

Agronomic Spotlight

Watermelon



WATERMELON DOWNY MILDEW

- » Downy mildew of watermelon can cause rapid defoliation leading to substantial yield losses.
- » The downy mildew pathogen overwinters in the southern United States and spreads northward in air currents.
- » Management of downy mildew on watermelon relies primarily on the application of fungicides.

Downy mildew is one of the most important diseases of cucurbit crops, including watermelon.¹ Not to be confused with powdery mildew, a disease caused by a completely different organism, downy mildew is caused by *Pseudoperonospora cubensis*, a water mold organism related to *Phytophthora* and *Pythium*. Downy mildew can cause substantial reductions in watermelon yields resulting from rapid defoliation leading to sunscald and reductions in growth and fruit quality.^{2,3,4,5}

SYMPTOMS

Downy mildew only infects the watermelon leaves. Leaves of all ages can be affected, but the symptoms typically develop first on older leaves near the crown before spreading to younger leaves.^{1,3,6} Symptoms develop three to twelve days after infection. The initial symptoms are light yellow, water-soaked spots on the lower leaf surface. Small, chlorotic to yellow spots that are circular to irregular in shape develop on the corresponding upper leaf surfaces.^{1,2,4,6} The lesions enlarge, becoming brown to black, surrounded by yellow halos (Figure 1A). Lesion expansion can be limited by major veins giving the lesions an angular appearance.^{5,6} The pathogen forms spores on the undersides of leaves, which can give the lesions a fuzzy brown to gray to purple appearance.^{3,5} The lesions can expand and coalesce to cover most of the leaf surface. Eventually, the leaf blades curl upward, wilt, and die, leaving the petioles attached to the stem. The collapsed leaves can have a brown to gray, scorched appearance (Figure 1B).^{3,5,6}



Figure 1. Symptoms of downy mildew on watermelon leaves, (A) necrotic leaf lesions and (B) upward curling and leaf scorch symptoms. Gerald Holmes, Strawberry Center, Cal Poly San Luis Obispo, Bugwood.org.

Downy mildew does not affect the fruit directly. However, the rapid defoliation can lead to sunscald of the newly exposed fruit, and reduced photosynthesis can result in fewer, smaller, lower-quality fruit.⁴

CYCLE AND CONDITIONS

Pathotypes of the cucurbit downy mildew pathogen are separated into two clades (genetic groups). Isolates belonging to clade 1 preferentially infect watermelon, pumpkin, and squash, while members of clade 2 preferentially infect cucumber and melon.^{5,6,7} The downy mildew pathogen is an obligate parasite that needs a living host to survive. It cannot overwinter on crop debris or in the soil. It overwinters on live cucurbit plants in frost-free areas or in greenhouses. In the U.S., the downy mildew pathogen typically overwinters on cucurbit plants growing in the gulf states. It then moves northward as the season progresses, typically arriving in the Northeast in July and August.^{1,5,6}

Downy mildew is spread by structures called sporangia, which function as spores. The sporangia are airborne and spread northward from southern growing regions as the season progresses. The sporangia can survive for one or two weeks and travel hundreds of miles in air currents.^{1,2,5} Sporangia deposited on watermelon leaf surfaces can germinate in as few as two hours if water films are present. Germinating sporangia can release several zoospores that swim in the films of water to find stomata on the leaf. The zoospores attach to the leaf surface near a stomate and form germination tubes that penetrate through the stomata to infect the leaf.^{1,4}

Moderate temperatures favor infection and disease development. Infections can occur at temperatures from 40° to 95°F. Temperatures between 59° and 68°F are optimal.^{1,4} Rain and high humidity levels also favor infection. Relative humidity levels of 100% for six or more hours are needed for infection to occur.^{3,6} Leaf spots will start to appear four to twelve days after infection, and new sporangia will develop on the undersides of leaves to continue the disease cycle.

MANAGEMENT

Management options for downy mildew are somewhat limited. Crop rotation is ineffective because the pathogen does not overwinter locally in most regions, and the pathogen can be windblown hundreds of miles. In addition, while there are cucumber varieties that are downy mildew resistant, there are no downy mildew resistant watermelon varieties.

Early planting in some areas of the U. S. can allow watermelon plants to mature and produce fruit before the pathogen arrives from the south.⁴ Wide row and plant spacings that



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decrease canopy density help increase airflow in the canopy. This can lower humidity levels in the canopy and promote leaf drying. Avoiding overhead irrigation also helps minimize periods of leaf wetness and helps reduce infection rates.^{1,5}

The primary method to manage downy mildew in watermelon is to apply fungicides. Routine scouting of the crop during the season can help growers detect initial disease outbreaks, allowing for the initiation of fungicide spray programs before the disease is too well established.⁴ Monitoring the occurrence of cucurbit downy mildew in neighboring states and counties can allow even better protection because fungicides are most effective if applied before the pathogen arrives in the area.⁵

Water mold organisms cause downy mildew diseases, and water molds are not fungi. Therefore, some fungicides applied to control foliar fungal diseases may not be effective against downy mildew. Downy mildew pathogens are related to *Phytophthora* and *Pythium*, and fungicides that are effective against those pathogens are often effective against downy mildew.⁶ Many of the products used to manage downy mildew on watermelon have little or no curative activity. So, a properly timed fungicide program is crucial. And, because the pathogen develops on the undersides of leaves, the use of mobile fungicides (those with translaminar activity) is recommended.^{4,8}

Both broad-spectrum protectant fungicides and narrow-spectrum mobile fungicides are labeled for use on watermelon to help manage downy mildew. Fungicide programs that include a mix of protectant and mobile fungicides and rotate among fungicide classes (FRAC groups) have been shown to provide good management of downy mildew and help minimize the development of fungicide-resistant strains of the pathogen.^{1,4} Protectant fungicides, such as chlorothalonil and mancozeb, can be tank mixed with the narrower spectrum, mobile fungicides or used in alternating application programs.⁵

Several fungicides are labeled for controlling downy mildew on watermelon (Table 1). Check regional production and pest management guides for the most current recommendations.^{6,8} Also, check product labels for reentry (REI) and days to harvest (PHI) restrictions, as well as restrictions on the total number of applications and amount of product that can be applied per season. Some labels state restrictions/instructions for rotating applications of the products with fungicides belonging to different FRAC groups to help manage fungicide resistance.⁴

Resistance to fungicides in FRAC groups 4,11, 28, 40, and 43 has been documented in the downy mildew pathogen. Fungicide resistance is more prevalent in the preferentially cucumber/melon infecting isolates compared to the preferentially watermelon/squash infecting isolates.^{4,7} However, the same fungicide resistance management strategies are used for both pathotypes. Several biopesticides that stimulate the host disease defense mechanism to help control downy mildew are registered for use on watermelon. These include *Streptomyces lydicus* strain WYEC 108, *Bacillus*

Table 1. Some fungicides used for managing watermelon downy mildew.^{4,7,8,9}

Active Ingredient(s)	Example Product	FRAC Group	REI* (hours)	PHI** (days)
ametoctradin + dimethomorph	Zampro® Fungicide	45, 40	12	0
chlorothalonil + zoxamide	Zing!® Fungicide	M5, 22	12	0
chlorothalonil + oxathiapiprolin	Orondis® Opti Fungicide	M5, 49	12	0
cyazofamid	Ranman® 400SC Fungicide	21	12	0
fluazinam	Omega® 500F Agricultural Fungicide	29	12	30
mancozeb + zoxamide	Gavel® 75DF Fungicide	M3, 22	48	5
oxathiapiprolin + mandipropamid	Orondis® Ultra Fungicide	49, 40	4	0

* Reentry interval ** Pre-harvest interval

subtilis strain 1AB/BS03, *Bacillus subtilis* strain QST 713, and *Bacillus amyloliquefacinens* F727.⁴

Determining the need and frequency of fungicide applications can be improved using disease forecast models, such as the one available on the Cucurbit Downy Mildew forecasting website.¹⁰ This site is part of the IPM-PIPE (Integrated Pest Management Pest Information Platform for Extension and Education) network. The cucurbit downy mildew forecast is based on the presence of the pathogen in or near an area and large-scale weather systems. Growers can subscribe to receive text or email alerts when outbreaks of downy mildew are confirmed in their area. This information can be useful when making application timing decisions.^{1,2,4}

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Websites verified 8/5/2022

For additional agronomic information, please contact your local seed representative.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about vegetable production. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with vegetable crops.

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