

# SCEPTREPLUS

## Final Trial Report

<b>Trial code:</b>	SP07
<b>Title:</b>	Identification of new products for control of downy mildew ( <i>Bremia lactucae</i> ) and related pathogens on outdoor and protected crops
<b>Crop</b>	Functional trial crop: Protected lettuce Also applicable to downy mildews in many other crops, including: Lettuce (outdoor), cucumber, herbs, brassicas (propagation and field crops), onions (bulb and salad), red beet, ornamentals (including hardy nursery stock, pot and bedding plants), peas and beans, hops, soft and cane fruit, and vines.
<b>Target</b>	Downy Mildew, <i>Bremia lactucae</i> BREMLA
<b>Lead researcher:</b>	Kirsty Wright
<b>Organisation:</b>	Stockbridge Technology Centre
<b>Period:</b>	August 2017 – October 2017
<b>Report date:</b>	24 <sup>th</sup> January 2018
<b>Report author:</b>	Kirsty Wright
<b>ORETO Number: (certificate should be attached)</b>	372

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

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# Trial Summary

## Introduction

Downy mildew is a priority target disease in many outdoor and protected crops, including cucumber, lettuce, brassicas, onions, herbs, peas and beans, soft/cane fruit, vines and ornamentals. The number of available products are limited in number and effectiveness and growers require alternative control measures to be identified. Novel conventional fungicides and biopesticides were screened for effectiveness against downy mildew using protected lettuce as a functional model crop. Once promising products have been identified more crop-specific studies can be undertaken, in particular, crop safety studies.

## Methodology

8 novel products (6 conventional fungicides and 2 biopesticides) were tested, alongside an untreated control and a standard programme, in a protected lettuce crop. The universally susceptible variety Cobham Green was used to avoid incompatibility between the *Bremia lactucae* strain and the DM genes in the cultivar, and hence increase the opportunity for downy mildew infection in the crop. Each plot comprised 30 plants and each treatment replicated 6 times. Treatments were first applied 5 days after planting and before the crop was exposed to infection by *B. lactucae* (i.e. products were applied as protectant treatments). Three days after the first treatment application infector plants, with actively sporulating downy mildew present, were planted out between plots. Unless otherwise recommended by the manufacturer, conventional products were then applied every two weeks and biopesticides applied weekly. Products were applied using an Oxford Precision Sprayer at a water volume of 300 L/ha for most products. AHDB 9957 was applied at 650L L/ha as recommended by the manufacturer. Two conventional products were late to arrive and were first applied 17 days after the introduction of infector plants. Downy mildew was first seen in the untreated plots 3 weeks after the first application of treatments and infection was then assessed weekly until harvest 3 weeks later (4 assessments in total).

## Results

Downy mildew disease severity was assessed on a 0-5 scale and mean values and results of analysis are presented in the table below.

Treatment	Mean downy mildew disease severity (0-5)				
	Date	20/9/2017	27/9/2017	4/10/2017	9/10/2017
Untreated (water only)		0.98	1.18	1.23	1.28
Standard		0.36	0.54	0.82	0.90
AHDB 9959		0.93	0.89	0.55	0.48
AHDB 9958		1.02	1.08	0.52	0.34
AHDB 9963		0.36	0.45	0.33	0.37
AHDB 9962		0.59	0.43	0.50	0.84
AHDB 9961		0.64	0.58	0.72	0.88
AHDB 9960		0.85	1.01	0.82	0.66
AHDB 9957		0.69	0.87	1.10	1.22
AHDB 9956		0.84	1.02	1.16	1.24
	Not significantly different from untreated control (p>0.05)				
	Significantly different from untreated control (p<0.05)				

## Conclusions

The level of disease was low-moderate throughout the trial. The standard programme performed as would be expected - it reduced downy mildew infection levels to a certain extent, but did not completely control the disease. One biological product (AHDB 9957) gave statistically significant levels of control compared to the untreated at the first two

assessments. At the end of the trial, all conventional products gave significant levels of downy mildew control compared to the untreated plots. The two conventional products which were applied late appear to have had some eradicator activity, with levels of downy mildew being reduced to significant levels 9 days after application of AHDB 9959 and 16 days after application of AHDB 9958.

One product (AHDB 9963) left a visible residue on the foliage, even after just one application, and one product (AHDB 9958) was phytotoxic, causing small necrotic spotting on the leaves.

### **Take Home Message**

Several conventional fungicides tested in the trial have potential for future commercial use against downy mildew and should be further investigated, for efficacy and crop safety, in protected lettuce and other susceptible crops where downy mildew is a priority target.

## Objectives

1. To evaluate the effectiveness of 6 conventional fungicides and 2 biopesticides against downy mildew (*Bremia lactucae*) on protected lettuce (as a model crop) as measured by disease severity.
2. To monitor the treated crop for phytotoxicity

## Trial conduct

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

Relevant EPPO guideline(s)		Variation from EPPO
PP 1/152(3)	Design and analysis of efficacy evaluation trials	None
PP 1/135(3)	Phytotoxicity assessment	None
PP 1/181(3)	Conduct and reporting of efficacy evaluation trials including GEP	None
PP 1/65 (3)	Downy mildews of lettuce and other vegetables	Yes

Deviations from EPPO guidance: 30 plants were planted per plot, as per EPPO guidance but only 18 plants per plot were assessed, as opposed to all plants, due to time constraints. This reduction in plants assessed was balanced by increasing the detail of assessments. The EPPO guideline states that recording presence or absence of disease is sufficient at moderate levels of disease, but in this trial disease severity was also recorded.

## Test site

Item	Details
Location address	Stockbridge Technology Centre, Stockbridge House, Cawood, Selby YO8 3TZ
Crop	Lettuce ( <i>Lactucaea sativa</i> , LACSA)
Cultivar	Cobham Green
Soil or substrate type	Soil
Agronomic practice	Calcium Nitrate (50 kg/ha N) applied 21/8/17 No herbicides (hand weeded) and no insecticides.
Prior history of site	Previous crop: cabbage seed crop.

## Trial design

Item	Details
Trial design:	Randomised Block
Number of replicates:	6
Row spacing:	27cm
Plot size: (w x l)	1.2m x 2m
Plot size: (m <sup>2</sup> )	2.4
Number of plants per plot:	30
Leaf Wall Area calculations	N/A

### Treatment details

AHDB Code	Active substance	Product name or manufacturer's code	Formulation batch number	Content of active substance in product	Formulation type
Standard	Mancozeb + Metalaxyl-M	Fubol Gold	SSP5D1426	64:4 % w/w	WG
	Dimethomorph	Paraat	B5562-01B	50% w/w	WP
	Mandipropamid	Revus	PE-1617GRA6G242E	250 g/l	SC
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 9961	N/D	N/D	N/D	N/D	N/D
AHDB 9960	N/D	N/D	N/D	N/D	N/D
AHDB 9957	N/D	N/D	N/D	N/D	N/D
AHDB 9956	N/D	N/D	N/D	N/D	N/D

### 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	-	-	ABCEFG
2	Fubol Gold Paraat Revus	122g + 76g 180 g 150 g	1.9 kg/ha 360 g/ha 0.6 l/ha	A C F
3	AHDB 9959	935.4 g	1.85 l/ha	DFG
4	AHDB 9958	240g + 960g	3.2 l/ha	DFG
5	AHDB 9963	150g + 1500g	2.5 kg/ha	ACF
6	AHDB 9962	48.2g	0.5 l/ha	AC
7	AHDB 9961	132g	0.4 l/ha	AC
8	AHDB 9960	180g + 180g	1.0 l/ha	ACF
9	AHDB 9957	45g	1.0 l/ha	ABCEFG
10	AHDB 9956	705.75g	0.75 kg/ha	ABCEFG

## Application details

	Application A	Application B	Application C	Application D
Application date	29/08/17	05/09/17	12/09/17	18/09/17
Time of day	13:00 – 16:00	10:00 – 12:00	10:00 – 12:00	13:00 – 14:00
Crop growth stage (Max, min average BBCH)	19	19	19	41
Crop height (cm)	N/A	N/A	N/A	N/A
Crop coverage (%)	>90	>90	>90	>90
Application Method	Spray	Spray	Spray	Spray
Application Placement	Foliar	Foliar	Foliar	Foliar
Application equipment	OPS	OPS	OPS	OPS
Nozzle pressure	2 Bar	2 Bar	2 Bar	2 Bar
Nozzle type	Flat Fan	Flat Fan	Flat Fan	Flat Fan
Nozzle size	02 F110	02 F110	02 F110	02 F110
Application water volume/ha	300 l/ha (T9 650 l/ha)			
Temperature of air - shade (°C)	N/A	N/A	32.4	28.8
Relative humidity (%)	N/A	N/A	49.6	53.8
Wind speed range (m/s)	N/A	N/A	N/A	N/A
Dew presence (Y/N)	N	N	N	N
Temperature of soil - 2-5 cm (°C)	N/A	N/A	N/A	N/A
Wetness of soil - 2-5 cm	N/A	N/A	N/A	N/A
Cloud cover (%)	N/A	N/A	N/A	N/A

	Application E	Application F	Application G
Application date	19/09/17	26/09/17	03/10/17
Time of day	08:45 – 09:30	09:00 – 11:00	09:00-10:00
Crop growth stage (Max, min average BBCH)	44	46	48
Crop height (cm)	N/A	N/A	N/A
Crop coverage (%)	>90	>90	>90
Application Method	Spray	Spray	Spray
Application Placement	Foliar	Foliar	Foliar
Application equipment	OPS	OPS	OPS
Nozzle pressure	2 Bar	2 Bar	2 Bar
Nozzle type	Flat Fan	Flat Fan	Flat Fan
Nozzle size	02 F110	02 F110	02 F110
Application water volume/ha	300 l/ha (T9 650 l/ha)	300 l/ha (T9 650 l/ha)	300 l/ha (T9 650 l/ha)
Temperature of air - shade (°C)	24.2	21.5	20.2
Relative humidity (%)	67.5	87.5	79.5
Wind speed range (m/s)	N/A	N/A	N/A
Dew presence (Y/N)	N	N	N
Temperature of soil - 2-5 cm (°C)	N/A	N/A	N/A
Wetness of soil - 2-5 cm	N/A	N/A	N/A
Cloud cover (%)	N/A	N/A	N/A

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

Common name	Scientific Name	EPPO Code	Infection level pre-application	Infection level at start of assessment period	Infection level at end of assessment period
Lettuce Downy Mildew	<i>Bremia lactucae</i>	BREMLA	Nil	Low	Moderate
Botrytis	<i>Botrytis cinerea</i>	BOTRCI	Nil	Low	Moderate
Sclerotinia	<i>Sclerotinia major</i>	SCLEMI	Nil	Low	Moderate

## Assessment details

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
20/09/17	22	44	Efficacy	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
27/09/17	29	46	Phytotoxicity	Phytotoxicity
27/09/17	29	46	Efficacy	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
04/10/17	36	48	Efficacy	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
09/10/17	41	49	Phytotox	Phytotoxicity
09/10/17	41	49	Efficacy	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)

\* DA – days after first application

Downy Mildew severity was scored on a 0-5 scale. The scale used was as follows:

0= no disease

1= <5% leaf area affected

2= 5-10% leaf area affected

3=10-25% leaf area affected

4=25-50% leaf area affected

5= >50% leaf area affected

Presence of *Botrytis cinerea* and *Sclerotinia sclerotiorum* was recorded at each assessment timing and converted to % incidence.

## Statistical analysis

The trial was laid out as a randomised complete block design and analysed using an extended (REML) analysis by Andrew Mead of Rothamsted Research. The analysis first assessed for differences between columns of plots across the polytunnel as well as between the replicate blocks along the length of the polytunnel. For all analyses there was evidence for some variation between columns, resulting in a reduction in the size of the SEDs and LSDs for comparing pairs of treatments. SED and LSD values vary between treatment pairs in this

analysis and so the LSD for each treatment compared to the untreated, alongside mean, maximum and minimum SEDs are presented in results tables below. Mean values presented are predicted values calculated during analysis to take into account the variation across the trial.

All variables expressed as percentages were transformed using an angular transformation before analysis.

Efficacy has been presented as percentage control, calculated as follows:

$$\text{Percentage control} = \frac{(1 - \text{Disease index of treatment})}{\text{Disease index of untreated}} \times 100$$

## Results

### Phytotoxicity

Phytotoxicity was observed in plots treated with AHDB 9958. Speckled, necrotic spots (see Figure 1) were observed on the leaves of plants treated with this product. These spots persisted through the life of the trial, without worsening, and additional spots appeared after each subsequent application of the product. Due to the open nature of the lettuce variety used for the trial, these necrotic spots were present on leaves that were not subsequently trimmed at harvest.

Visible residue was left on foliage by AHDB 9963 (see Figure 1) although no damage appeared to occur in association with this residue.

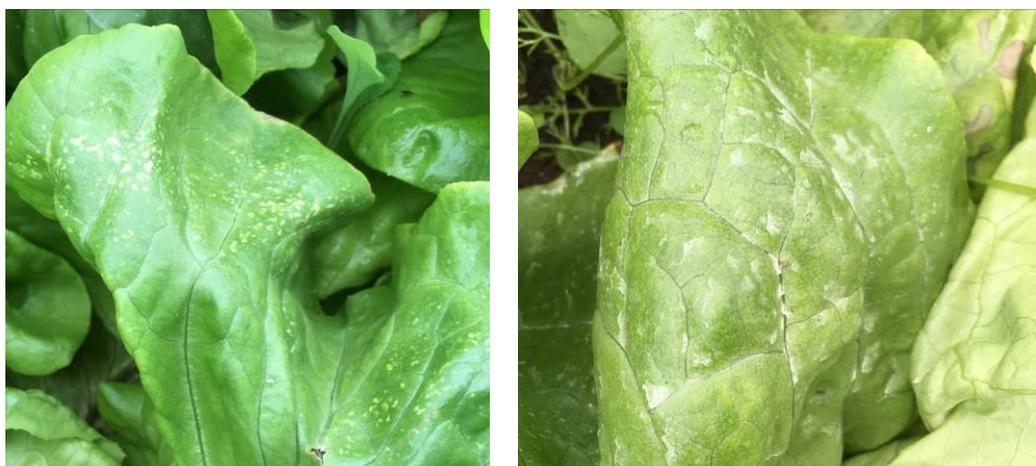


Figure 1: Phytotoxicity caused by AHDB 9958 (left) and residue caused by AHDB 9963 (right)

### Efficacy

Assessments of downy mildew severity at the four assessment timings are shown in Table 1 and presented in Figure 2: Downy Mildew Severity at all four assessment timings

Table 1: Downy Mildew Severity at all four assessment timings

Assessment Date	Downy Mildew Severity							
	20/9/2017		27/9/2017		4/10/2017		9/10/2017	
Treatment	Predicted Mean	LSD	Predicted Mean	LSD	Predicted Mean	LSD	Predicted Mean	LSD
Untreated (water only)	0.980		1.180		1.232		1.283	
Standard	0.357	0.165	0.537	0.199	0.824	0.295	0.896	0.307
AHDB 9959	0.926	0.167	0.894	0.200	0.555	0.297	0.478	0.310
AHDB 9958	1.024	0.167	1.082	0.201	0.520	0.298	0.341	0.311
AHDB 9963	0.360	0.165	0.446	0.199	0.330	0.295	0.367	0.308
AHDB 9962	0.590	0.165	0.433	0.199	0.496	0.295	0.839	0.307
AHDB 9961	0.637	0.165	0.578	0.199	0.715	0.295	0.875	0.307
AHDB 9960	0.851	0.165	1.005	0.199	0.825	0.295	0.664	0.308
AHDB 9957	0.693	0.169	0.871	0.203	1.096	0.301	1.220	0.314
AHDB 9956	0.839	0.165	1.019	0.199	1.164	0.295	1.242	0.307
F Value (9, 41.7)	17.13		16.34		8.76		10.58	
P value	<0.001		<0.001		<0.001		<0.001	
d.f.	41		41		41		41	
Average s.e.d.	0.082278		0.098889		0.146733		0.152956	
Minimum s.e.d.	0.0819		0.0984		0.1461		0.1522	
Maximum s.e.d.	0.0837		0.1005		0.1489		0.1556	

Significantly different from untreated control (p<0.05)

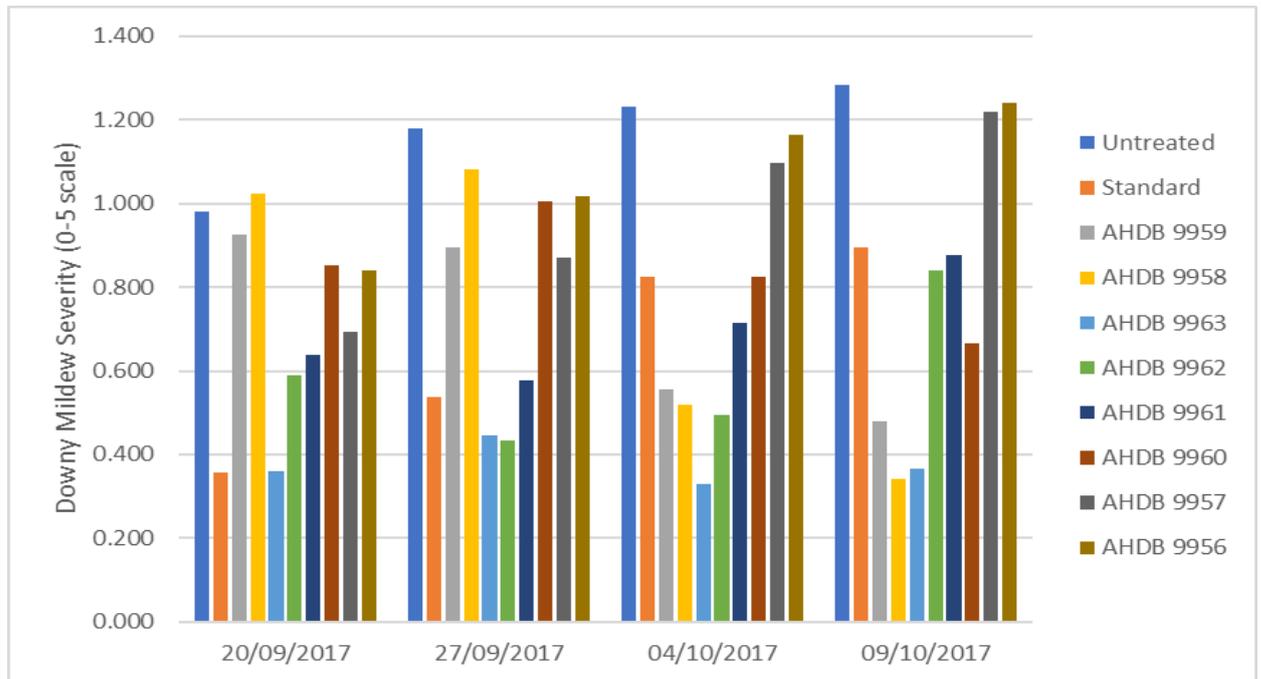


Figure 2: Downy Mildew Severity at all four assessment timings

Efficacy against downy mildew (calculated percentage reduction in downy mildew levels), at all four assessment dates, is presented in Table 2.

Table 2: Efficacy of products, shown as percentage reduction in downy mildew severity

	20/09/2017	27/09/2017	04/10/2017	09/10/2017
Untreated				
Standard	63.5	54.5	33.1	30.2
AHDB 9959	5.5	24.3	55.0	62.8
AHDB 9958	-4.5	8.4	57.8	73.4
AHDB 9963	63.3	62.2	73.3	71.4
AHDB 9962	39.8	63.4	59.8	34.6
AHDB 9961	35.0	51.1	42.0	31.8
AHDB 9960	13.2	14.8	33.1	48.2
AHDB 9957	29.3	26.3	11.0	5.0
AHDB 9956	14.4	13.7	5.5	3.2

Assessments were also made of the incidence of *Botrytis cinerea* and *Sclerotinia major*. There were no significant differences in this data, which is unsurprising, given that we would not expect the oomycete fungicides on test to have any activity against these fungal pathogens.

Harvest assessments were carried out and data is presented in Table 3 and Table 4.

Table 3: Harvest data- numbers of plants harvested

	% of plants harvested (from a possible 18)			% of marketable plants (from a possible 18)			% of marketable plants (of those harvested)		
	Ang	LSD	Back-trans	Ang	LSD	Back-trans	Ang	LSD	Back-trans
Untreated	50.70		59.88	43.60		47.56	69.85		88.14
Standard	60.40	11.047	75.61	53.33	13.208	64.34	65.71	18.377	83.08
AHDB 9959	55.39	11.127	67.74	45.21	13.288	50.37	66.46	18.499	84.04
AHDB 9958	51.10	11.188	60.56	36.81	13.329	35.91	55.88	18.579	68.53
AHDB 9963	66.14	11.047	83.64	55.25	13.208	67.51	71.14	18.377	89.55
AHDB 9962	62.00	11.047	77.96	50.06	13.208	58.78	69.17	18.377	87.35
AHDB 9961	57.74	11.026	71.51	49.84	13.208	58.40	69.66	18.377	87.92
AHDB 9960	65.45	11.047	82.74	50.47	13.208	59.49	61.47	18.377	77.19
AHDB 9957	59.47	11.309	74.20	45.40	13.430	50.70	58.81	18.701	73.18
AHDB 9956	64.75	11.047	81.81	51.18	13.208	60.71	65.90	18.377	83.33
F Value	2.10			1.37			0.63		
P Value	0.051			0.232			0.766		
d.f.	41			41			41		
Average s.e.d.	5.496			6.563			9.136		
Minimum s.e.d.	5.460			6.540			9.100		
Maximum s.e.d	5.600			6.650			9.260		



## Discussion

The trial was conducted as described in the protocol except for the following:

- 18 plants were assessed per plot instead of 30 but this still provided sufficient information to identify treatment differences.
- Application timing of AHDB 9959 and AHDB 9958: as these products applied late, they were applied at different timings to those listed in the protocol.

Moderate disease levels were observed in untreated plots and the standard treatment programme performed as expected, so the trial can be considered valid.

AHDB 9957 (a biopesticide) significantly reduced downy mildew levels early on in the trial. The percentage reduction in infection was not as high as seen with some of the conventional products, but this could be a useful product used closer to harvest as part of an integrated disease management strategy.

AHDB 9963 gave 60-70% control of downy mildew throughout the trial but left visible residues on leaves which may not be acceptable to growers. Of the two active ingredients in this product, one is likely to be responsible for the observed residue. There is potential to use this product soon after planting when visible residues are potentially less significant.

Two experimental products arrived late and were therefore applied as eradicant products. Both products reduced disease levels over the course of the trial. AHDB 9959 reduced downy mildew levels more quickly, but AHDB 9958 gave a greater reduction in downy mildew by the end of the trial. Plants treated with AHDB 9958 had the lowest levels of downy mildew in the trial (73.4% reduction compared to the untreated) by the final assessment. If this product had been applied earlier on in the trial, as intended, the level of control achieved could potentially have been better still.

The other conventional products used in the trial (AHDB 9960, AHDB 9961 and AHDB 9962) all significantly reduced downy mildew levels by between 30 and 50% over the course of the trial. These products could potentially help to control downy mildew as part of an integrated control strategy, especially where different modes of action can be deployed.

No significant effects were found in harvest data. A loss of marketable yield due to reduced head weight would ordinarily be expected where high levels of downy mildew are present. In this trial, however, the disease did not progress from the outer leaves onto the heart of the lettuce and therefore excessive trimming was not required to achieve a marketable standard.

Phytotoxicity was observed in plots treated with AHDB 9958. Small necrotic spots appeared on leaves as soon as two days post-application of the product. Plants did not recover from these symptoms although the necrotic spots did not develop any further.

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

## **Conclusions**

- Disease levels developed to moderate levels in untreated plots.
- The standard programme worked as expected, giving reasonable control of downy mildew.
- All six conventional products provided significant levels of downy mildew control by the end of the trial.
- One biopesticide provided a significant level of control at the first two assessment timings.
- Two products which arrived late, and which were applied after onset of disease, showed evidence of eradicant activity and provided good levels of downy mildew control.
- One product caused a relatively mild phytotoxicity symptom on the leaves.
- One product left a moderate but significant visible residue on the leaves.

## **Acknowledgements**

Liz Johnson (LJ Technical Consultancy) for supplying infected leaf material with which to inoculate the trial and for advising on appropriate standard products.

Andrew Mead (Rothamsted Research) for providing statistical support and data analysis.

## Appendix A: Crop Diary

Crop	Cultivar	Sowing date	Planting date
Lettuce	Cobham Green	03.08.17	24.08.17

### Previous cropping

Year	Crop
2016	Cabbage (seed crop)

### Fertilisers applied to the trial area

Date	Product	Rate	Unit
21.08.17	Calcium nitrate	50	Kg/ha N

No herbicides were applied to the trial- the area was hand weeded as necessary.  
Irrigation was applied as necessary by trickle tape.

## Appendix B: Trial Diary

Date	Event
29/08/17	Application A
05/09/17	Application B
12/09/17	Application C
18/09/17	Application D
19/09/17	Application E
20/09/17	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
26/09/17	Application F
27/09/17	Phytotoxicity
27/09/17	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
03/10/17	Application G
04/10/17	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
09/10/17	Phytotoxicity
09/10/17	Disease severity (Downy Mildew), disease incidence (Botrytis & Sclerotinia)
11/10/17	Harvest assessments- yield and count, untrimmed and trimmed

## Appendix C: Photographs



Trial layout



Downy mildew infection on untreated plant, visible as yellowing on upper leaf surface.



Downy mildew infection in untreated plot, visible as yellowing of upper leaf surface.

## Appendix D: Climatological data

Date	Max Temp °C	Min Temp °C	Average RH %
11/09/2017	19.5 °C	19.5 °C	62.6 %RH
12/09/2017	11.5 °C	11.5 °C	70.2 %RH
13/09/2017	12.0 °C	12.0 °C	75.6 %RH
14/09/2017	9.3 °C	9.3 °C	73.6 %RH
15/09/2017	9.0 °C	9.0 °C	76.1 %RH
16/09/2017	10.6 °C	10.6 °C	77.1 %RH
17/09/2017	10.1 °C	10.1 °C	78.6 %RH
18/09/2017	10.4 °C	10.4 °C	80.6 %RH
19/09/2017	10.1 °C	10.1 °C	78.6 %RH
20/09/2017	8.8 °C	8.8 °C	76.6 %RH
21/09/2017	14.8 °C	14.8 °C	81.1 %RH
22/09/2017	8.5 °C	8.5 °C	85.7 %RH
23/09/2017	12.3 °C	12.3 °C	81.1 %RH
24/09/2017	14.0 °C	14.0 °C	81.6 %RH
25/09/2017	14.2 °C	14.2 °C	81.6 %RH
26/09/2017	13.1 °C	13.1 °C	88.3 %RH
27/09/2017	14.5 °C	14.5 °C	88.3 %RH
28/09/2017	13.7 °C	13.7 °C	86.7 %RH
29/09/2017	12.0 °C	12.0 °C	85.7 %RH
30/09/2017	9.0 °C	9.0 °C	84.7 %RH
01/10/2017	13.7 °C	13.7 °C	88.3 %RH
02/10/2017	14.0 °C	14.0 °C	88.3 %RH
03/10/2017	9.6 °C	9.6 °C	84.2 %RH
04/10/2017	11.2 °C	11.2 °C	84.2 %RH
05/10/2017	12.3 °C	12.3 °C	90.9 %RH
06/10/2017	8.0 °C	8.0 °C	79.1 %RH
07/10/2017	10.9 °C	10.9 °C	80.6 %RH
08/10/2017	8.5 °C	8.5 °C	86.7 %RH
09/10/2017	11.5 °C	11.5 °C	85.7 %RH
10/10/2017	11.5 °C	11.5 °C	88.3 %RH
11/10/2017	12.3 °C	12.3 °C	85.7 %RH

## Appendix E. Raw data from assessments

Assessment		Downy mildew	Downy mildew	Botrytis	Sclerotinia	Downy mildew	Botrytis	Sclerotinia	Downy mildew	Botrytis	Sclerotinia	Total harvested plants
Scale		0-5	0-5	Count	Count	0-5	Count	Count	0-5	Count	Count	Count
Assessment Date		20/9/2017	27/9/2017	27/9/2017	27/9/2017	4/10/2017	4/10/2017	4/10/2017	9/10/2017	9/10/2017	9/10/2017	11/10/2017
No. Treatment Name	Plot											
1 Untreated (water only)	109	1.00	1.28	8.00	0.00	1.28	15.00	3.00	1.11	11.00	7.00	9.00
	206	1.17	1.67	3.00	1.00	1.50	11.00	5.00	1.50	10.00	7.00	7.00
	305	0.88	1.12	1.00	1.00	1.06	12.00	1.00	0.88	10.00	4.00	13.00
	402	0.94	1.17	4.00	2.00	1.22	12.00	5.00	1.39	11.00	4.00	14.00
	508	1.11	1.06	10.00	1.00	0.82	17.00	3.00	1.24	12.00	7.00	10.00
	607	0.83	0.89	2.00	0.00	1.61	7.00	4.00	1.72	9.00	5.00	10.00
	Mean =	0.99	1.20	4.16t	0.54t	1.25	12.33	3.23t	1.31	10.50	5.67	10.50
2 Fubol Gold/Paraat/Revus	105	0.22	0.39	1.00	1.00	0.72	1.00	3.00	0.44	3.00	7.00	18.00
	204	0.17	0.67	2.00	0.00	0.94	10.00	4.00	1.06	9.00	9.00	9.00
	303	0.56	0.61	5.00	1.00	0.83	10.00	8.00	0.81	8.00	8.00	14.00
	407	0.44	0.67	1.00	1.00	0.94	10.00	2.00	1.19	7.00	6.00	11.00
	506	0.28	0.28	2.00	1.00	0.61	8.00	1.00	0.82	8.00	4.00	14.00
	610	0.33	0.44	2.00	0.00	0.72	3.00	0.00	0.78	5.00	1.00	16.00
	Mean =	0.33	0.51	2.03t	0.45t	0.80	7.00	2.20t	0.85	6.67	5.83	13.67
3 AHDB 9959	101	1.00	1.00	3.00	0.00	0.44	11.00	8.00	0.00	12.00	13.00	13.00
	207	0.94	1.11	4.00	2.00	0.59	9.00	14.00	1.00	5.00	14.00	5.00
	304	0.94	0.89	3.00	0.00	0.83	11.00	6.00	0.50	7.00	7.00	10.00
	404	0.94	0.83	5.00	0.00	0.50	15.00	1.00	0.33	13.00	2.00	11.00
	507	1.00	1.00	4.00	0.00	0.82	13.00	2.00	0.76	7.00	7.00	15.00
	606	0.89	0.78	2.00	2.00	0.28	13.00	1.00	0.44	9.00	7.00	9.00
	Mean =	0.95	0.94	3.44t	0.22t	0.58	12.00	3.74t	0.51	8.83	8.33	10.50
4 AHDB 9958	108	0.94	1.06	2.00	0.00	0.39	10.00	7.00	0.33	9.00	10.00	11.00
	201	1.11	1.56	2.00	1.00	0.39	8.00	7.00	0.20	12.00	11.00	6.00
	306	1.39	1.22	4.00	0.00	0.39	14.00	8.00	0.13	9.00	13.00	9.00
	408	0.89	0.83	1.00	0.00	0.83	13.00	5.00	0.83	8.00	7.00	13.00
	505	0.89	0.83	2.00	0.00	0.67	10.00	3.00	0.44	6.00	7.00	15.00
	604	1.00	1.00	5.00	0.00	0.39	11.00	5.00	0.12	7.00	9.00	9.00
	Mean =	1.04	1.08	2.52t	0.03t	0.51	11.00	5.60t	0.34	8.50	9.50	10.50
5 AHDB 9963	103	0.56	0.61	0.00	0.00	0.33	8.00	6.00	0.22	8.00	8.00	17.00
	202	0.50	0.78	4.00	0.00	0.72	7.00	2.00	0.53	12.00	4.00	12.00
	309	0.44	0.50	3.00	1.00	0.33	16.00	1.00	0.50	12.00	2.00	11.00
	410	0.22	0.11	2.00	0.00	0.22	5.00	0.00	0.22	5.00	3.00	18.00
	501	0.17	0.22	2.00	0.00	0.06	12.00	1.00	0.22	11.00	4.00	16.00
	603	0.33	0.50	3.00	1.00	0.41	11.00	6.00	0.69	10.00	9.00	11.00
	Mean =	0.37	0.45	2.13t	0.11t	0.35	9.83	1.89t	0.40	9.67	5.00	14.17
6 AHDB 9962	106	0.89	0.71	0.00	2.00	0.35	8.00	5.00	0.50	8.00	8.00	13.00
	208	0.61	0.28	9.00	1.00	0.39	13.00	3.00	0.78	12.00	5.00	14.00
	307	0.78	0.61	3.00	0.00	0.72	11.00	3.00	1.00	9.00	4.00	12.00
	406	0.67	0.33	4.00	0.00	0.39	9.00	1.00	1.06	12.00	6.00	11.00
	510	0.44	0.39	0.00	1.00	0.22	6.00	1.00	0.39	5.00	2.00	18.00
	609	0.22	0.33	5.00	1.00	0.83	10.00	3.00	1.28	11.00	5.00	10.00
	Mean =	0.60	0.44	2.76t	0.54t	0.48	9.50	2.40t	0.83	9.50	5.00	13.00

Assessment		Downy mildew	Downy mildew	Botrytis	Sclerotinia	Downy mildew	Botrytis	Sclerotinia	Downy mildew	Botrytis	Sclerotinia	Total harvested plants
Scale		0-5	0-5	Count	Count	0-5	Count	Count	0-5	Count	Count	Count
Assessment Date		20/9/2017	27/9/2017	27/9/2017	27/9/2017	4/10/2017	4/10/2017	4/10/2017	9/10/2017	9/10/2017	9/10/2017	11/10/2017
No. Treatment Name	Plot											
7 AHDB 9961	102	0.78	0.67	2.00	1.00	0.94	10.00	4.00	1.00	11.00	6.00	15.00
	209	0.39	0.44	2.00	0.00	0.72	4.00	4.00	0.83	8.00	7.00	13.00
	310	0.39	0.33	2.00	1.00	0.17	9.00	1.00	0.17	5.00	2.00	17.00
	409	0.67	0.67	6.00	1.00	0.82	8.00	4.00	0.76	10.00	8.00	13.00
	503	0.94	0.83	8.00	1.00	0.72	15.00	2.00	1.00	8.00	6.00	7.00
	601	0.61	0.50	4.00	3.00	0.94	8.00	4.00	1.47	12.00	9.00	9.00
	Mean =	0.63	0.57	3.72t	0.91t	0.72	9.00	2.94t	0.87	9.00	6.33	12.33
8 AHDB 9960	104	0.56	0.83	2.00	1.00	0.72	6.00	3.00	0.67	9.00	4.00	17.00
	210	0.78	0.94	0.00	0.00	0.94	2.00	3.00	0.61	6.00	0.00	18.00
	302	1.00	1.28	3.00	0.00	0.94	6.00	6.00	0.76	6.00	10.00	12.00
	401	1.00	0.89	5.00	1.00	0.59	13.00	6.00	0.44	8.00	11.00	9.00
	509	1.00	1.00	3.00	0.00	0.83	18.00	0.00	0.72	8.00	6.00	15.00
	602	0.72	1.11	1.00	1.00	0.94	8.00	3.00	0.72	8.00	7.00	12.00
	Mean =	0.84	1.01	2.06t	0.25t	0.83	8.83	2.83t	0.65	7.50	6.33	13.83
9 AHDB 9957	110	0.56	0.67	0.00	0.00	0.94	7.00	0.00	1.06	6.00	1.00	18.00
	203	0.72	1.00	4.00	0.00	1.50	11.00	5.00	1.53	10.00	8.00	13.00
	308	0.89	1.28	7.00	0.00	1.50	15.00	2.00	1.61	12.00	3.00	15.00
	405	0.39	0.39	0.00	0.00	0.28	1.00	3.00	0.44	2.00	3.00	12.00
	502	0.94	0.94	3.00	0.00	0.78	14.00	0.00	0.94	12.00	3.00	14.00
	608	0.61	0.83	2.00	2.00	1.65	13.00	1.00	1.88	7.00	5.00	11.00
	Mean =	0.69	0.85	2.13t	0.06t	1.11	10.17	1.29t	1.24	8.17	3.83	13.83
10 AHDB 9956	107	0.89	1.11	0.00	0.00	1.19	4.00	9.00	1.20	7.00	10.00	12.00
	205	0.56	0.83	1.00	0.00	1.17	7.00	0.00	1.06	10.00	1.00	18.00
	301	0.94	1.22	3.00	1.00	1.29	11.00	4.00	1.38	9.00	5.00	11.00
	403	0.94	1.17	9.00	0.00	1.61	13.00	1.00	1.83	13.00	3.00	12.00
	504	1.00	0.89	2.00	0.00	1.00	11.00	1.00	0.88	10.00	6.00	15.00
	605	0.56	0.72	1.00	0.00	0.56	2.00	0.00	0.83	0.00	2.00	18.00
	Mean =	0.81	0.99	2.11t	0.03t	1.14	8.00	1.42t	1.20	8.17	4.50	14.33

Assessment		Total weight of harvested plants (untrimmed)	Mean untrimmed weight of harvested plants	Count of marketable (trimmed) plants	Total weight of marketable (trimmed) plants	Mean weight of marketable (trimmed) plants
Scale		Kg	Kg	Count	Kg	Kg
Assessment Date		11/10/2017	11/10/2017	11/10/2017	11/10/2017	11/10/2017
No. Treatment Name	Plot					
1 Untreated (water only)	109	2.45	0.27	9.00	1.77	0.20
	206	1.71	0.24	3.00	0.63	0.21
	305	2.81	0.22	13.00	2.16	0.17
	402	4.75	0.34	12.00	2.62	0.22
	508	3.48	0.35	5.00	1.39	0.28
	607	3.08	0.31	10.00	2.40	0.24
	Mean =		3.05	0.29	8.67	1.83
2 Fubol Gold/Paraat/Revus	105	3.80	0.21	18.00	3.14	0.17
	204	2.42	0.27	7.00	1.57	0.22
	303	4.93	0.35	9.00	2.06	0.23
	407	4.25	0.39	4.00	1.02	0.26
	506	3.56	0.25	13.00	2.62	0.20
	610	4.10	0.26	15.00	2.91	0.19
	Mean =		3.84	0.29	11.00	2.22
3 AHDB 9959	101	2.82	0.22	12.00	2.23	0.19
	207	1.76	0.35	4.00	0.94	0.24
	304	3.09	0.31	7.00	1.54	0.22
	404	3.72	0.34	11.00	2.63	0.24
	507	4.77	0.32	15.00	3.50	0.23
	606	2.43	0.27	4.00	0.79	0.20
	Mean =		3.10	0.30	8.83	1.94
4 AHDB 9958	108	3.99	0.36	2.00	0.54	0.27
	201	1.53	0.26	2.00	0.44	0.22
	306	2.55	0.28	7.00	1.25	0.18
	408	4.70	0.36	9.00	2.31	0.26
	505	1.83	0.12	9.00	1.12	0.12
	604	2.63	0.29	9.00	1.90	0.21
	Mean =		2.87	0.28	6.33	1.26
5 AHDB 9963	103	5.63	0.33	17.00	4.45	0.26
	202	4.17	0.35	8.00	2.14	0.27
	309	3.77	0.34	11.00	2.55	0.23
	410	2.48	0.14	11.00	1.38	0.13
	501	4.10	0.26	14.00	2.86	0.20
	603	3.75	0.34	9.00	1.68	0.19
	Mean =		3.98	0.29	11.67	2.51
6 AHDB 9962	106	2.99	0.23	11.00	2.16	0.20
	208	4.29	0.31	10.00	2.28	0.23
	307	3.96	0.33	12.00	2.93	0.24
	406	2.80	0.25	6.00	1.23	0.21
	510	3.26	0.18	13.00	2.01	0.15
	609	3.27	0.33	10.00	2.25	0.23
	Mean =		3.43	0.27	10.33	2.14

Assessment		Total weight of harvested plants (untrimmed) Kg	Mean untrimmed weight of harvested plants Kg	Count of marketable (trimmed) plants	Total weight of marketable (trimmed) plants Kg	Mean weight of marketable (trimmed) plants Kg
Scale				Count		
Assessment Date		11/10/2017	11/10/2017	11/10/2017	11/10/2017	11/10/2017
No. Treatment Name	Plot					
7 AHDB 9961	102	4.76	0.32	15.00	3.79	0.25
	209	4.10	0.32	13.00	2.95	0.23
	310	3.08	0.18	12.00	1.91	0.16
	409	4.16	0.32	11.00	2.72	0.25
	503	2.46	0.35	6.00	1.57	0.26
	601	2.58	0.29	6.00	1.38	0.23
	Mean =	3.52	0.30	10.50	2.39	0.23
8 AHDB 9960	104	4.50	0.26	16.00	3.27	0.20
	210	2.75	0.15	12.00	1.52	0.13
	302	4.55	0.38	7.00	1.79	0.26
	401	2.32	0.26	6.00	1.18	0.20
	509	4.78	0.32	12.00	2.76	0.23
	602	3.68	0.31	12.00	2.74	0.23
	Mean =	3.76	0.28	10.83	2.21	0.21
9 AHDB 9957	110	2.75	0.15	11.00	1.51	0.14
	203	4.18	0.32	9.00	2.11	0.23
	308	4.82	0.32	7.00	1.36	0.19
	405	1.67	0.14	7.00	0.90	0.13
	502	4.26	0.30	13.00	2.77	0.21
	608	3.46	0.31	8.00	1.85	0.23
	Mean =	3.52	0.26	9.17	1.75	0.19
10 AHDB 9956	107	3.51	0.29	11.00	2.55	0.23
	205	3.44	0.19	12.00	1.93	0.16
	301	3.23	0.29	11.00	2.40	0.22
	403	4.31	0.36	6.00	1.48	0.25
	504	4.07	0.27	13.00	2.75	0.21
	605	3.35	0.19	14.00	2.28	0.16
	Mean =	3.65	0.27	11.17	2.23	0.21



# Certificate of

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

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*This certifies that*

### **Stockbridge Technology Centre**

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  
Biologicals and Semiochemicals  
Stored Crops**

**Date of issue:** 19 July 2016  
**Effective date:** 1 April 2016  
**Expiry date:** 31 March 2021

**Signature**

  
*Authorised signature*

Certification Number

ORETO 372

  
**HSE**  
Chemicals Regulation Division

 Department of  
**Agriculture and  
Rural Development**