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Downy Mildew of Cucurbits and its Management

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What is downy mildew?

Downy mildew is a destructive disease caused by the fungus-like organsm *Pseudoperonospora cubensis* (Berkeley & Curtis) that affects different species of gourds (such as cucumbers, melons, pumpkins, cantaloupes and squashes) collectively called "cucurbits." Under cool and moist weather conditions, the disease can initiate from airborne spores (sporangium and zoospore) at any growth stage of the crop. However, after establishment of infection, the disease continues to spread even if the weather is dry. It can cause damage to plants over a wide range of temperatures (from 50 to 80° F, with the optimum being 59 to 72° F). In West Virginia and neighboring states, downy mildew has been a recurring problem for several years, occurring mostly on cucumbers and causing more damage than any other disease, especially from mid- to late-season.

How do I identify downy mildew?

The symptoms of this disease vary with the cucurbit species. The early symptoms appear on older leaves only. In severe cases, however, the younger leaves may also be infected. In its early stages, the disease appears as a pale green lesion on the upper surface of the leaf. Soon the color changes to yellow, and the shape of the lesion becomes irregular or angular depending on the cucurbit species affected. In cucumbers, most lesions are angular since the growth of the fungus is limited by major veins on the leaf. Upon progression of the disease, the color may remain yellow or turn brown, reddish-brown or black, or the leaves may become necrotic and their edges curl upwards (Fig. 1). In severe cases all the leaves may look burned. The fruits are not infected but, due to foliage loss, may be of poor quality, become sunburned and/or prematurely drop. During moist weather conditions, the lower surface of the leaf is covered with a downy, pale gray to blackish mildew. This mildew is made up of large numbers of sporangiophores (sporangium-bearing structures) bearing tremendous numbers of microscopic, lemon-shaped sporangia or sacks of spores (Fig. 2). The sporangiophores and sporangia are more visible as blackish growth during early morning and just after rain when humidity remains very high.

Figure 1. Downy mildew lesion on upper leaf surface of (a) melon (photo: Ontario Ministry of Agriculture) and (b) cucumber (photo: MM. Rahman)

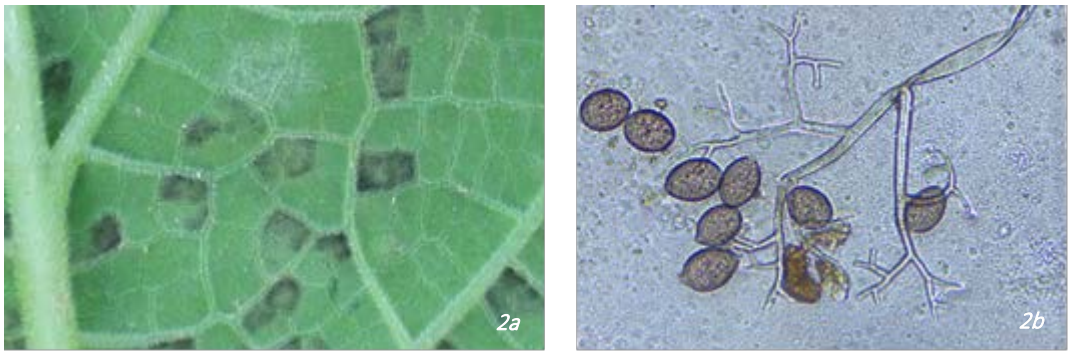

Figure 2. Fungal sporulation on the lower leaf surface under humid conditions: a) vein-bound blackish lesions that contain numerous sporangiophores and sporangia (photo M.T. McGrath); b) lemon-shaped sporangia on dichotomously-branched spronagiophore (photo plantpathology.ces.ncsu.edu)

What is the source of a downy mildew infection, and how does it survive?

The downy mildew-causing (fungus-like) organism *Pseudoperonospora cubensis* belongs to the group "Oomycetes." It is an obligate parasite or biotroph which means that it requires the host tissue of live cucurbits in order to survive and reproduce. Because of the hard frosts in the mid-Atlantic region, no cucurbit species survive winter in West Virginia. Therefore *P. cubensis* can't survive in the outdoor environment. That's why southern Florida, where wild or cultivated cucurbits may be present year round, is usually the source for this organism. The spores are dispersed via wind to neighboring plants and fields, and often over long distances to make their way from south to north in the eastern and central US. Although proof has not yet been found, greenhouses, where cucurbits may be present throughout the year, are suspected as a potential source for the disease.

How can downy mildew be managed?

Cultural controls:

1. Select cucurbit growing sites with full sunlight and low humidity.
2. Use resistant cucurbit varieties (due to the likely genetic changes in the organism, resistant varieties are no longer effective at preventing downy mildew, but can delay the disease onset by a few days)
3. Avoid overhead irrigation to prevent leaf wetness.
4. Remove infected plants at early stages of the disease.

Chemical controls:

Due to the unavailability of organically approved products and relative inefficacy of resistant cucurbit varieties, chemical control remains the most effective option for controlling downy mildew. Instead of applying chemicals on a seasonal schedule, however, timing of applications can be adjusted by utilizing the disease forecast system available online at http://cdm.ipmpipe.org/scripts/map.php. If the disease is reported from the neighboring state or county, it is imperative to start a preventative spray program that includes Bravo® or Zampro® or a tank mix of Previcur Flex®, Curzate® or Tanos® with protectants such as Bravo®, Echo®, Manzate®, Dithane®, or Penncozeb®. Once disease is reported from a local area (50 miles radius) or detected in the field, your spray program should include Gavel® (stand-alone) or Ranman® tank-mixed with protectants on a 7 to 10 day schedule.

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