Managing Cucurbit Downy Mildew

Dr. Mary K. Hausbeck and Matthew R. Uebbing

December 2022

Historically, Michigan growers produce over 1.4 million tons of cucurbits valued at about $83 million on 43,000 acres. Michigan ranks number 1 in the nation for production of pickling cucumbers, and in the top 6 for fresh market cucumber and fresh market/processing pumpkin and squash. Cucurbit downy mildew (DM), caused by *Pseudoperonospora cubensis*, infects cucumber, watermelon, cantaloupe, honeydew, zucchini, gourd, summer and winter squash and pumpkin. DM reemerged as a problem on Michigan cucumbers in August 2005 when the disease spread across the eastern region of the United States and has recurred annually since then.

Recognizing Downy Mildew on CUCURBITS

- Yellowing on top surface of leaves bound by veins
- Velvety or fuzzy dark spore growth on the underside of leaves

DM causes symptoms on the leaves similar to angular leaf spot. Yellow lesions may be visible on the top surface of infected leaves (Fig. 1A). The telltale sign of DM is the gray to black fuzz on the underside of the leaf giving a somewhat "dirty" or "velvet" appearance (Fig. 1B). This fuzz may be most evident in the morning.

DM is well-known for causing catastrophic losses in a brief period of time. *Ps. cubensis* is an obligate biotroph, meaning it cannot live long without a host plant. This condition restricts the pathogen to warmer climates during the winter months, including southern states and greenhouses. DM spreads to surrounding fields on air currents via tiny, microscopic spores that act as seeds of the pathogen. Cool (~ 60°F), wet, and cloudy conditions create an ideal environment for DM spores to survive outside the host. When the conditions are favorable, unprotected foliage can become completely blighted within 14 days of the initial infection, resulting in catastrophic yield losses.

To help achieve early detection of airborne spores, volumetric spore traps (Fig. 2A) have been placed in Michigan counties during the growing season. Spore traps continuously sample the air and collect spores by imbedding them on a film that is removed and taken to the laboratory for identification and quantification. Quantitative PCR (qPCR) is used to identify *Ps. cubensis* spores (Fig. 2A, inset) that are present on the tapes. The spore traps help us to detect the presence of spores in the production regions where the spore traps are located. Thus, when spore detection occurs, alerts can be issued for growers to begin their fungicide spray program.

Figure 1. A. Top side of cucumber leaf with yellow lesions and necrosis defined by the veins. B. Underside of cucumber leaf displaying dark fuzzy spore masses.

DM must be managed through a fungicide spray program. Before the DM outbreak of 2005, the disease was effectively controlled through host resistance. Since 2005, the formerly-resistant cultivars have showed slower progression of the disease; however, no current cucumber cultivar has been identified that exhibits complete DM resistance.

A fungicide management strategy should include application of the most effective products.

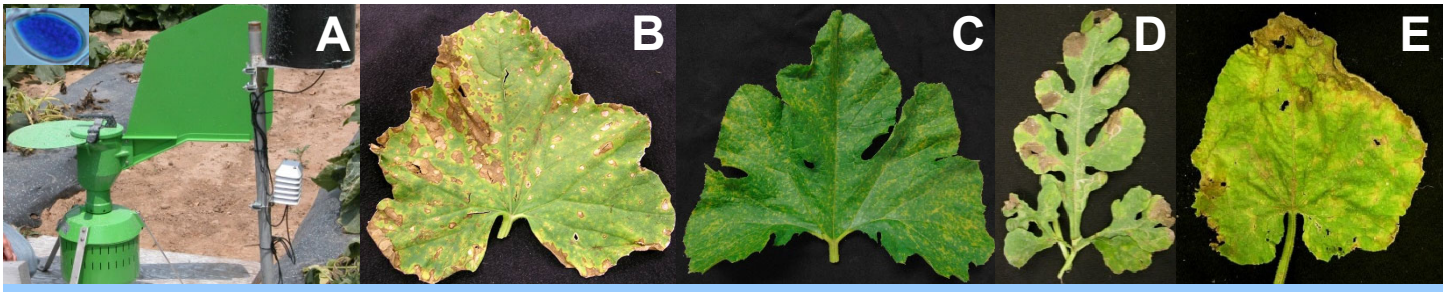

Figure 2. A, spore trap for monitoring airborne DM spores, inset (upper left) spore observed using a compound microscope and blue dye. DM on: B, cantaloupe, C, pumpkin, D, watermelon and E, yellow squash.

Figure 3. DM on A, untreated cucumber, and plants treated with B, Orondis, C, Previcur Flex, and D, Elumin

The Hausbeck Lab continues to evaluate new and existing products annually to determine the most effective fungicide products available for DM control (Fig. 3A-D). Research has found that the DM pathogen may be resistant to fungicides that were once extremely effective.

Rotating among FRAC groups (different modes of action) is imperative to delay development of resistance in the DM pathogen to new chemistries. The table below lists the products that have been tested and are effective against DM in field trials.

Preferred Downy Mildew Fungicides for CUCURBITS			
Product	**A.I.**	**FRAC**	**Comment (maximum applications/season)***
Orondis Opti**	oxathiapiprolin/ chlorothalonil	49/ M05	Do not use for more than 1/3 of the total foliar fungicide applications if applying 3 or more total foliar fungicide applications. (4)
Previcur Flex**	propamocarb	28	Mix with chlorothalonil or mancozeb. (5)
Elumin**	ethaboxam	22	Mix with chlorothalonil or mancozeb (2)
Ranman 4SC	cyazofamid	21	Mix with chlorothalonil or mancozeb. (6)
Omega (Orbus)	fluazinam	29	Mix with chlorothalonil or mancozeb. (6)
Zampro	ametoctradin/ dimethomorph	45/40	Mix with chlorothalonil or mancozeb. (3)
Use the following fungicides before symptoms and in combination with other fungicides:			
Gavel 75DF	zoxamide/ mancozeb	22/ M03	Do not apply within 5 days of harvest. (8)
Koverall	mancozeb	M03	See label for mixing restrictions. Do not apply within 5 days of harvest. (8)
Zing! SC	zoxamide/ chlorothalonil	22/ M05	(8)
Bravo Weather Stik	chlorothalonil	M05	See label for mixing restrictions. (10)
***Follow label recommendations for resistance management.**			

* The pesticide label is the legal document on pesticide use; read the label and follow all instructions closely. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals, and the environment, and can also lead to civil or criminal fines and/or condemnation of the crop. Pesticides are good management tools for the control of pests on crops, but only when they are used in a safe, effective and prudent manner according to the label

** Products considered to be especially effective based on Michigan field trials.

This material is based upon work that is supported by MSU project GREEEN, a Michigan Specialty Crop Block Grant awarded to the Michigan Vegetable Council, Pickle Packers International (Agricultural Research Fund and Pickle and Pepper Research Committee), and the National Institute of Food and Agriculture, U.S. Department of Agriculture, award number 2020-51181-32139.