BPOA Technical Seminar

Muck and Magic

Managing Ornamental Plants Sustainably (MOPS)

Developing Integrated Plant Protection Strategies

Jude Bennison, ADAS

http://hdcmopsblog.wordpress.com/

Objectives

- To develop a range of options for the control of priority pests & diseases on ornamental plants & for optimising nursery hygiene
- To evaluate novel conventional pesticides & biopesticides with a clear route to market for their potential as components of sustainable pest & disease control programmes in ornamentals.
- January 2014 - January 2016

Pests- 2014

- Peach-potato aphid – Harper Adams University
- Glasshouse whitefly- Warwick Crop Centre
- Western flower thrips (WFT)- ADAS
- Vine weevil- ADAS

Aphids

- Peach-potato aphid (*Myzus persicae*) with carbamate and pyrethroid resistance typical of those found on commercial nurseries
- Host plant pansy
- Glasshouse compartment at Harper Adams University

Trial design & treatments

- 8 treatments:
- Movento (+ve control)
- Water (-ve control)
- Teppeki (= Mainman)
- 2 new conventional pesticides
- 3 new biopesticides

- 4 weekly sprays
- 9 pansy plants per plot (6 reps)
- Insect-proof screens between plots

Results

- Movento gave good control from 6 days after 1st spray
- Teppeki (=Mainman) and one biopesticide gave good control from 3 days after 1st spray
- Teppeki and one conventional treatment eradicated aphids 3 weeks after 1st spray
- All treatments except for one conventional product gave good control by the end of the trial

Whitefly

- Glasshouse whitefly, *Trialeurodes vaporariorum)*
- Starter culture from commercial ornamentals
- Host plant verbena
- Glasshouse compartments at Warwick Crop Centre

Trial design & treatments

- 8 treatments:
- Teppeki (=Mainman) +ve control
- Water (–ve control)
- 1 new conventional pesticide
- 5 biopesticides

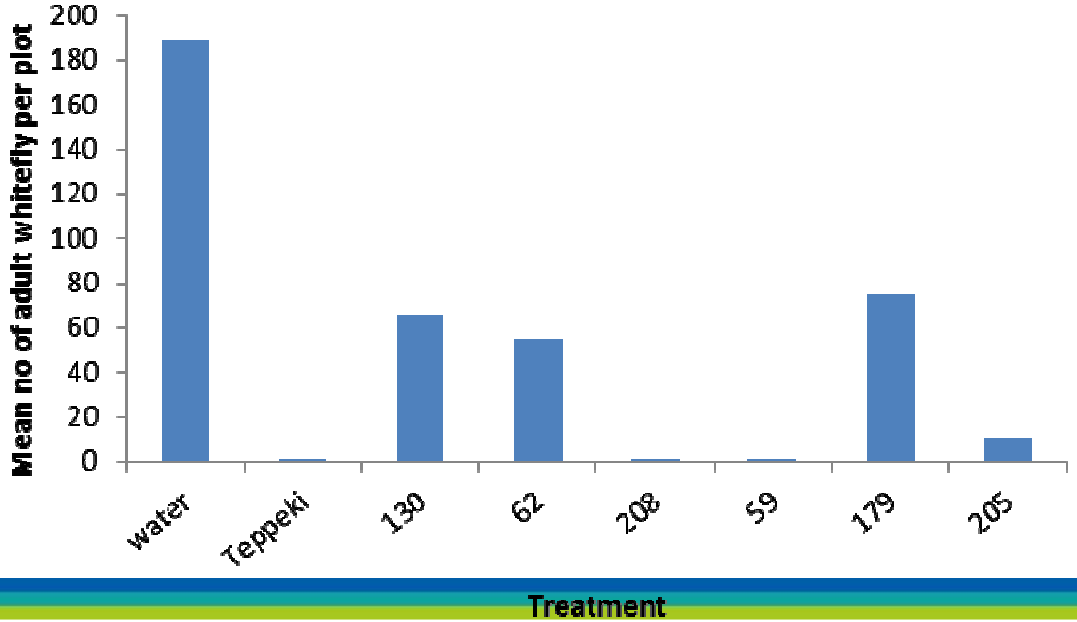
- 4 weekly sprays
- Each plot was an insect-proof cage
- 9 verbena plants per cage (6 reps)

Results

- No quick knockdown of adults after 1st spray
- 2 biopesticides reduced numbers of whitefly eggs and scales but not on all assessment dates

Results

- All treatments reduced numbers of whitefly adults per yellow sticky trap 28 days after final spray
- Teppeki (=Mainman), 1 conventional and 1 biopesticide reduced numbers to almost zero
- Most of control could have been kill of pupae preventing adult emergence



Western flower thrips (WFT)

- WFT with spinosad (Conserve) resistance typical of those found on commercial nurseries
- These WFT are also probably resistant to all/most currently approved pesticides
- Host plant verbena
- Glasshouse compartments at ADAS Boxworth

© Nigel Cattlin/FLPA

Choice of 'standard' positive control for WFT trial

- Many WFT populations are resistant to all approved pesticides
- So which pesticide to use as 'standard' +ve control?
- Actara (thiamethoxam) has an EAMU for use on protected ornamentals
- Considered by supplier to be effective against WFT resistant to other pesticides
- However, Actara subject to current EC neonicotinoid restrictions so just used as experimental tool
- Can only be used in a glasshouse and sprayed plants not moved outside or sold until after flowering

Trial design & treatments

- 8 treatments:
- Actara (+ve control)
- Water (-ve control)
- 3 new conventional pesticides
- 3 new biopesticides

- 4 weekly sprays
- Each plot was a thrips-proof cage
- 9 verbena plants per cage (6 reps)

Results

- None of the products gave a quick knock-down of WFT 3 days after the 1st spray
- 1 conventional pesticide reduced numbers of larvae per leaf 6 days after 1st spray
- Actara and all 3 conventional pesticides were equally effective in reducing numbers of larvae per leaf 6 days after 2nd, 3rd and 4th sprays
- Numbers of WFT larvae per leaf were reduced by all 3 biopesticides 6 days after 3rd spray and by 2 of them 6 days after 4th spray
- The biopesticides were equally effective to the conventional pesticides on these dates

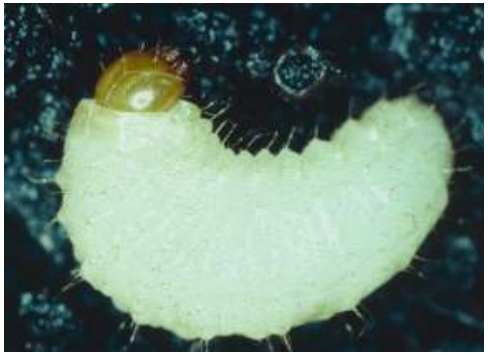
Results

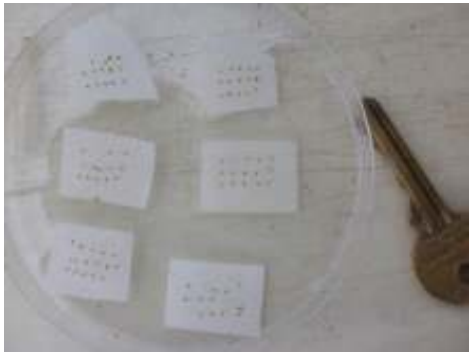
- None of the treatments prevented flower or leaf damage that would make the plants unmarketable
- They would need to be used as part of an IPM programme together with biological control agents
- Actara has an EAMU for use on protected ornamentals but can only be used in a glasshouse on plants that will not be moved outside or sold until after flowering

WFT damage to verbena petals & leaves

Vine weevil

- Host plant fuchsia
- Vine weevil eggs collected from ADAS culture (15 eggs per plant)
- Poly tunnel at ADAS, Boxworth





Treatments

- 10 treatments:
- Exemptor (thiacloprid) +ve control - substrate incorporated
- Met52 granular - substrate incorporated
- Water (-ve control) as drench
- Other drench treatments:

  Calypso (thiacloprid)

  Nemasys L (*Steinernema kraussei*)

  Larvanem (*Heterorhabditis bacteriophora*)

  SuperNemos (mix of 3 nematode species)

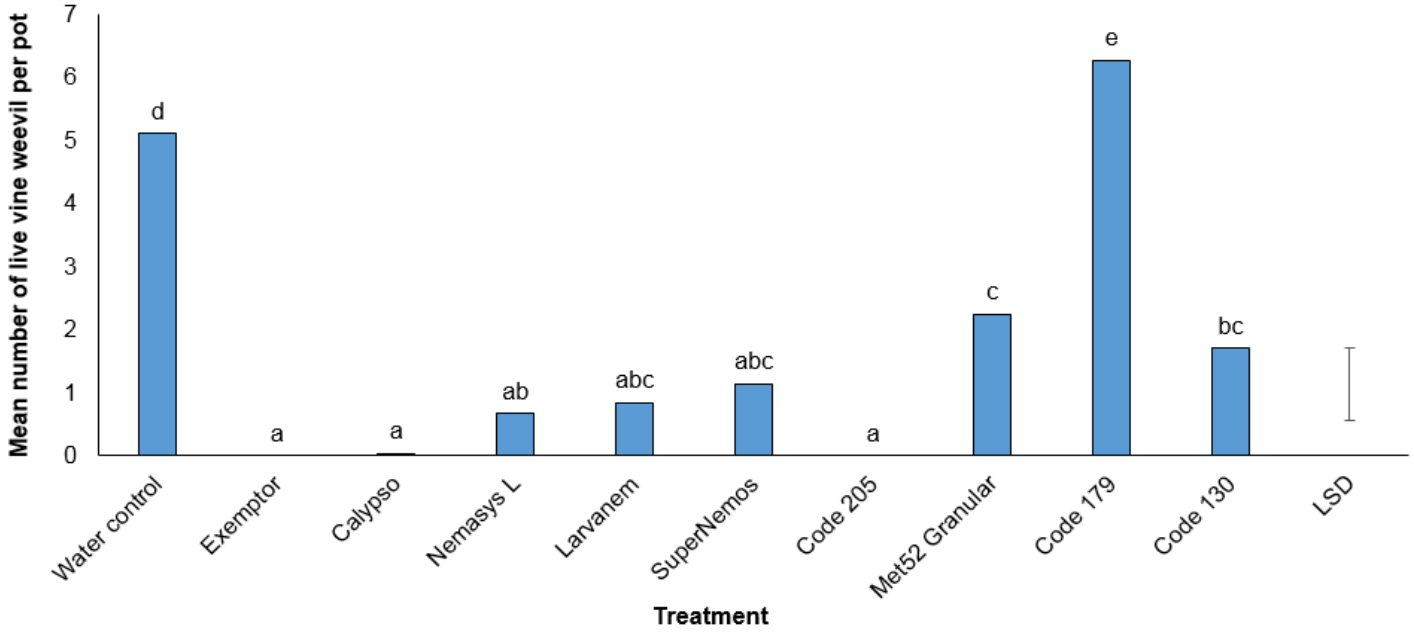
  3 coded biopesticides

Trial design

- 6 replicate plots per treatment
- 10 plants per plot

Results

- All treatments except for 1 biopesticide significantly reduced numbers of live vine weevil larvae per pot
- Exemptor, Calypso, code 205 and the 3 nematode products were the most effective



2015 trials

Pests

- Carnation tortrix (HNS)
- Aphids- *Aphis gossypii* (melon and cotton aphid - HNS)
- Novel techniques for leaf and bud nematodes (HNS)

Pests & diseases

- Phytotoxicity of best performing products (bedding & pot plants, cut flowers and HNS)

Thanks to:

- HDC for funding
- Tom Pope, Harper Adams University (aphid trial)
- Dave Chandler & Gill Prince, Warwick Crop Centre (whitefly trial)
- Gemma Hough, ADAS (vine weevil trial)
- Sarah Mayne for MOPS blog:

http://hdcmopsblog.wordpress.com/

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Managing Ornamental Plants Sustainably [MOPS]

STC studies in 2014

Dr Martin McPherson MBPR (Hort.)

Science Director

Trials conducted by:-

Mr Adam Ormerod

Project Manager - Plant Pathology

MOPS Pathogen Targets in 2014

Rust

(*Puccinia* spp.)

- Mitigated risk by establishing two susceptible crops
  - *Bellis*
  - *Antirrhinum*

Powdery Mildew

(*Erysiphe & Podosphaera* spp.)

- Mitigated risk by establishing two susceptible crops
  - *Aster*
  - *Pansy*

- Inoculum supply for both trial series critical due to host specificity

  'infector plants' ideally or leaf material for use as spore suspension

- The aim has to be to match the specific pathogen, not only to the host crop, but also to have it available at the correct growth stage
- The trials were both commenced in Autumn 2014 to coincide with optimum infection conditions and also the likelihood of sourcing suitable inoculum

MOPS Rust Control – 2014

- Rust – in Bellis cv. 'Goliath' and Antirrhinum cv. 'Magic Carpet Mixed'
- Seeds sown in plug trays on 3rd July 2014 and seedlings transplanted into 6 packs for trialling (2 x 6-packs or 12 plants/plot)
- Studies with biopesticide and conventional products separated spatially in the trials (different benches)
- Treatment application regime commenced on 29th August
- Bellis plants with rust (sourced from wild daisy and commercial Bellis) introduced into trial on 1st September
- Antirrhinum trial inoculated with spore suspension (prepared from infected leaves) on 1st September
- Glasshouse environment maintained conducive to disease development for 24-48hrs *(watered late in day & polythene cover overnight to raise humidity)*
- Biopesticide products applied as weekly foliar sprays (8 applications in total)
- Conventional fungicide products applied fortnightly (4 applications in total)

Products for Rust Control

Conventional Products

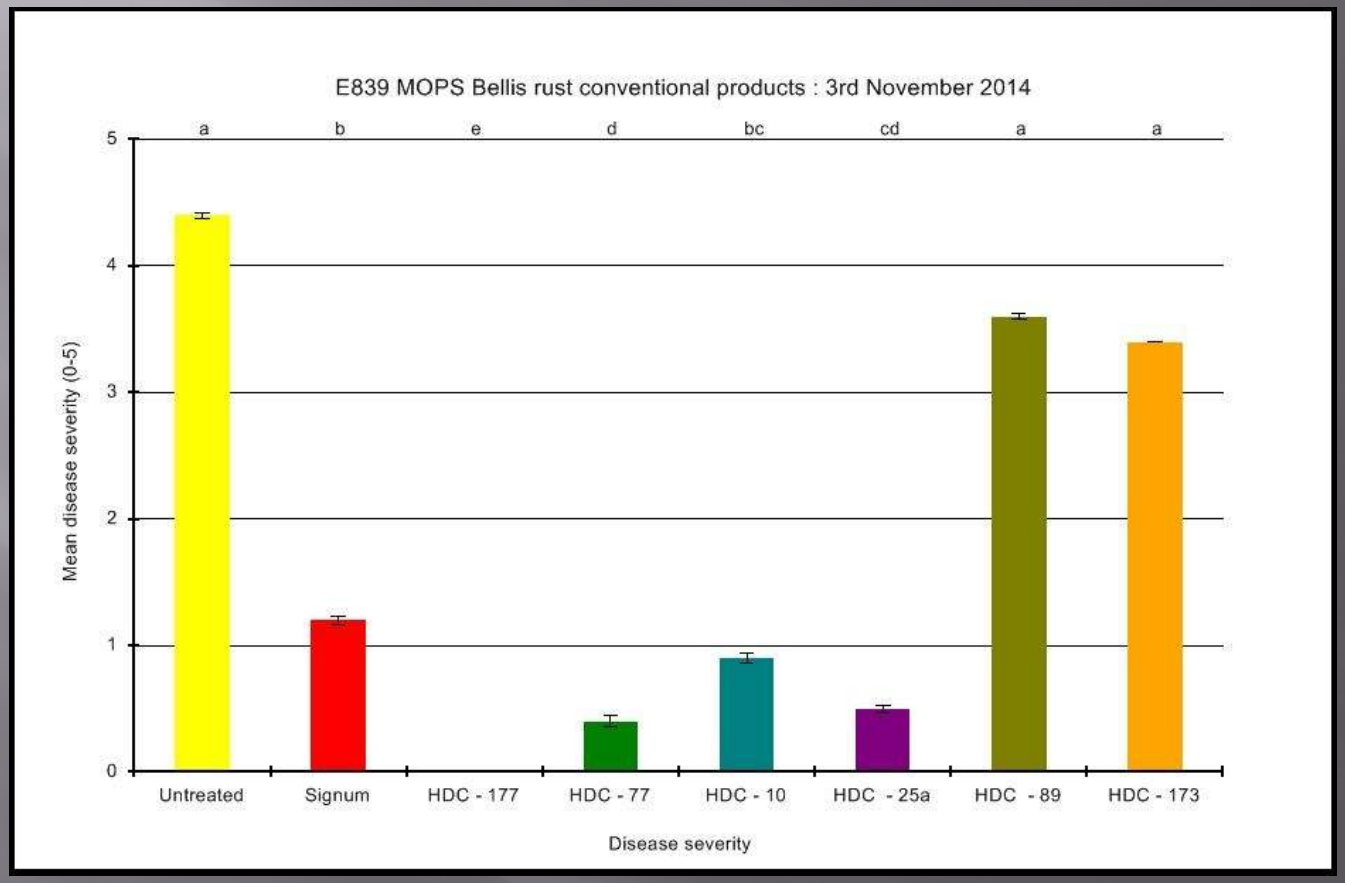
	HDC Code	Product
1	-	Signum (Pyraclostrobin + boscalid) SOLA 2141/12
2	177	-
3	77	-
4	10	-
5	25a	-
6	89	-
7	173	-

Biopesticide Products

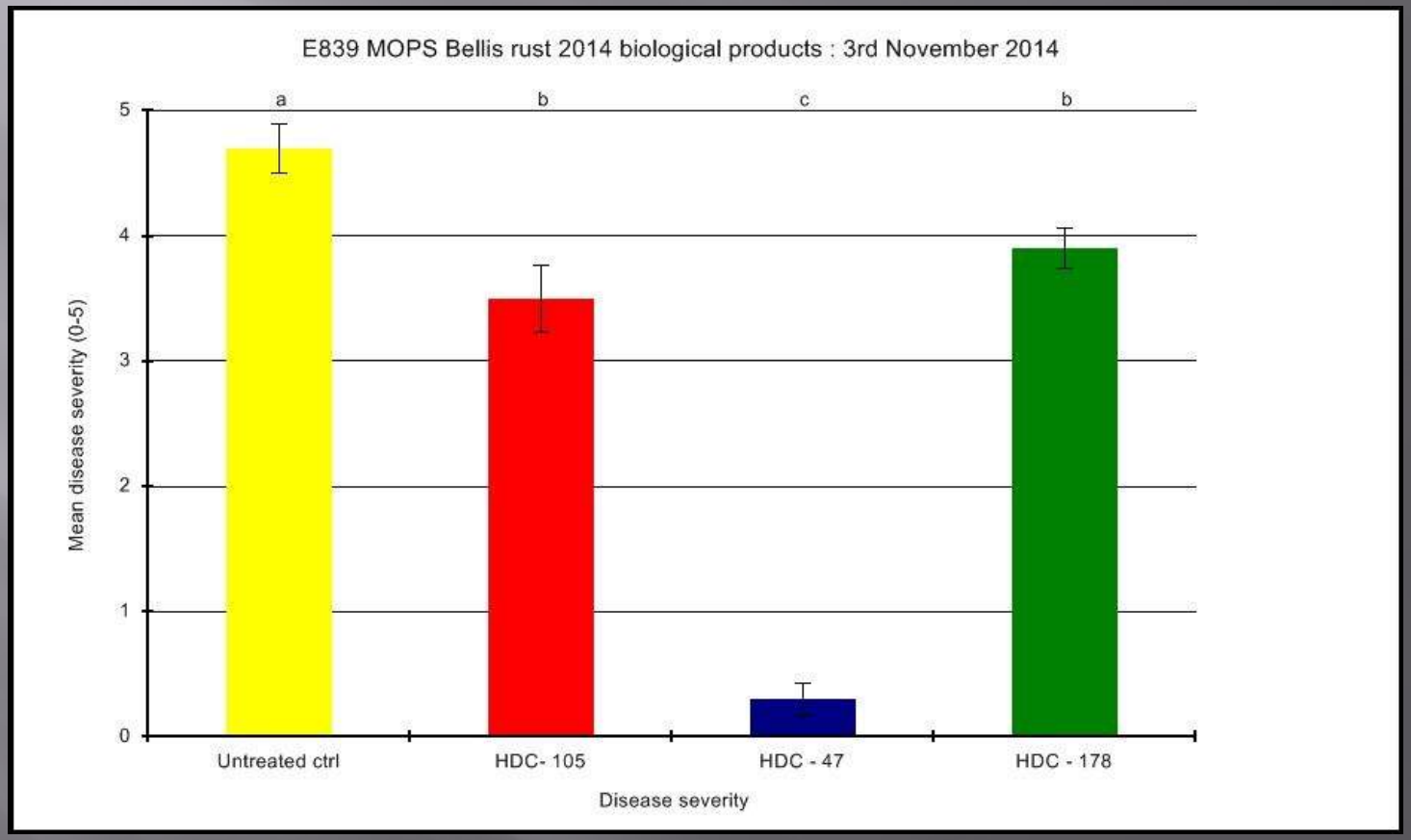
	HDC Code	Product
1	105	-
2	47	-
3	178	-

Disease Progression in Bellis Rust Trial
(*Puccinia distincta*)

Rust in Bellis
- Performance of conventional fungicides



Rust in Bellis
- Performance of biopesticide products



Bellis : Rust Control Comparisons

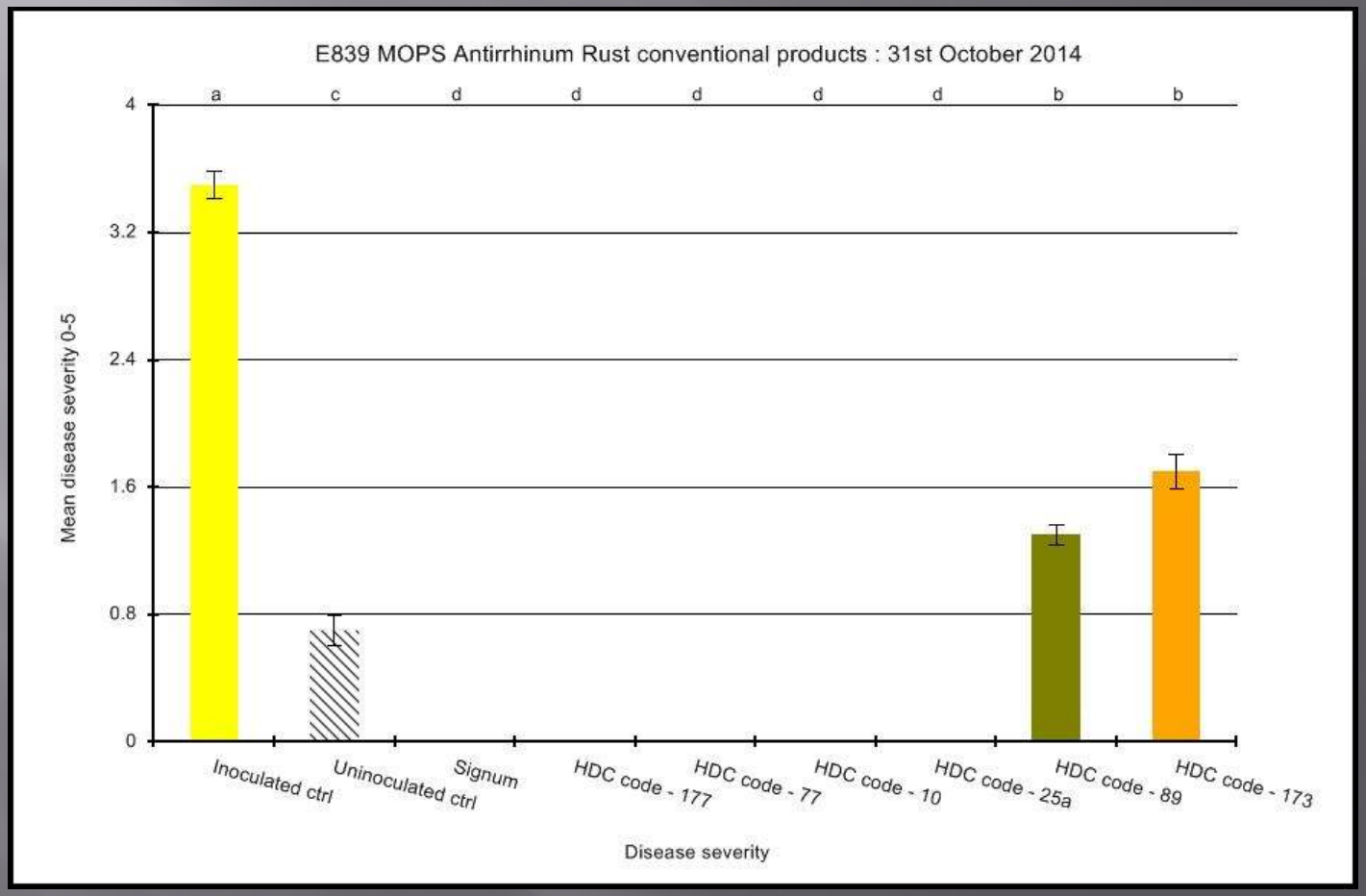
Untreated control
versus
HDC-47
(Best Bio-control)

Untreated control
versus
HDC-177
(Best Conventional)

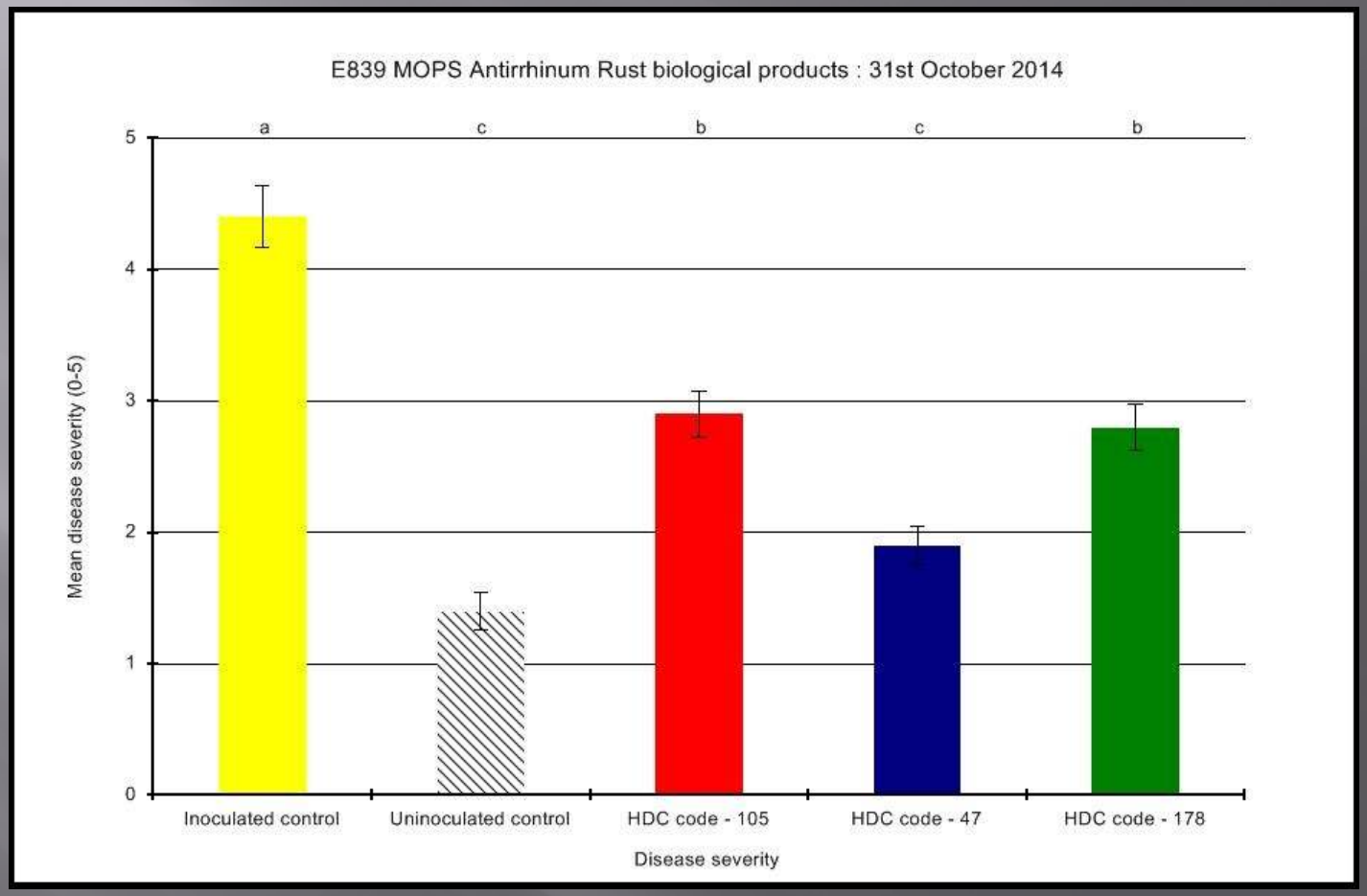
Disease Progression in Antirrhinum Rust Trial

(*Puccinia antirrhini*)

Rust in Antirrhinum
- Performance of conventional fungicides



Rust in Antirrhinum
- Performance of biopesticide products



Antirrhinum : Rust Control Comparison

Powdery Mildew in Aster & Pansy
- MOPS Autumn 2014

ASTERS

- Plug plants cv. Cassandra (kindly supplied by Lyndon Mason, CFC) potted-on into 11cm pots (12 pots/plot) on 20th June and grown-on
- Aster 'infector plants' with powdery mildew generated via natural infection
- Infector plants introduced to Aster trial (1 infector plant/plot) on 28th August

PANSIES

- Pansy seed cv. Early Flowering Mixed sown in plug trays on 3rd July and potted-on into 6 packs (2 x 6-packs/plot)
- Pansies inoculated with spore suspension (from infected leaves) on 29th August

- In each trial, the biopesticide and conventional products separated spatially
- Treatment application regimes commenced on 27th August
- Crops initially maintained with environmental conditions conducive to infection (watered late in day, covered with polythene overnight to raise humidity)
- Biopesticide products sprayed weekly (8 applications in total)
- Conventional products sprayed fortnightly (4 applications in total)

Products for Powdery Mildew Control

Conventional Products

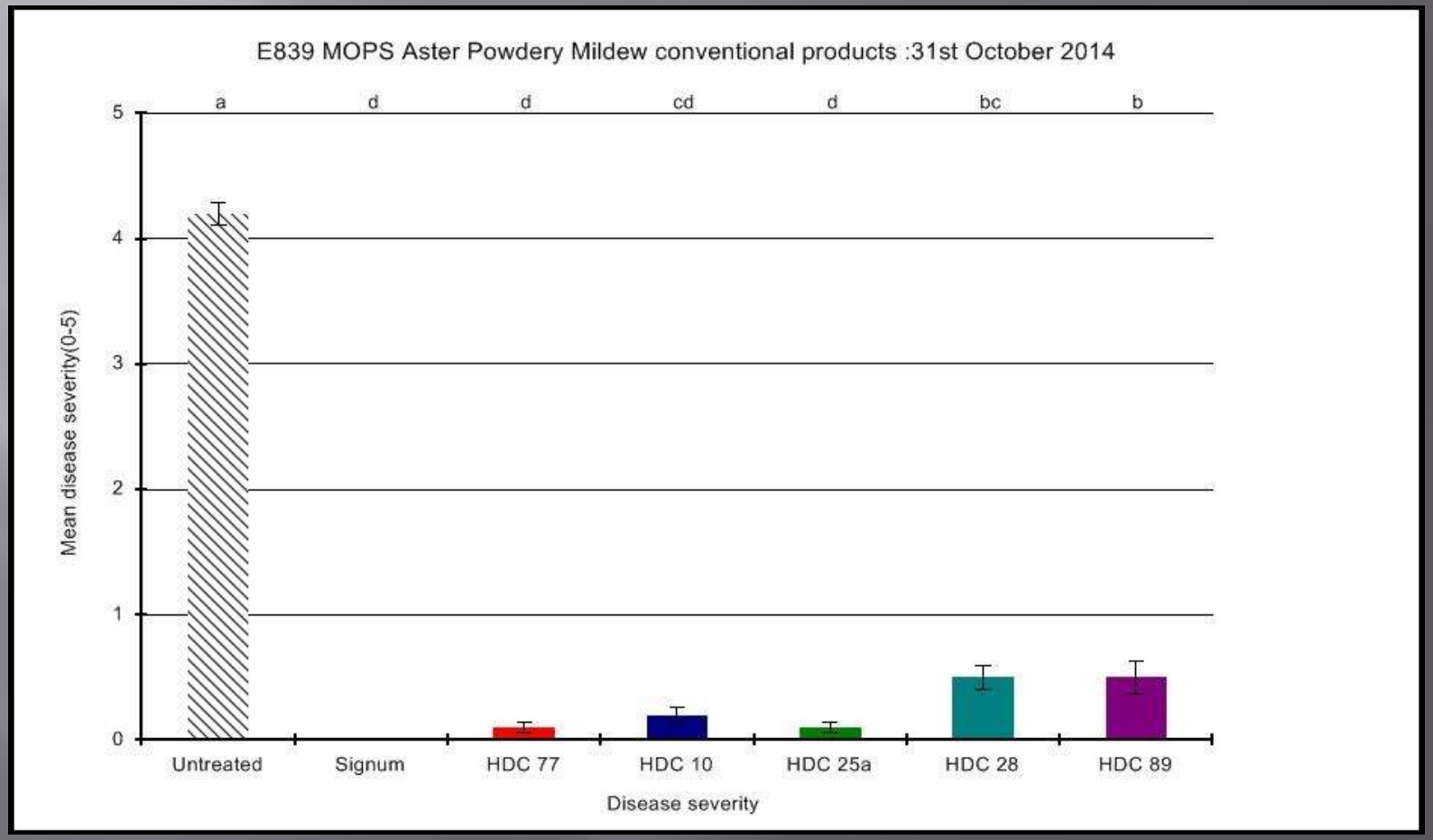
	HDC Code	Product
1	-	Signum (Pyraclostrobin + boscalid) SOLA No. 2141/12
2	77	-
3	10	-
4	25a	-
5	28	-
6	89	-

Biopesticide Products

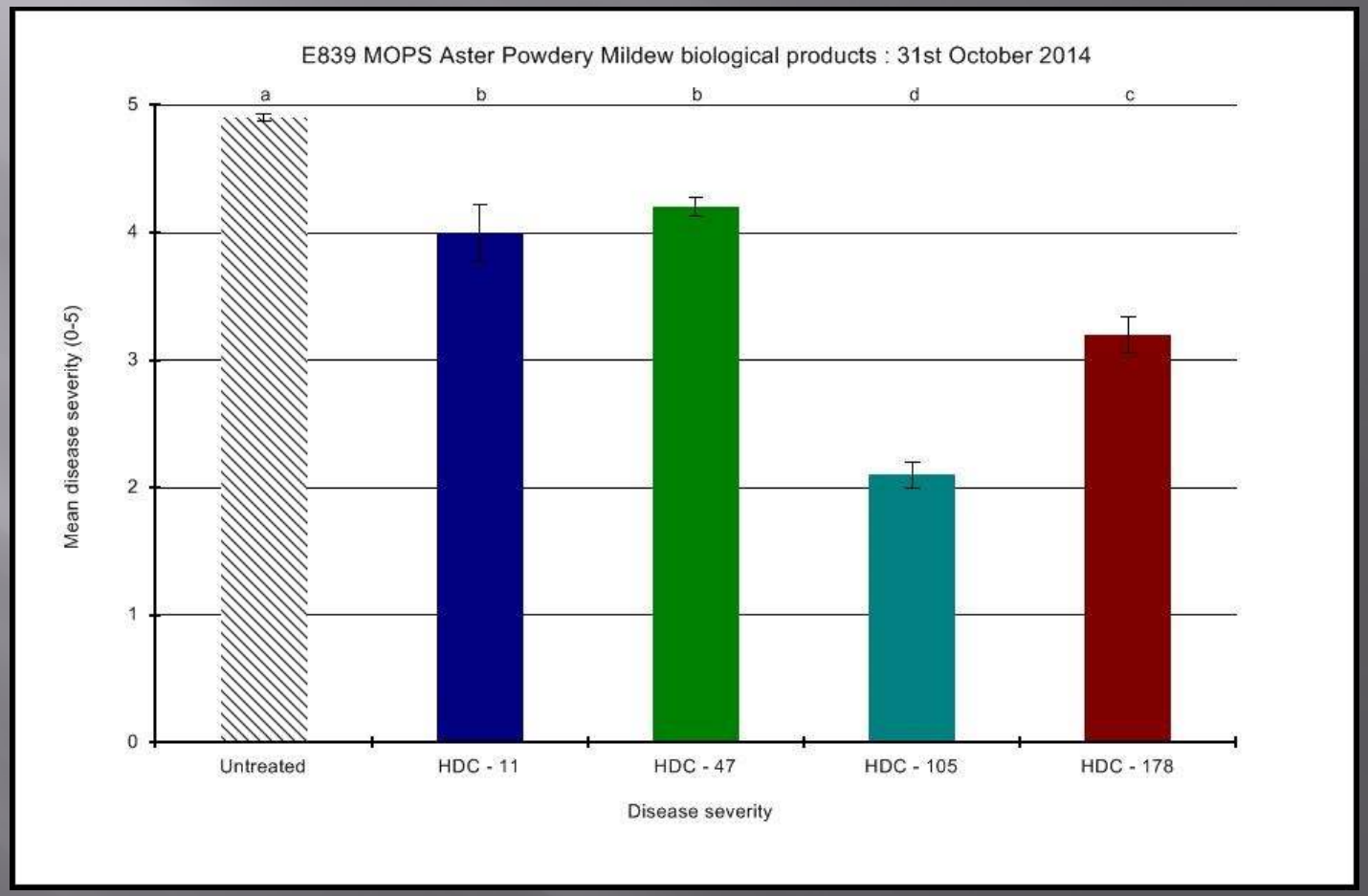
	HDC Code	Product
1	11	-
2	47	-
3	105	-
4	178	-

Disease Progression - Aster Powdery Mildew Trial
(*Erysiphe* sp.)

Powdery Mildew in Aster
- Performance of conventional fungicides



Powdery Mildew in Aster
- Performance of biopesticide products



Aster : Powdery mildew control comparisons

Disease Progression in Pansy Powdery Mildew Trial
(*Podosphaera violae*)

Powdery Mildew Control in Pansy

- Pathogen establishment in the trial was successful
- But….disease progress in both the biopesticide and conventional treatments was slow and variable
- Reasons for the slow disease development unclear - but could be associated with virulence of the specific mildew isolate used, susceptibility of the cultivar of pansy or one or more factors associated with the glasshouse climate
- Results from this particular trial not presented – data to be treated with caution as the low disease pressure and variability prevents meaningful comparisons between treatments

Summary of STC MOPS Rust trials

- Two very successful trials undertaken with moderate-high disease levels
- The standard product **Signum** (pyraclostrobin+boscalid) was very effective in both trials
- Several of the **conventional fungicides** (**HDC-177, HDC-77, HDC-25a & HDC-10**) provided excellent control of rust (**80-100% control**) over the course of the two trials and <u>were as good, or better, than</u> the standard product Signum
- The **biopesticide products** overall were much <u>less effective</u> and only provided around **20-40% control**. The exception was one product (**HDC-47**) on Bellis that provided excellent control (**94%**) - equivalent to some of the best conventional fungicide products
- Whilst **HDC-47** also provided some rust suppression in Antirrhinum it was much less effective compared to the Bellis trial (**57% versus 94% control**)
- It is hypothesised that the difference in disease control observed may relate to the different inoculation techniques - and this warrants further study

Summary of STC MOPS Mildew Trials

- One very successful p. mildew trial was undertaken on Aster. The pansy trial was less successful due to slow & variable disease development
- In Aster, the **conventional fungicides** (**HDC-77, HDC-10, HDC-25a, HDC-28 & HDC-89**) and the standard product **Signum** performed well and provided between **88-100% control.** Signum was most effective.
- The **biopesticide products** were largely ineffective against p. mildew and most products (**HDC-11, HDC-47 & HDC-178**) provided a low level of disease suppression (**14-35% reduction**)
- One **biopesticide product** (**HDC-105**) provided more promising results (**57% mildew reduction**) and, subject to regulatory approval, could be of value in an integrated spray programme for powdery mildew
- For the other biopesticides, especially the micro-organisms, a greater understanding of environmental & other parameters is still required for their successful application and integration


Thank you. Any Questions...

Biopesticide Categories

1. Products based on pheromone and other semiochemicals (for mass trapping or trap cropping)
2. Products containing a microorganism (e.g. bacterium, fungus, protozoa, virus, viroid)
3. Products based on plant extracts e.g. garlic
4. Other novel alternative products e.g. SAR inducers

BPOA Technical Seminar

Muck and Magic

Disinfectants against root rot pathogens

Dr Erika Wedgwood

Objectives

To test product efficacies against:

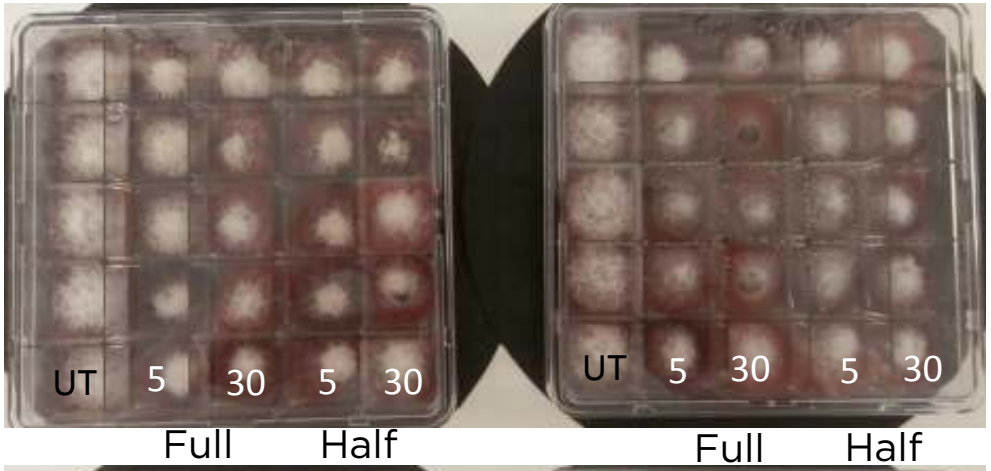
1. Fusarium* a) spores b) mycelium
2. Pythium* mycelium
3. Fusarium & Pythium after organic contamination of the disinfectant
4. Fusarium & Pythium mycelium & spore contamination of five different surfaces

Isolates used = *Fusarium oxysporum* f. sp. *mathiolae* (from wilt of stocks) & *Pythium irregulare* (root rot, isolated from yew)

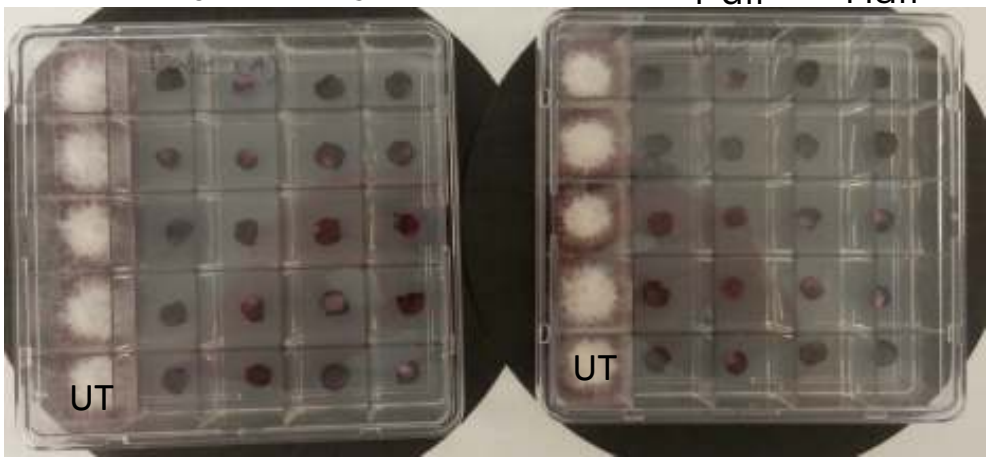
Disinfectant products tested

Product	Active ingredient(s)	Full rate on label
Jet 5	Hydrogen peroxide + peroxyacetic acid	1 : 125
Citrox P	Plant extract	1 : 150
Disolite	Phenolics	2%
FAM 30	Iodophor	1 : 125
Menno Florades	Benzoic acid	1%
Hydrocare	Hydrogen peroxide + silver	3%
Unifect G	Quaternary ammonium compounds + aldehyde	4%
Virkon S	Peroxygen compounds + organic acids	1 : 100
Domestos Extended Germ Kill	Sodium hypochlorite	120 ml into 5 L

Fusarium harder to kill than Pythium



This product gave 100% control of Pythium, but, as shown, Fusarium mycelium survived



Some products were effective against Fusarium, even at half rate for 5 min (also seen for Pythium)

% Control - 30 min contact

P = plastic, C= concrete,
G-C = ground-cover, G = glass

Product at full rate	Spores	Mycelium		Mycelium with peat		Surfaces ++ kill or better	
	Fusarium	Fusarium	Pythium	Fusarium	Pythium	Fusarium	Pythium
Jet 5	+++++	+++	+++++	-	+++++	only P	all
Citrox P	+++++	-	++++	+	++++	none	only P,C,G-C
Disolite	+++++	+++++	+++++	+++++	+++++	all	all
FAM 30	+++++	-	+++++	-	+++++	none	all
Hydrocare	+++++	-	++++	+	-	none	all
Virkon S	++++	-	+	-	-	none	only C,G-C
Unifect G	+++++	+++++	+++++	+++++	+++++	all	all
Menno Florades	+++	-	+++	-	+	none	all but G
Domestos	+++++	+++++	+++++	+++++	+++++	only G	all

No survival	80% - 90% control	50% - 70% control	30% - 40% control	10 – 20% control	Zero control
+++++	++++	+++	++	+	-

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FAM 30	+++++	-	+++++	-	+++++	none	all
Hydrocare	+++++	-	++++	+	-	none	all
Virkon S	++++	-	+	-	-	none	only C,G-C
Unifect G	+++++	+++++	+++++	+++++	+++++	all	all
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+++++	++++	+++	++	+	-

Conclusions

The relative efficacy of products differed between;

- Fusarium & Pythium
- Product dilution
- Contact time
- Organic matter presence
- Surfaces treated

- Examine full details in the MOPS annual report, plus the updated HDC biocides Factsheet, to assist product choice for individual situations

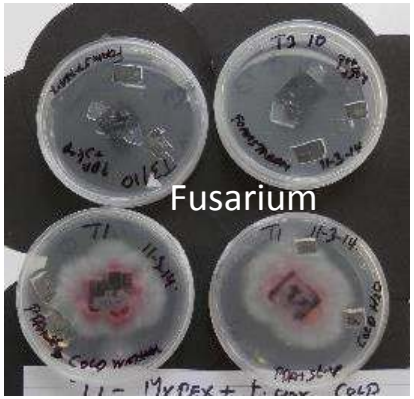
- 2015 MOPs research will utilise naturally infested materials. May also test Foamstream

Foamstream - an alternative to chemic disinfestation?

- Developed by WeedingTech for weed control in amenity areas
- Delivers a stream of water containing natural foaming agents at 90°C+
- Layer of foam in 1-2 secs

Foamstream pathogen control

- No Pythium or Fusarium grew from woven ground-cover artificially infested by mycelium & resting spores
- Fusarium did re-grow from within the depth of agar
- No Pythium or Phytophthora grew from raspberry roots
- No visible damage to pots & trays of various materials
- Commercially: may be of use



Foam-stream

Cold water

Foam-stream

Cold water

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Strategies for control of black root rot

Dr Erika Wedgwood

Symptoms of *Thielaviopsis basicola*

- Loss of vigour
- Foliage purpling/ yellowing as fungus removes plant sugars & produces conidia
- Roots develop dark streaks as chlamydospores form
- Can progress to root loss

Clusters of brown resting spores (chlamydospores) in roots

Thielaviopsis (*Chalara*) in pansy

Cultural control [PC38a]

- Disinfect trays, ground- cover etc. to kill mycelium & chlamydospores
- Raise trays to prevent conidia moving in water
- Use more-open media
- Maintain pH 5.5(more acid)
- Reduce any plant stress
- Examine plant roots before foliar chlorosis shows

Root tip releasing abundant colourless rectangular conidia

Chemical control of Black root rot (BRR) [PC 143, PO 14]

- Cercobin drench (thiophanate-methyl) preventative application currently used
- Reliance on Cercobin of concern
- Octave (prochloraz) & some azoles and a strobilurin gave BRR reduction [PC 143]
- Signum (boscalid + pyraclostrobin) & two experimental in Defra Chalara ash dieback screen
- Cyprodinil + fludioxonil in USA (in Switch)
- Phosphorous acid in USA (in Hortiphyte)
- Other actives, BRR activity unknown

Biological control of BRR [PO 14]

- Prestop *Gliocladium catenulatum* growing-media treatment. Approved. BRR in technical leaflet
- Serenade ASO *Bacillus subtilis* spray. EAMU. In USA on vegetables at planting against Fusarium, Rhizoctonia Pythium, Phytophthora
- T34 *Trichoderma asperellum.* EAMU. Fusarium wilt.
- *Trichoderma harzianum* T-22 in USA (in Trianum)
- Other Trichoderma species experimental products
- Stimulant to activate plants' natural defence responses used in Australia against BRR of cotton

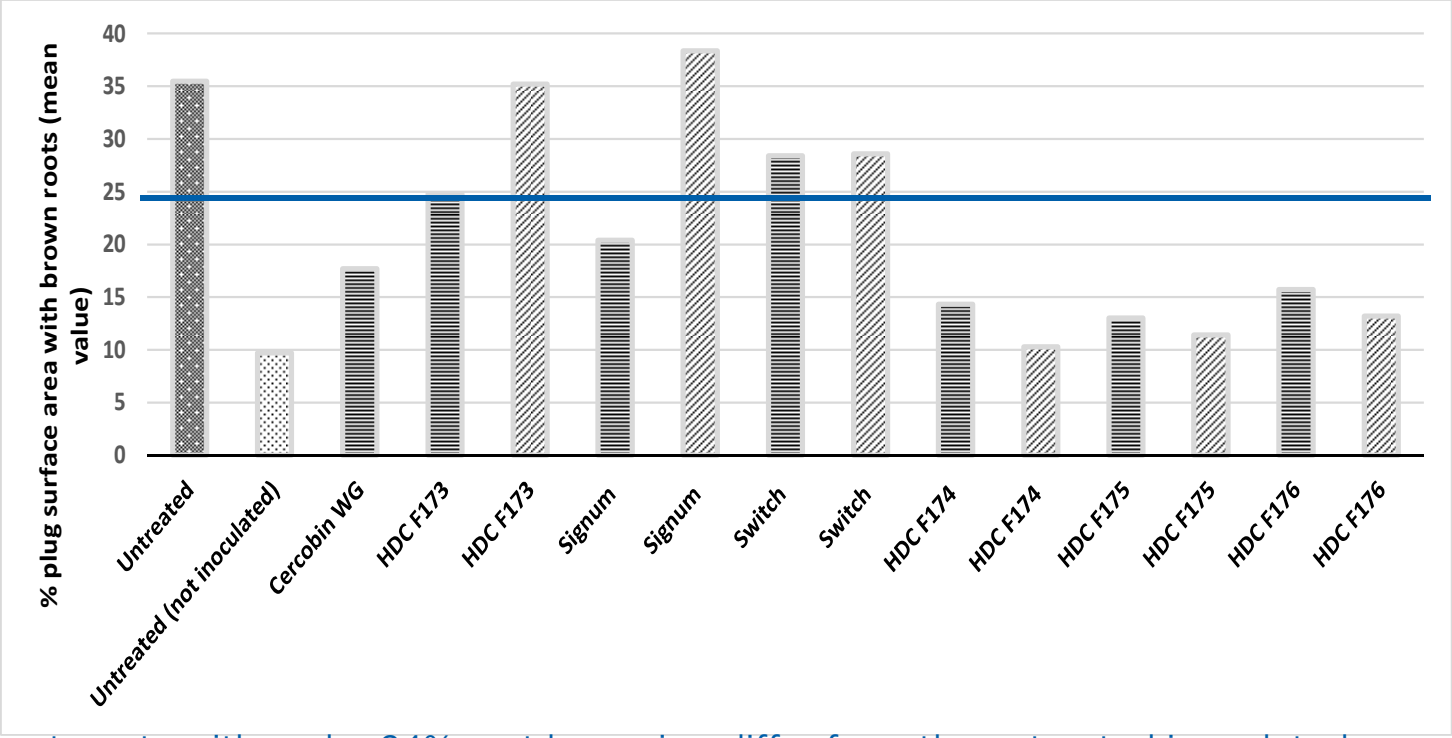
HNS/PO 190: Evaluation of fungicides & novel treatments

- Separate evaluations of conventional & non-conventional products (Expts 1 & 2)
- Protectant, or Protectant + Curative, application of treatments to Viola from 2-leaf stage
- Foliar fungicides applied as label followed by irrigation to “field capacity” of peat growing-media
- Growing-media incorporation/drenches as labels
- Syringe inoculation with BRR chlamydospores + conidia 1 wk after protectant, 1 wk before curative
- % root browning assessed after 9 wks & Expt 3 programs selected & commenced

Viola in ADAS glasshouse

- Experiments 1&2 in neighbouring compartments
- Plants grown into July to obtain heat stress likely to increase BRR severity

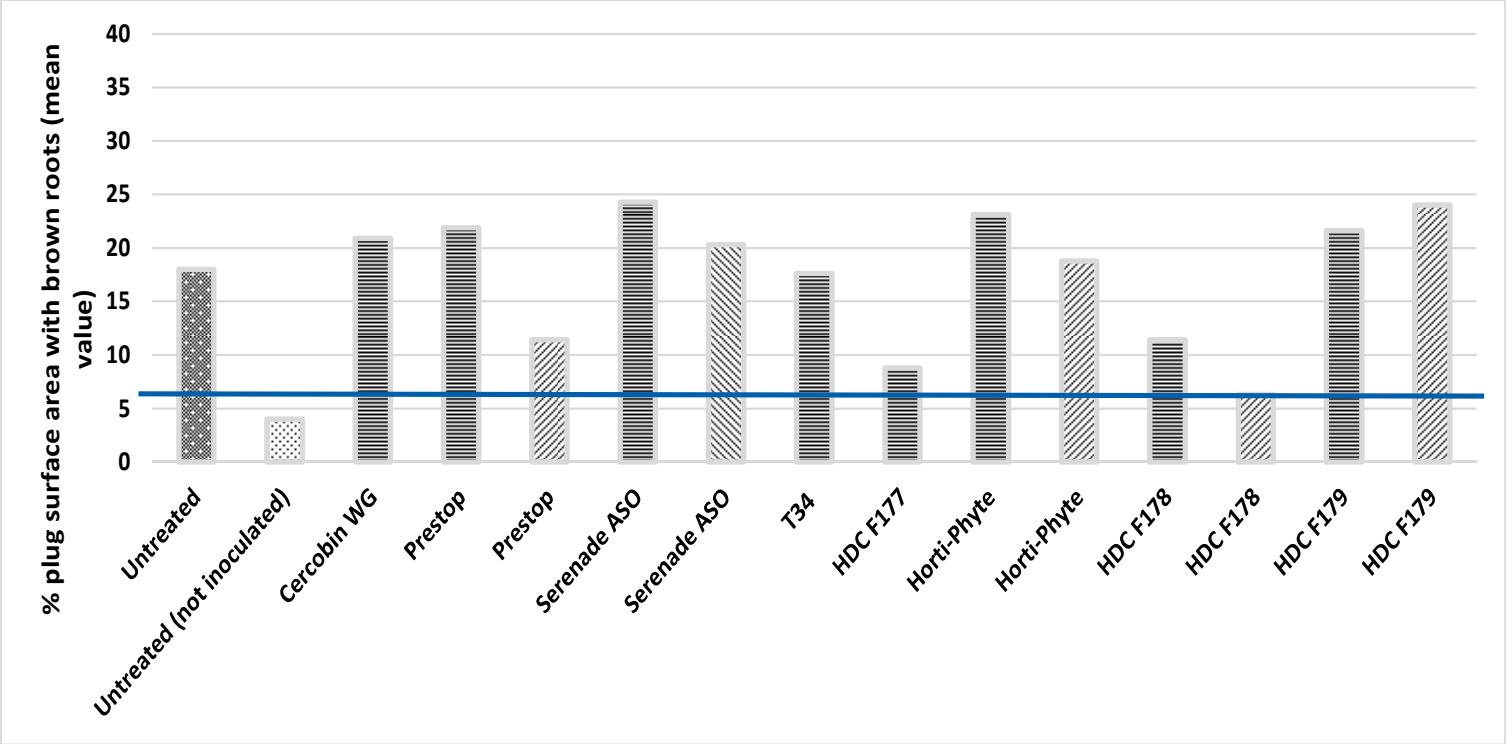
Conventional Products



Treatments with under 24% root browning differ from the untreated inoculated
(P<0.001, L.s.d. 13.964).

Horizontal lines = product application before inoculation (preventative)
Diagonal lines = preventative + curative

Non-Conventional Products



Treatments with under 6.32% root browning differ from the untreated inoculated
(P<0.05, L.s.d. 11.687)

Horizontal lines = product application before inoculation (preventative)
Diagonal lines = preventative + curative

Product selection for Expt 3

Expt 1: Highly sig. reduction given by protectant;

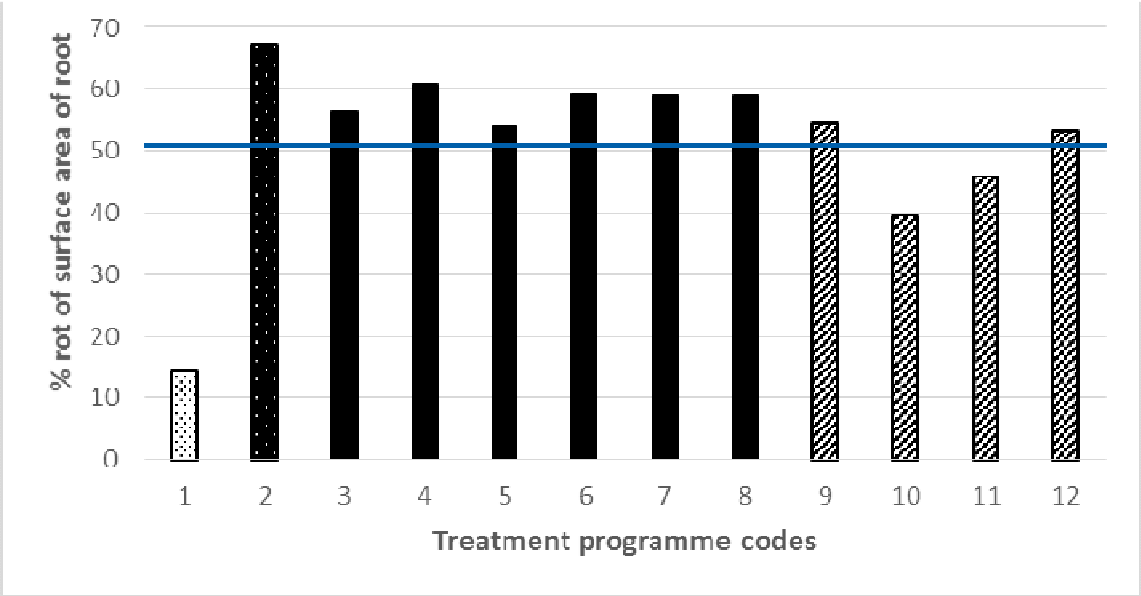
- Cercobin, Signum, HDC F174, F175 & F176

Expt 2: Some reduction by ;

- HDC F177 incorporated
- T34 drench at sowing
- Prestop protect + curative
- HDC F178 protectant

Treat-ment Expt 3	Weeks after sowing (BRR inoculation after 4 wks)		
	0	3	5
T1 UT no BRR	-	-	-
T2 UT	-	-	-
T3	-	Cercobin WG	
T4	-	Cercobin WG	HDC F174
T5	-	Cercobin WG	HDC F175
T6	-	HDC F174	-
T7	-	HDC F175	-
T8	-	HDC F178	-
T9	T34	-	-
T10	T34	HDC F174	-
T11	T34	HDC F175	-
T12	T34	HDC F178	-

Protectant & curative programs



Treatments with under 51% root browning differ from T2 untreated inoculated.

(P<0.001, L.s.d. 16.55).

Black = not treated with T34 at sowing

Checked = treated with T34 at sowing

9	T34	-	-
10	T34	F174	-
11	T34	F175	-
12	T34	F178	-

Year 1 Conclusions

- Signum protectant reduced BRR (UT 35% to 20%)
- Three of four coded conventional chemical products gave sig. control (10% - 16%) as protectants (P) or also with curative application (P+C)
- P+C applications of plant activator HDC F178 less BRR & three microbial products gave some reduction
- Protectant programs with microbial T34 + coded chemicals gave sig. less BRR, but ineffective alone
- In 2015 will treat Choisya plugs at potting with products from Expt 1 & 2 as P and P+C single product treatments

BPOA Technical Seminar

Muck and Magic

The National Cut Flower Centre Ltd

HDC Project PO BOF 002

Lyndon Mason
Project Manager

The Cut Flower Centre

- From Jan 2007 to Nov 2008 funded by the HDC, Fenland Leader+ and In-Kind..
- During 2009 funded by HDC PC and BOF panel (and £3K from Waitrose).
- Funded wholly by the HDC since 2009
- Operates as a not for profit Limited Company ie CFC Ltd for accountability to funding bodies.
- Entirely industry led and run by a Industry Management Group.

Remit of the CFC

- New Product Development (NPD) but less emphasis than under the "old CFC".
- To develop and facilitate trials on mainstream cut flower crops to solve topical technical issues.
- To develop a "Crop Association" role with particular emphasis on identifying and co-ordinating R&D priorities for the sector.
- To become an information hub for the industry especially via the CFC website.

How is the Project Managed?

- The project is industry led by a Management Group (MG) that determines the direction of the project.
- The MG is made up of all elements of the industry ie growers, packers, supermarkets, consultants and the HDC.
- The Project Manager makes the wishes of the MG "happen" and oversees all aspects of the project!!
- Key nursery staff look after the project "day to day" including recording of results.

Management Group Members

- Lyndon Mason (Project Manager)
- Sue Lamb (Lambs Flowers)
- Phil Collison (J A Collison & Son)
- Mark Eves (PS & JE Ward Ltd)
- Tracey Thomas (Butters Flowers)
- Jane Stanbury(ASDA)
- Emma Coupe (Waitrose)
- Gordon Flint (Winchester Growers)
- Wayne Brough (HDC)
- Debbie Wilson (HDC)
- Gordon Hanks (Independent Research consultant)

Location of the CFC

- For the first 2 year (2007 to 08) the CFC was located at the Kirton Research Centre.
- Kirton closed in Feb 2009.
- A number of options investigated but the favoured option was Rookery Farm, Holbeach St John.
- BUT in March 2009 the CFC was simply a cereal field!!!

Crops investigated over the years.

- German asters
- Antirrhinum
- Karma Dahlia
- Spray carnations and annula dianthus
- Pinks
- Ornamental Brassica
- Phlox
- Solidalgo
- Aster ericoides

Crops investigated

- Hardy foliage
- Seeds raised fillers (bupleurum, Cosmos, carthamus, Ammi etc)
- “Seasonal” alstroemeria.
- Sunflowers
- Hardy foliage
- Trachelium
- Leonotis
- Ornamental peppers
- Sedum

Crops investigated

- Eryngium
- Delphinium
- Larkspur
- Cyanara
- Ornamental grasses
- Zinnia
- Amaranthus
- Lynchnis
- Caryopteris
- Lisianthus

How to be involved with the CFC

- Go to www.thecutflowercentre.co.uk for updates and topical items.
- Discuss topics /issues with any MG member.
- Attend Open Days.
- Obtain copies of CFA reports / technical notes via the HDC or the CFA website.
- Attend other events such as the technical days held in 2013 and 2014.

How to get the best out of a crop Centre (a personal view)

- Make sure that the industry keep control of the Centres destiny!
- Get as many growers involved as possible.
- Keep the trials practical and relevant.
- Work closely with the Project Manager.
- Promote, promote, promote!!!
- Keep the HDC happy by meeting outputs, deadlines etc.

BPOA Technical Seminar

Muck and Magic

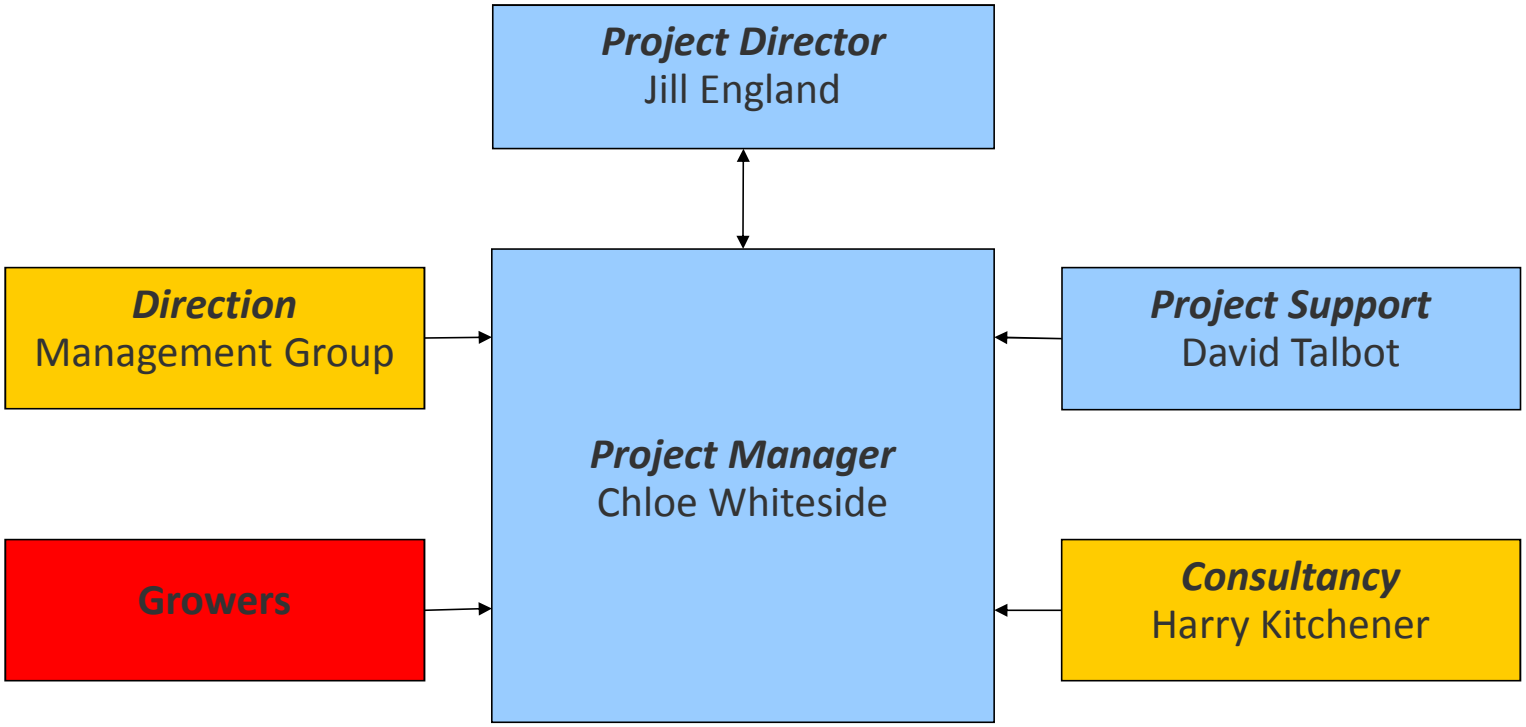
The Bedding and Pot Plant Centre: New product opportunities for bedding and pot plant growers

Chloe Whiteside, ADAS

Project objectives

- Trial potential new crops / varieties
- Provide practical solutions to problems
- Demonstrate the results to industry
- Provide a financial and technical impact assessment
- Develop a knowledge hub for the sector

Management Structure



Location: Baginton Nurseries

- Coventry, close to Stoneleigh Park
- Six acres of production
- Glass, Keder houses and polytunnels

Work Packages for Year 1

- Seed raised vs vegetative raised *Calibrachoa* and *Begonia boliviensis*
- Pot and pack perennials
- Cold / cooler growing systems
- Niche / novel crops (*Hellebore*)
- Spectral filters

Knowledge transfer

- Trial open days – coincide with HDC events e.g. HTA

  Plant Show 23 – 24 June 2015

- Briefing notes

- Blog – **www.hdcbppcblog.wordpress.com**

Make the Bedding and Pot Plant Centre work for you!

Contact us:

Jill England – jill.england@adas.co.uk

Chloe Whiteside – chloe.whiteside@adas.co.uk

BPOA Technical Seminar

Muck and Magic

The Food and Environment Research Agency

Monitoring metalaxyl-M sensitivity of downy mildew infections of *Impatiens* (PO 011b/012)

Dr Phil Jennings

Overview

- Background
  - Disease timeline
  - Infection process
- Disease control
- Metalaxyl-M resistance monitoring

Disease timeline

- Impatiens downy mildew is caused by *Plasmopara obducens*
- First reported in the UK in 2003
  - Considerable economic damage caused to commercial crops and municipal plantings particularly in SE England
- No disease reported between 2004 and 2006
- The disease reappeared in 2007 and 2008
  - Low to moderate disease levels reported in commercial crops during 2007
  - Widespread and damaging disease principally late-season in municipal and other outdoor plantings in 2008
- Early and widespread occurrence on nursery and in municipal and other outdoor plantings in 2011
  - Introduction of a metalaxyl-M resistant strain of *P. obducens* to the UK

Infection

- Sporangia land on wet upper leaf surface (overnight)
- Zoospores released from sporangia and infect plant
- 8-14 days after infection overnight wetness on upper leaf surface leads to sporulation
- Survival structures (oospores) produced in stems and leaves allow the pathogen to overwinter in soil

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The Food and Environment Research Agency

DISEASE CONTROL

Efficacy testing

- Trials carried out in two HDC projects PC 230a and PO 012
  - PC 230a tested chemicals against a metalaxyl-M sensitive isolate using both protectant and curative treatments
  - PO 012 tested chemicals against the metalaxyl-M resistant isolate using protectant treatments only

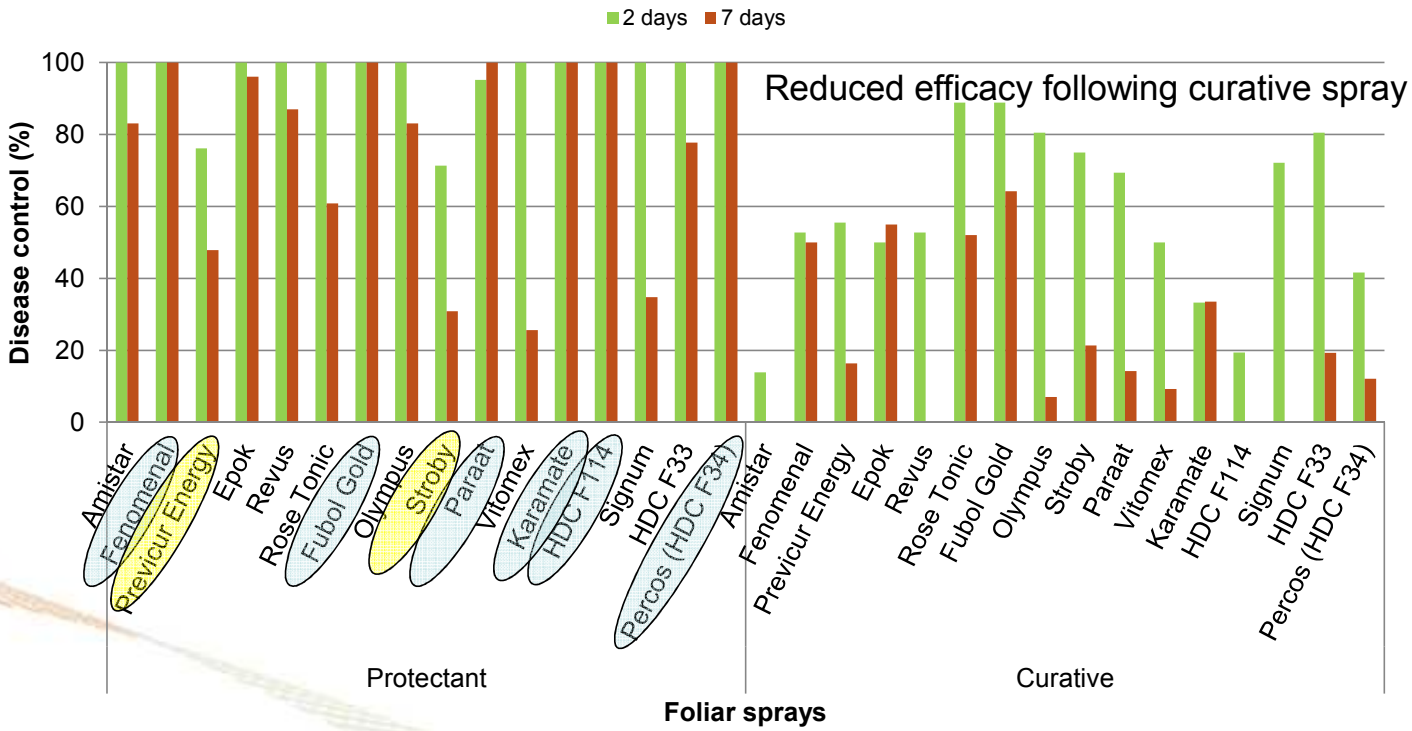
Products tested

The Food and Environment Research Agency

Product	Active ingredient	Application method	Current approval status on protected ornamental crops	Met-M Sensitivity*
Fenominal	fosetyl aluminium (600g kg^{-1}) + fenamidone (60g kg^{-1})	Spray + Drench	EAMU + On label	S + R
Previcur Energy	propamocarb-HCL (530 g L^{-1}) + fosetyl aluminium (310 g L^{-1})	Spray + Drench	EAMU	S + R
Revus	mandipropamid (250 g L^{-1})	Spray	**EAMU (31-01-15)**	S + R
Paraat	dimethomorph (500 g kg^{-1})	Spray + Drench	EAMU + Not approved	S + R
Karamate Dry Flo	mancozeb (750 g kg^{-1})	Spray	Not approved	S + R
HDC F114	experimental	Spray	Not approved	S + R
Signum	boscalid (267 g kg^{-1}) + pyraclostrobin (67 g kg^{-1})	Spray	EAMU	S + R
Subdue	metalaxyl-M (480 g L^{-1})	Drench	On label	S + R
HDC F33	experimental	Spray	Not approved	S + R
Percos (HDC F34)	ametoctradin (300 g L^{-1}) + dimethomorph (225 g L^{-1})	Spray	EAMU	S + R
Amistar	azoxystrobin (250 g L^{-1})	Spray	EAMU	S
Epok	fluazinam (400 g kg^{-1}) + metalaxyl-M (200 g kg^{-1})	Spray + Drench	Not approved	S
Rose tonic	potassium phosphite	Spray + Drench	Not a registered fungicide	S
Fubol Gold	mancozeb (640 g kg^{-1}) + metalaxyl-M (40 g kg^{-1})	Spray	EAMU	S
Olympus	azoxystrobin (80 g L^{-1}) + chlorothalonil (400 g L^{-1})	Spray	Not approved	S
Stroby	kresoxim-methyl (500 g kg^{-1})	Spray	Not approved (Roses only)	S
Vitomex	phosphonic acid + derivatives	Spray	Not a registered fungicide	S
HortiPhyte	potassium phosphite	Spray + Drench	Not a registered fungicide	R
ProPlant	propamocarb hydrochloride (722 g L^{-1})	Drench	On label	R
HDC F64	experimental	Soil incorp		R

* Test carried out using sensitive isolate (S) or resistant isolate (R)

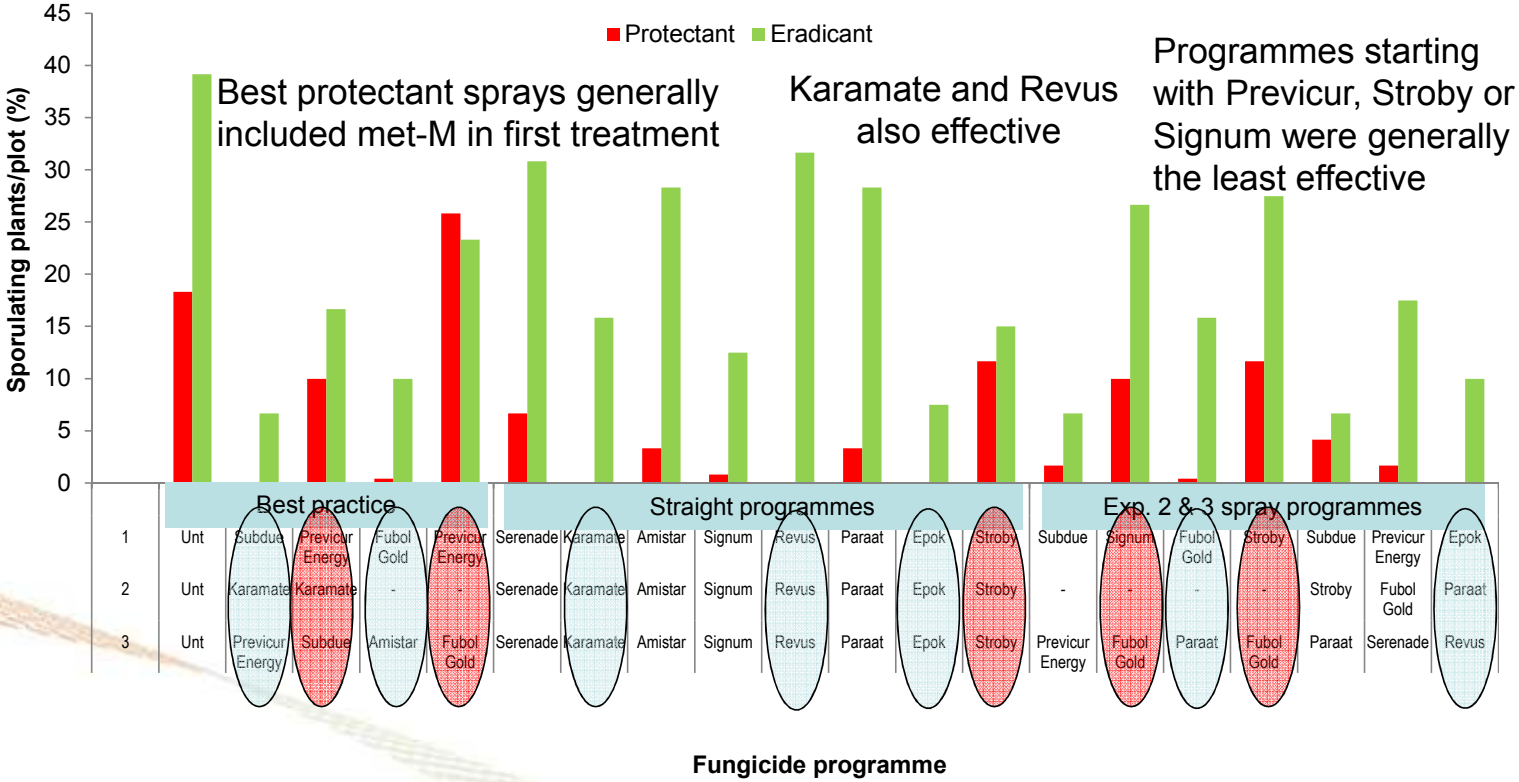
Application timing and disease control
(Metalaxyl-M sensitive isolate)



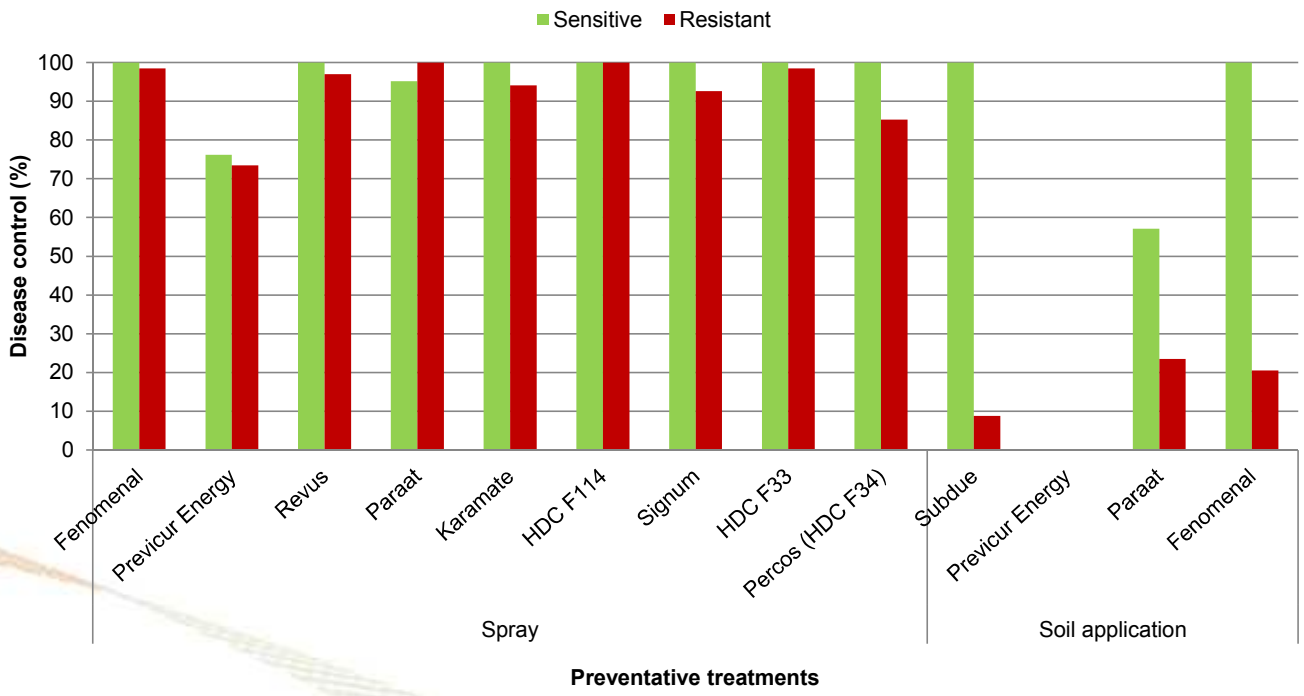
Semi-commercial efficacy trial (metalaxyl-M sensitive isolate)

- Studies carried out using young Impatiens plug plants potted-on into 6 packs
- ‘Infector plants’ were introduced after the 1st protectant sprays applied.
- Crop misted early evening and covered overnight to provide optimum infection conditions.

Fungicide programme results



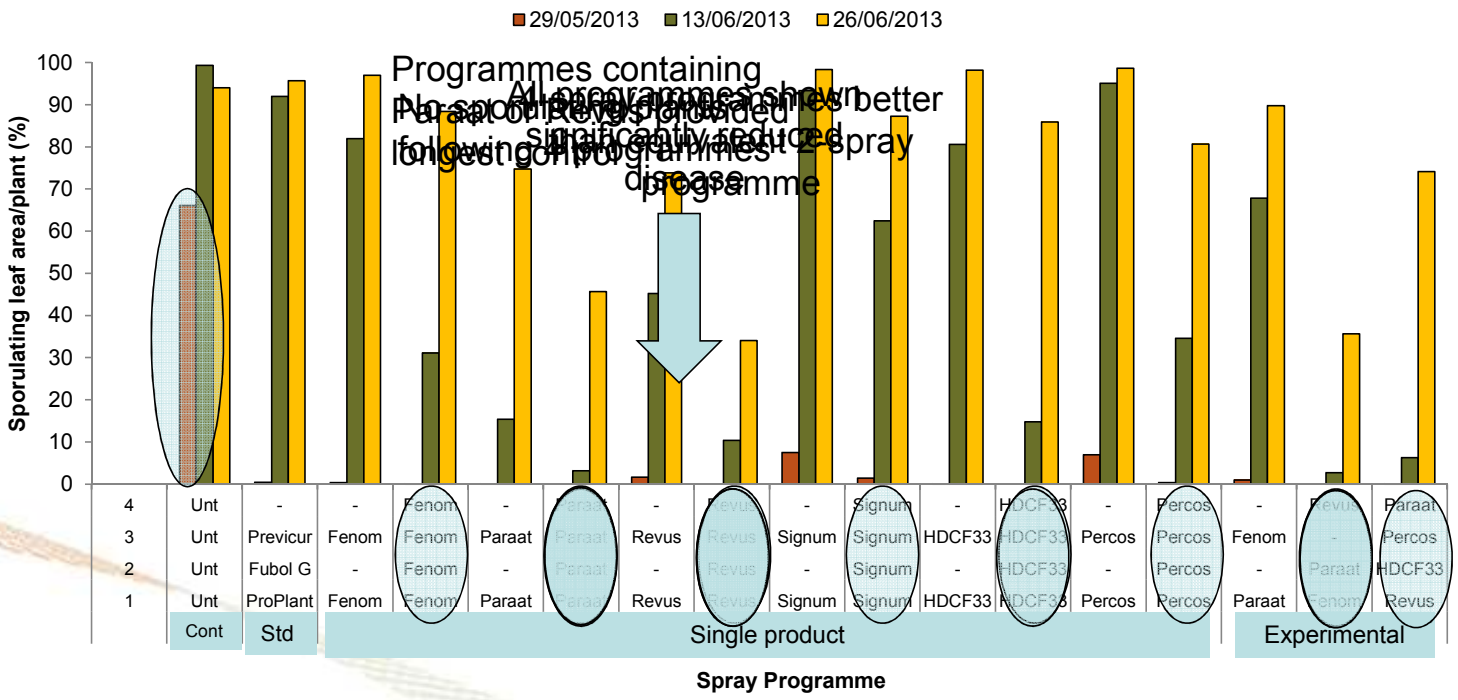
Comparison between Metalaxyl-M sensitive and resistant isolates



Semi-commercial efficacy trial (metalaxy M resistant isolate)

- Programmes included a standard 3-spray, single product (2 and 4-spray) and 3 experimental
- The first treatment in each programme was applied 3 days after potting (3rd May). Subsequent treatments were applied at 7 or 14 day intervals depending on the programme
- Plants were inoculated 15th May.
  - The inoculation timing challenged the longevity of a product, with inoculum arriving 12 days after an application for the 2-spray programme and 5 days after an application for the 4-spray programmes.
- Plants were assessed for disease symptoms 2, 4 and 6 weeks after inoculation
- The first assessment matched the time when commercially grown plants would be dispatched.

Fungicide programme results



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METALAXYL-M RESISTANCE MONITORING

Monitoring metalaxyl-M resistance

- Following the introduction of metalaxyl-M resistance in 2011 the HDC commissioned work under project PO 011, 011a and 011b with the aim of providing:
  - An early warning system to identify metalaxyl-M resistance
  - Information on the prevalence, persistence and geographical distribution of the metalaxyl-M resistance in the wider environment

Sensitivity testing

- For each sample arriving at the lab two set of replicate six week old impatiens are inoculated

    1. Plants treated with a Subdue soil drench (applied 2 days pre-inoculation at 12.5 mL product/ 100L water @ 10% of pot volume),
    2. Untreated control plants.

- Inoculated plants are grown in the glasshouse for 8-10 days then assessed for downy mildew symptoms

    - **Sensitive** isolates produce symptoms on control plants only
    - **Resistant** isolates produce symptoms on both the control and Subdue treated plants

Results

Year	Site	Arrival date	Location	Metalaxyl-M sensitivity
2012	Nursery	6th June 17th July 4th September	North Yorkshire West Sussex (2)	Sensitive
	Garden	25th June 23rd July 23rd August 29th September	West Midlands East Yorkshire Somerset North Yorkshire	Sensitive
2013	-	-	-	-
2014	Nursery	28th July	Cambridge	Resistant
	Garden	8th August 1st September 16th September	Warwickshire North Yorkshire West Sussex	Resistant Sensitive Sensitive

Conclusions from Monitoring

- Widespread metalaxyl-M resistance seen in 2011
- No metalaxyl-M resistance detected in 2012 or 2013
- In 2014, metalaxyl-M resistant isolates were detected for the first time since 2011
- First data to suggest that metalaxyl-M resistance in *P. obducens* has the potential to persist and establish itself in the 'wider environment'
- No metalaxyl-M resistance found on nurseries where plants have been raised from seed
- Occurrence of downy mildew in gardens occurs after nursery production has generally finished (late July on)

Future Surveillance

- Surveillance will be repeated 2015 to 2018
- So far low numbers of infected plant material has been sent to the lab.
  - low disease levels
  - a lack of awareness that the monitoring is taking place
- Starting this season we would like to set up a 'monitoring group' which includes participants
  - from different parts of the country who are growing impatiens on their nursery or in their gardens
  - Who are willing to send infected material to Fera
- Would anyone interested in taking part either talk to me after the presentation or e-mail me at philip.jennings@fera.gsi.gov.uk

The Food and Environment Research Agency

Thank you for your attention

philip.jennings@fera.gsi.gov.uk

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Q&A