



Grower Summary

HNS/PO 190

Evaluation of fungicides and novel treatments for the control of black root rot, *Thielaviopsis basicola*, in bedding and hardy nursery stock plants

Annual 2016

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Project title: Evaluation of fungicides and novel treatments for the control of black root rot, *Thielaviopsis basicola*, in bedding and hardy nursery stock plants

Project number: HNS-PO 190

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Report: Annual report, August 2016

Previous report: Annual report, August 2015

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Date project commenced: 1st September 2013

**Date project completed
(or expected completion date):** 31st August 2017

GROWER SUMMARY

Headline

Thielaviopsis basicola infection prevention by the use of either a thiophanate-methyl drench or application of novel products cannot be relied on. The extent of an infection can be underestimated while the fungus is feeding without producing typical blackened roots, and without plant stress, foliar vigour is maintained so supporting further *T. basicola* multiplication.

Background

Symptoms and prevalence

Black root rot (*Thielaviopsis basicola*, syn. *Chalara elegans*) affects plants from at least 15 families, causes root damage leading to reduced nutrient and water uptake, consequent leaf yellowing and potentially plant death. Losses to black root rot in *Viola* spp. production can be substantial, and some hardy nursery stock species such as *Choisya*, *Skimmia* and *Ilex* are particularly susceptible. Black root rot is a long-established problem for growers, and in the UK, it is likely that around 15% of ornamentals production on nurseries is susceptible to black root rot. It has been estimated that in any year 25% of susceptible crops on UK nurseries can be affected by black root rot, with a fifth of these failing to be sold because either the reduction in quality is too great or the infection has been so severe that the plants have died.

In bedding plants, such as *Viola* and *Primula* species, losses occur on nurseries within the couple of months preceding crop flowering. It is probable that around 2% of bedding and pot plants of *Viola* and *Primula* species become affected annually by black root rot, but as growers are aware of these plants' susceptibility, fungicide treatments can reduce this loss to around 0.5%. Losses tend to be greatest in July as the plants can suffer from heat stress and become more susceptible to infection. In nursery stock species, such as *Choisya* and *Skimmia*, losses are often seen during establishment shortly after crops are potted up, whereas losses tend to be seen in finished plants of herbaceous species such as geraniums. In addition to losses facilitated by stress from heat or root disturbance, early crops can succumb to black root rot when conditions are cold.

Existing control measures and potential novel products

Cultural control

Growers aim to employ cultural control measures such as reducing plant stress and taking care over crop hygiene to reduce the chance of plants becoming infected. However, the pathogen produces resting spores (chlamydospores) in roots which then survive in debris in matting, re-used containers and soil, and can be resistant to disinfectant treatments (as reported in AHDB Project PC 38c and Factsheet 03/14 revision of 15/05). Details of various

measures were given in the review of black root, PO 14 (Wedgwood, 2013).

Biological control

The biological products Prestop (*Gliocladium catenulatum*), Serenade ASO (*Bacillus subtilis*), T34 Biocontrol (*Trichoderma asperellum*), Trianum-G and Trianum-P (both *Trichoderma harzianum* T-22) can be used on ornamentals in the UK against root rots (principally targeting *Pythium* and *Phytophthora* spp.), although with various restrictions. Some growers have continued to only use chemical fungicides against root rots, in part due to the relatively recent availability of biofungicides in the UK, and also due to uncertainty in their efficacy. Only Prestop is said in the product technical notes to have some activity against *Thielaviopsis* sp. and some significant reduction was achieved after preventative plus curative application to *Viola* sp. with a low infection severity in Year 1 of this project. The current project showed some benefit from incorporation of Trianum-G in the growing media of *Viola* sp., but no benefit from Serenade ASO. In projects such as SCEPTRE CP 077 some biofungicides have occasionally shown some reduction of pathogens at low levels and in general more work needs to be done on how growers can best integrate biofungicides into their management programmes.

Chemical control

Growers of crops susceptible to black root rot usually treat them with a protectant fungicide drench such as Cercobin WG (thiophanate-methyl), applied to container plants at sowing (bedding plants) or potting-on (nursery stock). The product also protects against *Cylindrocarpon*, *Rhizoctonia* and *Fusarium* species. Treatment with products such as Subdue (metalaxyl-M) or Fenomenal (fenamidone + fosetyl-aluminium) are used in addition against the oomycete pathogen species of *Pythium* and *Phytophthora*, and do not give control of *Thielaviopsis* sp..

Cercobin WG can only be applied once per crop, which must then be left for three weeks before planting into open ground (EAMU 2011 1887). The resistance risk of this benzimidazole fungicide is noted to be high, having the same FRAC 1 grouping as benomyl. A further issue for growers is that although one application can be adequate to maintain quality for short-production bedding plants, this does not maintain protection for nursery stock under long production cycles. Nursery stock usually starts under protection, often with plug plants potted-on as liners then around a year later potted-on to finals. Only container-grown ornamentals under permanent protection are allowed to be drenched with Cercobin WG, although such crops are more likely to experience greater heat stress and consequently become more disease susceptible.

Research in AHDB project PC 38 showed good black root rot control by Benlate (benomyl), but resistance issues have since caused product withdrawal. Fungicide screening in AHDB project PC 143 against black root rot on pansy used foliar products as drenches. Amistar (azoxystrobin), Bavistin DF (carbendazim), experimental product F279, Scotts Octave (prochloraz), Plover (difenoconazole), Unix (cyprodinil) and Stroby WG (kresoxim-methyl) gave some control, without leaf scorch. Bavistin DF is now unavailable. Cyprodinil is available within Switch, but after use as a protectant and a curative foliar spray in the current project, the black root rot severity in *Viola* sp. did not differ significantly from that in untreated plants.

Amistar (EAMU 0443 of 2009) Scotts Octave (Full Approval) and Stroby WG (Full Approval) can currently be applied as foliar sprays in ornamental plant production. Scotts Octave (FRAC 3) can be applied as a growing media drench and this is the product currently used on susceptible ornamentals by many UK growers against black root rot in polytunnel crops. Scotts Octave does, however, cost about ten times that of Cercobin WG. There are other prochloraz products, such as Sporgon 50 WP, however in 2016, only limited volumes are still held by growers because of their impending withdrawal from use.

The current project aims to identify novel treatments, including non-conventional elicitors and microbial products, and to test their efficacy as preventative and curative drenches against black root rot. The products were tested individually (Experiments 1 & 2 on *Viola* sp., see 2014 Annual Report) and in programmes (Experiment 3 on *Viola* sp., see 2015 Annual Report). This current report is on *Choisya* sp. liners which received preventative and/or preventative + curative treatments found to be safe and effective on *Viola* sp. in 2014.

Summary

Experiment 4 investigated simple programmes on HNS liners, and was set up in a commercial glasshouse with 640 *Choisya ternata* plug plants potted up on 29 April 2015. There were ten 90 mm diameter pots per treatment in each of four replicate blocks. As shown in Table 1, five treatments comprising four biofungicides (available for use on ornamentals) and a non-conventional coded product were applied the day after potting (timing P1). Six weeks later, when new roots had established, these plants were re-treated with the same products (timing P2). In addition, three experimental conventional chemical products and a standard containing thiophanate-methyl, were also applied over the foliage and growing media surface in separate treatments. After a further week, plants (except one untreated treatment) were inoculated on 11 June 2015 using an isolate of *T. basicola* from *C. ternata*. Three chemicals with potential curative activity were applied to several plots a week after inoculation (timing C). No products were applied to plots of two of the treatments at any of the three timings.

Table 1. Experiment 4 on *Choisya* sp. in 2015. Products, application timings and rates and approval status in ornamentals. (Protectant timings: P1 at potting on 30 April, and P2 five weeks after potting, one week before inoculation was done on 11 June. Curative timing: C 10 weeks after potting and four weeks after inoculation)

T	Product & code & [MAPP No.]	Active ingredient	Application timing			Dose & water volume	Comments & UK approval status
1	Un-treated	none	-	-	-	water alone	Inoculated with black root rot spores
2	Un-treated	none	-	-	-		
3	Un-treated	none	-	-	-	water alone	NOT inoculated
4	Topsin* [13988]	thiophanate-methyl	-	P2	-	1.1 g per 10 L water using 1000 L/ha	Standard rate for BRR. One Cercobin WG drench permitted
5	Signum [11450]	boscalid + pyraclostrobin	-	P2	-	1.35 kg / ha in 400 L/ha water	EAMU 1107 of 2009 for ornamentals
6	HDC F174	chemical mixture	-	P2	-	Spray using 400 L/ha water	Agrochemical company rate
7			-	P2	C		
8	HDC F175	chemical	-	P2	-	Spray using 400 L/ha water	Agrochemical company test rate
9			-	P2	C		
10	HDC F176	chemical mixture	-	P2	-	Spray using 400 L/ha water	Agrochemical company test rate
11			-	P2	C		
12	HDC F178	chemical	P1	P2	-	P1 : half rate in 400 L/ha water P2 : full rate in 400 L/ha water	Agrochemical company rate
13	T34 Bio-control [15603]	<i>Trichoderma asperellum</i> T34	P1	P2	-	<u>2 hours before use</u> spore suspension made up 0.5 g in 10 L water per 100 L growing media.	EAMU 1118 of 2012 for outdoor container ornamentals and any protected ornamentals Irrigation rate at 10% of pot volume.
14	Trianum-P [16741]	<i>Trichoderma harzianum</i> T-22	P1	P2	-	P1 : 0.3g /10 L growing media using 1 L water P2 : 0.15 g /10 L growing media using 1 L water	"Lower crop density" rate. 10% of pot volume. Approved on protected ornamentals
15	Prestop [17223]	<i>Gliocladium catenulatum</i> J1446	P1	P2	-	5.0 g Prestop in 1 L water. Used at 10 % pot volume over foliage	Approved on ornamentals
16	Serenade ASO [16139]	<i>Bacillus subtilis</i> QST 713	P1	P2	-	10 L Serenade per ha (10,000 m sq) in 1000 L water / ha	EAMUs 0706 and 0708 of 2013 for ornamentals.

* Topsin WG was supplied in place of Cercobin WG, both have an identical formulation.

In July 2015, all of the treated inoculated *Choisya* sp. had foliar vigour equivalent to that of untreated uninoculated plants. By August nine treatments had become significantly more vigorous. By October, vigour was equally good in all treatments, but still significantly better

after preventative F175 use as a foliar spray followed by irrigation. Unfortunately, product F175 is not now going to be brought to the UK. At destructive assessment in December 2015 all treatments (including the untreated) had become equally affected by black root rot, and there had also been natural infection by *Pythium* spp., leaving (on average) only 30% of the root surface area healthy across all the treatments. Biofungicides and novel chemical products tested on *Choisya* sp. liners inoculated with black root rot, were thus unable to prevent root rot any more than a standard thiophanate-methyl drench, but foliage vigour was improved most consistently by one novel chemical treatment. It was noted that the extent of root infection by *Thielaviopsis* sp. had the potential to be underestimated on nurseries as the pathogen invaded root tissue beyond the area of blackening caused by the resting spores.

Experiment 5 commenced in April 2016. A fresh batch of *Choisya* spp. liners were potted as finals and treated with products selected from earlier trials, using them in alternating programmes. The plants' foliage will be assessed until destructive assessment after a year. The results will be reported in the Final Report in August 2017.

In this project, growers using available products for use in these crops have proved to be effective against black root rot. Any chemical products that can be made available through the EAMU approval system will enable different modes of action to be employed, therefore reducing the chance of fungicide resistance developing. Biological products containing *Trichoderma* spp. with activity already known against other root pathogens such as *Pythium* spp. were shown to provide wider protection at no additional cost.

The use of biological products to suppress black root rot will help the industry to comply with the EU Sustainable Use Directive for reduced pesticide use, by using integrated crop management. This will ensure that suppliers can secure the business of clients anxious to source plants grown with minimal adverse environmental impact.

Financial Benefits

It is difficult to quantify plant losses due to black root rot for several reasons: the intermittent symptom expression usually associated with periods of heat stress, unrecorded incidence (particularly if symptoms develop no further than causing lower quality plants), and roots affected by *T. basicola* can also be infected by other root rotting pathogens without losses being quantified. Fungicides are used in preventative programmes by most growers. On the nursery hosting this project the *Choisya* sp. are grown under protection and so Prestop can be used at potting against the whole spectrum of root rot pathogens. It costs around £1.50 to protect 1000 rooted plugs (selling at £280-£350) and £15 per 1000 liners (selling at £900-£1150). Cercobin WG is also applied in autumn to liners against fungal (not oomycete) root rots, costing around 8.3 pence per 1000 pots. A biofungicide application is currently more

costly than Cercobin WG use, but Scotts Octave use would cost £3.33 per 1000 liners.

Nationally, in England and Wales, it is probable that 1% of pansies are killed by black root rot, equating to an annual loss of £21,000, but this would rise to £105,000 if fungicides were not used. Around 5% overall of *Choisya* and *Skimmia* are probably lost to black root rot. These are the main HNS subjects affected and they represent about 2% of the container plant range. This would equate to annual losses to the disease in the UK from these plants alone of £346,000. Losses however, can be around 20% on some nurseries in years where controls fail. Effective treatments will improve crop quality by maintaining a healthy root system, improving crop establishment and reducing crop losses. Providing a range of products that can be applied at intervals during production to improve root system performance will be particularly important for hardy nursery stock where plants are sold by pot size.

Action Points

- Pay close attention to nursery hygiene and avoid plant stress to prevent introducing and encouraging black root rot. See the PO 14 review for further guidance.
- Early infection stages may cause the roots to become pale brown and typical dark brown speckling will not be seen until resting spores are formed. Do not wait to see reduced vigour, regularly inspect roots.
- Treat or destroy affected plants promptly (do not compost) otherwise other plants can be infected and produce further spread within weeks.
- Clear off root debris on matting or trays, as the mycelium and resting spores can survive for several years.
- Consider preventative use of microbial products to increase resistance to a number of pathogens. Prestop (*Gliocladium catenulatum*) and Triatum-G (*Trichoderma harzianum*) are permitted as drenches to ornamentals and significantly reduced black root rot in the tests with inoculated *Viola* sp., with some beneficial effects from T34 Biocontrol (*Trichoderma asperellum*) applied at sowing.
- Check AHDB Horticulture e-mail alerts for EAMUS. One is being sought for F174.
- As and when new products become available, select a range of chemical plant protection products with different modes of action to avoid build-up of resistance to active ingredients. Be prepared to test the crop safety and efficacy of products with EAMUs before inclusion in nursery-wide programmes.

