STAYING AHEAD OF CUCURBIT DOWNY MILDEW WITH THE IPM*pipe* FORECASTING SYSTEM

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Cucurbit downy mildew is unique among diseases affecting vegetable crops, because the only source of inoculum is spores dispersed potentially long distances by wind, and it has a unique management tool in the IPM*pipe* forecasting system, which predicts where these spores will be dispersed and likely result in downy mildew developing. Many other pathogens of vegetable crops, including some other downy mildew pathogens, can survive over winter where cold temperatures kill their host plant because they can survive in crop debris, seed, potato tubers, or soil or by producing a type of spore that can withstand cold (e.g. oospore that some other downy mildew pathogens can produce). This is a unique forecasting system because unlike others, it is predicting spore movement as well as when conditions are favorable for infection. Only environmental conditions favoring disease development are considered with other systems, including Tomcast, Blitecast, and Simcast. The IPM*pipe* forecasting system for cucurbit downy mildew is a valuable management tool because this disease can be very destructive when not managed due to how quickly leaves can be killed. It occurs sporadically, especially on cucurbit crops other than cucumber. And cucurbit plants are susceptible to downy mildew from emergence. In contrast, field-grown cucurbits are not susceptible to powdery mildew until fruiting.

The IPM*pipe* website has forecasts and additional information about cucurbit downy mildew useful for its management. The website is at http://cdm.ipmpipe.org. Forecasts are produced and posted online at least twice (usually three times) a week during the growing season by a trained meteorologist. The forecast program monitors where the disease occurs and predicts where the pathogen likely will be successfully spread. Knowing when a pathogen is likely to first infect a crop enables ideal timing of fungicide applications and other protective measures. Fungicides perform best when applied before infection. Equally important, the forecasts indicate when there is no risk of downy mildew. This can be especially useful for reducing unneeded fungicide applications when conditions are expected to be favorable (rainy weather forecast when downy mildew is present in a nearby region) but wind trajectories are predicted to go in a different direction. An important component of the status of downy mildew provided at the website is information about the type of cucurbit crop found affected. This is important because the pathogen exists as pathotypes that differ in their ability to infect the various crops, with the exception of cucumber which is susceptible to all. Thus a grower would not need to apply fungicide to protect pumpkin or watermelon crops despite a high risk forecast if downy mildew was only found affecting cucumber and cantaloupe at the forecasted source area for pathogen spores. By using the forecasting system, reduction of 2 to 3 fungicide applications has been reported for growers in Georgia, North Carolina, and Michigan. With about 122,000 acres of cucurbits in the three states and at an average cost of $25/acre for each fungicide application, this equates to more than $6 million in savings to producers in these states. The website also has resources including images to assist with diagnosis, information about the biology of the pathogen, and current disease control recommendations.

Continual refinements to the IPM*pipe* forecasting system and additional information at the website increase its value to growers. A disease alert system was developed in 2010 to provide growers customized, real-time information on status of downy mildew, disease forecasts, and occurrence of new outbreaks near their farm. About 10,000 alerts were sent out during a

growing season. Alerts can be received as text or e-mail messages. The risk forecasting model has been improved in recent years by adoption of a better meteorological model and development of a model to relate survival of the pathogen's spores (sporangia) to cumulative solar radiation, which is important for predicting spore survival during transportation. More improvements are being planned.

Success of the forecast system depends on knowledge of where downy mildew is occurring; therefore prompt reporting of outbreaks by growers is critical. Growers can log a report directly at the website, or notify vegetable extension faculty or educators who will log a report.

While most growers use the forecasting system to optimize fungicide applications, one innovative grower uses it to determine when to operate his Spore Exclusion Tunnels. Lou Lego, Elderberry Pond Farm, designed and built low and high tunnels with low-cost air filtration system capable of blocking pathogen spores from entering. The system contains standard allergen reduction filters. It was completely successful: downy mildew did not develop on cucumber plants inside the Spore Exclusion Tunnels while plants were killed in outdoor and conventional high tunnel plantings.

Fungicides. There are several fungicides now registered with targeted activity for oomycete pathogens like the one causing cucurbit downy mildew. They are highly effective and rainfast because of their mobility in plants. Therefore they are excellent choices for managing downy mildew. The forecasting system is especially valuable for determining when to apply these fungicides because of their narrow-spectrum activity. Phytophthora blight is the only other disease most of these fungicides control. Use them in alternation and tank mixed with a protectant fungicide. Label directions for some state to begin use before infection or disease development. The forecasting program helps ensure this is accomplished.

Presidio (FRAC Code 43). This has been the most effective fungicide. It has provided less suppression than expected in fungicide efficacy trials conducted recently in the southern USA suggesting that resistance may have developed. It is prudent to use it judiciously in a good rotation program. Presidio has a long rotational interval of 18 months for non-labeled crops, which can be a constraint on production. The label has been expanded and now includes all cucurbits, fruiting vegetables, leafy vegetables, brassica (head and stem), bulb vegetables, sweet potatoes and root vegetables (except carrot, sugar beet, potato). REI is 12 hr. PHI is 2 days. Apply no more than 4 times in a season with no more than 2 consecutive applications. Presidio must be applied with another fungicide.

Zampro (40, 45) or Forum (40) and Revus (40). Zampro contains a new mode of action for oomycete pathogens, armetoctradin (FRAC Code 45), plus dimethomorph (Code 40), the active ingredient in Forum. It is not yet registered in NYS. It will be recommended used in place of Forum. While the active ingredient in Forum and Revus are 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.

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

There are several biopesticides labeled for managing cucurbit downy mildew, including Actinovate, Double Nickel 55, Milstop, Organocide, Oxidate, Regalia, Serenade, Sonata, Sporatec, and Trilogy. They are approved for organic production.

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.