Phytophthora Blight Session
Can Phytophthora Blight Be Effectively Managed?

Margaret Tuttle McGrath
Plant Pathology & Plant-Microbe Biology Section, SIPS, Cornell University
Long Island Horticultural Research & Extension Center
3059 Sound Avenue, Riverhead, NY 11901
mtm3@cornell.edu; http://blogs.cornell.edu/livegpath/; http://vegetablemdonline.ppath.cornell.edu

Phytophthora blight (caused by *Phytophthora capsici*) is arguably the most destructive disease for several crops and also the most challenging disease to manage. Susceptible crops include cucurbits, pepper, eggplant, tomato, lima bean, and snap bean. It can be successfully managed with an integrated management program that includes cultural practices to manage soil moisture to avoid saturation plus a preventive targeted fungicide program. Promptly destroying affected plants when feasible is also important. But an intense rainfall when soil is moist can thwart success.

Management Practices:

1. Long rotations between susceptible crops and selecting fields where Phytophthora blight has never occurred seem like important management practices considering this disease is caused by a soil-borne pathogen that does not easily move between fields. However, there have been cases where these were not successful. This may be because (1) both mating types of the pathogen are present enabling the pathogen to produce oospores, which are capable of long-term survival, (2) the pathogen can infect roots of some weeds including purslane, and (3) the pathogen can be moved between fields in soil on farm equipment or in running water. Additionally, beneficial antagonistic soil microbes might play a role in suppressing the pathogen following years of Phytophthora blight occurring.

2. Grow a mustard biofumigant cover crop before a crop susceptible to Phytophthora blight, preferably during spring rather than previous fall.

3. Use deep-zone reduced tillage to produce pumpkin, winter squash, or another crop like corn grown in rotation.

4. Select well-drained fields.

5. Make sure water will be able to drain out of the field. Use a land plane to level the field as much as possible. If water does not normally drain out of the field, then make a trench between beds or rows at their ends, make a ditch or waterway across the end of the field for water coming out of the field in the trenches, and continually grade soil at the end to allow water to leave.

6. Physically separate plantings of susceptible crops. Plantings should be located such that there is no opportunity for water to move from one planting to another. The pathogen can also be dispersed in rain splash during storms. Therefore it is prudent to consider prevailing wind direction when deciding where to locate multiple plantings of susceptible crops on a farm.

7. When growing small-fruited pumpkins, select varieties producing hard, gourd-like rinds (such as Lil' Ironsides). Mature fruit of such varieties are substantially less susceptible than varieties with conventional rinds which are softer.

8. Minimize hardpans and plowpans by subsoiling or chisel plowing before planting.

9. Do not plant the crop in areas of the field that do not drain well. Plant a cover crop in place of the crop in these areas.

10. Prepare raised dome-shaped beds for pepper, eggplant, summer squash and other non-vining crops. Ideally beds should be a minimum of 9 inches high. Use a bed shaper to provide more lasting beds as opposed to a simple ridge. Use a transplanter that doesn't leave a depression around the base of the plant. Fill in any depressions. Raised beds are not recommended for vining crops as some fruit will develop in the low area between beds where conditions will be favorable for Phytophthora blight.

11. Minimize hardpans and plowpans by not driving through wet fields.

12. Clean farm equipment, shoes, etc. of soil between fields. Movement in soil on equipment and shoes probably is an important means by which *Phytophthora* has been spread between fields on farms and may account for the occurrence of Phytophthora blight in fields with no previous history of susceptible crops.

13. Subsoil between rows after planting and before vining to improve drainage. Subsoil again as needed after rain. Good drainage is also important for driveways in fields, as symptoms have been observed first on plants next to the compacted soil of driveways, therefore, subsoiling along the edge of driveways is also needed. It is preferable to plan driveways before seeding leaving ample space, instead of seeding the entire field and then driving over plants.

14. Avoid over irrigating. Normal irrigation practices usually do not encourage Phytophthora blight except when leaks and puddles occur. Do not irrigate at night time when temperatures are above 70° F.

15. Do not irrigate from a pond that could contain water that drained from infested field.

16. Several fungicides have been developed with targeted activity for *P. capsici* and other oomycetes. Limited development of blight has been observed in plantings where these fungicides have been applied regularly, especially where a preventive spray program was used rather than waiting until symptoms were found. There also are several biopesticides labeled for application to soil before or at planting and to foliage. See list below. For updates in the future see the pdf file about Fungicides for Managing Phytophthora Blight in Cucurbits and Other Vegetables (http://vegetablemdonline.ppath.cornell.edu/NewsArticles/Phytophthora%20Blight-Fungicides-2018-NY.pdf). It is updated yearly.

17. Scout fields for symptoms routinely, especially after major rain storms. Include any areas where water did not drain well and near the end of irrigation pipe. But also look elsewhere. Symptoms have been found in areas where least expected, including on the slope of high areas.

18. When symptoms are localized in a small area of a field, disking the area is worthwhile. Begin with a border of healthy-appearing crop around the affected area.

19. Do not discard cull fruit in the field, including fruit that are healthy but over-sized or over-ripe.

Fungicides for Phytophthora blight (PB) and downy mildew (DM):
Both diseases often are of concern in a crop. Many of the same targeted fungicides are labeled for both as they are caused by oomycete pathogens. Modern fungicides because of their targeted mode of action typically have medium to high risk for resistance to develop in the pathogen. These need to be used in alternation to delay development of resistance, avoid control failure when resistance develops, and comply with label use restrictions. Limited work has been done testing isolates of *Phytophthora capsici* for fungicide resistance. Resistance is expected to vary among farms reflecting past use of specific fungicides. Resistance has been detected to Ridomil, Ranman, and Presidio. Four fungicide chemistries listed below are the main ones to include in a fungicide program. Add additional ones based on past use for PB and whether DM is developing.

Orondis (FRAC Code 49). The novel active ingredient, oxathiapiprolin, has exhibited excellent activity in fungicide evaluations. It is formulated with mandipropamid as Orondis Ultra (REI is 4 hr) for managing both DM and PB and with chlorothalonil as Orondis Opti (REI is 12 hr) for managing only DM. Orondis Gold 200, is only labeled for application to soil for Phytophthora blight. REI is 4 hr. Its use in a crop prohibits foliar application of Orondis fungicides for DM or PB. PHI is 0 day for all 3 fungicides. With all, make no more than 2 consecutive applications before rotating to a different fungicide. When at least 3 applications will be made, Orondis fungicides can be no more than 33% of the applications, or a maximum of 4 applications per planting, whichever is fewer. Orondis Opti is labeled for several other diseases because it contains chlorothalonil. It is only recommended used for these diseases when DM is also present. Orondis Gold 200 is considered the best choice for PB in a crop that has drip irrigation set up for applying pesticides and DM is expected to be manageable with other fungicides.

Zing! and Gavel (22). These are the only products that have a targeted fungicide and a protectant fungicide (chlorothalonil or mancozeb). Only Gavel is labeled for PB as well as DM. REI is 12 hr for Zing! and 48 hr for Gavel. PHI is 0 and 5 days, respectively. Apply no more than 8 times in a season with no more than 2 in succession. Limit total use with all products used to 1.6 lb zoxamide and 9.44 lb chlorothalonil per acre per season. The amount of chlorothalonil in an application of Zing! (1.18 lb/A) is less than the highest label rate of chlorothalonil fungicides for downy mildew (1.5 lb/A) and is below the range for other diseases including powdery mildew (1.5-2.25 lb/A). Increasing the amount of chlorothalonil applied is prudent for these diseases. To obtain an application rate of 1.5-2.25 lb/A chlorothalonil, tank mix Bravo WeatherStik at 0.43-1.43 pt/A with Zing!. Elumin is a new fungicide not yet registered in NYS.

Omega (29). REI is 12 hr. PHI is 7 days for squash/cucumber subgroup, which includes pumpkin, and 30 days for melons. Apply no more than 7.5 pts/A to a crop or 4 applications applied at highest label rate of 1.5 pts/A. Omega is more expensive than other fungicides.

Phosphorous acid fungicides (33). There are numerous products (e.g. Agri-Fos, Fosphite, K-Phite, Phostrol, ProPhyt, Rampart), all effective only for PB. They are recommended used at a low label rate tank mixed with the targeted fungicides listed above for PB.

Fungicides with documented or suspected resistance in the US. Resistance to Ridomil, Ranman, and Presidio has been detected in the PB pathogen; testing with Ranman and Presidio has only been done in the southeastern US. Resistance in pathogens is confirmed through laboratory testing of isolates. Resistance to Ridomil and to QoI (FRAC code 11 fungicides, e.g. Cabrio) in the DM pathogen are sufficiently common that fungicides with these ingredients are not recommended. Resistance to fungicides listed below was detected in the DM pathogen. Laboratory testing revealed that resistance to these is mostly in the DM pathogen lineage that affects cucumber and melon; therefore, these fungicides are recommended used sparingly (less than label limit listed below), especially for DM in cucumber and melon, and used for PB early in the season when DM is not a concern and where these fungicides have not been used extensively for PB.

Zampro (40, 45) and Revus (40). While in the same fungicide chemical group (40), there is indication they may have slightly different mode of action, thus there may be benefit to using one for the first application of a product in this group in a fungicide program and then switching to the other product later in the program. REI is 12 hr. PHI is 0 day. Maximum label use is 3 times (4 for Revus) in a season with no more than 2 consecutive applications (no consecutive with Revus). Revus must be applied with a spreading/penetrating type adjuvant. Forum is no longer recommended since it has the same FRAC Code 40 ingredient as Zampro, except on Long Island where Zampro is not permitted.

Ariston, Curzate or Tanos (27). These have some curative activity (up to 2 days under cool temperatures) but limited residual activity (about 3-5 days). They can be a good choice when it was not possible to apply fungicide at the start of a high risk period when temperature is below 80 F. Apply another targeted fungicide 3-5 days later. Curzate and Tanos must be tank-mixed with a protectant; Ariston also contains chlorothalonil. REI is 12 hr. PHI is 3 days. Maximum label use is 4 times in a season (6-9 for Curzate depending on rate); no consecutive applications of Tanos are permitted. Ariston and Curzate are not labeled for PB. Tanos also has a FRAC Code 11 ingredient. It is recommended used for DM only when this ingredient is needed for other diseases that are also occurring, such as Plectosporium blight, or where needed to also manage PB.

Ranman (21). Use organosilicone surfactant when water volumes are less than 60 gallons per acre. REI is 12 hr. PHI is 0 day. Maximum label use is 6 times in a season with no more than 3 consecutive applications.

Presidio (43). Must be applied with another fungicide. REI is 12 hr. PHI is 2 day. Maximum label use is 4 times in a season with at most 2 consecutive applications.

Previcur Flex (28). Activity is limited to DM. Maximum label use is 5 times in a season. REI is 12 hr. PHI is 2 days.

Recommended protectant fungicides. Chlorothalonil and mancozeb are the main protectant fungicides for DM and PB. Copper is also good for PB, but isn't as effective for DM.

For more information about Phytophthora blight, its management, and symptoms see http://vegetablemdonline.ppath.cornell.edu/NewsArticles/PhytoBlight_cucurbits-others.html

Please Note: The specific directions on fungicide labels must be adhered to -- they supersede this information, if there is a conflict. Before purchase, make sure product is registered in your state. Any reference to commercial products, trade or brand names, is for information only; no endorsement is intended.