

## Disease Management in Cucurbit Crops

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Every year in the northeast, cucurbit crops are potentially affected by more diseases than most other vegetable crops. All cucurbits at a minimum are affected by powdery mildew due to the quantity of easily wind-dispersed spores that the pathogen produces. Pathogens causing other diseases are not as widely dispersed. Several can survive in the soil, thus rotation is an important management practice. Most diseases are more severe during a rainy than dry season because wet leaves or soil are favorable conditions for most pathogens (exceptions include powdery mildew, bacterial wilt, and virus diseases). Successful management is based on knowledge of pathogen biology, in particular sources of inoculum and conditions favoring disease development, which is used to identify appropriate cultural management practices. Knowing early symptoms facilitates early detection. It is also important to have current information on fungicides and resistant varieties. Below is information on select diseases followed by an integrated management program. See also: [vegetablemdonline.ppath.cornell.edu](http://vegetablemdonline.ppath.cornell.edu).

**Phytophthora blight.** This destructive disease has more severe recently in areas where there were intensive rainfall events, which created unusually favorable conditions. A key to successfully managing this disease is managing soil moisture to avoid saturated conditions. Achieving this is difficult when rainfall amounts are large. Another key has been fungicides registered in recent years with targeted activity for pathogens in this biological group (Oomycetes): Forum (FRAC Code 40), Revus (40), Tanos (27), Presidio (43), Ranman (21), Gavel (22), and phosphorous acid fungicides (33). These are considered the reason many growers have been effectively managing Phytophthora blight. A preventive fungicide program is considered essential. Ineffective control with fungicides has been associated with poor application timing in some fields (application missed when rain began before expected) while in others favorability of environmental conditions seemed to have been too great. Development of fungicide resistance is a concern with all targeted fungicides due to single site mode of action; therefore, alternation amongst chemistry is recommended. Resistance to Ranman has been detected in the southeastern US. Protectant fungicides, such as coppers, are not sufficiently effective to be recommended alone for Phytophthora blight; however, they are useful tank-mixed with targeted fungicides to manage resistance. Presidio has a long rotational interval of 18 months for non-labeled crops, which can be a constraint on its utility. Most vegetable crops are now on the primary or supplemental labels. An important notable exception is sweet corn, which is commonly grown in rotation with pumpkins. There are also now several biopesticides (include Actinovate, Double Nickel, Regalia, RootShield, Serenade Soil, and Bio-Tam) that can be applied to soil pre-transplant, at planting, and via drip to manage the blight pathogen, *Phytophthora capsici*, in the root and crown zone and to induce resistance (Regalia). Most of these biopesticides can also be applied to foliage.

Typically Phytophthora blight begins to develop in low areas where water drainage is poor, but symptoms have been found first in sloped areas. This documents the need to look throughout a crop for symptoms and not focus exclusively on low areas. It is better to avoid planting low areas. While crops planted in a field lacking the pathogen (based on crop and disease history) typically will be free of Phytophthora blight, this is not absolute. The pathogen can be moved between farms via water. Two cultural practices that have proved useful are biofumigation and deep zone reduced tillage. Biofumigation can be accomplished by growing a biofumigant mustard cover crop typically in early spring, chopping into small pieces 4-6 weeks after onset of flowering, and immediately incorporating the mustard, then sealing the soil surface with a culti-packer and irrigation. Plant after at least 7 days.

**Powdery mildew.** An integrated program with both management tools (resistant varieties and fungicides) is recommended to maximize likelihood of effective control. Evidence has been obtained that the pathogen is evolving and becoming less effectively controlled by currently-available tools. Alternate among targeted, mobile fungicides in the following 4 chemical groups

(see list below), and apply with protectant fungicide to manage resistance development and avoid control failure if resistance occurs, and also to comply with label use restrictions. Note that the main goal is delaying resistance development, not managing resistance. Begin very early in powdery mildew development (one older leaf out of 50 with symptoms).

Torino (FRAC Code U6) is a new fungicide with a new mode of action. It has exhibited excellent control in fungicide evaluations conducted recently. Activity is limited to powdery mildew. It can only be applied twice to a field in a 12-mo period. Consecutive applications are not recommended. REI is 4 hr. PHI is 0 days.

Quintec (Code 13) has been consistently effective in fungicide evaluations. Activity is limited to powdery mildew. Labeled crops are pumpkin, winter squash, gourd, and melon. The crop rotational restriction is 12 months. Recent crop additions to the Quintec label have increased the options of what can be planted within 12 months of the last application. The Quintec label specifies no more than two consecutive applications plus a crop maximum of four applications. It is the only fungicide in this chemical group available in the USA. REI is 12 hr. PHI is 3 days.

DMI fungicides (Code 3) include Procure, Rally, Tebuzol, Folicur, and Inspire Super. Resistance is quantitative. Highest label rate is recommended because the pathogen has become less sensitive to this chemistry. Efficacy has varied in fungicide evaluations. Procure applied at its highest label rate provides a higher dose of active ingredient than the other Code 3 fungicides. Five applications can be made at this rate. REI is 12 hr. PHI is 0 days. Powdery mildew is the only labeled cucurbit disease for these fungicides, except for Inspire Super, which contains another active ingredient (Code 9) and is labeled for additional diseases. PHI is 7 days.

Carboxamide fungicides (Code 7) currently registered are Pristine, Fontelis, and Luna fungicides (all 4 Luna formulations are labeled for use only on watermelon so far). Strains of the powdery mildew pathogen resistant to Pristine have been detected and likely are the reason its efficacy has varied. All are labeled for additional diseases. Fontelis can be applied 4 times at highest labeled rate with no more than 2 consecutive applications. REI is 12 hr. PHI is 1 day. Cross resistance has documented between Pristine and Fontelis, but not Luna.

Resistance continues to be very common to MBC fungicides (FRAC code 1; Topsin M) and QoI fungicides (Code 11; Quadris, Cabrio and Flint); therefore, these continue to not be recommended. There are several protectants for powdery mildew, including chlorothalonil, sulfur, copper, botanical and mineral oils, and several biopesticides.

**Plectosporium blight.** This disease occurred more commonly in 2011 than previous years, reflecting that rainy weather provided favorable conditions. Rotate, clean equipment between fields, apply chlorothalonil before rain, and incorporate infested debris right after harvest.

**Downy mildew** is primarily managed with fungicides. Resistance bred into cucumbers provides some suppression of the pathogen strains present recently, but substantially less that what was achieved against strains present before 2004. However, they are still considered a worthwhile component of an integrated program. As with powdery mildew, fungicide resistance is also a concern with the downy mildew pathogen and therefore the fungicide program recommended is also targeted, mobile fungicides applied in alternation based on FRAC Code (see list below) on a weekly schedule and tank mixed with a protectant fungicide (chlorothalonil or mancozeb) beginning very early in disease development.

An important tool for determining when fungicide application is warranted is the forecast web site for this disease at <http://cdm.ipmpipe.org>. Cucurbit plants are susceptible to downy mildew from emergence; however, this disease usually does not start to develop in the northeast until later in crop development when the pathogen is dispersed by wind into the region. The forecast program monitors where the disease occurs and predicts where the pathogen likely will be successfully spread. The pathogen needs living cucurbit crops to survive, thus it cannot survive where it is cold during winter. The risk of downy mildew occurring throughout the eastern USA is forecast and posted three times a week. Forecasts enable timely fungicide applications. Label directions for some fungicides state to begin use before infection or disease development. The forecasting program helps ensure this is accomplished. Growers can subscribe to receive customizable alerts by e-mail or text message. Information is also maintained at the forecast web site of cucurbit crop types being affected by downy mildew. This is important because the pathogen exists as pathotypes that differ in their ability to infect the various crops. All

pathotypes can infect cucumber; some also can infect melons and squashes are susceptible to others. Success of the forecast system depends on knowledge of where downy mildew is occurring; therefore prompt reporting of outbreaks by growers is critical.

Presidio (FRAC Code 43). This has been the most effective fungicide. However, it has provided less suppression than expected in fungicide efficacy trials conducted recently when the original source of the pathogen for the season is southeastern US; Presidio remains highly effective against mid-west strains. See [cdm.ipmpipe.org](http://cdm.ipmpipe.org) to determine likely source. It is prudent to use it judiciously in a good rotation program. Apply no more than 4 times in a season with no more than 2 consecutive applications. Must be applied with another fungicide.

Zampro (40, 45) and Revus (40). While in the same fungicide chemical group, 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. Apply no more than 3 times (4 for Revus) in a season with no more than 2 consecutive applications (none with Revus). Revus must be applied with a spreading/penetrating type adjuvant.

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

Previcur Flex (28). This fungicide is more systemic than others and has good activity for downy mildew, but it is not effective for Phytophthora blight, which usually is also a concern in cucurbit crops. REI is 12 hr. PHI is 2 days. Apply no more than 5 times in a season.

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. Both must be tank-mixed with a protectant. REI is 12 hr. PHI is 3 days. Apply no more than 4 times in a season (6-9 for Curzate depending on rate); no consecutive applications of Tanos are permitted. Curzate is not labeled for Phytophthora blight.

Gavel (22). This is the only product that consists of a targeted fungicide and a protectant fungicide (mancozeb). REI is 48 hr. PHI is 5 days. Apply no more than 8 times in a season. Some cantaloupe varieties are sensitive to Gavel. Workers must be notified that a dermal sensitizer was applied both orally and by posting at entrance to treated area for 4 days.

*Recommended protectant fungicides.* Chlorothalonil and mancozeb are the main protectant fungicides for downy mildew. Copper is not as effective. Dithane now has a supplemental label that includes winter squash.

No longer recommended. Resistance to mefenoxam and metalaxyl and to strobilurins is sufficiently common that fungicides with these active ingredients (e.g. Ridomil and Cabrio), which use to be highly effective, are now ineffective.

### ***Integrated Management Program for Cucurbit Diseases:***

**Sign up for alerts about downy mildew occurrence** before the season at the forecast web site <http://cdm.ipmpipe.org>. Monitor the web site during the season for information on outbreaks.

**Select resistant varieties.** See [vegetablemdonline.ppath.cornell.edu/Tables/TableList.htm](http://vegetablemdonline.ppath.cornell.edu/Tables/TableList.htm).

**Use fungicide-treated seed and/or seed that has been tested for pathogens.** FarmMore commercial seed treatment also has an insecticide. Alternaria leaf blight, angular leaf spot, anthracnose, damping-off, Fusarium wilt, gummy stem blight/black rot, scab, Septoria leaf spot.

**Rotate land** to control diseases caused by pathogens that can survive in soil or on weeds in hedge rows, which include Alternaria leaf blight, anthracnose, angular leaf spot, Fusarium crown and fruit rots, Fusarium wilt, gummy stem blight/black rot, Phytophthora blight, Plectosporium blight, scab, Sclerotinia white mold, Septoria leaf spot, and viruses.

**Select a well-drained site** to manage cottony leak, damping-off, Phytophthora blight, Rhizoctonia belly rot, and scab.

**Minimize leaf wetness.** Select a site with good air movement and overhead irrigate when leaves will have time to dry before evening dew period to manage foliar diseases.

**Physically separate cucurbit plantings.**

**Avoid moving infested soil into clean fields.** Work last in fields where pathogens occur that survive in soil, then clean equipment before working in fields where these diseases haven't occurred (see list under rotate above). Apply pesticides to areas without soil-borne diseases first.

**Scout for diseases** regularly during the growing season. Focus on older leaves as diseases often start to develop there. Look on both leaf surfaces. It is especially important to scout once plants start to produce fruit. Check low areas for Phytophthora blight. Monitor downy mildew forecasts. Also look for cucumber beetles early in crop development.

**Apply pesticides as needed** (fungicides before rain for most diseases except powdery mildew):

Insecticide Admire Pro at planting or transplanting for cucumber beetles, which carry bacteria that cause bacterial wilt. Or use FarMore-treated seed. Planting Blue Hubbard or another cucurbit highly attractive to beetles around the crop to form a perimeter trap is an effective strategy that can result in insecticide only being needed on the trap plants.

Contans before or at planting for white mold.

Ridomil Gold EC (Code 4) at planting for damping-off and cottony leak. Another option for damping-off is Previcur Flex (28) and biopesticides.

Phosphorous acid fungicides (33) and/or biopesticides (see list above) at planting for Phytophthora blight.

Protectant fungicides (chlorothalonil, mancozeb, and/or copper) before disease onset. A preventive schedule is especially important with copper for angular and bacterial leaf spots.

Where bacterial wilt is a concern, apply insecticide if treatment at planting is no longer killing cucumber beetles early in crop growth, especially prior to canopy closure. Labeled products are Asana, Assail, Baythroid, Brigade, Danitol, Lannate, Pounce, Sevin XLR Plus, Volium Xpress, and Admire applied through drip.

Phytophthora blight. Alternate among the following fungicides tank mixed with copper or chlorothalonil beginning before symptoms are observed: Ranman (FRAC Code 21)\*, Revus (40), Presidio (43), Zampro (40,45), Tanos (27), Gavel (22), and phosphorous acids (33).

Apply targeted fungicides in alternation based on FRAC code when the following diseases occur starting at first symptom, tank-mix with protectant fungicide:

Alternaria leaf spot. QoI fungicides (11), Reason (11), Fontelis (7), Inspire Super (3,9), Pristine (7,11), Tanos (27).

Anthracnose. QoI fungicides (11), Inspire Super (3,9), Pristine (7,11), Tanos (27), and Topsin M (1).

Belly rot. Quadris (11) and Topsin M (1).

Downy mildew. Previcur Flex (28), Curzate (40), and all fungicides for Phytophthora blight except phosphorous acid fungicides.

Gummy stem blight. QoI fungicides (11)\*, Fontelis (7), Inspire Super (3,9), Pristine (7,11)\*, Switch (9,12), and Topsin M (1).

Plectosporium blight. QoI fungicides (11)\* and Inspire Super (3,9).

Powdery mildew. Torino (U6), Quintec (13), Procure or other Code 3 fungicide, and Luna (7), Fontelis (7)\*, or Pristine (7,11)\*.

Septoria leaf spot. Inspire Super (3,9).

\* Resistance detected in the US.

**Hasten decomposition of infested crop debris** by chopping debris to break it up and then incorporating with disk, roto-till or plow. Do immediately after harvest.

*Please Note: The specific directions on pesticide labels must be adhered to -- they supersede these recommendations, if there is a conflict. Note that some products mentioned are not yet registered for use on cucurbits. Check labels for use restrictions. Any reference to commercial products, trade or brand names is for information only; no endorsement is intended.*