Grower Summary

PC 291

Protected ornamentals: evaluation of control options for bacterial diseases of pot plants

Annual Final 2011

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Industry Representative:	Ms Fay Richardson, Coletta & Tyson
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Headline

- Young plants were the predominant source of bacterial soft rot in cyclamen, although extent of infection varied with batch and links between infection and conditions in transit are suspected (particularly exposure of plants to condensation). None of the products tested were effective at controlling these infections once found and drenching with excess water prior to potting significantly increased levels of infection.
- Bacterial leaf spots on ivy and impatiens however were reduced by using preventative sprays of Cuprokylt FL. Amitar also had some effect against leaf spot of Impatiens.

Background and expected deliverables

A number of genera of bacterial pathogens cause disease in pot plants:

- Seed-borne *Xanthomonas* spp. e.g. on Begonia, Pelargonium and Cheiranthus
- *Pseudomonas* spp. causing leaf spots e.g. on Impatiens, Pelargonium and Primula.
- *Pectobacterium* causing soft rot e.g. on Cyclamen, Euphorbia, Pelargonium, Primula and Zantedeschia.
- *Agrobacterium* spp. causing crown gall of Dendranthema and other ornamentals.
- *Rhodococcus fascians* causing leafy gall e.g. on Pelargonium and Petunia.

Bacterial diseases causing significant losses on individual nurseries in recent years include cyclamen bacterial soft rot *(Pectobacterium carotovorum;* formerly *Erwinia carotovora*), poinsettia bacterial leaf spot (*Xanthomonas axonopodis* pv. *poinsettiicola*), wallflower bacterial wilt (*Xanthomonas campestris* pv. *campestris*) and geranium bacterial wilt (*Ralstonia solanacearum*).

Some control is possible through crop management, including avoiding high temperatures, waterlogged growing media, and mechanical and pest damage. Good nursery hygiene can also reduce the risk of persistent bacterial disease problems. There are no chemical controls recommended for bacterial diseases other than copper fungicides, which provide limited protective control.

This project aimed to assess the benefit of some chemical and biological interventions that could increase the options available to growers for management of bacterial diseases.

The expected deliverables were:

- A review of potential treatments for control of bacterial diseases.
- Greater awareness by growers of bacterial diseases and their management.
- An illustrated Factsheet on control of bacterial diseases on protected ornamentals.

Summary of the project and main conclusions

Review of potential treatments for control of bacterial diseases

A full review is given in the Year 1 Annual Report. In summary, there are very few approved products with proven bactericidal activity. Copper compounds have mostly been used to limit spread of bacterial leaf spots (*Xanthomonas* spp. and *Pseudomonas syringae* pathovars) but the level of control is limited, treatment can be phytotoxic and resistance can develop. Overseas, Serenade ASO (*Bacillus subtilis*) is recommended for control of fire blight (*Erwinia amylovora*) and some leaf spot diseases caused by *Pseudomonas syringae*.

Aliette 80WG (fosetyl Al) and potassium phosphite products applied regularly and at high doses have sometimes given moderate control of *Xanthomonas* leaf spot diseases. There is limited evidence for reduction of some bacterial diseases using products that induce Systemic Acquired Resistance (SAR), including the fungicides Amistar (azoxystrobin) and Signum (boscalid + pyraclostrobin). There is increasing interest in the use of specific viruses (phage) that infect and kill bacteria for control of bacterial diseases; a product based on phage was recently approved for use on ornamentals in the USA.

Occurrence of P. carotovorum in young cyclamen plants

Latent infection by *P. carotovorum* was detected in some batches of plug plants. During 2009 and 2010, only one batch out of 86 tested positive. In 2011, however, bacterial soft rot developed within a few days of receipt of some deliveries while plants were still in the plug trays. *P. carotovorum* was confirmed in 16 out of 17 lots of plug cyclamen cv. Halios sampled on 14 June 2011, including 4 out of 5 samples of visibly healthy plants. It is suggested that moisture and temperature conditions experienced during transport of young plants over long distances may induce development of bacterial soft rot.

Nursery sources of P. carotovorum

Samples of water from concrete pathways and cyclamen leaves tested positive for *P. carotovorum*. The presence of *P. carotovorum* in water droplets on leaves suggests the possibility of secondary disease spread from initial sources of infection. Samples of growing medium, dust from pathways, irrigation water, slime from irrigation lines, sand from beneath capillary matting and adult shore and sciarid flies, all tested negative for the bacterium.

Association of cyclamen bacterial soft rot with delivery batches of young plants

Cyclamen plants cv. Halios were assessed for bacterial soft rot in a growing-on test. In 2009, the disease was first observed 8 weeks after potting and eventually occurred in plants from four of five propagators (Table 1). Cumulative losses were significantly greater in plants from propagator C (9.7%) than other suppliers (nil to 1.2%). Losses to bacterial soft rot averaged over all propagators were greatest in the first two deliveries (9.2% and 6.0% respectively) than later deliveries (1.4 to 0.2%).

Sciarid fly were found associated with some of the early batches of plants and, after recognition of the problem, all deliveries were treated with Nemasys (*Steinernema feltiae*) for control of this pest. Possibly the high level of bacterial soft rot which developed in the first delivery may be associated with grazing damage to young plants by sciarid larvae that increased their susceptibility to infection by *P. carotovorum*. The effect of other factors, such as differences in leaf loss or occurrence of corm bruising at mechanical planting, cannot be discounted as influences on final losses to the disease. An experiment in 2010 on young cyclamen cv. Halios Flame showed that bruising the corm prior to inoculation with *P. carotovorum* greatly increased occurrence of bacterial soft rot over the following 10 weeks. Removal of leaves and addition of sciarid fly larvae prior to inoculation had no significant effect, although there was a trend to greater disease with addition of sciarid larvae.

In 2010, losses in plants of cv. Halios supplied by two propagators were monitored. All plants were treated at receipt for control of sciarid fly. Losses were slightly greater in the early deliveries and affected plants from one propagator more than the other (Table 1).

Table 1: Effect of propagator and delivery week on cyclamen bacterial soft rot, cv. Halios, grown on one nursery

Year and	**% bacterial soft rot in delivery week:**				
propagator	**20**	**22**	**24**	**26**	**28**
<u>2009</u>					
A	1	2	3	0	0
B	-	2	1	0	0
C	30	18	2	1	1
D	5	4	0	1	0
E	-	0	0	-	0
<u>2010</u>					
F	5	4	0	1	1
G	2	2	1	0	0

Effect of some foliar treatments on cyclamen bacterial soft rot

Six treatments were evaluated for control of cyclamen bacterial soft rot on a commercial nursery in 2009. Sprays of Amistar, Anthyllis growth stimulant (garlic extract), Cuprokylt (copper oxychloride), Farm Fos 44 + Silwet L77 (potassium phosphite + silicon wetter) and Signum were each applied up to five times from soon after potting, and Purogene (chlorine dioxide) was applied at every watering. None of the treatments reduced bacterial soft rot which ranged in severity from 14% plant collapse (untreated) to 8% (Cuprokylt). None of the treatments affected Botrytis severity or plant quality.

Effect of some integrated measures for control of cyclamen bacterial soft rot

The effect of an immersion treatment for sciarid control, different methods of potting and sprays of Cuprokylt FL (3 ml/L) and Serenade ASO (*Bacillus subtilis*) (10 L/ha) applied alone, in alternation and in mixture at half rate were evaluated on a nursery in 2011. The sprays were applied at potting and then weekly for 5 weeks, except for Cuprokylt FL alone which was applied 3 times at fortnightly intervals.

P. carotovorum was detected in plug plants immersed in water pre-potting and sampled immediately, and not in non-immersed plants. Symptoms of bacterial soft rot developed within 1 week of potting and the incidence of affected plants increased steadily over the course of the trial. *P. carotovorum* was confirmed in affected plants; no Fusarium wilt or other disease was found. At 1 week after the final sprays of Cuprokylt FL and Serenade ASO, the incidence of plants that had collapsed from bacterial soft rot ranged from nil to 19% (Table 2). Bacterial soft rot was greatly increased by immersing the plug plants in water at potting and slightly increased by spraying with Cuprokylt FL. Serenade ASO did not influence disease levels. Hand-potting did not reduce the disease compared with machine potting. At 13 weeks after potting the proportion of affected plants ranged from 30% to 71% (Table 2); differences between treatments at this time were not statistically significant, probably a reflection of secondary spread between plants during the trial period, masking the effects of treatments applied at and soon after potting.

Table 2: Effect of various treatments applied at and within 5 weeks of potting on occurrence of bacterial soft rot in cyclamen – 2011

Treatment		**Spray treatments after potting:**						**Mean % plants with bacterial soft rot**	
Potting	**Immersion in Nemasys**	**Wk 0**	**Wk 1**	**Wk 2**	**Wk 3**	**Wk 4**	**Wk 5**	**30 Aug**	**18 Oct**
1. Hand	Yes	-	-	-	-	-	-	6	39
2. Hand	No	-	-	-	-	-	-	0	30
3. Machine	Yes	-	-	-	-	-	-	10	47
4. Machine	No	-	-	-	-	-	-	2	31
5. Machine	Yes	Cup	-	Cup	-	Cup	-	15	53
6. Machine	Yes	Ser	Ser	Ser	Ser	Ser	Ser	6	46
7. Machine	Yes	Cup	Ser	Cup	Ser	Cup	Ser	19	71
8. Machine	Yes	Cup/Ser	Cup/Ser	Cup/Ser	Cup/Ser	Cup/Ser	Cup/Ser	13	62

Cup – Cuprokylt FL spray; Ser – Serenade ASO spray; Cup/Ser – spray of Cuprokylt FL and Serenade ASO in mixture, each at half recommended rate.

Evaluation of treatments for control of Xanthomonas leaf spot of ivy

A greenhouse trial was done to assess the potential of five preventative treatments to control leaf spot on ivy caused by *Xanthomonas hortorum* pv. *hederae*. Foliar sprays of Cuprokylt FL (5 ml/L) significantly reduced the disease. Treatments with Farm-Fos 44, Aliette 80WG (3.75 g/L), Amistar (1 ml/L) or methyl jasmonate (a chemical used to induce SAR) failed to reduce the disease in comparison with untreated controls. Two applications (before and after inoculation) with Cuprokylt FL were more effective than a single preventative spray.

Evaluation of treatments for control of Pseudomonas leaf spot of impatiens

A greenhouse trial assessed the potential of six preventative treatments to control leaf spot on impatiens caused by *Pseudomonas syringae* pv. *syringae*. None of the treatments prevented development of leaf spot symptoms following artificial inoculation. Sprays of Cuprokylt FL (5 ml/L) reduced the incidence of infections by around 40%; Amistar (1 ml/L), Biosept (0.5 ml/L) and an experimental application of methyl jasmonate reduced the incidence of infections by 20%. Applications of Farm-Fos 44 (10 ml/L) and Aliette 80WG (3.75 g/L) were ineffective.

Evaluation of disinfectants for control of bacteria

Experiments were done to compare the activity of seven disinfectants against three bacterial pathogens (*Pectobacterium carotovorum, Pseudomonas syringae* and *Xanthomonas hortorum* pv. *hederae*). Products were: Biosept (grapefruit seed extract), bleach (sodium hypochlorite), Fam-30 (iodophor), Hortisept (quaternary ammonium compound), Menno-Florades (organic acid), Sanprox P (peroxygen) and Virkon S (peroxygen). All disinfectants completely inhibited bacterial growth in an agar plate test, at the manufacturers recommended rate, except for Biosept on *Ps. syringae*. Mypex-type matting and concrete were more difficult to disinfect than glass and aluminium. Sanprox P at 1% and Virkon S at 1% fully disinfected all surfaces of all three bacteria after 0.5 hour. *Xanthomonas hortorum* pv. *hederae* was most persistent, surviving exposure to 0.8% Hortisept, 1% Menno-Florades, 0.8% Fam-30 and 0.05% Biosept for 24 h on concrete.

Aspects of leafy gall (Rhodococcus fascians)

Leafy gall was diagnosed on a commercial crop of trailing petunia in summer 2010. The causal agent was identified as *Rhodococcus fascians*, although the bacterium differed slightly from the reference type strain. Cuttings taken from healthy parts of plants with symptoms were found to carry infection, suggesting that systemic infections can be spread through cuttings. Other plants (e.g. Hebe) were also found to be infected and may act as reservoirs of infection on the same nursery.

Financial benefits

UK cyclamen production is around 16 million plants per year (4-6 million large-flowered and 10-12 million mini-cyclamen) valued at around £16 million (industry estimate, 2008). Assuming an average of 5% of plants are lost to bacterial soft rot (*Pectobacterium carotovorum*), the potential savings to growers by introduction of effective control measures would be worth around £800,000/annum.

In 2007 and 2008, several UK nurseries growing poinsettia suffered losses caused by *Xanthomonas* leaf spot, affecting young plants from at least two different suppliers. Severely affected plants are unmarketable, others require more labour to remove affected leaves and product will also be downgraded. This disease is currently notifiable to PHSI. Information on treatments that prevent and/or reduce spread of this disease is therefore likely to be well received by growers.

Action points for growers

1. Several potentially very damaging diseases of pot plants are caused by bacteria including soft rot of cyclamen and a leaf spot of poinsettia. Growers should consult the factsheet produced as part of this project and follow the guidance provided about prevention and action required to minimise damage when outbreaks occur.
2. A slimy soft rot of cyclamen, usually originating in the upper part of the corm, is a good indication of bacterial soft rot caused by *Pectobacterium carotovorum*. Leaf petiole blackening is not a reliable indicator of the disease.
3. Work in this project strongly indicates that waterlogging of young cyclamen plants can greatly increase losses to bacterial soft rot. Do not immerse plug plants in water or drench or irrigate plants to excess such that plants become waterlogged.
4. Work in this project showed that *P. carotovorum* may be present in plug cyclamen plants and bacterial soft rot may develop within a few days of receipt on a nursery. Inspect each delivery of plants carefully on arrival; if disease symptoms are found, have a sample of plants tested to determine if *P. carotovorum* or other pathogens are present. The effect of plug plant transport conditions (particularly condensation) on occurrence of cyclamen bacterial soft rot warrants investigation but it would be advisable to remove packaging around trolleys of delivered plants on receipt to minimise exposure to wetness/high humidity and to carry out particularly thorough inspections on batches where excess condensation is observed inside the plastic film packaging.
5. Bruising of young, cyclamen corms greatly increases the potential for bacterial soft rot. Check that corms are not visibly damaged where mechanical transplanting is used.
6. There is circumstantial evidence that sciarid fly in young cyclamen may be associated with subsequent increased levels of bacterial soft rot. Check young plants arriving on a nursery for sciarid fly and take measures to control damage to corms caused by sciarid larvae.
7. Due to the lack of approved products with proven bactericidal activity, it is recommended that plants affected by bacterial diseases are removed promptly from a crop.
8. Foliar sprays of copper oxychloride (eg Cuprokylt FL) applied preventatively can significantly reduce bacterial leaf spot of ivy (*Xanthomonas hortorum* pv. *hederae)* and Impatiens (*Pseudomonas syringae* pv. *syringae*). Sprays of Amistar (1 ml/L)

slightly reduced the latter disease. Use of Cuprokylt FL on protected ornamentals (maximum rate 3 ml/L) is currently permitted under the Long Term Arrangements for Extension of Use of Pesticides; higher rates are permitted on outdoor crops. Use of Amistar is permitted under a Specific Off Label Approval (SOLA 0443/09). Check the label and approval status before use on a crop. Test treat a small batch of plants first to check for crop safety and/or deposit.

9. Before laying out a new crop known to be susceptible to a bacterial disease, consider disinfection of standing areas and pathways. Concrete and Mypex-type matting are more difficult to disinfect than glass or plastic; peroxygen products at the manufacturers' recommended rates were more effective than other products we tested on these surfaces.

10. Do not take cuttings from petunia plants with symptoms of leafy gall; work in this project showed that visibly healthy shoots on affected plants can be infected systemically with the causal bacterium.