Grower Summary

HNS 191

The epidemiology and control of heuchera rust

Final 2016

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GROWER SUMMARY

Headline

Puccinia heucherae has been confirmed by molecular testing as the rust species present on UK nurseries.

Overwintered heuchera are an important source of inoculum, but reducing leaf wetness and preventative fungicide programmes can prevent rust infection

Background

Heuchera rust, caused by *Puccinia heucherae*, was first identified in the UK in gardens in 2004 and in nurseries in 2005. From 2010 to 2012, the incidence of the disease in nurseries and gardens (RHS advisory data, unpublished) increased significantly on a range of species and varieties. Information received from growers suggested that the rust has proven difficult to eliminate from nurseries. In the last three years many growers have used a combination of fungicides and cultural control methods, and so by 2015 symptoms were being seen less frequently where control measures were kept up. However, the limit to the number of fungicide applications of azoles (FRAC 11) and succinate dehydrogenase inhibitors (FRAC 7) for chemical resistance management means that covering the whole growing period from April to October is difficult, and likely to become harder with legislation changes, either not re-registering, or removing products from the market, in addition to the threat of loss through resistance. Products Folio Gold (chlorothalonil + metalaxyl-M (FRAC M5 + 4) and Fubol Gold (mancozeb + metalaxyl-M (FRAC 3 + 4) are available against rust at present, but resistance is known to metalaxyl-M by strains of Impatiens downy mildew, lettuce and onion downy mildews and potato blight. There have been a number of AHDB reports on fungicide control of rusts e.g. PC 057a, PC 185, PC 292, BOF 033 on chrysanthemum white rusts and HNS 106 on rose rust.

A principle query from UK heuchera growers is how and why crops are now becoming infected by rust. More information about the recent heuchera rust problem in the UK, e.g. material sources, disease incidence in relation to plant growing conditions, were needed, which could then be used by growers to prevent or reduce the establishment of rust on nurseries. Observations from growers and experiments together with information on other *Puccinia* species, was needed to gain greater understanding of the conditions favouring the pathogen and the potential source/s of the pathogen on nurseries. Symptoms are often reported in heuchera two to five months after potting and it is conjectured that this is from latent infection. Work on chrysanthemum rust has shown detection by molecular testing four days post-infection, 10 days before any visible symptoms. By developing a molecular test for *P.*

heucherae it should be possible to confirm if this is the species affecting UK heucherae and whether the rust is present in the supply chain as a symptomless infection.

Summary

The majority of heuchera growers from across England and Wales surveyed in 2014 had seen rust on plants at some time. No particular husbandry differences were found for the five out of 18 nursery sites which had not seen rust, compared with those where it had been found. Most growers used a number of plug suppliers (with 18 named). Most of the 73 varieties grown (UK growers have not seen rust on 48 of the varieties) were bred by Terra Nova in the USA. The varieties on which rust was most commonly reported by some growers were those grown more frequently such as Peach Flambé, Obsidian, Marmalade and Key Lime Pie, although others such as Plum Pudding, Green Spice, Palace Purple and Fire Chief were also frequently grown and not seen with rust. A Terra Nova breeder reported that the lighter, more recessive foliage colours and those with very thin leaves get the worst rust. Not much yellow foliage is bred now and selection is being made for tougher, thicker lime-coloured leaves.

All the UK growers consulted recognised that prolonged periods of leaf wetness and high humidity from close spacing and less-open growing media could encourage rust. The grower at Terra Nova in the USA lets heuchera flag before watering, to increase resistance to rust, possibly through increased cuticle thickness. Fungicides including azoxystrobin, propiconazole and myclobutanil were used routinely. Several UK growers had started to use preventative fungicide programmes including the same actives, but in one instance, once these stopped in October, severe rust was seen within a fortnight across many varieties. Latent rust may have become symptomatic or possibly the mild weather with morning dew in October may have favoured infection once fungicides ceased and allowed pustule formation.

Overwintered plants were consistently highlighted by growers as having a problem with rust, and are likely to be a major source of infection of new stock. Only one spore type, the teliospore, was seen to be produced in plants held under observation from 2014 to 2015. No *P. heucherae* infection developed in growth cabinets tests in 2014, and so the environmental requirements of *P. heucherae* for infection were unable to be determined. White rust of chrysanthemum, *Puccinia horiana*, also only has teliospores. Teliospores bud off basidiospores which can infect within five hours of dispersal at an optimum of 96% relative humidity and 17-24°C, with symptoms within 10 days. Teliospores of white rust can survive for up to eight weeks on detached leaves.

In 2014, samples of rust-infected heuchera leaves were collected from ten different nurseries and garden centres and the rust was determined to be *P. heucherae* through DNA sequencing. A molecular PCR test was developed to detect the rust on symptomless plants.

Heuchera plants were sampled throughout 2015 across five supply chains at various growth stages: seedlings, micro-propagated plants, plugs/liners, retail plants and overwintered plants (Figure 1). This involved four micropropagators and one seed supplier who supplied four different nurseries. The supplied material was then collected from the nurseries as it grew into plugs and then 1 L container plants. Overwintered plants were originally micropropagated in 2014, but were from the same sources at each nursery as the 2015 produced plants. Plants were all visibly healthy on arrival and were tested for non-symptomatic rust infection using the molecular test. Plants were then grown in a controlled environment glasshouse and outdoors with overhead irrigation and inspected weekly for subsequent development of rust symptoms.

Rust was not detected in 2015 in either micro-propagated heuchera plants, plug plants from four supply chains (cv. Marmalade) or in seed-grown plants (cv. Palace Purple) from a fifth supplier. These plants at the start of the supply chain are unlikely to be the source of heuchera rust infections. Using the molecular test, rust was detected in four out of 36 symptomless overwintered heuchera (cv. Marmalade), collected from a nursery, and of these one developed a rust pustule on a leaf five weeks after quarantine in a glasshouse.

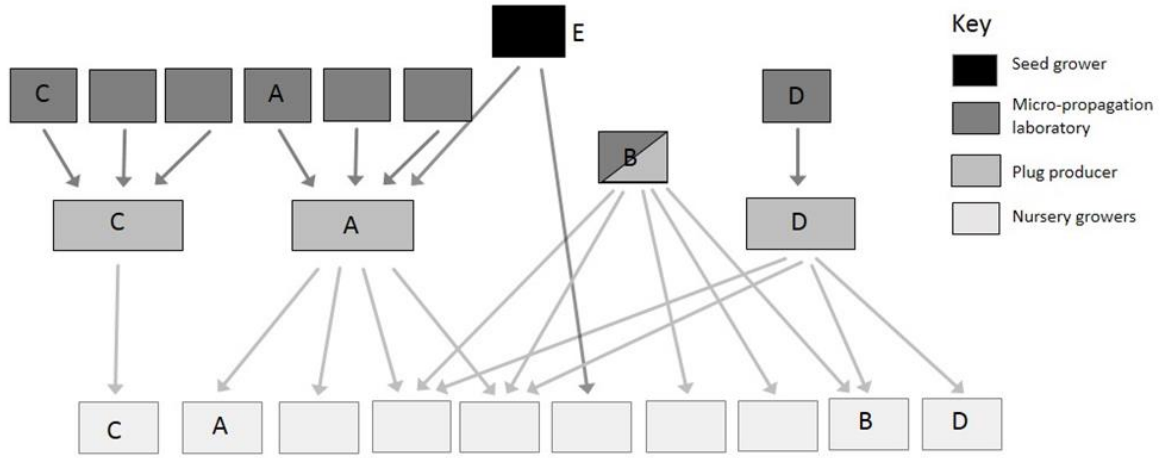

Figure 1. Schematic illustrating the complexity of the heuchera supply chain within the UK for a sample of 10 surveyed herbaceous nurseries. Nurseries A to E supplied material for testing for *P. heucherae* from each of the supply levels/plant stages shown in the key.

The likely lifecycle of *P. heucherae,* based on information about other species of *Puccinia* is shown in Figure 2 below. Conditions for basidiospore release from the brown teliospores held tightly in pustules on heuchera, are likely to be best when rain or irrigation splash can aid dispersal and when surfaces can remain wet for about five hours to aid spore survival and infection. As infection is favoured between 17 to 24°C, spring and autumn in the UK are likely to be the most favourable periods for infection. From molecular tests carried out in this project it is likely that the pathogen does not move through the plant from the infection point and so picking off individual leaves with pustules from plants when rust is first seen will prevent rust spread to other leaves on the same plant. Symptoms are likely after fungicide programmes finish in the autumn. Plants may take a month to develop symptoms after infection.

Infection is most likely to arise from overwintered plants, particularly as the dense canopies of finals will provide good infection conditions. Careful inspection of plants is required as dark spots visible from above caused by *P. heucherae* on older leaves can be attributed to other causes, and on the underside pustules can become flat. Some pustules drop out to leave only dark-rimmed holes. Trimming will remove infected leaves and reduce the chance of spores being produced in spring that will infect healthy tissue on the same and other plants.

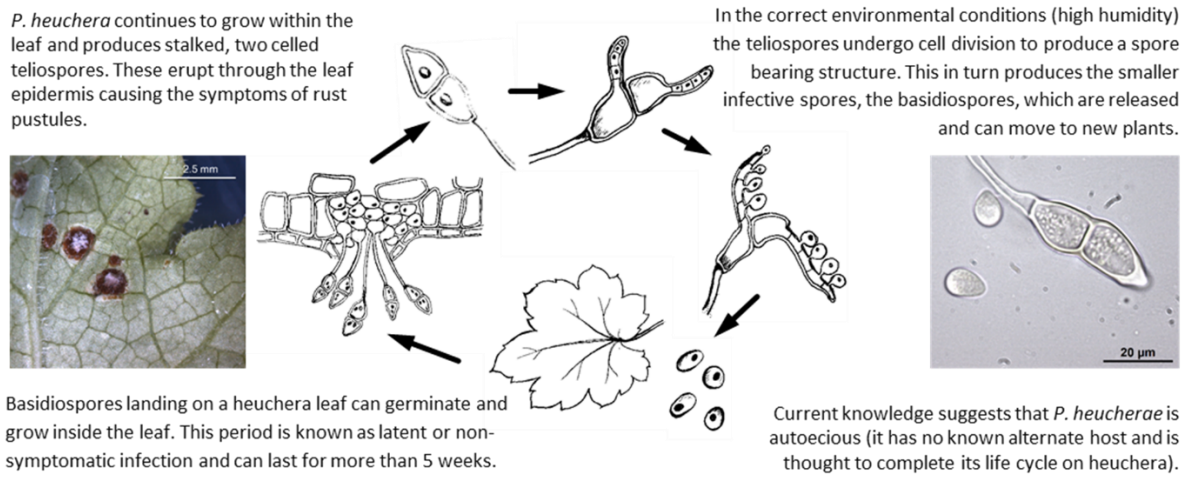

Figure 2. Probable lifecycle of *Puccinia heucherae*, with one host and two spore stages.

Financial Benefits

This project has provided growers with information on cultural control measures. These could mean fewer fungicide applications – currently some treat fortnightly over the six months from April. If all overwintered inoculum source is removed then in theory no sprays would be needed. For outdoor crops in drier years then timing watering so water does not stand on leaves should also mean no infection in these low risk situations. Allowing plants to flag to build up tissue resistance to infection may further reduce the chance of rust developing.

Information from growers found the variety Peach Flambé infected by rust by a greater proportion of producers and it may need to be avoided or grown using preventative fungicides. Growers with rust occurring on their nurseries could still continue to profit from heuchera, but could save plant losses by selecting varieties such as Palace Purple, Berrie Smoothie and Plum Pudding for their low chance of rust developing. However, many popular and so profitable lighter-coloured leaved varieties were rust-free on some nurseries and so do not need to be dropped by others from production. No plants from micropropagation or seed production contained *P. heucherae.* This should give propagators and growers confidence that micro-propagated and seed produced plants start off clean and so allow them to continue to source and sell popular varieties. A second benefit of the molecular test is that it has shown that if visibly infected leaves can be removed from a plant then there is unlikely to have been systemic spread within it. The plant could be sold without any justification for a refund request if rust is subsequently seen. Awareness by growers that the rust can be symptomless in the tissue for at least a month after infection means that growers prepared to quarantine can either seek redress from their suppliers if rust develops and/or apply fungicide before pustules develop further and reduce marketability.

Action Points

- Reject any incoming plants showing symptoms of rust infection
- Aim to quarantine plants (or a sample of each variety) for a month after arrival, without fungicide application, in order to allow symptoms to show
- Regularly (at least weekly) inspect the foliage of all heuchera batches on the nursery closely (in particular leaf undersides) for rust pustule formation
- Remove old, senescing leaves from plants in autumn to help to prevent the fungus from overwintering and infecting new growth in spring. Thining will also facilitate leaf drying and remove surface moisture favourable to infection.
- Avoid watering overhead, or if this is not possible then water in the morning so that the leaf surfaces dry out rapidly, so that rust spores are unable to infect
- Improve air circulation around plants to speed leaf surface drying
- Let plants go very dry before irrigating. Irrigation should resume when first symptoms of wilting or 'flagging' appear
- If rust is seen then, if able to do so when under protection then raise temperatures to above 21° C during the day, and 15° C at night to produce conditions less favourable to the rust
- Use a preventative fungicide programme, especially if there has been overhead irrigation, and/or periods of rain on outdoor plants
- Avoid growing varieties that continue to be seen with infection, as they may have greater susceptibility to rust than other varieties. Darker varieties such as Palace Purple, Berrie Smoothie and Plum Pudding are popular and no rust has been seen, in contrast to the paler variety Peach Flambé, for example.

Molecular testing for latent infection of *P. heucherae* is now possible and could be used in propagation, and growers should let AHDB know if this would be useful so that work can be done to develop a service.