

Plant healthcare

Factsheet

Key facts

- A foliar fungus-like disease spread primarily by airborne spores
- Unrelated to powdery mildews - more closely related to *Phytophthora* and *Pythium*
- Requires living host tissue on which to develop
- May produce long-lived resting spores
- Leaf wetness and high humidity needed for spore production and infection
- Manipulating the microclimate will help prevent outbreaks
- Protectant and curative fungicides available for many crops
- Strategies required to prevent the development of fungicide resistance

Introduction

Symptoms of downy mildew infection can be confused with those caused by powdery mildew. Unlike powdery mildews, the downy mildews are not true fungi but fungus-like. They are more closely related to algae, and are also related to *Phytophthora* and *Pythium*.

Downy mildews are specialised pathogens, requiring a living host on which to grow. Like most diseases of this type the downy mildews have restricted host ranges, so for example the species attacking pansies will not affect roses, and vice versa.

Control of leaf wetness and humidity are critical if damaging attacks of downy mildew are to be avoided. Plants on which the disease is an important problem include *Hebe*, *Impatiens*, lisianthus, pansy, *Nicotiana*, rose, grapevine, brassicas, lettuce and onion. In most cases (although there are exceptions) downy mildew will not kill a plant, but can soon lead to loss of yield or quality.

Symptoms

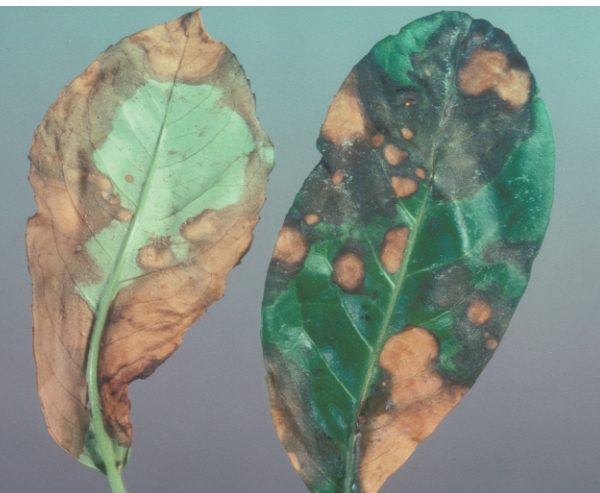
The visible growth of the pathogen (consisting of spores and their associated structures) is often confined to the underside of the leaf. As the common name for the disease suggests, this growth is often 'downy' or felty in nature, and may be white, grey or purplish-brown in colour depending on the mildew species. There is usually some discolouration and / or distortion of the corresponding upper leaf surface. In pansies, for example, infected leaves take on a pale green or yellowish colour, and their margins may roll downwards.

Affected tissue may eventually turn brown and die - this necrosis may be limited to affected parts of the leaf, but occasionally leads to death of the whole plant. The latter is usually found when a seedling or young plant has become infected systemically. In some cases leaves may be shed readily, even if they have not become necrotic. Severe leaf necrosis or leaf fall is commonly seen in *Impatiens*, lisianthus, *Nicotiana* and rose. Further details about *Impatiens* downy mildew is available at <http://www.defra.gov.uk/plant/pestnot/e/downmil.htm>.

The majority of the growth of downy mildews occurs within the leaf tissues. Sometimes the pathogen may spread throughout the plant to cause a systemic infection, in which case the entire plant may be stunted, discoloured and distorted. Spore production on systemically infected plants can occur on both leaf surfaces and also on other plant parts such as the stems. Systemic infection is common in pea, onion and lisianthus, but can also occur in some other hosts.

Leaf symptoms of some downy mildews can be quite angular in appearance, as the main veins of the leaf sometimes restrict growth and spore production. If visible growth of the fungus is not obvious these symptoms can be confused with those produced by bacterial diseases or foliar nematodes.

Downy mildew infection of certain brassicas such as radish, turnip and cauliflower can lead to a diffuse blackening of the internal tissues of the root or curd, without any obvious fungal growth.



Cherry laurel downy mildew

Biology

Asexual spores produced as part of the downy growth are readily shed and dispersed by water splash and air currents. High humidity is required for the production of these spores, and they need a film of water on the leaf surface in order to germinate and infect the plant. The spores of some downy mildews show their relationship to *Phytophthora* and *Pythium* by germinating to produce minute swimming spores (zoospores) that infect the leaf, but in most cases the spores act like those of the true fungi and infect the plant directly.

A resilient and long-lived sexual spore stage (oospore) may also be produced within leaves, stems or even roots. These can contaminate soil, standing areas, etc. In many cases it is not known whether oospores play an important role in the disease, even where they are produced in large numbers (e.g. in lisianthus).

In addition to the air-borne asexual spores or soil-borne oospores, important sources of downy mildew include seed (e.g. peas), other planting material (e.g. onion sets) and bought-in plants with latent infections (where the disease is present but not yet producing visible symptoms).

Diagnosis

This usually involves microscopic examination, to identify the characteristic spores of downy mildew. Incubation of affected plant parts at high humidity can encourage spore production where it is not already present. Occasionally more detailed work, including molecular testing, may be required.

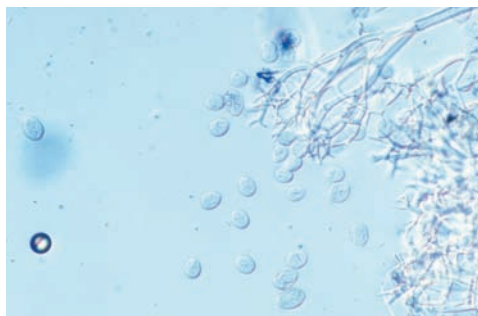
Chemical Control

Fungicides with activity against downy mildew will vary in their availability according to the crop, and detailed lists are beyond the scope of this factsheet. They range from protectant products, which need to be applied before the disease is present, to fungicides with some eradicant activity (although these should still be applied as soon as possible if downy mildew is found). Many of the more modern fungicides effective against downy mildew will have little activity against powdery mildews, so it is important that the disease is identified correctly. Fungicides used for the control of potato blight (*Phytophthora infestans*) will often have activity against downy mildews - such use, where legal, is usually off-label.

There have been a number of cases of fungicide resistance occurring in downy mildews, so an anti-resistance strategy is very important when formulating a fungicide programme. Many of the products available are mixtures that also contain older, broad-spectrum fungicides to which resistance is less likely to develop. Further information can be obtained from the Fungicide Resistance Action Group (FRAG) or downloaded from www.pesticides.gov.uk/rags_home.asp.



Sporulation on undersurface of impatiens leaf



Spores and spore bearing structures

Preventative measures

- Avoid prolonged leaf wetness or high humidity. For protected crops use ventilation (with heat if necessary) and fans.

Ensure plants are spaced as widely as practicable. It is particularly important that the foliage of susceptible crops does not remain wet overnight, as this is when many downy mildews produce their spores

- Use sub-irrigation systems if available

- Check bought-in plants or planting material for downy mildew

- Monitor crops closely and dispose of affected material promptly and carefully

- Ensure that there is a thorough clean up after susceptible or affected crops. Consider using disinfectants if there could be contamination by oospores

- Ensure that weeds are controlled. Closely related weeds could harbour a downy mildew that infects the adjacent crop. A dense population of weeds will also increase humidity around the crop, leading to prolonged leaf wetness

- Use resistant varieties where available

- Practice crop rotation where soil-borne oospores may be a problem



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