

# WATER MOLDS 101: UNDERSTANDING AND MANAGING THE PATHOGENS CAUSING LATE BLIGHT, DOWNY MILDEW, AND PHYTOPHTHORA FRUIT AND CROWN ROT

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## Introduction

The group “water molds,” or oomycetous plant pathogens, is comprised of both foliar and soilborne organisms with the potential to cause great destruction of a number of economically valuable crops when environmental conditions are wet and warm. Water molds are distinguished from true fungi, the classification of most plant pathogenic organisms, by several features including 1) lack of cell walls in hyphae resulting in the coenocytic condition, 2) diploid nuclei of vegetative cells, 3) cell walls composed of beta-1,3 and beta-1,6 glucans rather than chitin in true fungi, and 4) many species produce biflagellated swimming spores termed zoospores in structures called sporangia (3). The distinguishing features of water molds make their control on agricultural crops a challenge unique from that of true fungi. On vegetable and potato crops, the water molds which threaten the greatest crop losses include *Phytophthora infestans* (causal agent of late blight on potatoes and tomatoes), *Phytophthora capsici* (causal agent of Phytophthora crown and fruit rot on tomatoes, peppers, squash, and cucumbers), and *Pseudoperonospora cubensis* (causal agent of downy mildew on cucumbers).

Late blight and downy mildew can both be aerially dispersed over long distances and genotypes identified in the region are not known to be soilborne at this time (1, 3). Initial inoculum and infection occurs as the result of movement of spores in the air from diseased fields to healthy, infected seed or transplants, or by overwintering plant tissues harboring the pathogen from the previous year (e.g., volunteers, cull piles, compost piles). Phytophthora crown and fruit rot is a soilborne oomycete and is not known to be aerially dispersed over long distances (2). The Phytophthora crown and fruit rot pathogen is most often spread by movement of infected fruit, plant material, or infested soil or water. Populations of *Phytophthora capsici* in field soils have been shown to contain two mating types, or sexually compatible types, which result in the production of soil persistent oospores.

## Results and Discussion

In the 2010 growing season in most of Wisconsin, wet (30 in rainfall from May-Oct 2010) and warm (growing degree days base 50 of 2381) weather conditions promoted the initiation and development of epidemic levels of late blight, Phytophthora crown and fruit rot, and downy mildew in vegetable and potato crops (Fig. 1).

Symptoms of ‘water mold’ vegetable diseases were first noted in Central Wisconsin in July of 2010 with the confirmation of late blight on potato and tomato (Table 1). Phytophthora crown and fruit rot and downy mildew diseases were observed in Central and Southern Wisconsin during the month of August (Table 1). Once the water mold diseases were identified in fields, disease progressed rapidly and was persistent throughout the rest of the growing season. Management recommendations for water molds are limited in season and include repeated application of

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effective fungicides such as: chlorothalonil, mancozeb, zoxamide, copper, propamocarb hydrochloride, fenamidone, cymoxanil + famoxadone, dimethomorph, cyazofamid, cymoxanil, fluazinam, metiram (potatoes), triphenyltin hydroxide (potatoes), mefenoxam, mandipropamid, difenoconazole, and fluopicolide (tomatoes). This is a comprehensive list of active ingredients across host crops and diseases. For specific crop allowances and uses, see fungicide labels for both federal and state-specific allowances. Wisconsin fungicide recommendations for water molds can be found in the University of Wisconsin Extension Publication entitled “Commercial Vegetable Production in Wisconsin,” publication number A3422 (<http://learningstore.uwex.edu/assets/pdfs/A3422.PDF>).

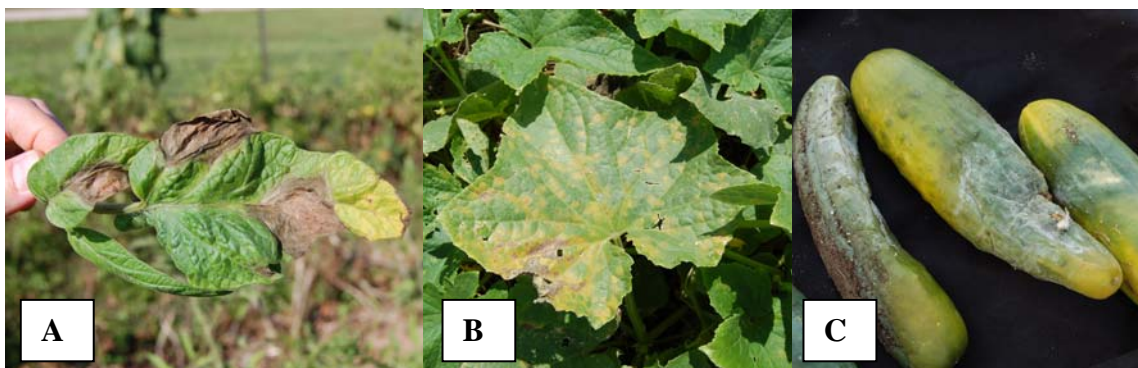


Figure 1. Disease symptoms on vegetable crops. A. Late blight on tomato leaf. B. Downy mildew on cucumber leaf. C. Phytophthora crown and fruit rot on cucumber fruit.

Table 1. Symptoms associated with oomycete plant pathogens diagnosed in Wisconsin, 2010.

Disease	Host crop	Symptoms
Late blight	potato and tomato	Foliage: Olive green to brown circular to irregularly-shaped lesions on leaves and stems, white fuzzy pathogen sporulation on foliar lesions with warm and wet conditions. Potato tuber: Internal brown, corky textured tuber tissue; External brown to purple, water-soaked yet firm lesion. Tomato fruit: firm, circular, brown or golden lesions often exhibiting rings, white fuzzy pathogen sporulation on fruit lesions with warm and wet conditions.
Downy mildew	cucumber, squash, melon	Pale green, yellow, or brown angular (contained within veins) lesions on leaves. Pathogen sporulation appears brown, gray, or purple and fuzzy or dirty on leaf underside only. Lesions can expand and coalesce to give an entirely yellow or necrotic leaf. Severe infection looks like plant experienced frost. No direct fruit infection.
Phytophthora crown and fruit rot	cucumber, pepper, tomato, squash, pumpkin	Foliage: wilting of cucurbit vines, lower stem water-soaked lesions with white pathogen sporulation. Fruit: water-soaked circular or irregularly shaped lesions. Under warm, wet conditions, lesions contain white pathogen sporulation that looks like powdered sugar.

Additional recommendations for managing water mold diseases in vegetable crops include: selection of varieties with resistance, planting or transplanting of clean, disease-free seeds or plants, crop rotation away from susceptible hosts, management of water in field and judicious irrigation (drip irrigation), increased plant spacing, effective fungicides applied when disease forecasting tool indicates time of risk, raised beds, and soil fumigation.

#### References

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