

Downy Mildew in Cucurbits

Author: Michael Celetti - Plant Pathologist, Horticulture Crops Program Lead/OMAFRA;
 Elaine Roddy - Vegetable Crops Specialist/OMAFRA;
 Dr. Pitblado - Ridgetown Agriculture Technology College/University of Guelph

Creation Date: 03 April 2007

Last Reviewed: 03 April 2007

Table of Contents

1. [Introduction](#)
2. [Symptoms](#)
3. [Biology](#)
4. [Pathogen Survival and Spread](#)
5. [Management Strategies](#)
6. [Additional Sources of Information](#)
7. [References](#)

Introduction

Downy mildew is a serious disease of cucurbit crops grown in Ontario (Figure 1). It is caused by the fungus-like water mould *Pseudoperonospora cubensis*. Once established in a region, the disease can spread rapidly causing significant loss of fruit quality and yield.



Figure 1. Downy mildew symptoms on cucumber leaves.

Downy mildew infects gourds, squash, pumpkins, melons and cucumber. However, cucumbers are the most susceptible crop to this pathogen. Several different strains (pathotypes) of this organism have been identified. Some only infect cucumbers while others can infect melons, cucumbers, pumpkins and squash (Table 1). The downy mildew pathogen tends to be specific to crops within a plant family. The pathogen that causes downy mildew in cucurbits will not infect legumes or spinach and visa versa

Table 1: Interaction of Cucurbit host with different pathotypes (strains) of Downy Mildew
 Host Pathotype (strain)

Host	Pathotype (strain)					
	1	2	3	4	5	6*

Cucumber	+	+	+	+	+	
Cantaloupe	-	+	+	+	+	+
Sweet Melon	-	+	+	+	+	
Sour Melon	-	-	+	+	+	
Water Melon	-	-	-	+	+	-
Pumpkin and Squash	-	-	-	-	+	+

* 6th pathotype identified in Israel in 2003

+ indicates infection and disease

- indicates no or very little disease

(modified from Compendium of Cucurbit Diseases, APS Press, St. Paul MN)

[| Top of Page |](#)

The downy mildew pathogen primarily infects the leaves, resulting in decreased photosynthesis. Occasionally the fruit of melons can become infected as well. During favourable environmental conditions the pathogen can defoliate plants and destroy entire fields within a week. Fruit of infected plants are usually undersized and misshapen. They are also more likely to develop sun scald which further reduces their quality.



Figure 2. Small yellow "greasy" spots (arrow) on the topside of leaves (a) are often the first symptom of downy mildew infection. The yellow spot eventually develop a tan brown necrotic center (arrow) as the lesion matures (b).

Symptoms

Downy mildew symptoms first appear as small yellow spots on the topside of older leaves (Figure 2 a). The centre of the lesion will eventually turn tan or brown and die (Figure 2 b). The yellow spots sometimes take on a "greasy" appearance. They usually lack a distinct border. During prolonged wet periods the disease may move onto the new growth.

As the disease progresses, the lesions expand and multiply, causing the field to take on a brown and "crispy" appearance.

On most cucurbits the lesions appear irregular but on cucumber, they often are angular and confined by the leaf veins (Figure 3).



Figure 3. Expanding lesions on cucumbers are often restricted by leaf veins giving the lesion an angular or square appearance.

Under humid conditions, the lesion often develops a downy growth immediately on the underside of the light yellow lesions observed on the top of the leaf. This downy growth is particularly noticeable in the mornings after a period of wet weather or when conditions favour dew formation. The downy growth on the underside of the lesions is frequently speckled with dark purple sporangia (spore sacks) which can be observed with a hand lens (Figure 4).



Figure 4. Sporangia (spores) on the underside leaf surface appear as black specks.

The presence of the downy growth on the underside of the lesion is a key to diagnosing this disease.

Lesions are sometimes invaded by secondary pathogens such as soft rot bacteria or other fungi.

Due to the rapid spread of this disease and because symptoms often do not appear until 4 to 12 days after infection, **a successful disease management program must be implemented prior to the appearance of the disease symptoms.**

[| Top of Page |](#)

Biology

Downy mildew is favoured by cool, wet and humid conditions. The pathogen produces microscopic sac-like structures called sporangia over a wide range of temperatures (5- 30°C). Optimum sporangia production occurs between 15-20°C and requires at least 6 hours high humidity. The sporangia act similar to spores. They are easily transferred to healthy plant tissue by air currents or splashing rain. Once they land on a susceptible host, they germinate and can directly infect the leaf within one hour. During prolonged cool wet periods, the sporangia can also burst open and release many zoospores. The zoospores swim through the film of water along the leaf surfaces towards the stomates. These natural pores are a primary point of entry for the pathogen, resulting in multiple infections on the leaf.

This disease may progress slowly or stop temporarily when temperatures rise above 30°C during the day time. Night time temperatures in the 12-23°C range will promote disease development particularly if free moisture is present. With night time temperatures around 15°C and day time temperatures around 25°C, a downy mildew infection on cucurbits can produce more inoculum within 4 days.

Pathogen Survival and Spread

The Downy mildew pathogen is an obligate parasite. It requires living green plant tissue on which to survive. Killing frosts and cold winters effectively prevent spores from overwintering in the field in Ontario. There is the potential for downy mildew to overwinter on living cucurbit plant material in the greenhouse.

Downy mildew primarily overwinters in the Southern United States and Mexico. In these areas, the inoculum builds up on susceptible hosts in the spring. Sporangia are carried long distances by storms. Sporangia may survive for several days before being deposited on susceptible crops growing in the eastern US states. During the late spring, inoculum build in the eastern US States and the disease continues to move northward, carried by storms. Downy mildew typically arrives in Ontario on summer storms in mid to late summer. Once the disease becomes established, sporangia are disseminated locally from plant to plant and from field to field by splashing rains, overhead irrigation, moist air currents, insects, tools, farm equipment, the clothing of workers, and through the handling of infected plants.

[| Top of Page |](#)

Management Strategies

Managing downy mildew involves the use of cultural practices integrated with registered fungicide applications.

1. If possible, produce vegetable transplants in greenhouses dedicated solely for transplant production.
2. Growers who plant cucurbit transplants should ensure that the transplants are free from disease.
3. Consider a fungicide application on field-planted transplants prior to installing a row cover or tunnel and immediately after the row cover or tunnel is removed.
4. Select fields and manage the crop to promote air movement and reduce humidity levels inside the crop canopy.
5. Avoid excess irrigation. Consider irrigating during the late morning to facilitate rapid leaf drying. If possible, use trickle irrigation.
6. Scout fields for symptoms of the disease every week or more often if possible.
7. Maintain good weed control in the field. Control alternate weed hosts (wild cucumber, golden creeper and volunteer cucumbers) in neighbouring fence rows and field edges.
8. Follow a preventative spray program. Under wet and humid conditions apply a fungicide every 5 days. When dryer weather occurs, the interval between applications can be relaxed to 7 - 10 day intervals.
9. Always apply fungicides with at least 250-300 litres of water per hectare (25-30 gallons/acre). Ensure adequate coverage and spray penetration into the canopy.
10. Rotate between fungicides from different chemical families. Use both multi-site and single-site mode-of-action products.

11. Consult OMAFRA Publication 363, Vegetable Production Recommendations for registered fungicides that can be applied to control downy mildew.
12. Consider washing equipment and tools before moving from one field to another.
13. Field workers should wash their hands before moving from one field to another and wear freshly laundered clothing each day.
14. Attempt to work in diseased fields at the end of the day.
15. A web based Downy mildew forecasting systems has been developed that follows the movement of Downy mildew from the south to north throughout the growing season. The forecasting system also alert growers to the potential movement of the disease into a region. Following the movement of the disease throughout the growing season and adhering to the regional disease alerts allows growers to make timely fungicide applications.
<http://www.ces.ncsu.edu/depts/pp/cucurbit/thedisease.php#strains>

Additional Sources of Information

- http://web.aces.uiuc.edu/vista/pdf_pubs/927.PDF
- <http://www.ipm.ucdavis.edu/PMG/r116101611.html>

References

Zitter, Thomas A., Donald L. Hopkins and Claude E. Thomas, 1996. Compendium of Cucurbit Diseases; APS Press

Babadoost, Mohammad, Richard A. Weinzierl, John B. Masiunas. 2004. Identifying and Managing Cucurbit Pests, University of Illinois Extension pp.7.

Blancard, D., H. Lecoq and M. Pitrat. 2005. A Colour Atlas of Cucurbit Diseases: Observations, Identification and Control 3rd ed.

George N. Agrios. 2005. Plant Pathology, 5th ed. pp. 427-433.

This Infosheet was written by Michael Celetti, Plant Pathologist, Horticulture Crops Program Lead OMAFRA, Guelph, Elaine Roddy, Vegetable Crops Specialist, OMAFRA, Ridgetown, and Dr. Ron Pitblado, Ridgetown Agriculture Technology College, University of Guelph, Ridgetown.

| [Top of Page](#) |

For more information:
Toll Free: 1-877-424-1300
Local: (519) 826-4047
Email: ag.info.omafra@ontario.ca

| [Crops Home Page](#) |

| [Central Site](#) | [Feedback](#) | [Search](#) | [Site Map](#) | [Français](#)
| [Home](#) | [What's New](#) | [Calendar](#) | [Products](#) | [News Releases](#) |



This site is maintained by the Government of Ontario, Canada.

This information is provided as a public service, but we cannot guarantee that the information is current or accurate. Readers should verify the information before acting on it.

Feedback and technical inquiries to: ag.info.omafra@ontario.ca
© Copyright 2007 [Queen's Printer for Ontario](#)
Last Updated: April 4, 2007