

07-13972
P PM Point 6.5

Summary Pest Risk Analysis for PHSI interceptions

Name of organism and disease: *Plasmopara obducens*, the cause of downy mildew of *Impatiens*
Date of production, or revision and revision number: 22 October, 2007, third revision for publication on Defra website
Material: *Impatiens* on > 11 premises in the UK found affected from June to August 2003. In 2004 and 2007 several more outbreaks occurred in the UK but these have not been investigated for the purpose of this PRA.

Pest risk analysis:	
1. Name of pest:	
1. (a) Fungus-like organism (Kingdom Chromista)	
Teleomorph:	*Plasmopara obducens* (synonym *Peronospora obducens*)
Common name for disease	Downy mildew of impatiens
Special notes on taxonomy or nomenclature	Two pathogens causing downy mildew diseases have been recorded on species of *Impatiens*. These are *Bremiella sphaerosperma* and *Plasmopara obducens*. The former is described from northeastern North America and far eastern Russia. The latter is more common and widespread (Constantinescu, 1991; Anon., 2003). A sample of the pathogen (CSL reference 20307943) causing disease in the UK was examined by John David of CABI, UK. The sporangiophores were monopodially branched at the base, the individual branches not arising in a distinct pattern. The apical branchlets occurred at right angles to the main axis and to each other and were relatively long [12-15 (-18) µm] and thin [2µm at the base] giving an 'open' appearance to the sporangiophore. The sporangia were subsphaerical to ovoid [18 x 15 µm]. The walls of the branchlets were not conspicuously thickened, as they are in *Bremiella*. Also the sporangia were not spherical, as is the case with *Bremiella sphaerosperma.*

	1. Continued Based on the pattern of the main branchings, the specimen sent to CABI was assigned to *Plasmopara*. However, the apical branchlets were long and thin, unlike those of *Plasmopara obducens*. The conclusion was

	that the pathogen was a *Plasmopara* sp. (J. David, CABI, 2003, personal communication). The literature suggests that the pathogen has been called *Plasmopara obducens* or *Peronospora obducens* in the past although it may not conform exactly to the type specimen from which the description is derived. The sexual stage of *P. obducens* has been described (Z. Jovaisene, Lithuania, 2003, personal communication). Subsequent to the identification made by CABI, a sample of infected material sent to O. Constantinescu (Sweden) has been examined and the fungus is now reported to be *Plasmopara obducens* (C. Lane, CSL, 2003, personal communication).
Primary pathogen (Y/N)	Y

2. (ai) Does it occur in the UK? There are no records of this pathogen in the UK.

(aii) Has it been intercepted before on this host in the UK (check "pathdiary")? No.

(aiii) Has it been recorded before on this host in the UK? No.

2. (b) Is there any other reason to suspect that the pest is already established in the UK? Yes. Outbreaks on cultivated *Impatiens* first occurred in 2003. Further outbreaks were officially reported in 2004 and 2007. It is not known whether more outbreaks have occurred because in the absence of statutory action there is no official requirement to notify the PHSI.

With respect to wild *Impatiens*, records of diseases affecting this genus in the UK have been described as "neglected" (P. Hatcher, University of Reading, 2003, personal communication). Recently published work (Hatcher, 2003) describes wild *I. noli-tangere* as being a host of four fungal plant pathogens, none of which are downy or powdery mildews. Unpublished reports of mildewed wild *Impatiens noli-tangere* in the Lake District and Wales in the late summer and early autumn of 2003 (P. Hatcher, G. Jones; University of Reading, 2003, personal communication) have been investigated. Samples have been collected (G. Jones, University of Reading, 2003, personal communication) and have been examined at CSL. The organism affecting the plants is now known to be an unspecified powdery mildew and not a downy mildew (P. Beales and C. Lane, CSL, UK, 2003; personal communication). This disease has apparently been observed in these locations since at least 2000.

2. Continued The absence of any published records of powdery mildew on wild *Impatiens noli-tangere* in the UK, despite it being observed for at least 3 years, supports the suggestion that disease records for wild *Impatiens* (at least in the UK) are incomplete. As such, it is not possible to say that *Plasmopara obducens*, the cause of downy mildew on ornamental *Impatiens*, is categorically not present on wild *Impatiens* species in this country.

3. EC Directive Status? None.

4. EPPO Status? Not listed.

5. What are its host plants? *Impatiens* spp.
Plasmopara obducens has been recorded on *Impatiens aurea, I. balsamina*, *I. capensis* syn. *I. biflora, I. fulva, I. noli-tangere, I. pallida*, and *I. textoria* (Anon., 2003). The ornamental *Impatiens* infected in the 2003 UK outbreaks is derived from *I. balsamina*. In the Netherlands, the pathogen has been found on New Guinea impatiens, which is a hybrid possibly derived from *I. schlechteri* (J.O. Meffert, the Netherlands, 2003, personal communication). In Lithuania, *P. obducens* has been found on wild plants of *I. noli-tangere* (Z. Jovaisene, A. Treigiene, Lithuania, 2003, personal communications).

5. (a) Highlight crop plants grown commercially, including those of environmental or amenity value, in the UK (include figures for potential yield/quality losses): Ornamental *Impatiens* in the horticultural trade is the commercial host reported to have been affected by this pathogen. Quality losses have been significant on some plantings in the UK. Plants have withered with few or no flowers. *Impatiens* is one of the most important components of the bedding plant industry of the UK. Its value in the UK has been estimated at £40,000,000/year (S. Coutts, British Bedding and Pot Plant Association, 2003, personal communication). It is not known whether any of the wild species of *Impatiens* known to be susceptible are produced for sale commercially in the UK, although apparently *I. noli-tangere* is occasionally cultivated (Hatcher, 2003).

5. (b) Are any of the host plants of forestry importance? No.

6. What is its present geographical distribution?
Locations where *P. obducens* has been identified are presented here from information provided by Anon. (2003), J.O. Meffert (the Netherlands, 2003, personal communication) and Z. Jovaisene/A. Treigiene (Lithuania, 2003, personal communications). This information has not been updated since 2003.
North America: Canada (Ontario); USA (Alabama, Connecticut, Delaware, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New York, Pennsylvania, Tennessee, West Virginia, Washington DC, Wisconsin, Virginia)
Asia: China, India
Europe: Czech Republic, Denmark, Finland, Lithuania, Germany, the Netherlands, Romania, Russia

Present in EU ? Yes: Denmark, Finland, Germany, Netherlands

Present in EPPO region ? Yes. In addition to the above EU countries: Czech Republic, Lithuania, Romania, Russia

7. Does it appear capable of establishing in the UK? Yes. The pathogen is present in the EU/EPPO region and has now been found in the UK in 2003, 2004 and 2007.

7. (a) Could the pathogen establish outdoors? Yes. The first UK reports of diseased plants of commercial *Impatiens* in outdoor locations were in 2003 in Devon, Surrey, Wiltshire and the East Riding of Yorkshire. More UK outbreaks occurred in 2004 and 2007. On wild *Impatiens*, to date there are no published or unpublished reports of the pathogen in the UK, but see section 2(b); absence of evidence is not evidence of absence.

Regarding the overwintering potential of the pathogen this would rely on the pathogen either surviving in infected hosts or in plant debris or in or on seed. With respect to the potential to overwinter in infected hosts, *Impatiens* are annual plants and are not frost hardy. As such they would not survive over winter unless brought indoors. It is not known whether the pathogen itself would survive outdoors over winter, either in dead or dying plant material or systemically in seeds. If it formed long-lived oospores in these tissues, which it has the potential to do, this might allow it to overwinter and infect new plants, or plants raised from infected seeds, in the following year. *Impatiens* are mainly raised from seed but some can be raised from cuttings (R. Natt, CSL, 2003, personal communication). It is not clear however whether the pathogen is truly seedborne i.e. whether it can be transmitted from seed to seedling direct. Two samples of seed imported from the USA have been tested by CSL for this fungus but the pathogen was not detected in wash tests and the disease did not develop in plants grown from seed after 21 days incubation (A. Inman, CSL, 2003, personal communication). Work in India (Sohi and Tyagi, 1974) suggests that the fungus is seedborne and systemic in *I. balsamina*. The pathogen was observed both as oospores and mycelium in the testa and the authors stated that seed from diseased capsules produced diseased plants. Histopathological observations of seeds of this host made by Srivastava and Singh (1988) revealed seedborne mycelium and oospores of the pathogen. The authors stated that seeds collected from diseased capsules and grown in sterilised soil produced plants that invariably developed disease symptoms. The environment in which plants were grown from seed in both of these studies is not described however (i.e. whether they were isolated from any external sources of inoculum). From these papers the route of transmission from seed to plant is unclear. It is not known whether the pathogen infects the embryo systemically or even if any other internal infection of seed such as in the testa, or external contamination of seed, can result in transmission to plants derived from such seed.

In the UK outbreaks in 2003, *Impatiens* raised from seed may have become infected through seed transmission, or, could have become infected as seedlings, or as older plants, either under glass or outdoors. Given the potential to overwinter and infect through seed or by infecting plants directly, establishment outdoors is possible. However, more information is needed on the overwintering potential of the fungus in the UK and the route by which it infects.

7. (b) Could the pathogen establish on protected crops? As described in 7(a) provided a source of inoculum survives within the glasshouse environment over the winter period, between crops of *Impatiens*, the potential for establishment on protected crops is a possibility. This could occur if the end of season clean up is not thorough enough. As with outdoor material, there is the potential for survival as oospores in senescent infected material or possibly in infected or contaminated seed. Good hygiene practice at the end of the season would help to ensure no carry-over of the pathogen.

8. What is its potential likely to be as a pest in the UK?

Plasmopara obducens has caused a serious disease of ornamental *Impatiens* in the UK in 2003 and this crop is most at risk. In the 2003 outbreaks, although not proven, the pathogen may have spread on material provided by at least one major supplier of *Impatiens.* This disease resulted in some significant losses over a short period of time. In one private garden all plants were affected. No information is available on losses caused by the disease in the rest of the EU/EPPO region. The lack of information may be because the disease is of minor significance elsewhere, or, that measures are in place to prevent epidemics. Further outbreaks occurred on UK premises in 2004 and 2007 but these are not accounted for in this PRA.

Other species *of Impatiens* may be at risk in the UK. *Impatiens noli-tangere* (Touch-me-not balsam) is a known annual host (Anon., 2003). This wild plant is native in the Lake District and Wales and has been introduced elsewhere in this country. It is also occasionally cultivated (Hatcher, 2003). It has not been recorded as a host in the wild in the UK, but this does not mean to say that it is not already affected by this pathogen. It is a known wild host in Lithuania. If not already a host, should the pathogen becomes endemic, this native plant could be at risk.

Impatiens capensis (Small balsam), *I. parviflora* (Orange balsam) and *I. glandulifera* (Indian balsam), which are naturalised plants, may also be susceptible. *Impatiens capensis* is found by rivers, canals and adjacent reservoirs, and is recorded as a natural host of *P. obducens*. This native of North America is steadily expanding into semi-natural habitats. *Impatiens parviflora* is found in semi-natural woodland, especially along tracks, but can also occur along shaded riverbanks. It is a native of central Asia and is increasing its UK range steadily. *Impatiens glandulifera* can form continuous stands on the banks of waterways and is the tallest annual in Britain. This native of the Himalayas has significantly increased in frequency in the UK since 1962 (Preston *et al*., 2002).

As described in 7(a) the pathogen may be seedborne. If this is the case, the pathogen has the potential to cause disease anywhere infected seed is sown. The pathogen could travel long distances with seed to initiate new outbreaks.

If freedom from infection cannot be guaranteed for imported cuttings, these also have the potential to introduce the pathogen and would need to be sprayed with an appropriate systemic fungicide soon after arrival, to try to prevent the development of any infection that may be present.

8. Continued:
With respect to control using chemicals, there are no UK fungicides, including seed treatments, specifically approved for use against this disease on *Impatiens*. However, under the long-term arrangements for the extension of use of pesticides in the UK, products approved or with a specific off-label approval (SOLA) for use on edible crops can be used on ornamentals at the growers own risk. It is not permissible to extend approvals or SOLAs for seed treatments.

Under these arrangements, the main condition that must be complied with is that only chemicals approved for use on outdoor crops can be used outdoors and similarly, those approved for protected crops can only be used under protection. For a product where approval is given for both outdoor and protected use then this can be used in both situations. There is a range of products that could be used under these arrangements and have been shown to have efficacy against downy mildew diseases on a range of other crops. They may have potential for control of this disease on *Impatiens* but their efficacy needs to be tested.

9. What are the prospects for continued exclusion? For commercial *Impatiens*, continued exclusion would rely on overseas sources of cuttings/seed being clean and/or possibly a suitable early fungicide treatment applied to cuttings soon after arrival, or to seedlings at the cotyledon stage. This treatment would be beneficial if it was known to be effective against latent infections. (See section 8 for advice on fungicide treatments). A survey of imported seed, cuttings and seedlings might determine the extent of the pathogen overseas and could be used to determine whether routine treatment of imported material is needed; this has not been undertaken.

10. What are the prospects for eradication? Eradication would not be possible if the pathogen is already endemic in the UK on native *Impatiens*.

In 2003, disease outbreaks occurred in UK nurseries and outdoor flowerbeds. The pathogen affected plants in the wholesale and retail chain as well as in private gardens. It may have formed long-lived, sexual oospores in decaying plant debris or in seeds, which could infect *Impatiens* during subsequent years depending upon their long-term survivability. Seed harvested by private gardeners from diseased plants and sown in subsequent years may also be a possible source of infection. Further UK outbreaks occurred in 2004 and 2007 but these have not been investigated. There may have been other UK outbreaks which have not been reported as there is currently no official requirement to do so.

Eradication of the pathogen may not be possible

10. Continued

If the pathogen survives over winter, then prevention of any new outbreak may be possible if seed, seedlings and cuttings in supply nurseries were treated with an appropriate systemic fungicide. If this does not happen and infected material is grown, further outbreaks could occur on commercial supply nurseries. Such occurrences would need to be detected early before infected material was distributed onwards to retail premises and planted outdoors. This would only be possible if action is taken prior to distribution. After this, if the season favours disease development, it may prove difficult to control unless suitable effective fungicides are used.

11. How would eradication be achieved ? To eradicate the pathogen, all plants obtained from suppliers/nurseries/garden centres where the disease has occurred, such as those in floral displays in parks and home gardens, would need to be traced and destroyed by burning or deep burial. Diseased plants at suppliers/nurseries/garden centres would need to be rogued from existing stocks. Some severely affected stocks may need to be totally destroyed. Remaining unaffected plants at nurseries/garden centres with the disease would need to be sprayed with an effective fungicide (see section 8). Follow-up visits to check these plants for disease would be required. Plants senescing and being composted at the end of the season would need to be removed and burnt in case oospores are present and capable of reinfecting in the following season. Seed from any suspect plants would also need to be destroyed if seedborne transmission is proven to be possible.

12. Conclusion and CSL action recommendations:

The downy mildew disease of *Impatiens* found in the UK in 2003 for the first time was identified as being caused by *Plasmopara obducens*. This pathogen is reported to occur in North America and parts of Asia and Europe, including Denmark, Finland, the Netherlands and Germany in the EU and in the Czech Republic, Lithuania, Romania and Russia in the rest of the EPPO region. It may be more widespread. Its distribution has been described as worldwide (Anon., 2003).

In 2003, the pathogen caused a significant disease of ornamental *Impatiens*, a valuable crop in the UK and this caused major concern to the UK bedding plant industry. In 2004 and 2007 several more outbreaks occurred in the UK but these have not been investigated.

The pathogen is already present elsewhere in some EU countries and may be much more widespread than reported. It has been distributed to many locations in the UK. The full extent of its distribution in the UK is not known but it may also occur on natural relatives in the wild.

12. Continued

It is not known whether the pathogen can overwinter outdoors or under protection. It is also not known whether it could infect from overwintering oospores either present in dead plant material or from seed. This information is critical in determining the ease with which eradication of the pathogen could be achieved. If it does survive, it is possible that given the potential scale of the outbreaks in the UK, and the problems associated with tracing all infected plants, eradication would be difficult, if not impossible. If affected nurseries conduct a thorough clean up of glasshouses and disposed of infected material in such a way that the pathogen has not got the potential to overwinter and reinfect in the following season there may be some prospect of controlling the problem. This would not account, however, for infected material planted in private gardens or kept indoors overwinter. Neither would this account for any infected wild hosts.

If the pathogen survives overwinter on affected premises and is able to infect plants in the new growing season it might be possible to control it using fungicide treatments. However, research is needed to determine the effectiveness of the various fungicides which are available under the long-term arrangements for extension of use of pesticides in the UK. Care would also be needed to ensure that the pathogen did not develop resistance to the systemic fungicides used in supply and retail nurseries both at home and abroad.

If it is thought that the pathogen is being introduced on imported material it may be possible to prevent entry by the utilisation of clean sources of seed and cuttings and/or the routine use of fungicides found to be effective against this pathogen. Identifying clean sources of material from overseas would require a limited survey but this has not been undertaken. Four years after the first UK outbreaks which triggered this PRA, the industry are managing the disease themselves; thus, it is not considered appropriate to propose *P. obducens* as an A2 quarantine pest for the EU.

Pest Risk Analyst: **Claire Sansford**

Advice **Peter Reed, Neil Giltrap, Alan Inman, Charles Lane, Paul Beales**

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13. References:

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