Project title:	Monitoring metalaxyl-M sensitivity of Downy Mildew infections of Impatiens
Project number:	PO 011b
Project leader:	Dr Philip Jennings Fera, Sand Hutton, York, YO41 1LZ
Report:	Annual report, October 2016
Previous report:	Annual report, October 2015
Key staff:	Gilli Thorp (Fera)
Location of project:	Fera, York
Industry Representative:	Mr Mike Smith W D Smith and Son, Grange Nurseries, Woodham Road, Battlesbridge, Wickford, Essex, SS11 7QU
Date project commenced:	1 March 2014
Date project completed (or expected completion date):	31 October 2018

DISCLAIMER

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

[Name]

[Position]

[Organisation]

Signature ..... Date .....

[Name]

[Position]

[Organisation]

Signature ..... Date .....

Report authorised by:

[Name]

[Position]

[Organisation]

Signature ..... Date .....

[Name]

[Position]

[Organisation]

Signature ..... Date .....

CONTENTS

Grower Summary

Science Section

GROWER SUMMARY

Headline

Downy mildew monitoring undertaken in 2016 highlighted only one late season infection in the wider environment; the infection was caused by the metalaxyl-M sensitive form of *Plasmopara obducens*.

Background

Impatiens downy mildew (IDM), caused by *Plasmopara obducens*, is a foliar disease specific to impatiens. During early 2011, a metalaxyl-M resistant strain of *P. obducens* was introduced into commercial impatiens production resulting in widespread downy mildew infections which were difficult to control. To try and minimise the risk posed by the resistant strain, pro-active action was taken by the industry to restrict impatiens production using cutting raised plants. This action appeared to have been successful as no IDM infections caused by the resistant strain were detected during monitoring in 2012 (PO 011) or 2013 (PO 011a); in 2013 no downy mildew infections of impatiens were reported. However the risk of infection by the resistant strain still remains, particularly in areas where infection has occurred previously.

This small scale project aims to continue the monitoring work undertaken during 2012 and 2013 to provide growers with:

1. An early warning system for identifying the presence of metalaxyl-M resistance, in order to assist with decisions on suitable spray programmes.
2. Guidance as to the prevalence, persistence and geographical distribution of the metalaxyl-M resistance compared to metalaxyl-M sensitivity in the wider environment.

Summary

Sporangia washed from downy mildew-infected impatiens samples sent to Fera were inoculated onto three replicate impatiens plants, each treated with a Subdue soil drench prior to inoculation. An additional three plants, drenched with an equivalent volume of water, were

inoculated as untreated controls. Inoculated plants were grown at 20ºC until symptoms developed on the controls (8-10 days), at which point the metalaxyl-M sensitivity of the inoculated isolate was determined based on the pattern of infection; resistant isolates infected both treated and control plants whereas sensitive isolates only infected the control plants.

In 2016, one sample was received from a private garden in Cheshire during early September. As in previous years the detection of disease late in the season, and a lack of samples from nurseries, suggested that the disease had not come from seed-raised material but from other inoculum sources.

Testing showed that the *P. obducens* isolate collected was sensitive to metalaxyl-M. This is consistent with results from monitoring in 2012, 2013 and 2015 when no metalaxyl-M resistance was detected.

Financial Benefits

In the UK, the annual retail value of the impatiens crop before 2008 was estimated to be £40m; however the onset of impatiens downy mildew has considerably reduced this value. The outbreak of downy mildew in 2011 demonstrated that the disease has potential to destroy whole site annual production as well as undermine consumer confidence in this commercially important product.

Prompt (up to 10 days after sample receipt) and widespread (sample originator and the wider network of growers) reporting of the metalaxyl-M resistance status of any infections would allow growers to ensure that spray programmes used will be effective in minimising losses that may result from any outbreaks.

Action Points

- Where possible grow impatiens from seed, not vegetative cuttings.
- Apply a protectant fungicide programme to seed raised crops during the production phase.
- Monitor crops carefully for signs of the disease, provide good levels of ventilation and don’t water crops late at night.
- Send infected plants to Fera for metalaxyl-M sensitivity testing.
- Dispose of infected plant material into sealed bags or bins.

SCIENCE SECTION

Introduction

Downy mildew of impatiens caused by *Plasmopara obducens* first arrived in the UK during 2003 and caused considerable economic damage to commercial crops and municipal plantings, especially in the South of England. Initially emergency statutory action was taken by the Plant Health & Seeds Inspectorate (PHSI) and the downy mildew pathogen on impatiens was declared notifiable. This was revoked in 2005 on the proviso that the industry took on responsibility for management of the disease through implementation of an industry code of practice (Good Horticultural Practice (GHP)). Between 2004 and 2006, the disease was not reported in commercial crops but reappeared at low to moderate levels in 2007. In 2008, the disease was once again quite widespread and damaging, especially in municipal & other outdoor plantings. In 2011 early outbreaks originating from cutting raised product, but spreading to seed raised crops, proved difficult to control due to the emergence of metalaxyl-M resistance and resulted in devastating impacts on UK production.

Work in HDC funded projects (PC 230, PC 230a and PC 230b) has contributed to a greater understanding of the disease and hence provided guidance for minimising outbreaks (e.g. HDC briefing notes issued in 2011 and updated in 2012). It was clear from this work that spray programmes including metalaxyl-M were the most effective against the disease. With the discovery of resistance to this active ingredient late in 2011 however, growers now need to make educated decisions on suitable spray programmes. This project aimed to provide prompt identification of resistant isolates in 2012 and beyond to assist growers in making informed decisions on suitable action against outbreaks, helping to minimise spread where infections do arise. Results for 2016 are reported here.

Materials and methods

Collection of impatiens infected by downy mildew

The need for downy mildew infected impatiens to be sent to Fera was publicised to HDC levy payers through weekly news, HDC news and broadcast mail systems as well as via the HDC briefing note update on IDM.

Testing Plasmopara obducens isolates for metalaxyl-M sensitivity

On arrival at the laboratory, samples were treated in one of two ways depending on the condition of the sample.

1) Samples with high levels of fresh sporulation

Infected leaves were removed and sporangia washed from the leaf surface. The spore suspension was filtered through a double layer of lens tissue to remove any leaf or soil debris and the spore concentration adjusted to give 10^4 sporangia mL^{-1}. The spore suspension was then used to inoculate three replicate impatiens plants (6 week old) treated with a Subdue soil drench containing metalaxyl-M (at 12.5 mL product/100L water at 10% of pot volume) two days prior to inoculation. An additional three plants, drenched with an equivalent volume of water, were inoculated as untreated controls.

2) Samples with low level of fresh sporulation or low spore viability

Sporangia were washed from the leaf and filtered through a double layer of lens tissue. The sporangial suspension was then inoculated on to a single untreated impatiens plant in order reinvigorate the disease to produce additional inoculum for testing.

Directly after inoculation all plants were incubated in the dark at 5°C for approximately 18 hrs. Plants were kept in a propagator top to prevent drying out of inoculum and then transferred to a glasshouse, maintained at a constant 20°C, with 12 hr day period and grown on for 8-10 days. During this period plants were watered from the bottom to ensure sporangia were not produced prematurely. Sporangial production was stimulated by wetting the upper surface of leaves and incubating overnight in a propagator top. The presence of disease was confirmed by assessing the underside of leaves for the white downy growth associated with a sporulating downy mildew infection. Sporulation on the control plants only indicated metalaxyl-M sensitivity, whereas sporulation on both control and metalaxyl-M treated plants indicated metalaxyl-M resistance.

Results were sent to the AHDB Horticulture research manager for appropriate dissemination.

Results

In 2016, no samples were received from nurseries during plant production. One sample was received from a garden location in Cheshire (**Table 1**) in early September. The detection of disease late in the season suggested that disease had not established from seed-raised

material but from other sources of inoculum e.g. oospores surviving in the soil from previous infections.

Table 1. Metalaxyl-M sensitivity of *Plasmopara obducens* isolates collected in 2015.

Sample	Date	Site	Location	Metalaxyl-M sensitivity
1	02/09/2015	Garden	Cheshire	Sensitive

Result from sensitivity tests showed that the *P. obducens* isolate was sensitive to metalaxyl-M (Table 1). This was consistent with results from monitoring in 2012, 2013 and 2015 when no metalaxyl-M resistant isolates were detected. Summary results from current and previous monitoring are shown in **Table 2**. Results show a declining incidence of disease and level of resistance since the problems encountered in 2011.

Table 2. Metalaxyl-M sensitivity of *Plasmopara obducens* isolates collected between 2012 and 2015.

Year	Number of samples	Date received	Site	Metalaxyl-M sensitivity
2012	9	June to September	3 Nursery 6 Garden	All sensitive
2013	0	-	-	-
2014	5	July to September	1 Nursery 3 Garden	3 resistant 2 sensitive
2015	2	August	2 Garden	Both sensitive
2016	1	September	Garden	Sensitive

Discussion

In 2016, the low level of samples received suggested that there was low prevalence of downy mildew infection on impatiens. Infections were caused by the metalaxyl-M sensitive strain of downy mildew which was consistent with results from monitoring in 2012, 2013 and 2015 when no metalaxyl-M resistance was detected.

Conclusions

Once again there was a lack of disease samples from nurseries, which reflects the continued success of the decision by the majority of UK growers to produce only seed-raised impatiens.

Since the start of the monitoring, disease in the wider environment has generally appeared late-season once impatiens displays are beyond their best. This late season expression of the disease in the wider environment would not pose a risk to nursery production; however early season transport of infected impatiens material from continental Europe could still provide a threat to nursery production of impatiens.

Knowledge and Technology Transfer

Poster at the Ornamentals Pest, Disease and Weed Control Conference, The Arthur Rank Centre Council Chambers, Stoneleigh Park, 23 February 2016.