New Project Summary Report for HNS/PO 190: Treatments for the control of black root rot in bedding plants and hardy nursery stock

Project Number	31401900
Title	Evaluation of fungicides and novel treatments for the control of black root rot, Thielaviopsis basicola, in bedding plants and hardy nursery stock
Short Title	HNS/PO 190
Lead Contractor	ADAS UK Ltd
Start & End Dates	1st September 2013 – 31st August 2017
Industry Representative	Ian Lavelle, Ivan Ambrose Co. Ltd. & Mike Norris, New Place Nurseries Ltd,
Project Budget	£53,096
AHDB Contribution	£53,096

The Problem

Black root rot (*Thielaviopsis basicola*, syn. *Chalara elegans*) causes a root rot and consequently reduces root development and can lead to uneven growth, leaf yellowing and plant death in at least 15 plant families. Losses in pansy production can be substantial and black root rot is frequently implicated in losses of susceptible hardy nursery stock species such as *Choisya*, *Skimmia* and *Ilex*.

Cercobin WG (thiophanate methyl) can be used as a single fungicide drench application to glasshouse grown crops (under permanent protection) in the UK up to 3 weeks before planting in the ground, but there are concerns about resistance developing. A recent HDC review (Wedgwood, 2013) has examined options for the control of black root rot. Most work has been carried out by the USA States' Extension Services to provide grower recommendations for products to use on ornamental crops in alternation with thiophanate-methyl products including; azoxystrobin, fludioxonil + cyprodinil, myclobutanil, polyoxin-D zinc salts, triadimenol, trifloxystrobin, triflumizole, phosphorous acid and a biopesticide containing *Trichoderma harzianum* T22 and *Trichoderma virens* G-41. Some of these actives are available in the UK. In March 2013 a list of 15 UK registered products from a range of fungicide groups with potential activity against *Chalara fraxinea* (the cause of ash dieback) was produced by Defra and these might similarly control black root rot because its asexual state is also in the Chalara family. The list includes products such Amistar (azoxystrobin), Aviator 234 Xpro (bixafen + prothioconazole), Signum (boscalid + pyraclostrobin), Systhane 20EW (myclobutanil) and potassium phosphite (available as Hortiphyte). There is evidence for the activity against *T. basicola* by two experimental products and their use in efficacy trials on ornamentals would be supported by the suppliers.

The most recent laboratory and glasshouse research on black root rot of ornamentals in the UK was carried out in 2000 (Jackson, 2000) and screened a range of fungicides for control of black root rot on pansy by drenching. A number of products were identified that reduced the severity of root infection. Of the effective non-phytotoxic products Amistar (azoxystrobin) and Stroby WG (kresoxim-methyl) can currently be used on ornamentals. Phytotoxicity to pansy has been recorded for some of the products when used as drenches at sowing and then 14 days later; Octave (prochloraz) drenched at 0.72 g/L caused slight deleterious effects in the first experiments (Scrace, 1993) and Folicur (tebuconazole) drenched at 1.88 ml / L water reduced plant vigour (Jackson, 2000). Use on hardy nursery stock was not reported. As azoles are systemic, effective protectively and curatively against a wide range of fungi, then foliar application may give efficacy against *T. basicola*, especially where there is run off into the growing medium. However, where products do not have approval as drenches it is necessary to ensure the maximum dose per ha approved as a spray is not exceeded.

Novel biological products incorporated into the growing medium have potential to provide cost-effective control of black root rot. Two growing-media treatment biopesticides Prestop (*Gliocladium catenulatum* strain J1446), and T34 (*Trichoderma asperellum* T34), and the plant growth promoter Trianum G (*Trichoderma harzianum* T22) are available in the UK for root rot control. The biopesticide Serenade ASO (*Bacillus subtilis* QST 713) has an off-label approval for drench use on amenity vegetation in the UK, with full registration against soil pathogens in the USA.

Growing-media amendments such as chitin and biochar can enhance biocontrol agent (e.g. *Trichoderma* and mycorrhiza species) establishment in growing media (Downie *et al.* 2009, Warnock *et al*. 2007) and these could be considered for use in further testing on microbial products shown to reduce black root rot.

Downie, A., Crosky, A and Munroe, P. (2009). Chapter 2: Physical characteristics of Biochar, in J Lehman and S. Joseph (editors), Biochar for environmental management. Earthscan. London.

Jackson, A.J. (2000). Bedding plants: evaluation of fungicides for the control of black root rot and downy mildew. HDC report for project PC 143.

Scrace, J.M. (1993). The effect of pH, plug nutrition and fungicide timing on control of black root rot in autumn pansy. HDC Final Report for project PC38b.

Warnock, D.D., Lehmann, J., Kuyper, T.W. and Rillig, M.C. (2007). Mycorrhizal responses to biochar in soil – concepts and mechanisms. Plant Soil 300:9-20.

Wedgwood, E. F. (2013). Black root rot in containerised subjects-chemical and biological options for control. HDC report for project PO 14.

Project Summary

Chemical and biological plant protection products and plant activators will be tested for plant safety and efficacy against *T. basicola* black root rot. A Cercobin WG drench will be used as the industry standard. There will be two sets of experiments:
1) sowing *Viola* sp. and 2) transplanting *Choisya* sp. plugs. Treatments will be applied at label rates where available. The first application will be one to two weeks after either sowing or transplanting. The growing media will then be spore-drench inoculated with *T. basicola* and a second product application will be made two weeks after the first, except where only a single treatment is authorised on the product label.

Around twelve products will be tested on *Viola* sp. over two 8 week periods against the standard, with a further selection tested as alternating treatments. The most promising six products will be tested on *Choisya* sp. over a 7 month period, with subsequent examination of fewer products in programmes of alternating treatments over a period of a year.

Benefits to industry

• Reduced losses due to black root rot
• The products tested could reduce losses to black root rot and some may also improve plant growth in the absence of infection. A higher quantity and quality of bedding plants and finals could be produced by the end of the season.
• If microbial products prove effective then their use on nurseries would be a further step in the adoption of Integrated Crop Management, and in keeping with the EU Sustainable Use Directive's aims to reduce or replace pesticides in crop production.
• There is interest and already some adoption of biofungicides and other biological control agents in the industry, but a lack of replicated experimentation (with known pathogen presence) means that the evidence is not available to encourage wider usage.
• Depending on the selections in the final year, guidance on conditions that will favour the activity of some beneficial microorganisms (including possibly the inclusion of amendments to support the beneficials) without favouring the pathogen will ensure the best value is obtained from the products.
• Products are needed to reduce dependence on Cercobin WG drenches, preferably in alternation, to reduce the chance of pathogen resistance developing.
• Information on effective products would be shared with growers at a suitable HDC event.

Aims and Objectives

(i) Project aim(s):
To Improve control of black root rot *(T. basicola*) and increase the quality of container-grown ornamentals through the use of plant protection products and plant stimulants.

(ii) Project objective(s):
1. To determine the efficacy against black root rot and plant safety of some chemical plant protection products to *Viola* sp.
2. To determine the efficacy against black root rot and plant safety of some biological plant protection products and plant stimulants to *Viola* sp.
3. To utilise the results from work carried out under objectives 1 and 2 to select products for application to *Choisya* sp. to protect against black root rot.
4. To communicate the research results to the industry

Approach

The main experimental work will be carried out over a three year period under protection at ADAS Boxworth to determine the efficacy and crop safety of pesticides and biological plant protection products and stimulants against *T. basicola* in growing-media. The products will be selected based on HDC review PO 14 and industry consultation. The results from work on *Viola* sp. seedlings in this project will be used to inform the selection of products for use on *Choisya* sp. plants.

Peat-based seed growing media (suitable for an 8-week growing period) and reduced peat (bark supplemented) potting-on growing media will be used. *Viola* sp. (possibly *Viola xwittrockiana*) of a variety of known susceptibility to black root rot will be used to screen chemical and biological plant protection products and plant activators, before selecting the best products and testing alternating programmes.

The final two years will use *Choisya* sp., testing products found to be the most efficacious on *Viola* sp., testing single products before using sequential applications of different products.

The growing media will be drench-inoculated with a *T. basicola* spore suspension produced as described in HDC Project 38b using 7-10 day old agar plate cultures to produce around 3,000 chlamydospores / ml. 500 ml (or dilution thereof) will be used per 10 L of growing media. The inoculum will be put on the pots once plants have established and after their first (protectant) chemical or biological control treatments.

All products will be applied at the label rates, preferably as drenches when this is given on the label. Sprays will be applied at high water volume while not exceeding any maximum dose per hectare. Viola sp. will be treated about 14 days after sowing, when true leaves are present. *Choisya* sp., probably *C. ternata* cv. Aztec Pearl, will be treated 1-2 weeks after potting-on plugs, once plants have just started to establish.

After treatment and then inoculation, in initial experiments around half the plants of both species will also receive the same product 2 weeks later (except for e.g. Cercobin WG as only one drench is permitted). In later experiments a second product will be applied, where possible from a different mode of action group to the first. Where a growing-media incorporated product is applied this will be added at the same time as the *T. basicola* inoculum for both host species and any follow-up spray applied at the same time as the second applications in other treatments.

Products and methods will be finalised with industry representatives closer to the project start date to ensure that new products and any information from in vitro testing against *Chalara fraxinea* being carried out in 2013 at the Food and Environment Research Agency are considered. The provisional treatment lists of products which may be tested on *Viola* sp. are given in Tables 1 and 2. Information on their potential efficacy against black root rot (BRR) as obtained from PO 14 is given in the tables. Whether or not Cercobin WG is used as one of the components in the combination test programmes will depend on the earlier results, and the decision on its inclusion will be made in consultation with the industry.