytophthora capsici* can cause Buckeye rot of tomato fruit (as can additional *Phytophthora* species). Weed hosts include common purslane, jimson weed and nightshade.

Given the number of plants susceptible to *Phytophthora capsici,* it is difficult to effectively manage Phytophthora blight through crop rotation. Another reason is the fungi's long-lasting spores. Resilient resting structures, known as oospores, may survive 10 years or more in the absence of any host. Crop rotations of at least four years without a susceptible host are recommended.

Phytophthora capsici also produce spores known as sporangia, which may form under ideal temperature and moisture conditions and resemble balloons on stalks. In the presence of water, each sporangium may break open to release 20 to 40 zoospores, which remind one more of algae than fungi. Zoospores are motile and can swim to cause another infection, or splash from leaf to leaf or plant to plant. Thus, one strong recommendation for Phytophthora blight is water management. Avoid poorly drained fields, use raised beds, and avoid overhead irrigation.

Temperature and relative humidity are additional factors important to understanding the biology of any plant/pathogen system. Using cucumber fruit as an example, 77°F represented an ideal temperature for lesion formation, but lesions formed on cucumber from 59°F to 86°F and from 35 to 100 percent relative humidity. Therefore, Phytophthora blight may cause disease under a great range of environmental conditions.

Phytophthora Blight Management

Cultural management methods are integral to managing Phytophthora blight, as fungicidal treatment will not work without them.

Water management is the most important control measure. If possible, choose fields with well-drained soils. At best, the soil in such fields will be sufficiently light so that rain drains into the soil shortly after it falls. In heavy-soil fields, try to minimize areas where water ponds after rainfall. Even a few such areas are likely to be hot spots for Phytophthora blight. Once the disease has a foothold, it can quickly work its way across a field, splashing from plant to plant.

Using raised beds 6 to 8 inches high may help plant survival. After heavy rainfall, such plants are likely to see the crown area under water. Adding black plastic mulch can act as a barrier to soil that may harbor *P. capsici,* reducing chances of disease. However, improperly formed mulch may cause water to pool on the plastic; if these pools contain *P. capsici,* it may splash up into the canopy with the next rainfall. Plastic mulch that is well-fitted to slightly domed beds — which will help prevent water from standing on plastic mulch — can act as a good management tool for Phytophthora blight.

Drip irrigation (instead of overhead irrigation) also will help to reduce spread of Phytophthora blight. If overhead irrigation can't be avoided, apply it so leaf surfaces dry before dew can form. Under no circumstances should irrigation water be allowed to stand in the field. When squash or pumpkins are direct seeded into killed rye or wheat, the cover crop may help protect the fruit from Fusarium fruit rot and generally keep the fruit clean. Such a technique may help to lessen the splash of P. capsici on fruit if the vegetation doesn't keep the fruit surface constantly moist.

P. capsici spores survive in surface water. Irrigation ponds may spread *P. capsici* if a vegetable field with Phytophthora blight drains into that pond. If that field's blight drains into a river or stream, the disease may spread to downstream fields.

There are no cultivars with host resistance to Phytophthora blight in cucurbits. Through experience, however, growers may learn, and avoid, the most susceptible varieties.

Phytophthora blight also has the potential to survive for a long time in the soil. Most specialists recommend at least a four-year crop rotation before planting a cucurbit crop. In the meantime, avoid susceptible crops such as tomatoes, peppers and green beans.

Brassica cover crops have been used to manage Phytophthora blight with mixed results. Many brassica varieties are sold as potential cover crops that may be used as a biofumigant. If planted in the fall and mowed in the spring with a flail mower before incorporation, these crops release compounds that may help reduce the severity of soil-borne diseases such as Phytophthora blight. Several factors affect the biofumigant potential of cover crops, including biofumigant activity of the brassica cover crop variety, the amount of growth of the cover crop overwinter, and whether the cover crop is itself susceptible to Phytophthora blight.

Fungicides are important to most management schemes for cucurbit Phytophthora blight. However, in the absence of cultural controls mentioned above and in the presence of conducive weather conditions, fungicides will be ineffective. Additionally, some strains of *P. capsici* have also shown resistance to select fungicides.

When managing Phytophthora blight in watermelon and cucumber, it is important to remember that, for the most part, the disease affects only the fruit. Therefore, it is unnecessary to apply fungicides to watermelon or cucumber foliage prior to fruit development. By contrast, both the foliage *and* fruit of pumpkin and squash are susceptible to Phytophthora blight. Cantaloupe foliage and fruit may be symptomatic, but this crop doesn't seem as susceptible as others.

Fungicides should be applied to pickling cucumber when fruit are 1, 2 and 3 inches long in addition to application before and after significant rain events. Watermelon should have a preventive fungicide application at softball stage and roughly every week thereafter. Depending on weather, apply foliar fungicides to pumpkins at bush stage, immediately before pumpkins begin vining, and roughly every week thereafter. While direct-seeded crops may benefit from a seed treatment such as Apron®, such seed treatments do not make sense for transplanted crops.

Table 1: Products recommended to manage Phytophthora blight, including trade names, common names REI/PHI, and FRAC codes.

Product	Common name	REI/ PHI[1]	FRAC code[2]	Comments
Agri-Fos®, Phostrol®, Prophyte®, Rampart®	Phosphorus acid/ phosphite	4/0	33 or P07	Apply to watermelon when fruit is about the size of a softball. Acibenzolar-S-methyl applied to manage diseases such as angular leaf spot or bacterial fruit blotch may help to lessen severity of Phytophthora blight. Phosphite products drenched onto squash or pumpkin crowns at about bush stage may help to lessen disease severity.
Forum 4.18SC®	Dimethomorph	12/0	40	
Actigard®	Acibenzolar-S-methyl	12/0	P01	
Elumin®	Ethaboxam	12/2	22	
Orondis Ridomil Gold SL®	Oxathiapiproprilin/ mefenoxam	48/5	U15/4	These products may be available at pre-mixes or co-packs. See label for description of application methods. Do not follow a soil application of Orondis Ridomil Gold® with foliar applications of Orondis Ultra®. Orondis Ultra® and Orondis Ridomil Gold® are combinations of two different systemic active ingredients.
Orondis Ultra ®	Oxathiapiproprilin/ mandipropamid	4/0	U15, 40	
Presidio 4SC®	Fluopicolide	12/2	43	
Ranman®	Cyazofamid	12/0	21	
Revus®	Mandipropamid	4/0	40	
Ridomil Gold®	Mefenoxam	48/5	4	Strains of the Phytophthora blight fungus that are resistant to Ridomil® might be present, so be sure to alternate this product with others that have different modes of action.
Zampro®	Ametoctradin/ dimethomorph	12/0	40	
Gavel®	Mancozeb/zoxamide	48/5	M/22	The products Gavel® and Zing!® are premixes of the systemic active ingredient zoxamide and the respective contacts mancozeb and chlorothalonil,. These products may be useful because the combination of systemic and contact active ingredients can help manage fungicide resistance.
Zing!®	Chorothalonil/ zoxamide	12/0	M/22	

[1]**REI** (re-entry interval) in hours: Do not enter, or allow workers to enter, treated areas during the REI period without protective clothing and equipment as specified on the label. PHI (pre-harvest interval) in days: The minimum time that must pass between the last pesticide application and crop harvest.
[2]Fungicide Resistance Action Committee: Fungicides with a number as the FRAC code should not be tank-mixed or alternated with a fungicide with the same FRAC code unless specified on the label.