

Impatiens

Protected Crops

Impatiens downy mildew

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A downy mildew was found affecting impatiens for the first time in the UK in 2003. The cause was identified as *Plasmopara obducens*, a fungus-like organism that has been described overseas on wild and cultivated species of *Impatiens*. This factsheet gives information about this notifiable disease and its control.

Action points

- Inspect both cuttings and seed-raised impatiens for the disease at regular intervals.
- Check any wild Impatiens (balsam) near to glasshouses for the disease.
- Inform the Plant Health and Seeds Inspectorate (PHSI) if you suspect that impatiens downy mildew is present on your nursery.
- Remove any self-seeded impatiens in or around glasshouses.
- Ventilate glasshouses as far as practicable.
- Consider drip irrigation for stock plants.
- Only irrigate from overhead when the leaves will dry quickly.
- Routine preventative treatment with fungicides is difficult to justify at this stage; PHSI will provide advice on control if the disease is confirmed.

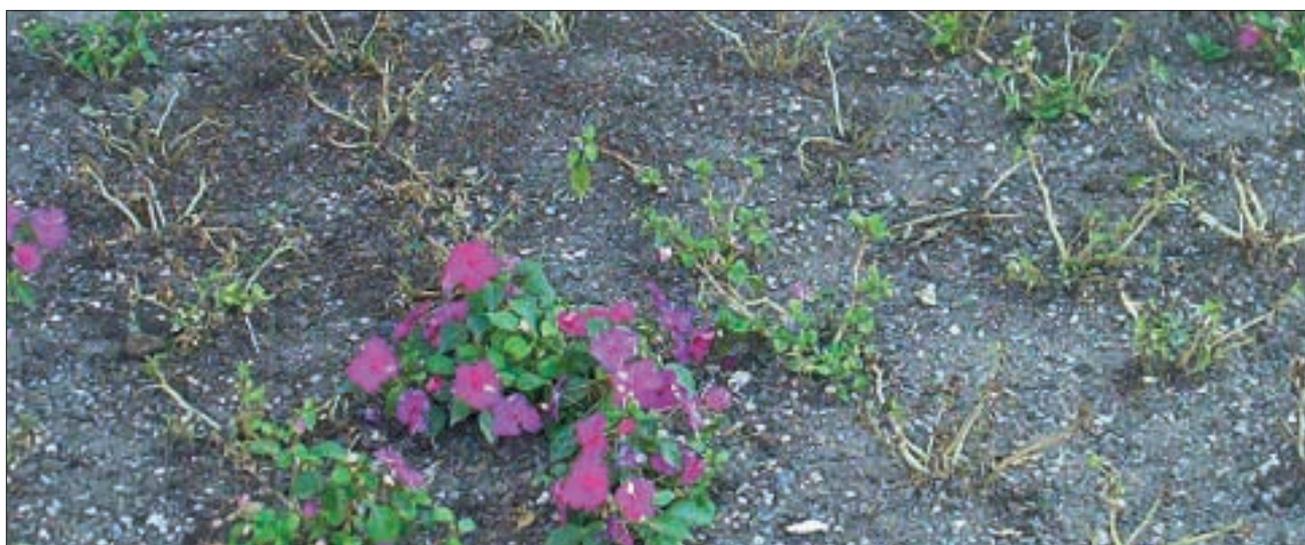
Background

What is the disease situation in the UK?

During the summer of 2003, *Plasmopara obducens* was confirmed on both seed and cutting-raised

impatiens in various locations around the UK, including nurseries, garden centres, civic floral displays and private gardens (Fig 1). Severely affected plants were killed before flowering and partially affected plants lost their ornamental value. Most of the outbreaks were first observed after planting out.

In one diseased flowerbed, impatiens plants with one flower colour were almost totally destroyed while adjacent plants with a different flower colour were unaffected (Fig 2). This suggests that there were either differences in plant susceptibility or, more likely, only stocks of certain lines were affected at the time of propagation.



1 Impatiens plants affected by downy mildew with dead or dying leaves and few or no flowers



2 Severely affected purple-flowered impatiens plants bordered by unaffected white-flowered plants

Currently, statutory action is being taken against the disease because it is very damaging and new to the UK. Staff at nurseries where the presence of *P. obducens* is suspected are obliged to inform PHSI so that measures can be implemented to eradicate the pathogen and prevent further spread.

Where did the disease originate?

The exact origin of the disease in the UK has not been determined, but it is likely it gained entry in impatiens material from overseas. Although the disease was first recognised in the UK in 2003, it may have been introduced earlier, remaining undetected in impatiens stocks whilst being disseminated with cuttings/plants before symptoms became apparent.

Where else has the disease been found and on which hosts?

Plasmopara obducens was first described in Germany in 1877 on *Impatiens noli-tangere*, a wild species of *Impatiens* native to many temperate countries in the northern hemisphere including the UK. The fungus was subsequently reported on the same host in Bulgaria, Czech Republic, Denmark, Finland, Lithuania, Romania and Russia. It is likely to be widespread on *I. noli-tangere* throughout northern and central Europe, although it has never been reported on this wild host in the UK. There is an unsubstantiated report from the Netherlands that the disease has been found on New Guinea impatiens, which is an ornamental hybrid derived from *I. hawkeri*.

In North America, *P. obducens* has been identified since the 1880s on

native species of *Impatiens* including *I. capensis* (synonym *I. biflora*), *I. fulva* and *I. pallida*. The pathogen has also been found in China and India primarily on *I. balsamina* (garden balsam). The impatiens bedding plant common in the UK is derived from *I. balsamina*, which originates from the Indomalayan region. Epidemics of downy mildew on *I. balsamina* have been reported in India.

Although specific reports of the pathogen have only come from the countries identified above, its distribution has been described as worldwide by one authority. Therefore, plants in the genus *Impatiens* in many other locations may be harbouring *P. obducens*.

Symptoms

Downy mildew diseases can remain latent for varying periods of time after infection. Symptoms may only appear when conditions favour sporulation.

The first symptoms of impatiens downy mildew are leaves turning a

paler green than normal with a white growth developing on lower surfaces. This white layer can be sparse (Fig 3) or conspicuous and cover the entire lower surface except for the main veins (Fig 4). Affected leaves yellow (Fig 5) and may fall prematurely. If they remain attached, the tissue

eventually collapses. Loss of leaf can result in bare stems (Fig 1). Plants can become stunted and produce small, pale green or yellow leaves (Fig 6). Flowers are either reduced in number or absent (Figs 1, 2 and 6).



3 Diffuse, white, spores and spore-bearing structures of *Plasmopara obducens* on the lower surface of an impatiens leaf



4 A dense, white layer of spores and spore-bearing structures of *Plasmopara obducens* on the lower leaf surfaces of a systemically-infected impatiens plant

Biology

Spread and survival of impatiens downy mildew

Under conditions of high humidity, *P. obducens* produces spore-bearing structures that are visible as a white coating on the underside of leaves (Figs 3 and 4). The spores are spread from plant to plant by water splash and over longer distances on air currents.

Leaf wetness caused by dew, rain and irrigation water is essential for spore germination and infection. If conditions are not favourable for

germination and infection, spores soon die. Once inside the plant, the downy mildew pathogen colonises and feeds on living cells. It is capable of invading all parts of its host. The cycle begins again when spores are formed on leaf surfaces.

The pathogen eventually exhausts the food reserves of the plant. Just before the death of host tissues, the pathogen may produce long-lived spores. These over-wintering spores can survive in decaying host tissue and soil for extended periods of time. After over-wintering, they can germinate and may infect new hosts. Although no over-wintering spores have yet been observed in impatiens

material in the UK, it is possible that they have been produced.

In India, over-wintering spores of *P. obducens*, as well as vegetative strands of the pathogen, have been detected inside seed harvested from diseased *I. balsamina* plants. When sown, infected seed is reported to give rise to systemically infected plants. There can be a long latent period before symptoms are expressed.

The pathogen can unwittingly be spread long-distances in infected cuttings and plants before symptom expression, and possibly with consignments of seed.



5 Two impatiens plants showing advanced symptoms of downy mildew. Leaves on the plant on the left are pale yellow and show signs of degeneration following sporulation of the pathogen. The lower leaves on the plant on the right are conspicuously yellow and may drop prematurely.

Pathways for the pathogen to enter impatiens production systems

The pathogen is most likely to have been introduced into production systems as a symptomless infection in cuttings or seed. Another possibility is that the disease may have been originated from wild plants, such as *Impatiens noli-tangere*, growing in close proximity to nurseries. Three other *Impatiens* species grow wild in the UK, including *I. glandulifera* (Indian balsam), and these may also be

susceptible and capable of harbouring the pathogen. However, evidence to date, which includes the lack of records of *P. obducens* in the UK until 2003, suggests that it is highly unlikely that the outbreak came from wild plants.

Conditions that favour disease development

Disease outbreaks occur after a period of wet weather. Moisture raises humidity levels at night and permits

the pathogen to sporulate. Surface water on leaves also allows spore germination and infection. In protected environments, overhead irrigation systems creating high humidity and surface moisture encourage disease development. A few diseased plants could generate sufficient spores to infect hundreds of others in the confined space of a glasshouse.

Management and control

What should be done to prevent the disease occurring?

Disease exclusion

The most effective form of control is to exclude the pathogen from nursery

production. **This can only be achieved if sources of propagating material are free of the pathogen.**

Growers should choose their sources of stock material carefully. Suppliers should undertake precautionary measures to ensure nursery-freedom from downy mildew.

Monitoring for disease

Growers should carefully inspect all seed and cutting-raised plants for

signs of disease at regular intervals. However, as the disease can have a long latent period, plants may be sold before symptoms become apparent. In addition, symptom expression, spore release and infection of surrounding plants may occur very quickly in succession and before being noticed. Nevertheless, inspections are deemed to be worthwhile as the first signs of the disease may be detected before spread has occurred.

Hygiene

Any *Impatiens* plants self-seeding in or around glasshouses should be destroyed. Wild species of *Impatiens* growing as weeds near to glasshouses should be checked for downy mildew and destroyed if diseased. Bench tops and other surfaces should be kept clean and disinfected if there is a high risk of disease.

Cultural practices

Good ventilation and air movement in glasshouses should help prevent the build-up of high humidity that favours disease development. Drip and ebb-flood irrigation reduce the chances of moisture on plant surfaces thus lowering the risk of infection. Overhead irrigation should only be used when the leaves are likely to dry quickly.

Preventative fungicide treatment

Routine preventative treatments with fungicide are difficult to justify at this stage. However, if the disease becomes more common in the UK, or if a certain variety is deemed to be extremely susceptible, then the use of fungicides on young plants soon after arrival in the glasshouse may become worthwhile. A systemic product with curative activity that can eliminate latent infections should be applied (see Table 1).

What should be done if the disease is suspected?

Early detection followed by prompt action is the basis of effective disease management. The Plant Health and Seeds Inspectorate (PHSI) of Defra should be contacted if *Impatiens* downy mildew is suspected on plant material (see under 'Further Information'). An inspector will examine the crop and specimens will be sent to the Central Science Laboratory (CSL), an agency of Defra, for identification. If the presence of the pathogen is confirmed, PHSI will give appropriate advice (summarised below).

What should be done if there is a disease outbreak?

If there is a disease outbreak, the PHSI will provide advice on control. This is summarised here.

Hygiene

- Diseased plants on nurseries must be removed and destroyed by deep burial or burning.
- Hard surfaces, such as benching and flooring, should be thoroughly washed with water and then treated with a solution of 2% Antec Farm Fluid S®, 1.66% Panacide M® or 1% Jet 5®, which are known to be effective against the spores of related pathogens.
- Diseased plants and associated debris in floral displays and gardens should be removed and burnt or deep buried at the end of the season, as there may be a chance that long-lived, over-wintering spores of the pathogen may be present in the soil.

- Soil on which affected *Impatiens* plants have shed dead leaves or in which poorly performing plants have been 'dug-in' may be contaminated with over-wintering spores. These beds should not be replanted with *Impatiens* the following season.

Cultural practices

Any apparently healthy *Impatiens* plants remaining on nurseries at the end of the season that are not specifically required for the next season should be destroyed as a precautionary sanitation measure.

Destruction of any wild species of *Impatiens* immediately around glasshouses at nurseries where downy mildew has been detected is advisable as they may host the pathogen and be a source of infection for next season.

Seed or cutting material should not be harvested from affected or suspect plants as they could carry the pathogen.



6 Plants systemically infected by *Plasmopara obducens* showing stunting, small yellow leaves and a lack of flowers

Table 1

Commercially-available fungicides with potential for the control of impatiens downy mildew and permitted for use on ornamental crops (February 2004)

Fungicide group and products	Active ingredient	Curative/protectant activity	Permitted on crops		Approval status and comment
			Outdoor	Protected	
Carbamate					
Filex®	Propamocarb hydrochloride	Protectant	✓	✓	Label approval for use on ornamentals
Propeller®	Propamocarb hydrochloride	Protectant	✓	✓	
Proplant®	Propamocarb hydrochloride	Protectant	✓	✓	Extrapolation from on-label use on lettuce
Dithiocarbamate + carbamate					
Tatoo®	Mancozeb + propamocarb hydrochloride	Protectant	✓	X	Extrapolation from on-label use on potato
Dithiocarbamate + cinnamic acid derivative					
Invader®	Mancozeb + dimethomorph	Protectant + Curative	✓	X	Extrapolation from on-label use on potato
Dithiocarbamate + cyanoacetamide					
Curzate M68®	Mancozeb + cymoxanil	Protectant + Curative	✓	X	Extrapolation from on-label use on potato
Dithiocarbamate + phenylamide					
Fubol Gold WG®	Mancozeb + metalaxyl-M	Protectant + Curative	✓	✓	Extrapolation from SOLA 2142/03 on lettuce

Table 1 (continued)

Fungicide group and products	Active ingredient	Curative/protectant activity	Permitted on crops		Approval status and comment
			Outdoor	Protected	
Phthalonitrile					
Bravo 500® (and equivalent products)	Chlorothalonil	Protectant	✓	✓	Label approval for use on protected ornamentals; extrapolation from on-label use on various field crops to outdoor ornamentals
Phthalonitrile + phenylamide					
Folio Gold®	Chlorothalonil + metalaxyl-M	Protectant + Curative	✓	X	Extrapolation from on-label use on various field crops
Phosphonate					
Aliette 80 WG®	Fosetyl-aluminium	Protectant + Curative	✓	✓	Label approval for use on protected pot plants; extrapolation from on-label use on field crops to outdoor ornamentals. Do not mix with other products
Standon Fosetyl-AL®	Fosetyl-aluminium	Protectant + Curative	✓	✓	
Strobilurins					
Amistar®	Azoxystrobin	Protectant + Curative	✓	✓	Extrapolation from SOLA 1684/01 to protected ornamentals. Extrapolation from SOLA 1465/01 to outdoor ornamentals. Reported to cause leaf tip damage on some crops.
Barclay ZX®	Azoxystrobin	Protectant + Curative	✓	X	Extrapolation from on-label use
Me2 Azoxystrobin®	Azoxystrobin	Protectant + Curative	✓	X	
Standon Azoxystrobin®	Azoxystrobin	Protectant + Curative	✓	X	
Stroby WG®	Kresoxim-methyl	Protectant + Curative	✓	✓	Extrapolation from on-label use on roses and protected strawberries

Note: regular changes occur in the approval status of pesticides arising from changes in the pesticides legislation or for other reasons. For the latest information, please check with a professional supplier or with the Information Office at the Pesticides Safety Directorate (Tel: 01904 455775; www.pesticides.gov.uk)

- Always read the label or Specific Off-Label (SOLA) notice of approval.
- Use pesticides safely.
- Check with suppliers for full details of any side effects on biological control agents.

Fungicides

Use of fungicides effective against downy mildew can provide protection against the disease. Statutory action in 2003 required the destruction of diseased plants in nurseries and the application of fungicides to remaining plants in an attempt to eliminate any latent infection and prevent further spread of the pathogen.

Permitted products

There are no fungicides with a label recommendation for the control of impatiens downy mildew. However, some fungicides with a label approval for use on ornamentals do have activity against downy mildew diseases. Other fungicides may be used on ornamentals at growers' own risk, by extrapolation from an on-label use or a Specific Off Label Approval (SOLA) under the Pesticide Safety Directorate's 'Long Term Arrangements for Extension of Use (2002)'. The conditions of use on the label must be followed.

Fungicides that have been used successfully to control downy mildew diseases of various crops and are permitted on ornamentals are shown in Table 1.

Curative activity

Fungicides listed in Table 1 that are likely to have some curative action

against downy mildew of impatiens include those containing the active ingredients:

- azoxystrobin (Amistar[®]; Barclay ZX[®]; Me2 Azoxystrobin[®]; Standon Azoxystrobin[®]; Stroby WG[®])
- dimethomorph (Invader[®])
- fosetyl-aluminium (Aliette 80WG[®]; Standon Fosetyl-AL[®])
- metalaxyl-M (Folio Gold[®]; Fubol Gold WG[®])

The treatment of plants and cuttings using a fungicide with curative activity against downy mildew, soon after their arrival on a nursery, would seem a sensible approach to disease management. However, it is not known at this stage whether the application of curative fungicides would totally eliminate any latent infections or merely suppress the pathogen so that disease expression occurs further along the supply chain.

Crop safety

None of the fungicides listed in Table 1 have been tested specifically for their action on impatiens downy mildew or for any potential phytotoxic effects on impatiens. A few plants should be sprayed first to check for crop reaction before large batches are treated.

Resistance management

Fungicides should be used in a planned resistance management strategy to reduce the chances of the development of resistance. Some commercial products are formulated with a protectant, such as mancozeb, as well as a curative fungicide, as a mechanism to reduce the risk of selecting resistant strains.

It is not known if populations of *P. obducens* found on impatiens have developed resistance to any of the fungicides listed in Table 1. In order to minimise the risk of selecting resistant strains of the pathogen, it is recommended that:

- Fungicide products from different active ingredient groups (see Table 1) are alternated.
- Strobilurins (see Table 1) should not comprise more than 50% of the total applications of fungicide per crop.
- Label recommendations should be followed carefully especially advice on dose rate.
- Fungicides should not be relied on alone for disease control; monitoring, cultural and hygiene measures detailed in this factsheet should also be followed.

Further information

Further information on impatiens downy mildew is available from the

Plant Health and Seeds Inspectorate (PHSI). PHSI Headquarters is located in York, Tel: 01904 455174; Fax: 01904 455197;

Email: planthealth.info@defra.gsi.gov.uk.

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