

SCEPTREPLUS

Final Trial Report

Trial code:	SP 33
Title:	Evaluating the crop safety of promising downy mildew products on ornamental plants
Crop	Group: Ornamental plants – 7 species
Target	Crop safety
Lead researcher:	Ruth D'urban-Jackson
Organisation:	RSK ADAS Ltd.
Period:	1 st October 2018 – 31 st December 2018
Report date:	31 st March 2019
Report author:	Ruth D'urban-Jackson
ORETO Number: (certificate should be attached)	409

I the undersigned, hereby declare that the work was performed according to the procedures herein described and that this report is an accurate and faithful record of the results obtained

31.03.19

Date



Authors signature

Trial Summary

Introduction

Downy mildew (*Peronospora* spp.) is a common disease in ornamental plants, which can lead to significant losses due to unmarketability. The disease presents a challenge to growers because it can be present but not always obvious, and is difficult to control with fungicides once established. As a consequence of this, regular fungicide treatment in ornamental plant production is frequently required. Previous work in SCEPTREplus (SP 07) in lettuce identified eight treatments for control of downy mildew. Using a cross-sector approach, this work investigated the crop safety of the same treatments on seven commonly grown ornamental species.

Methodology

A trial was sited at a commercial nursery in Herefordshire, England. Seven commonly grown hardy nursery stock species were selected based on their susceptibility to downy mildew; these species would therefore be highly likely to require fungicide treatments commercially. These species included *Buddleja*, *Aquilegia*, *Digitalis*, *Lamium*, *Veronica*, *Monarda* and *Potentilla*. Eight products (six conventional fungicides and two biopesticides) were tested for potential phytotoxicity, alongside an untreated control and a standard (Fubol Gold). Of the eight products tested, four (AHDB 9959, AHDB 9958, AHDB 9963 and AHDB 9962) had shown efficacy in previous work on downy mildew in lettuce (SP 07).

Treatments were applied alone as a four spray repeated programme at a 10 day interval as foliar sprays on 13th November, 23rd November, 4th December and 14th December 2018, respectively. Products were applied using a 0.5m boom with an Oxford Precision sprayer at a 500 L/ha water volume.

Individual trials were established for each species, due to the need for specific husbandry inputs. For each species, a randomised block design was used with four replicates of the ten treatments, totalling 40 plots. Each plot included five plug plants planted in individual 10 cm liner pots. Phytotoxicity was assessed 10 days following each treatment, and two weeks following the final treatment application.

Results

Products caused no phytotoxic effects, nor left any visible residues on the plants at any assessment.

Date	Phytotoxicity score			
	13-Nov	23-Nov	04-Dec	14-Dec
Treatment				
Untreated	0	0	0	0
Fubol Gold	0	0	0	0
AHDB 9959	0	0	0	0
AHDB 9958	0	0	0	0
AHDB 9963	0	0	0	0
AHDB 9962	0	0	0	0
AHDB 9870	0	0	0	0
AHDB 9883	0	0	0	0
AHDB 9967	0	0	0	0
AHDB 9885	0	0	0	0
	Not significantly different from untreated control (p>0.05)			

Conclusion

No phytotoxic effects or visible product residues were observed on plants.

Take home message

Several promising downy mildew chemical fungicide and biofungicide products were tested, and none had phytotoxic effects, or left any visible residues on the plants.

Objectives

1. To monitor and assess seven ornamental species for phytotoxicity following four applications of different fungicide / biopesticide treatments, at 10 day intervals.

Trial conduct

UK regulatory guidelines were followed but EPPO guidelines took precedence. The following EPPO guidelines were followed:

Relevant EPPO guideline(s)		Variation from EPPO
PP1/135(4)	Phytotoxicity assessment	Yes – see below
PP1/065(3)	Downy mildews of lettuce and other vegetables	None
PP1/257(2)	Efficacy and crop safety extrapolations for minor uses	None

Deviations from EPPO guidance:

1. EPPO PP1/135(4) - Plot size was reduced to five plants due to space constraints, plot size remained sufficient for robust statistical analysis, (confirmed by the ADAS statistician).

Test site

Item	Details							
Location address	Polytunnel, Wyevale Nurseries, Wyevale Way, Hereford, HR4 7AY							
Crop	<i>Buddleja</i>	<i>Aquilegia</i>	<i>Digitalis</i>	<i>Lamium</i>	<i>Veronica</i>	<i>Monarda</i>	<i>Potentilla</i>	
Cultivar	Buzz Velvet	Red Hobbit	Pam's Choice	Beacon Silver	Ionian Skies	Fireball	Scarlet Star	
Soil or substrate type	Compost							
Agronomic practice	See Appendix A							
Prior history of site	See Appendix A							

Trial design

Item	Details
Trial design	Randomised block
Number of replicates	4
Row spacing	12 cm
Plot size: (w x l)	20 cm x 30 cm
Plot size: (m ²)	0.06m ²
Number of plants per plot	5

Treatment details

AHDB code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product	Formulation type
N/A	Water	Untreated control	-	-	-
N/A	Mancozeb + metalaxyl-M	Fubol Gold	SSP8D 1415	64:4%	Water dispersible granule
AHDB 9959	N/D	N/D	N/D	N/D	N/D
AHDB 9958	N/D	N/D	N/D	N/D	N/D
AHDB 9963	N/D	N/D	N/D	N/D	N/D
AHDB 9962	N/D	N/D	N/D	N/D	N/D
AHDB 9870	N/D	N/D	N/D	N/D	N/D
AHDB 9883	N/D	N/D	N/D	N/D	N/D
AHDB 9967	N/D	N/D	N/D	N/D	N/D
AHDB 9885	N/D	N/D	N/D	N/D	N/D

No adjuvants were added to the products at any treatment application

*N/D = content of active ingredient/s not disclosed by manufacturer

Commercial trial: methods, assessments and records

Due to specific crop husbandry inputs required for each species, nine individual trials were established. All trials were conducted next to one another in the same polytunnel, and were overhead watered in the evening, to simulate conditions favourable to downy mildew, and so under which the products would be applied in commercial practice.

All test products were applied alone as foliar sprays at the maximum dose rate recommended by the suppliers, within a four spray programme, at 10 day intervals (Application codes A-D). This approach to test products singly, rather than within mixed programmes, was used to directly link any potential phytotoxic effects to individual products. All treatments were applied using a 0.5 m boom with an Oxford Precision Sprayer knapsack at 500 L ha⁻¹ water volume, using 03F110 nozzles.

The trial took place from early November to late December 2018. Following arrival, on October 31st 2018, trial plants were potted up into 10 cm liner pots by staff at the host nursery. All aspects of plant husbandry were performed by the host nursery, following standard commercial practice. Apart from a Nimrod (bupirimate) overspray on November 28th to treat powdery mildew, no pesticides, apart from the test products were applied. Bupirimate is specific to powdery mildew and its use was not considered to have a detrimental impact on the results gathered. This was confirmed when no phytotoxicity issues were recorded on any of the plant species following the Nimrod overspray.

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml or g a.s./ha)	Rate of product (l or kg/ha)	Application code
1	Water control	-	-	ABCD
2	Fubol Gold	122 + 76	1.9	ABCD
3	AHDB 9959	935.4	1.9	ABCD
4	AHDB 9958	240 + 960	3.2	ABCD
5	AHDB 9963	120 + 1200	2.0	ABCD
6	AHDB 9962	48.2	4.0	ABCD
7	AHDB 9870	330 + 330	4.5	ABCD
8	AHDB 9883	160	5.0	ABCD
9	AHDB 9967	Not stated	4.0	ABCD
10	AHDB 9885	Not stated	4.0	ABCD

Application details

	Application A	Application B	Application C	Application D
Application date	13/11/18	23/11/18	04/12/18 ⁱ	14/12/18
Time of day	13:50 - 15:20	14:15 - 15:25	14:35 – 15:15	15:10-16:15
Crop growth stage (Max, min average BBCH)	Vegetative	Vegetative	Vegetative	Vegetative
Crop height (cm)	4	5	6	6
Crop coverage (%)	>90	>90	>90	>90
Application method	Spray	Spray	Spray	Spray
Application placement	Foliar	Foliar	Foliar	Foliar
Application equipment	Oxford Precision Sprayer (knapsack)			
Nozzle pressure	2 bar	2 bar	2 bar	2 bar
Nozzle type	Flat Fan	Flat Fan	Flat Fan	Flat Fan
Nozzle size	03F110	03F110	03F110	03F110
Application water volume/ha	500	500	500	500
Temperature of air – shade (°C)	12.6 - 13.6	7.5 - 7.9	5.0	4.1 - 4.2
Relative humidity (%)	74.1 - 82.0	89.4 - 89.5	90.8 – 91.0	92.3 – 92.4
Wind speed range (m/s)	0	0	0	0
Dew presence (Y/N)	N	N	N	N
Temperature of soil – 2-5cm (°C) ⁱⁱ	Not recorded	Not recorded	Not recorded	Not recorded
Wetness of soil – 2-5cm	Damp	Damp	Damp	Damp
Cloud cover (%) ⁱⁱ	N/A	N/A	N/A	N/A

ⁱ Application C was delayed by one day due to issues with the spray lance. No plots received any treatment on this date and the trial was successfully treated on 4th December.

ⁱⁱ Plants were grown in substrate in 10 cm liner pots in a protected environment (polytunnel). Temperatures in the substrate were not recorded.

Untreated levels of pests/pathogens at application and through the assessment period

Common name	Scientific Name	EPPO Code	Species	Infestation level pre-application, untreated disease severity (average %)	Infestation level at start of assessment period, untreated disease severity (average %) ⁱⁱ	Infestation level at end of assessment period, untreated disease severity (average %)
Powdery Mildew ⁱ	<i>Podosphaera</i> species	ERYSP	Aquilegia	35.0	35.0	0.00
Powdery Mildew	<i>Podosphaera</i> species	ERYSP	Monarda	15.1	15.1	0.00

ⁱ Downy mildew is the primary target of this study, not powdery mildew. A curative overspray of Nimrod (bupirimate), a systemic, specific fungicide for powdery mildew was applied on November 28th to both cure current infection, and prevent further infection occurring.

ⁱⁱ The first full assessment took place immediately prior to the first application.

No pests or pest damage were recorded on any plants at any assessment date.

Assessment details

Plant vigour was scored at trial start. All plants were then assessed for phytotoxicity 10 days after each treatment timing, beginning on November 13th, and 14 days following the final treatment.

Phytotoxic effects and visible residues recorded at each assessment.

Evaluation date	Evaluation timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (plant vigour, efficacy, phytotoxicity)	Assessed e.g. plant vigour, disease incidence and severity, phytotoxicity
13/11/2018	0	Vegetative	Plant vigour	Plant vigour (1-5), 1 = very poor, 5 = excellent.
23/11/2018	10	Vegetative	Phytotoxicity	Phytotoxicity (scale 0-10, 0 = no damage, 100 = dead).
03/12/2018	20	Vegetative	Phytotoxicity	Phytotoxicity (scale 0-10, 0 = no damage, 100 = dead).
13/12/2018	31	Vegetative	Phytotoxicity	Phytotoxicity (scale 0-10, 0 = no damage, 100 = dead).
27/12/2018	45	Vegetative	Phytotoxicity	Phytotoxicity (scale 0-10, 0 = no damage, 100 = dead).

* DA – days after first spray application

Statistical analysis

The trial was analysed by Chris Dyer, ADAS statistician as a randomised block design with four replicates of 10 treatments using ANOVA (Genstat). As no phytotoxicity resulted from any of the treatments, no statistical analysis was performed on this measure.

Results

No phytotoxic effects were observed after any of the treatments, at any application time. Residues were left on the liner tray by AHDB9963 after every application, but were never visible on the plants.

During the assessment on 27.12.18 in the Monarda trial, a number of plants were seen to have developed a Botrytis infection. No Botrytis occurred on Monarda plants treated with AHDB 9959, AHDB 9962 and AHDB 9883 but overall, analysis of variance (GenStat 14th Ed) showed that, there were no significant differences between any of the treatments or the untreated control ($p=0.252$, l.s.d. 4.247).

Phytotoxicity

Phytotoxicity did not result from any of the treatments. Residues were left on the plastic liner tray by AHDB9963, but never on the plants (see Figure 1).



Figure 1. White residue left by AHDB 9963 on plastic liner tray, but none visible on plants.

Discussion

As no phytotoxic effects from the fungicide treatments were observed, all treatments appeared to be crop safe in this trial. No visible residues were seen on plants. Residues were left on trays by AHDB 9963, but as the trial was carried out at the time of year when watering is minimal, this was not unexpected.

At an observation during assessment on 27.12.18 in the Monarda trial, a number of plants were seen to have developed a Botrytis infection. The products in this trial targeted downy mildew, which is an oomycete, not a fungus, so whilst it was interesting to check for any efficacy of the products against Botrytis, the products were not expected to show efficacy against this pathogen and this was confirmed through a lack of any significant differences between treatments following statistical analysis.

No problems were encountered with the mixing or application of any of the products.

Conclusions

All products tested, were crop safe on the range of ornamental species involved.

Acknowledgements

We would like to thank Steve Reed and all the staff at Wyevale Nurseries Ltd. for hosting and maintaining the trial. We would also like to thank Chris Dyer for performing the statistical analysis, AHDB Horticulture and participating crop protection companies for advice on product selection, their use, and for supporting the SCEPTREplus program.

Appendix

a) Crop diary

Species list

Species	Cultivar	Planting date
Buddleja	Buzz Velvet	9.11.18
Aquilegia	Red Hobbit	9.11.18
Digitalis	Pam's Choice	9.11.18
Lamium	Beacon Silver	9.11.18
Veronica	Ionian skies	9.11.18
Monarda	Fireball	9.11.18
Potentilla	Scarlet Star	9.11.18

Previous cropping – Various commercial ornamental crop species

Cultivations, fertilisers etc. – The trial was watered by hand as necessary. All watering was performed in the evening. No fertiliser was applied.

Pesticides

Date	Product	Rate	Unit
26.11.2018	Nimrod (bupirimate)	1	L ha ⁻¹

b) Trial diary

Date	Event
31/10/18	Plant plugs potted up by nursery staff for all species
09/11/18	Trial set-up
13/11/18	Application A Plant vigour assessment
23/11/18	Application B Phytotoxicity assessment
26/11/18	Nimrod overspray for powdery mildew
03/12/18	Phytotoxicity assessment
04/12/18	Application C
06/12/18	Trial open day
13/12/18	Application D Phytotoxicity assessment
27/12/18	Phytotoxicity assessment

c) Photographs

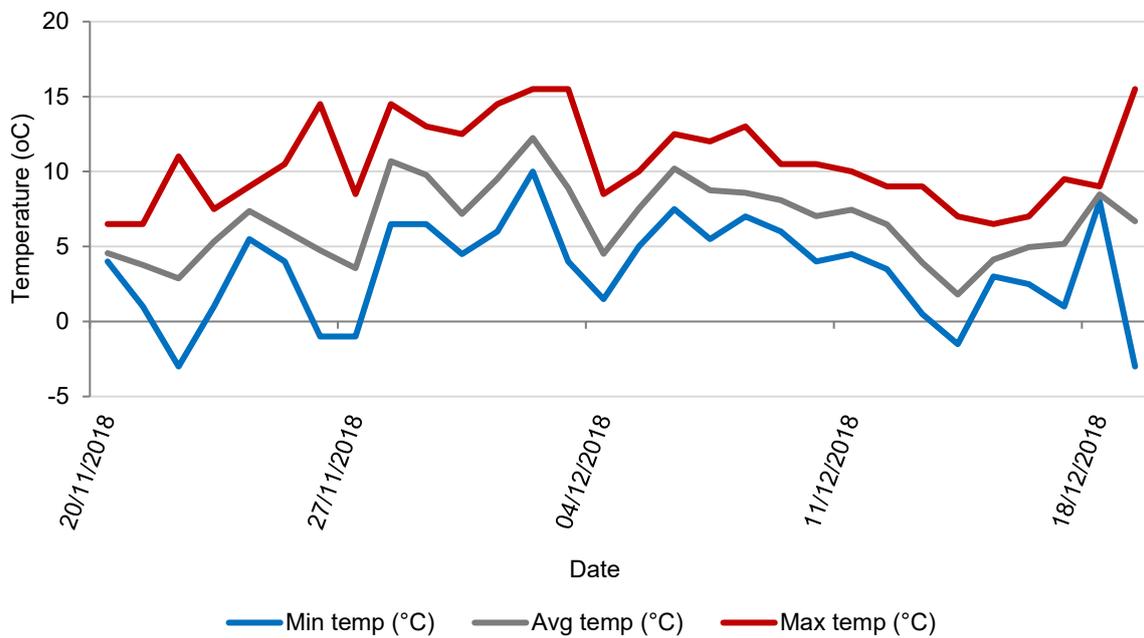


Trial layout: individual blocks of 7 ornamental species in a polytunnel at Wyevale Nurseries, Hereford, UK.



No phytotoxicity occurred on any species following product applications, including Digitalis (left) and Lamium (right).

d) Climatological data



e) Raw data from Botrytis assessment on Monarda 27. 11. 18

Plot	Treatment	Average Botrytis (%)
1	8	15
2	5	7
3	3	0
4	7	0
5	6	0
6	2	0
7	4	6
8	9	0.2
9	1	0
10	10	0
11	1	0
12	3	0
13	6	0
14	8	0.6
15	5	0
16	9	0
17	10	0
18	4	0
19	2	0
20	7	0
21	2	2
22	4	2
23	7	1
24	1	0
25	10	0
26	9	0
27	5	0
28	8	2
29	6	0
30	3	0
31	5	2
32	9	0
33	4	0
34	8	0
35	10	0
36	6	0
37	2	0
38	7	0
39	1	16
40	3	0

f) Trial design

		Buddleja									
BLOCK 1		8	1	3	4	10	6	2	5	9	7
PLOT		1	2	3	4	5	6	7	8	9	10
BLOCK 2		2	4	9	1	7	6	5	8	3	10
PLOT		11	12	13	14	15	16	17	18	19	20
BLOCK 3		9	5	10	6	1	4	3	2	7	8
PLOT		21	22	23	24	25	26	27	28	29	30
BLOCK 4		5	10	9	1	6	4	2	3	8	7
PLOT		31	32	33	34	35	36	37	38	39	40

		Aquilegia									
BLOCK 1		7	2	1	9	10	3	6	4	8	5
PLOT		1	2	3	4	5	6	7	8	9	10
BLOCK 2		3	2	8	7	5	9	10	6	1	4
PLOT		11	12	13	14	15	16	17	18	19	20
BLOCK 3		10	7	5	3	4	1	8	2	9	6
PLOT		21	22	23	24	25	26	27	28	29	30
BLOCK 4		5	6	1	9	2	8	3	10	4	7
PLOT		31	32	33	34	35	36	37	38	39	40

		Digitalis									
BLOCK 1		4	1	6	3	8	10	9	7	5	2
PLOT		1	2	3	4	5	6	7	8	9	10
BLOCK 2		8	4	7	3	5	10	2	9	1	6
PLOT		11	12	13	14	15	16	17	18	19	20
BLOCK 3		3	7	10	1	9	8	4	6	5	2
PLOT		21	22	23	24	25	26	27	28	29	30
BLOCK 4		8	5	9	1	7	4	6	3	10	2
PLOT		31	32	33	34	35	36	37	38	39	40

		Lamium									
BLOCK 1		3	8	10	2	7	6	1	4	9	5
PLOT		1	2	3	4	5	6	7	8	9	10
BLOCK 2		1	4	3	8	6	2	7	9	5	10
PLOT		11	12	13	14	15	16	17	18	19	20
BLOCK 3		5	8	3	6	4	9	7	1	10	2
PLOT		21	22	23	24	25	26	27	28	29	30
BLOCK 4		4	6	1	8	9	7	10	5	3	2
PLOT		31	32	33	34	35	36	37	38	39	40

		Veronica									
BLOCK 1		6	5	1	3	9	7	2	4	8	10
PLOT		1	2	3	4	5	6	7	8	9	10
BLOCK 2		1	2	4	10	9	5	6	3	7	8
PLOT		11	12	13	14	15	16	17	18	19	20
BLOCK 3		10	6	7	8	4	5	1	3	2	9
PLOT		21	22	23	24	25	26	27	28	29	30
BLOCK 4		3	6	1	9	10	4	8	7	2	5
PLOT		31	32	33	34	35	36	37	38	39	40

		Monarda									
BLOCK 1		8	5	3	7	6	2	4	9	1	10
PLOT		1	2	3	4	5	6	7	8	9	10
BLOCK 2		1	3	6	8	5	9	10	4	2	7
PLOT		11	12	13	14	15	16	17	18	19	20
BLOCK 3		2	4	7	1	10	9	5	8	6	3
PLOT		21	22	23	24	25	26	27	28	29	30
BLOCK 4		5	9	4	8	10	6	2	7	1	3
PLOT		31	32	33	34	35	36	37	38	39	40

	Potentilla									
BLOCK 1	6	5	7	10	4	2	8	3	1	9
PLOT	1	2	3	4	5	6	7	8	9	10
BLOCK 2	4	2	6	8	7	9	10	1	5	3
PLOT	11	12	13	14	15	16	17	18	19	20
BLOCK 3	3	5	2	10	4	8	9	7	1	6
PLOT	21	22	23	24	25	26	27	28	29	30
BLOCK 4	9	5	10	4	6	1	3	2	7	8
PLOT	31	32	33	34	35	36	37	38	39	40

g) ORETO Certificate



Certificate of

**Official Recognition of Efficacy Testing Facilities
or Organisations in the United Kingdom**

This certifies that

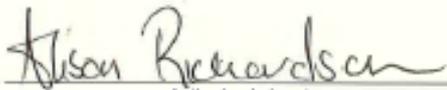
RSK ADAS Ltd

complies with the minimum standards laid down in
Regulation (EC) 1107/2009 for efficacy testing.

The above Facility/Organisation has been officially
recognised as being competent to carry out efficacy trials/tests
in the United Kingdom in the following categories:

**Agriculture/Horticulture
Stored Crops
Biologicals and Semiochemicals**

Date of issue: 1 June 2018
Effective date: 18 March 2018
Expiry date: 17 March 2023

Signature 
Alison Richardson
Authorised signatory

Certification Number ORETO 409


HSE
Chemicals Regulation Division


Department of
**Agriculture and
Rural Development**