Cucurbit Downy Mildew

Downy mildew is a potentially devastating disease of cucurbit crops that can cause significant yield losses. This disease is known to infect more than 40 cucurbit species, including cantaloupe, cucumber, pumpkin, squash, and watermelon. In Mississippi, this disease has been more of a problem in the fall than in the spring.

Signs and Symptoms

Signs and symptoms of downy mildew typically occur only on leaves. Leaves of all ages may be affected. Symptoms appear between 3 and 12 days after infection and begin as slightly yellow to bright yellow lesions on the upper leaf surface. Lesions may remain yellow or may turn brown. In most cucurbits, lesions have irregular margins (**Figures 1, 2, and 3**); however, in cucumbers, lesions are angular (**Figures 4 and 5**). The lesions may expand to cover much of the leaf surface, eventually resulting in the death of the entire leaf. Under favorable environmental conditions, the pathogen may produce gray- to purple-colored structures on the lower leaf surface below the yellow lesions present on the upper leaf surface (**Figure 6**).

Figure 1. Symptoms of downy mildew on cantaloupe. Photo: G. Holmes, Cal Poly–San Luis Obispo, Bugwood.org.

Figure 2. Symptoms of downy mildew on squash. Photo: G. Holmes, Cal Poly–San Luis Obispo, Bugwood.org.

Figure 3. Symptoms of downy mildew on watermelon. Photo: J. Brock, University of Georgia, Bugwood.org.

Figure 4. Symptoms of downy mildew on cucumber. Photo: D. Ferrin, LSU AgCenter, Bugwood.org.

Figure 5. Close-up of downy mildew lesions (symptoms) on cucumber. Photo: R. A. Melanson, MSU Extension, Bugwood.org.

Figure 6. Gray to purple pathogen growth (sign) on the lower surface of a cucumber leaf. Photo: R. A. Melanson, MSU Extension, Bugwood.org.

Pathogen and Disease Spread

Downy mildew in cucurbits is caused by the pathogen *Pseudoperonospora cubensis*. This pathogen is a member of a group of a fungal-like organisms (oomycetes) commonly referred to as water molds. Several pathotypes (subdivisions) of the pathogen exist. Each pathotype differs in which cucurbit host or hosts it can infect. This means that, in a given area, downy mildew may develop on one or more cucurbit hosts, but may not develop on others.

The cucurbit downy mildew pathogen requires a living host to survive and does not overwinter in areas where freezing temperatures prevent cucurbit production in the field. In these areas, pathogen spores are introduced each year on air currents from warmer areas. The timing of spore arrival each year often varies by prevailing weather patterns.

Disease development is favored by moderate temperatures, and moisture is required for infection.

Management

An integrated disease management program using several disease management methods should be used to manage downy mildew in cucurbits. While each of these practices can reduce the occurrence and development of downy mildew, fungicides are often necessary.

Biological Management

Plant cultivars that have some level of disease resistance. The cucumber varieties Calypso, Dasher II, General Lee, and Thunder are recommended for planting in Mississippi and have tolerance or resistance to downy mildew. Other cucurbit varieties with resistance may be available. Disease-resistance information for various varieties is available on seed packets and seed company catalogs and websites.

Cultural Management

Use cultural practices that promote air flow and reduce leaf wetness. Cultural practices that promote air flow and reduce leaf wetness can help to reduce disease development; however, these practices may not be sufficient for managing downy mildew if favorable environmental conditions and high inoculum pressure are present. Leaf wetness may be reduced by increasing plant spacing, growing cucurbits on a trellis system, and avoiding overhead irrigation.

In protected structures, efforts should also be made to reduce the relative humidity.

Chemical Management (Fungicides)

Apply fungicides that are effective against downy mildew. Fungicides are often required to successfully manage downy mildew in cucurbits. Fungicides are most effective when applied before disease develops. It will be necessary to make regular applications of fungicides as long as the pathogen is present and environmental conditions are favorable for disease development. A list of fungicides labeled for use against downy mildew in various cucurbit crops grown for commercial production, as well as an efficacy table of those fungicides against certain diseases in each of the cucurbit crops, can be found in the latest edition of the Southeastern U.S. Vegetable Crop Handbook (available online at ***http://www.thepacker.com/guides/Pest-production-guides***).

Fungicides can be categorized as protectants and systemics. Protectant fungicides, such as chlorothalonil and mancozeb, remain on the surface of the plant and do not move into the plant; these fungicides prevent the pathogen from infecting the plant by acting like a shield. Systemic fungicides move into the plant and have some degree of mobility within it; these fungicides may attack the pathogen within the plant after infection has occurred. Protectant fungicides should be used in a spray program before the onset of disease; once disease has developed, systemic fungicides should be incorporated into a spray program.

Because the downy mildew pathogen can quickly develop resistance to fungicides, resistance-management strategies should be used when applying fungicides to manage downy mildew.

Rotating (alternating) fungicides is one method of resistance management. Each fungicide uses a specific biochemical mode of action to attack a pathogen. Fungicides are arranged into groups based on their mode of action. These groups, designated by the Fungicide Resistance Action Committee (FRAC), are assigned FRAC codes (e.g., M3, 21, 27). Rotation of fungicides should be based on the FRAC codes (groups), provided on the label, rather than by the product name or the active ingredient of a fungicide because different products may use the same active ingredient or related active ingredients that have the same mode of action.

Tank-mixing a systemic fungicide with a protectant fungicide or a fungicide with a different mode of action (different FRAC group) is another method of resistance management. Always read the label to determine the FRAC group(s) of the active ingredient(s) in a product. It is not always necessary to tank-mix two products, each with a different active ingredient, since some products

contain two active ingredients (sometimes a systemic and a protectant fungicide). Rotation and tank-mixing for resistance management can be used in combination as part of a spray program to manage downy mildew.

Homeowners do not have access to the variety of fungicides that are used to manage downy mildew in commercial cucurbit production. However, various trade name products containing the fungicides chlorothalonil or mancozeb are labeled for downy mildew on cucurbits and are available at local garden stores. These products can be used to manage downy mildew on cucurbits in home gardens. Since chlorothalonil and mancozeb have multiple modes of action, there is a decreased risk of the pathogen developing resistance to these fungicides. Various copper products are also available to homeowners and may also be labeled for use against downy mildew in cucurbits. Caution, however, must be used with the application of copper fungicides. Application during temperatures near or greater than 90°F or before three or more days of overcast, usually rainy, weather can burn plant tissue (cause phytotoxicity).

A number of approved organic or OMRI-listed products are labeled for use against downy mildew in cucurbits, including various biologicals, coppers, neem oil, and peroxides. The efficacy of tested products has varied across fungicide trials; however, coppers have generally shown the best efficacy. In these trials, tested products typically reduced disease in comparison to nontreated controls but did not prevent a significant level of disease from developing. Approved organic products are most effective before the onset of disease and will not provide adequate protection once disease pressure is high.

When using fungicides, remember: ***the label is the law.*** You must completely read product labels, and you must follow the label.

Use the cucurbit downy mildew forecasting system to target critical periods for fungicide applications. A disease-forecasting system for cucurbit downy mildew was started in North Carolina in 2008. This free forecasting system tracks outbreaks of the disease and uses disease reports and weather data to generate forecasts or risk-prediction maps that determine the risk of downy mildew occurring in a particular area. These forecasts, available at the CDM ipmPIPE website (***http://cdm.ipmpipe.org***), can help growers decide when it is necessary to apply a fungicide to manage downy mildew. Website visitors can sign up to receive customized text or email alerts when outbreaks of cucurbit downy mildew are confirmed within a designated proximity of a specified location.

The accuracy of the forecasting system is dependent on timely reports of downy mildew outbreaks. These reports are provided by university personnel or plant pathologists who diagnose downy mildew from field samples or actively monitor sentinel plots for downy mildew.

The purpose of the sentinel plots is to regularly monitor susceptible cucurbit hosts for downy mildew to detect when the disease first appears in the area. The sentinel plots are maintained to keep plants as healthy as possible, but fungicides that have activity against cucurbit downy mildew are not applied.

2016 and 2017 Cucurbit Downy Mildew Sentinel Plots in Mississippi

In 2016, sentinel plots for cucurbit downy mildew were planted in the spring and maintained through crop completion at the Truck Crops Branch Experiment Station in Crystal Springs and the North Mississippi Research and Extension Center in Verona. A sentinel plot was also planted and maintained at the Truck Crops Branch Experiment Station during fall 2016. Each sentinel plot contained a susceptible variety of acorn squash, butternut squash, cantaloupe, cucumber, pumpkin, and watermelon. Dr. Rebecca A. Melanson, MSU Extension plant pathologist, with the help of Dr. Bill Evans, MSU research horticulturist, Dr. Casey Barickman, MSU research/Extension horticulturist, and others with MSU, coordinated, maintained, and monitored these sentinel plots.

Cucurbit downy mildew was not observed in either of the spring sentinel plots; downy mildew did appear in the fall sentinel plot. The first confirmed report of downy mildew in 2016 in Mississippi was on cucumbers in mid-August in Hinds County. Downy mildew was also later confirmed in Copiah (cucumber, pumpkin, squash), Lee (pumpkin), and Madison (cucumber, squash) counties.

Sentinel plots for cucurbit downy mildew will be planted in the spring and fall of 2017 at the Truck Crops Branch Experiment Station and in the fall of 2017 at the North Mississippi Research and Extension Center.

If downy mildew on a cucurbit crop is suspected in Mississippi, please contact your local county Extension agent or Dr. Rebecca A. Melanson (rebecca.melanson@msstate.edu) so that samples can be obtained for disease confirmation and outbreaks of downy mildew can be reported.

References

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Additional Resources

Cucurbit Downy Mildew ipmPIPE website, ***http://cdm.ipmpipe.org/***

Organic Materials Review Institute (OMRI) website, ***https://www.omri.org***

How to Collect and Package Plant Disease Specimens for Diagnosis (M1562), ***http://extension.msstate.edu/publications/miscellaneous/how-collect-and-package-plant-disease-specimens-for-diagnosis***

Plant Disease Sample Submission Form (Form 1139), ***http://extension.msstate.edu/sites/default/files/publications/forms/f1139.pdf***

Southeastern U.S. Vegetable Crop Handbook, available at ***http://www.thepacker.com/guides/Pest-production-guides*** or by contacting your local county Extension office.

Taking Photos of Plant Disease Problems (Publication 3022), ***http://extension.msstate.edu/publications/publications/taking-photos-plant-disease-problems***

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