

BY MADELINE ANTHONY AND MARY HAUSBECK

# Protecting herbs from mildews

Both downy and powdery mildews are well-known for spreading quickly, so act preventively using multiple strategies.

**P**athogens infecting potted culinary herbs have gone largely understudied in the U.S. despite an increase in demand over the last decade. New control strategies for greenhouse-grown herbs are advancing through the USDA-funded project CEA HERB: Controlled Environment Agriculture Herb Extension & Research Base.

Limiting mildews has been an early focus, and in partnership with the USDA IR-4 Project, new control options have become available, with others in the pipeline.

## Downy mildew and basil

Sweet basil is susceptible. Sweet basil (*Ocimum basilicum*) is an especially popular herb for gardeners and cooking enthusiasts, making it a top seller for greenhouses producing potted plants or fresh-cut sprigs. Nothing ruins a Margherita pizza like

**This article** is the **fourth** of an **eight-part series** focused on nutrient deficiencies, post-harvest shelf life, disease management, food safety and marketing of culinary herbs produced in controlled environments. To see the first three articles, go to **[producegrower.com/magazine](https://producegrower.com/magazine)**.



CEA HERB Controlled Environment Agriculture  
Herb Extension & Research Base

basil leaves with a dark, fuzzy underside from downy mildew. Downy mildew is caused by *Peronospora belbahrii*, and sweet basil cultivars are the most susceptible. First discovered in the U.S. in Florida in 2007, downy mildew is a problem wherever sweet basil is grown. Luckily, it hasn't caused significant problems on other types of plants.

Turn the leaves over. Early symptoms may include yellow "striping" of the leaves, as the downy mildew is restricted to the leaf section bordered by major leaf veins (**Figure 1**). When these leaves are turned over, a dark mildew on the underside gives the leaf a "dirty" appearance (**Figure 2**). Sometimes, the leaves appear entirely green and healthy, but when turned over, the mildew is evident. Basil plants with yellow or brown discolorations on leaves should be the target for downy mildew scouting. Turn over the leaves that are discolored and those that appear normal to look for the dark mildew. Downy mildew can also develop on young plants and cotyledons.

Frequent scouting is important because a small outbreak on one or two infected plants can go undetected but serve as a source of disease for other plants in the greenhouse. The dark mildew on the undersides of the leaves is made up of spore clusters that form in the dark during the evening and early morning hours (**Figure 3**). These spores can move via air currents to nearby plants, resulting in a widespread outbreak.

Identifying infected plants early and disposing of them immediately using a sealed plastic bag keeps more plants from becoming infected. In southern regions of the U.S., downy mildew on basil can occur naturally, as it overwinters wherever a killing frost is absent. In northern areas, basil downy mildew

**Figure 1.** Yellow "striping" of a 'Genovese' basil leaf typical of downy mildew.

PHOTO BY MARY HAUSBECK



cannot overwinter outside, and the pathogen must be introduced each year. Seed contaminated with the downy mildew pathogen can be one way the disease gets started.

Sweet basil cultivars that feature a medium to high level of genetic resistance to downy mildew include 'Rutgers Obsession DMR', 'Rutgers Passion DMR', 'Rutgers Thunderstruck DMR', 'Rutgers Devotion DMR', 'Amazel Basil', 'Prospera DMR', 'Prospera Compact DMR', 'Prospera Italian Large Leaf DMR' and 'Prospera Premium F1 Basil'. Each year of the CEA HERB project, we've conducted large-scale field trials to compare commercially available basil varieties and newly developed lines for their resistance to downy mildew.

Keeping the foliage dry, the relative humidity low and limiting the time that leaves are wet reduces the threat of downy mildew. While downy mildew prefers cooler temperatures, around 65 °F, spores can be produced at a range of temperatures, especially under extended wet and humid conditions.

At Michigan State University, we've focused on securing downy mildew-specific fungicides through the USDA IR-4 Program to protect greenhouse-grown sweet basil from downy mildew. Growers have several choices for fungicide management of basil downy mildew, based on the growing environment (greenhouse or field) and intended use (seedlings for field production, potted plants for sale to consumers or greenhouse production of basil for fresh-cut harvest).

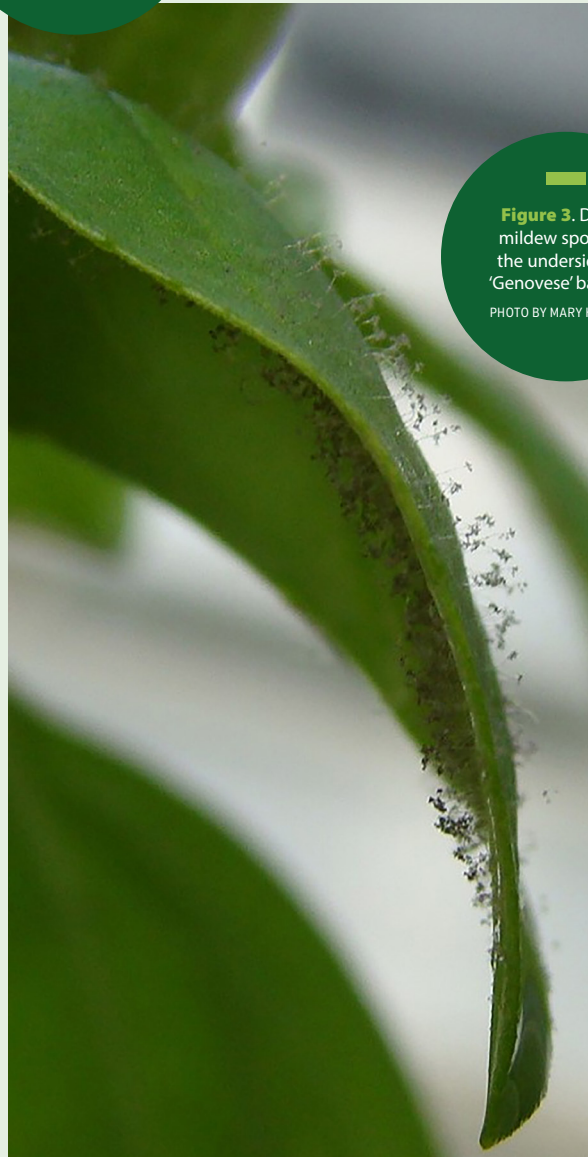
No matter your growing situation, rotating fungicides based on their mode of action is important. The first page of each fungicide's label contains a FRAC number, which is assigned based on the product's mode of action against the pathogen. The downy mildew pathogen can adapt and overcome a downy mildew fungicide if it is overused. Using fungicides with different FRAC codes will keep these helpful tools effective and in use for many years. Growers concerned about seed contamination may consider applying a recommended fungicide early in the production cycle.

Subdue Maxx (FRAC 4) can be used as a soil spray at seeding and has good soil activity. Other downy mildew fungicides that can be considered for use in an overall program, depending on the specific production system, include azoxystrobin (Heritage, FRAC 11), cyazofamid (Segway or Ranman, FRAC 21), fluopicolide (Adorn, FRAC 43), mandipropamid (Revus or Micora, FRAC 40), Segovis (FRAC U15), fenamidone (Reason, FRAC 11) and certain phosphorous acid fungicides. (Note: Please carefully read each fungicide label for specifics regarding restrictions and use patterns.) For organic basil produced in the greenhouse, OMRI-certified copper-based fungicides and other products can be considered for downy mildew control.



**Figure 2.** Downy mildew spores on the underside of a 'Genovese' basil leaf.

PHOTO BY MADELINE ANTHONY



**Figure 3.** Downy mildew spores on the underside of a 'Genovese' basil leaf.

PHOTO BY MARY HAUSBECK

## HERB PRODUCTION

### Powdery mildew and mint

Mint (*Mentha* spp.), particularly spearmint (*Mentha spicata*) and peppermint (*Mentha x piperita*), are favored by consumers for their oils used in flavoring and are a staple in home gardens. The white powdery growth from this mildew causes the leaves to die and the plant to lose vigor. Spearmint varieties are especially susceptible. Powdery mildew is caused by *Golovinomyces cichoracearum* and is not related to downy mildew that occurs on basil. This powdery mildew fungus can infect many different flower and vegetable crops, making it a challenge to control.

Inspect plants. Early symptoms on mint include the yellowing leaves, then small colonies of white fungal growth developing on the leaves, stems and petioles (Figure 4). As powdery mildew advances, the leaves turn brown and die (Figure 5). Powdery mildew colonies can develop on the underside of the leaves. These white colonies turn gray with age, and leaves covered with powdery mildew drop from the plant, which reduces quality.

Infection may be hard to see at first and may look like residue from water or pesticide spray. A diseased plant in the production area provides powdery mildew to nearby plants, so it should be removed right away. Powdery mildew can survive on some weeds, so all weeds in and close to the greenhouse should be removed.

Powdery mildew prefers overcast conditions and high humidity, so maintain good airflow and avoid excess watering. Overhead watering was once used by cut rose growers to limit powdery mildew, as the free moisture causes the spores to rupture. However, this practice is generally not used today because it favors *Botrytis* and other diseases.

Mint is not in the same crop grouping as other herbs, so when checking fungicide labels, look for mint specifically. If the fungicide label mentions herbs, but not mint, check further to make sure that the product can be applied to mint. Several fungicides for use on mint have been prioritized through the USDA IR-4 Project as the CEA HERB project has highlighted the need for new disease control tools. Once prioritized, it takes a few years for residue studies to be conducted and the data submitted to the U.S. EPA for approval. OMRI-certified copper-based fungicides and other biological products can be used effectively.

### Overarching mildew-busting strategies

Keep leaves dry and the greenhouse humidity low. The longer that the leaves are wet and the greenhouse humidity is high (over 85%), the better it is for the mildews.

Reduce the leaf wetness period by irrigating in the mid-morning so that the leaves have plenty of time to dry. Using HAF fans to mix the greenhouse air prevents pockets of high humidity that favor mildews. Spacing plants prevents a dense canopy that limits airflow and creates a humid microenvironment.

Prioritizing sanitation is a basic disease management strategy that is always worth the effort. The good news with powdery and downy mildews is that these pathogens survive only on living plants. That's why it's important to scout and remove diseased plants right away so that the mildew doesn't spread farther.

Cull piles located near the greenhouse may allow some




Figure 4. New powdery mildew colonies on a mint leaf.

PHOTO BY ETHAN TIPPETT




Figure 5. Established powdery mildew colonies on mint leaves and stems, along with leaf yellowing and death.

PHOTO BY ETHAN TIPPETT

diseased plants that were tossed to continue to grow and produce mildew spores that can be blown back into the production facility. If the plant has been completely killed by a mildew, the spores will not be long-lived and shouldn't pose a long-term threat.

Both downy and powdery mildews are well-known for spreading quickly and infecting many plants before an outbreak can be detected.

Since sweet basil and mint are known to have frequent mildew problems, it may be helpful to expect them and act preventively by using multiple strategies before they show up. **pg**

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