

SCEPTREPLUS

Final Trial Report

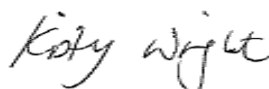
Trial code:	SP14
Title:	Evaluation of biopesticides and conventional fungicides for control of <i>Pythium aphanidermatum</i> in cucumber
Crop	Cucumber, Protected Edibles
Target	Cucumber Pythium Root Rot, <i>Pythium aphanidermatum</i> , PYTHAP
Lead researcher:	Kirsty Wright
Organisation:	Stockbridge Technology Centre
Period:	August 2017 – November 2017
Report date:	22 nd January 2018
Report author:	Kirsty Wright
ORETO Number: (certificate should be attached)	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

22.01.2017

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Date



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Authors signature

Trial Summary

Introduction

Root rot of cucumber, caused by *Pythium aphanidermatum*, can lead to significant crop losses, weakening and even killing young plants when transplanted onto previously infested, re-used rockwool slabs. Inoculum build up in early crops when temperatures are low are often symptomless. However, late summer crops under higher temperatures can be badly affected, especially during the early establishment phase post-planting. Safe, effective and approved treatment options are limited and identifying new products with activity against oomycete pathogens will be of benefit to a number of crop sectors.

Methodology

A mature hydroponic cucumber crop was inoculated in the root zone with cultures of *Pythium aphanidermatum*. Cucumber seedling bait plants were used to confirm presence and spread of the pathogen within the rockwool before planting new young cucumber plants onto the infested slabs one month after inoculation. Each plot comprised one rockwool slab containing 3 plants and plots were replicated 6 times. Four conventional fungicides and two biopesticides were tested, alongside untreated and standard (Previcur Energy) controls, by application as drenches to the rockwool blocks. The first treatments were applied immediately after planting and repeated at weekly (biopesticides) or fortnightly (conventional fungicides) intervals, unless otherwise recommended by the manufacturer. Assessments were made, during the life of the crop, of agronomic features (plant height, leaf area, stem diameter and yield) as well as visible disease symptoms (stem base lesions). A final destructive assessment on 1st November 2017 included root vigour, root colour, root coverage of blocks/slabs. Phytotoxicity symptoms were recorded as they were observed, and most phytotoxicity effects were recorded as variance in agronomic features.

Results

Symptoms developed slowly in the crop, potentially because ambient temperatures and radiation were low for the time of year and, as a result, plants were less stressed. All plants survived for the duration of the trial as a result of the low-moderate disease levels. Severity of stem base lesions (using a 0-3 severity scale) was therefore used to differentiate between treatments. Data was then converted to a disease index score per plot (0-100 scale) as presented in the table below.

Date	DISEASE INDEX (0-100)	
	16/10/2017	01/11/2017
Treatment		
Untreated	22.1	26.7
Previcur Energy	5.4	6.4
AHDB 9959	28.2	21.8
AHDB 9958	4.2	10.6
AHDB 9963	42.4	39.5
AHDB 9960	27.5	28.4
AHDB 9967	5.4	12.0
AHDB 9955	16.5	17.6
	Not significantly different from untreated control ($p > 0.05$)	
	Significantly different from untreated control ($p < 0.05$)	
	N.B. AHDB 9963 is significantly different from the untreated control, but is not highlighted because disease symptoms are worse than in the untreated control.	

Conclusions

The pathogen was uniformly distributed in the rockwool slabs across all trial plots, as demonstrated by use of susceptible bait plants. However, disease did not develop rapidly in the newly planted crop. Low to moderate levels of disease were observed as stem base lesions, but lack of crop mortality made visual differences harder to observe.

The standard treatment (Previcur Energy) worked well, reducing stem base lesion severity by approximately 75%. Two test products (AHDB 9958 and AHDB 9967) significantly reduced stem base lesions compared to the untreated. Fruit yield was reduced with treatment AHDB 9958 but not with AHDB 9967. However, AHDB 9967 appeared to have a detrimental effect on root development, with reduced coverage of block bases by roots. One treatment (AHDB 9963) caused severe phytotoxicity, with plants wilting, having reduced growth and yield, and having poorly developed roots. These symptoms appear to have caused an increase in disease susceptibility as stem base lesions were higher in this treatment than in the untreated control.

Take home message:

One new conventional pesticide (AHDB 9958) and one biopesticide (AHDB 9967) significantly reduced disease symptoms in the trial. One product (AHDB 9963) led to severe phytotoxicity which was linked to difficulties with calculating application rates for its use as a drench in hydroponic systems where there is little buffering in the inert substrate. This is likely to be a complication for other products and we recommend taking particular care with application rate calculations in this scenario. Further work under higher disease pressure would be necessary to better evaluate the performance of promising candidate products to ensure both efficacy and crop safety during higher temperature periods.

The results of this trial are already guiding product choices in SCEPTREplus Year 2 projects including field vegetable work (SP 37) and further protected edibles work on root diseases (SP 21). It is also expected that the results will contribute to product choice in crop safety work in the ornamentals sector (SP 33).

Objectives

1. To evaluate the effectiveness of four conventional fungicides and two biopesticides against root rot of cucumber caused by *Pythium aphanidermatum*, as measured by disease severity.
2. To monitor and assess the treated crop for phytotoxicity.

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
PP 1/152(3)	Design and analysis of efficacy evaluation trials	No
PP 1/135(3)	Phytotoxicity assessment	No
PP 1/181(3)	Conduct and reporting of efficacy evaluation trials including GEP	No

Test site

Item	Details
Location address	Stockbridge Technology Centre, Stockbridge House, Cawood, Selby YO8 3TZ
Crop	Cucumber <i>Cucumis sativus</i> (CUMSA)
Cultivar	Shakira
Soil or substrate type	Rockwool blocks (propagation) and rockwool slabs (production)
Agronomic practice	<ul style="list-style-type: none">- Irrigation and feed regime as per commercial practice.- 29/09/17 Systhane (0.375 l/ha) applied for powdery mildew control. Foliage sprayed weekly with water to limit powdery mildew spread.- Thripex and Encarsia biocontrol .
Prior history of site	Previous crop: cucumber (June-August 2017) Rockwool slabs from previous cucumber crop reused, as per commercial practice. The slabs were inoculated with cultures of <i>Pythium aphanidermatum</i> whilst the previous crop was in place and bait plants used to confirm presence of active disease in all slabs. The aim of this was to simulate what happens commercially. It was, in effect, a natural means to evenly introduce <i>P. aphanidermatum</i> into the trial area pre-planting.

Trial design

Item	Details
Trial design:	Incomplete Trojan Squares
Number of replicates:	6
Row spacing:	43cm
Plot size: (w x l)	130cm (l) x 15cm (w) x 7cm (d) rockwool slab
Plot size: (m ²)	0.195 m ²
Number of plants per plot:	3
Leaf Wall Area calculations	N/A

Treatment details

AHDB Code	Active substance	Product name or manufacturers code	Formulation batch number	Content of active substance in product	Formulation type
Water control	-	-	-	-	-
Standard	Propamocarb + Fosetyl	Previcur Energy	EM4L019041	530 g/l + 310 g/l	SL
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 9960	N/D	N/D	N/D	N/D	N/D
AHDB 9967	N/D	N/D	N/D	N/D	N/D
AHDB 9955	N/D	N/D	N/D	N/D	N/D

Application schedule

Trt 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	-	-	ABCDEFGF
2	Previcur Energy	530g + 310g And then 1590g + 5700g	1.0 l/ha within 10 days of transplanting and then 3.0 l/ha	AC
3	AHDB 9959	932.4g	1.85 l/ha	BCDEFG
4	AHDB 9958	240g + 960g	3.2 l/ha	BDF
5	AHDB 9963	108g + 1080g	1.8 kg/ha	ACEG
6	AHDB 9960	180g + 180g	1.0 l/ha	ACEG
7	AHDB 9967	200g	0.04 %	ABCDEFGF
8	AHDB 9955	3.83 x 10 ¹⁰ Colony forming units (min)	0.005 g/l substrate	AB

Application details

	Application A	Application B	Application C	Application D
Application date	11/09/2017	18/09/2017	25/09/2017	02/10/2017
Time of day	13:00-16:00	14:00-16:00	10:00-12:00	10:00-12:00
Crop growth stage (Max, min average BBCH)	GS61	GS 62	GS 65	GS 71
Crop height (cm)	N/A	N/A	N/A	N/A
Crop coverage (%)	N/A	N/A	N/A	N/A
Application Method	Drench	Drench	Drench	Drench
Application Placement	Block	Block	Block	Block
Application equipment	By hand	By hand	By hand	By hand
Nozzle pressure	N/A	N/A	N/A	N/A
Nozzle type	N/A	N/A	N/A	N/A
Nozzle size	N/A	N/A	N/A	N/A
Application water volume	500 ml/plant	500 ml/plant	500 ml/plant	500 ml/plant
Temperature of air - shade (°C)	24.4	25.0	22.1	26.1
Relative humidity (%)	99.3	53.7	87.2	71.4
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	10/10/2017	16/10/2017	23/10/2017
Time of day	14:00-16:00	14:30-16:00	10:00-12:30
Crop growth stage (Max, min average BBCH)	GS 74	GS 76	GS 79
Crop height (cm)	N/A	N/A	N/A
Crop coverage (%)	N/A	N/A	N/A
Application Method	Drench	Drench	Drench
Application Placement	Block	Block	Block
Application equipment	By hand	By hand	By hand
Nozzle pressure	N/A	N/A	N/A
Nozzle type	N/A	N/A	N/A
Nozzle size	N/A	N/A	N/A
Application water volume/ha	500 ml/plant	500 ml/plant	500 ml/plant
Temperature of air - shade (°C)	23.0	22.3	20.4
Relative humidity (%)	93.2	91.3	80.8
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
Pythium root rot	<i>Pythium aphanidermatum</i>	PYTHAP	Nil in blocks, moderate in slabs	Moderate	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)
18/9/17	7	62	Phytotox	All symptoms due to phytotoxicity assessed
02/10/17	21	71	Yield	Harvest assessment- fruit count and weight (g) from each plot
09/10/17	28	74	Efficacy/ Phytotox	Leaf 8 detached from each plant and area measured using Leaf Area Meter (cm ²)
09/10/17	28	74	Efficacy/ Phytotox	Height of each plant measured (cm)
09/10/17	28	74	Yield	Harvest assessment- fruit count and weight (g) from each plot
16/10/17	35	76	Efficacy	Stem base lesions assessed, per plant, using 0-3 severity scale
16/10/17	35	76	Yield	Harvest assessment- fruit count and weight (g) from each plot
23/10/17	42	79	Yield	Harvest assessment- fruit count and weight (g) from each plot
30/10/17	49	79	Efficacy/ Phytotox	Plant vigour and colour, per plot, assessed on 0-3 scale
30/10/17	49	79	Yield	Harvest assessment- fruit count and weight (g) from each plot
01/11/17	51	79	Efficacy/ Phytotox	Stem diameter measured halfway between block and cotyledons (mm)
01/11/17	51	79	Efficacy	Stem base lesions assessed, per plant, using 0-3 severity scale
01/11/17	51	79	Efficacy	Rooting strength between block and slab assessed on 0-3 scale
01/11/17	51	79	Efficacy	Root discolouration on underside of block assessed on 0-3 scale
01/11/17	51	79	Efficacy	Root coverage on underside of block assessed, %
01/11/17	51	79	Efficacy	Root discolouration on underside of slab assessed on 0-3 scale
01/11/17	51	79	Efficacy	Root coverage on underside of slab assessed, %

* DA – days after first application (11/09/2017). Note that AHDB 9958 and AHDB 9959 did not arrive before the start of the trial and so first applications were made on 18/09/2017.

Assessments were carried out using the following scales:

Stem base lesion

- 0 = no evidence of stem base lesion
- 1 = slight discolouration to a small area of stem base
- 2 = moderate area of discolouration
- 3 = severe lesion causing breakdown of tissues and discolouration extending around much of stem base

Plant Vigour

- 0 = Dead
- 1 = Substantial reduction in overall vigour, but still growing
- 2 = Reduced vigour compared to healthiest plants- appear healthy but smaller overall
- 3 = Most vigorous plants in trial

Plant Colour

- 0 = Dead
- 1 = Substantial yellowing/chlorosis
- 2 = Paler than healthiest plants in trial, but still green.
- 3 = Greenest plants in trial.

Rooting Strength (assessed at point of block attachment to slab)

- 0 = No rooting into slab
- 1 = Only loose attachment by roots into slab
- 2 = Well attached but some movement possible
- 3 = Strong and secure attachment to slab

Root discoloration

- 0 = No evidence of root discoloration or decay
- 1 = <5% roots with discoloration & decay
- 2 = 5-25% roots with discoloration & decay
- 3 = > 25% roots with discoloration & decay

Statistical analysis

The trial layout was based upon an incomplete Trojan Square design which allowed for variation between rows and columns of plots. ANOVA analysis of the data using Genstat was carried out by Andrew Mead of Rothamsted Research. In this particular implementation of a Trojan square design, the 8 treatments have been assigned both to 2 sub-groups of 4 (as identified by the levels of ps1) and to 4 pairs (as identified by the levels of ps2). This trial layout means that 2 different LSD values were produced for each assessment- one to be used when treatments share a ps2 value, and one to be used when treatments have different ps2 values allocated. These different LSD values are shown at the bottom of results tables in this report.

Efficacy was calculated using disease index scores, based on stem base lesion assessments carried out on 2 dates.

Disease Index was calculated using the following formula:

$$\text{Disease Index} = \frac{1(\text{no. scored 1}) + 2(\text{no. scored 2}) + 3(\text{no. scored 3})}{3 (\text{No. of plants assessed})} \times \frac{100}{3}$$

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

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

Results

Phytotoxicity

Phytotoxicity was assessed in several ways. 7 days after the first application of treatments an assessment was made of general phytotoxicity symptoms (yellowing, stunting, necrosis) relative to the negative control. Agronomic features such as plant height, leaf area and stem diameter were also measured, along with crop yield, during the life of the crop. These measurements could potentially be indicative of either a phytotoxic effect, or of root infection so the results of these assessments must be considered alongside disease assessments and are discussed later in this report.

Severe phytotoxicity was observed in plots treated with AHDB 9963. Two days after the first application plants in these plots were observed to be wilting and when a full assessment was made 5 days later, plants in these plots were stunted, yellowed and necrotic patches were appearing on leaves. See Figure 1.

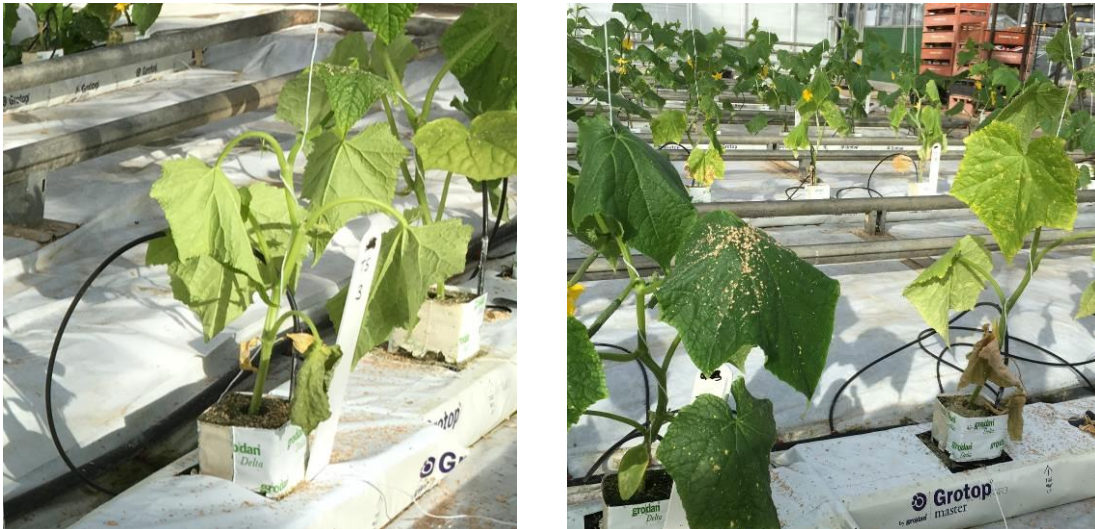


Figure 1: AHDB 9963 Phytotoxicity.
Left: 2 days after first application. Right: 7 days after first application

Efficacy

Assessments of stem base lesions (converted to a disease index score), root discolouration and root growth, as indicators of disease presence, are shown in Table 1 and illustrated in Figure 2, Figure 3 and Figure 4.

Table 1: Assessments of disease symptoms

			Stem Base Lesion Disease Index (0-100)	Stem Base Lesion Disease Index (0-100)	Root Strength (0-3)	Root coverage of block (%)	Root coverage of slab (%)	Block root discolouration (0-3)	Slab root discolouration (0-3)
	ps1	ps2	16.10.17	01.11.17	01.11.17	01.11.17	01.11.17	01.11.17	01.11.17
Untreated	1	1	22.1	26.7	2.385	88.34	50.6	1.875	1.61
Previcur Energy	2	1	5.4	6.4	2.663	92.79	58.1	2.153	1.61
AHDB 9959	1	2	28.2	21.8	2.611	87.74	49.7	2.024	2.48
AHDB 9958	2	2	4.2	10.6	2.167	92.02	43.9	2.691	2.31
AHDB 9963	1	3	42.4	39.5	0.958	15.52	35.7	2.878	2.16
AHDB 9960	2	3	27.5	28.4	0.903	87.63	22.3	2.545	1.82
AHDB 9967	1	4	5.4	12	2.323	56.06	41.5	2.167	2.08
AHDB 9955	2	4	16.5	17.6	2.434	87.84	41.5	2.111	2.08
F value (7, 29)			9.99	7.02	23.65	100.36	1.61	1.49	0.96
P value			<0.001	<0.001	<0.001	<0.001	0.171	0.21	0.478
d.f.			29	29	29	29	29	29	29
s.e.d. (different ps2 values)			6.11	5.82	0.2017	3.863	11.8	0.4078	0.443
s.e.d. (same ps2 values)			5.93	5.65	0.1957	3.748	11.44	0.3956	0.43
I.s.d. (Different ps2 value)			12.5	11.91	0.4125	7.901	24.12	0.8341	0.907
I.s.d. (same ps2 value)			12.13	11.55	0.4002	7.665	23.4	0.8092	0.88

	Results significantly better than the untreated control
	Results significantly worse than the control

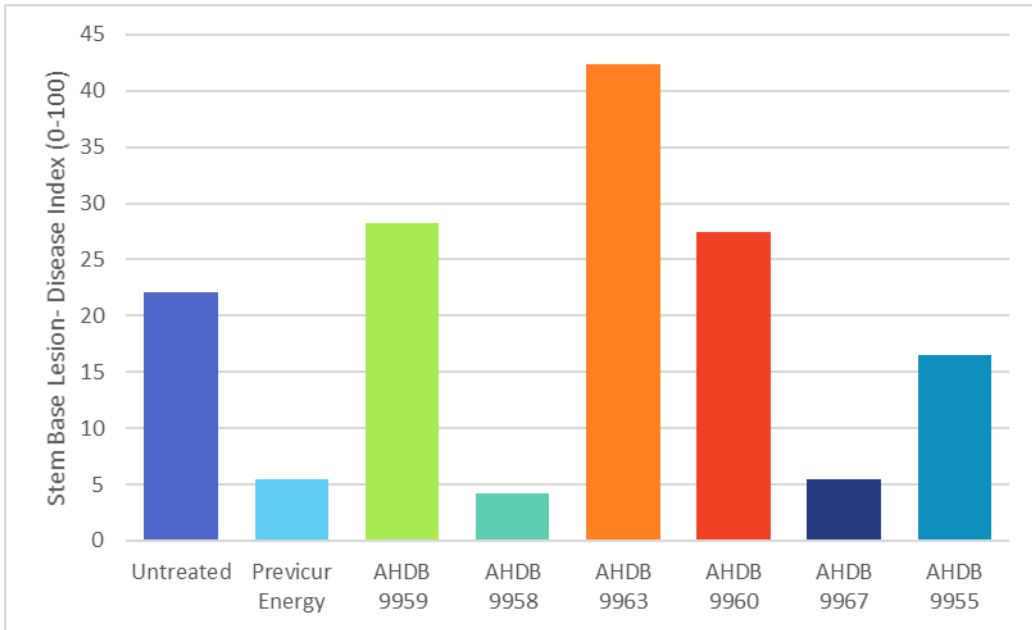


Figure 2: Stem Base Lesion (Disease Index) 16.10.17

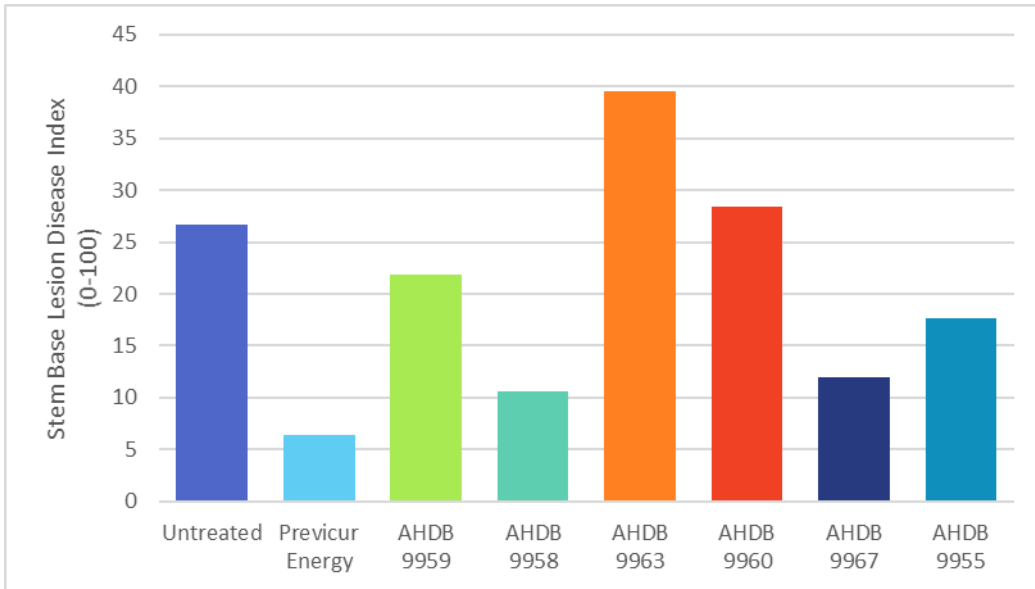


Figure 3: Stem Base Lesion (Disease Index) 01.11.17

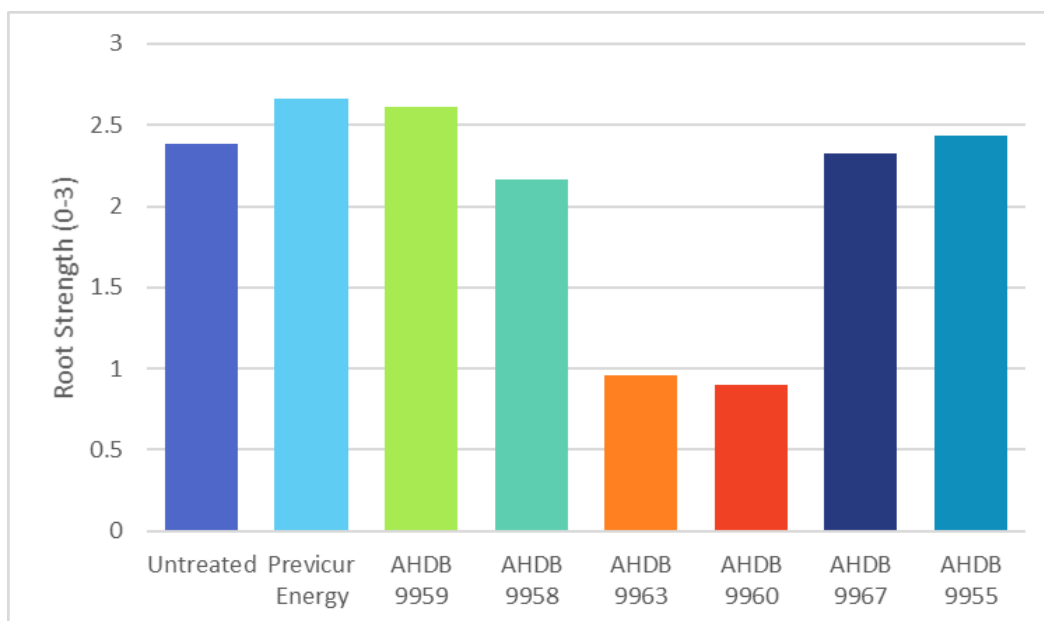


Figure 4: Root Strength (0-3) 01.11.17

Efficacy

The most useful disease assessment carried out in the trial was the severity of stem base lesions. Percent efficacy of the test products, based on the disease index calculated from stem base lesion assessments, is shown in Table 2

Table 2: % Efficacy of products based on stem base lesion assessments

	Date	16/10/2017	01/11/2017
Untreated			
Previcur Energy		75.6	76.0
AHDB 9959		-27.6	18.4
AHDB 9958		81.0	60.3
AHDB 9963		-91.9	-47.9
AHDB 9960		-24.4	-6.4
AHDB 9967		75.6	55.1
AHDB 9955		25.3	34.1

Agronomic Features

Assessments of agronomic features are shown in Table 3. These assessments may highlight disease effects (where root rot is limiting plant growth and development) but in most of these assessments, where the untreated plots are not significantly worse than the standard, differences observed are perhaps most likely to be caused by phytotoxicity.

Table 3: Assessments of agronomic features

			Total Fruit Number (count)	Total Fruit Weight (g)	Plant Height (cm)	Leaf Area (cm ²)	Stem Diameter (mm)
	ps1	ps2			09.10.17	09.10.17	01.11.17
Untreated	1	1	17.45	8515	178.1	360.8	9.456
Previcur Energy	2	1	17.61	8511	180.5	410.5	9.666
AHDB 9959	1	2	14.34	6869	167.8	341.5	9.193
AHDB 9958	2	2	14.34	6875	157.8	329.6	9.276
AHDB 9963	1	3	3.81	1141	73.4	157.5	8.489
AHDB 9960	2	3	10.31	4513	123.4	286.1	8.689
AHDB 9967	1	4	16.23	7733	172.3	357.9	9.617
AHDB 9955	2	4	17.4	8288	180.5	362.1	9.672
F value (7, 29)			33.18	29.83	34.35	27.7	4.38
P value			<0.001	<0.001	<0.001	<0.001	0.002
d.f.			29	29	29	29	29
s.e.d. (different ps2 values)			1.147	648.4	8.92	20.25	0.2971
s.e.d.(same ps2 values)			1.113	629	8.65	19.65	0.2882
LSD (Different ps2 value)			2.346	1326.1	18.24	41.42	0.6077
LSD (same ps2 value)			2.276	1286.5	17.7	40.18	0.5895

	Results significantly better than the untreated control
	Results significantly worse than the control

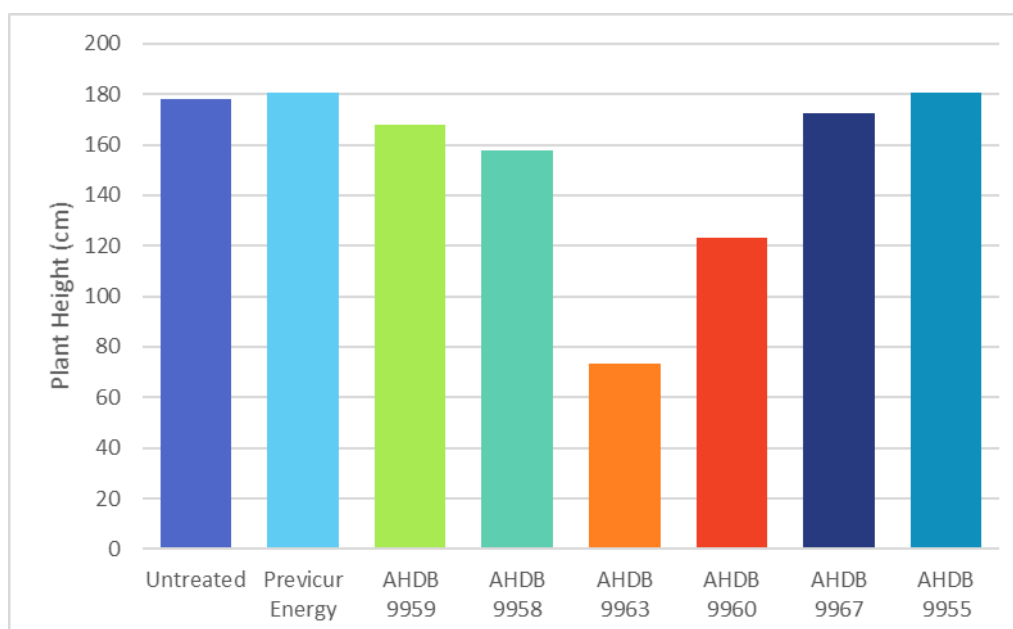


Figure 5: Plant Height (cm) 09.10.17

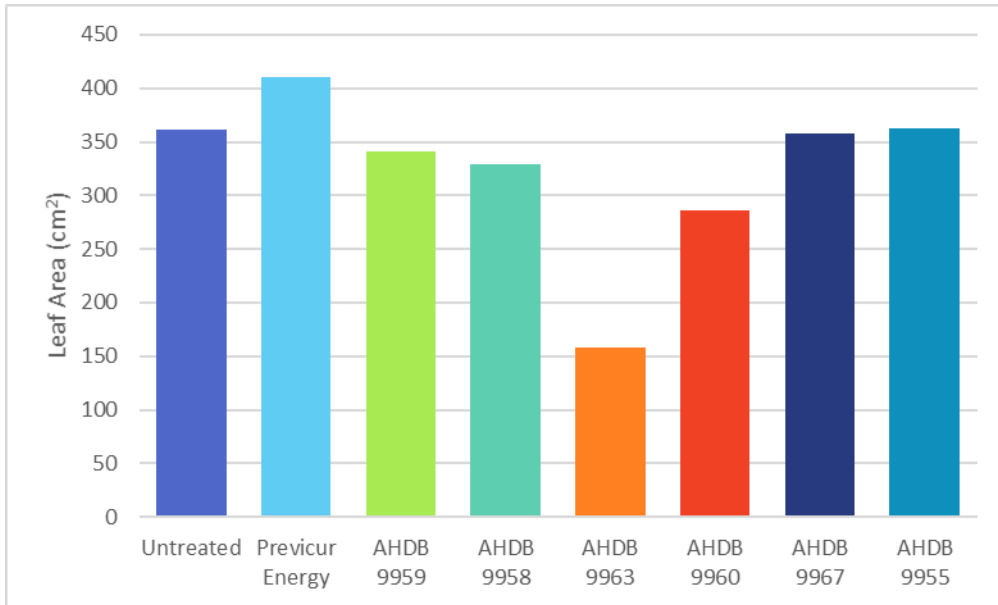


Figure 6: Leaf Area (cm²), measured on leaf 8. 09.10.17

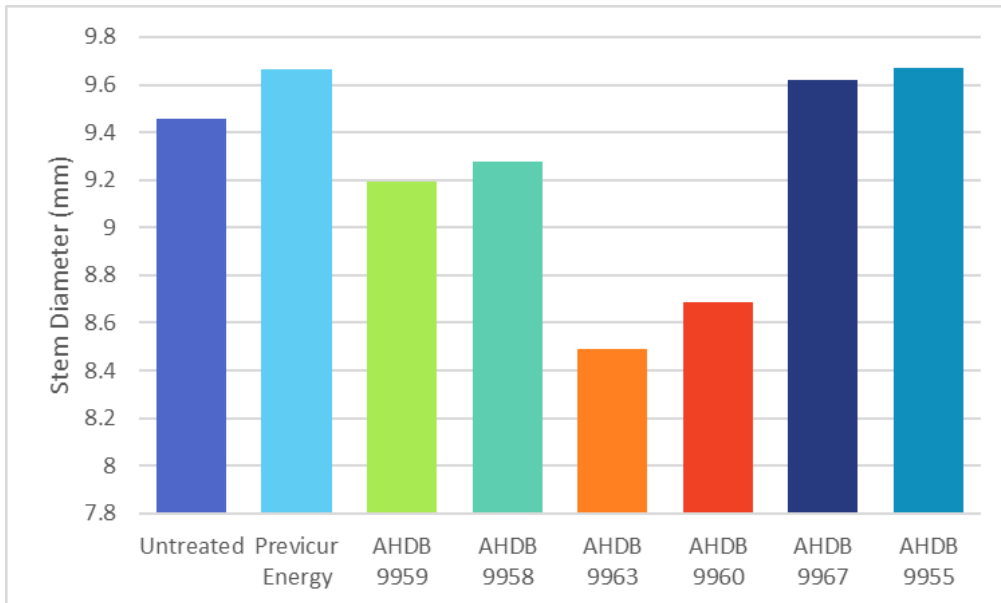


Figure 7: Stem Diameter (mm), measured halfway between stem base and cotyledons 09.10.17

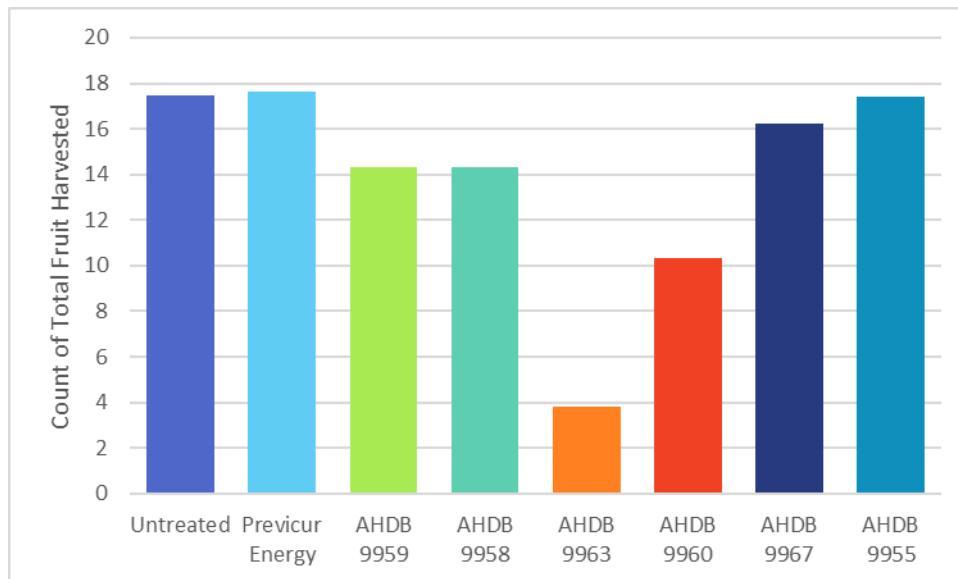


Figure 8 : Total number of fruit harvested during the trial

Root sampling was also carried out and samples inspected microscopically for presence of resting spores (oospores) as an indicator of *Pythium* infection. Results between replicate samples of the same treatment were very inconsistent and no differences were found between treatments.

Discussion

The trial was conducted as described in the protocol, with the following exceptions:

- Treatments AHDB 9958 and AHDB 9959 did not arrive on time to be applied on the day of planting, and so were applied one week late. This had the potential to impact on their efficacy, as their activity was expected to be protectant and not eradicant.
- Due to a calculation error, treatment AHDB 9967 was applied at 0.04% rather than at the 0.4% stated in the protocol.

Disease levels in the trial were expected to be moderate to high due to the level of inoculum used and the effectiveness of this inoculum as proven by the use of bait plants. Planting of the trial was delayed for one week as some test products had not arrived. This delay meant that the test plants were bigger and therefore more robust at planting and got off to a better start on the infested slabs than smaller plants might have. Disease did not reach high levels in the trial and did not cause death of any plants. However, disease symptoms were still observed and the trial provided a moderate test of product efficacy.

The standard product (Previcur Energy) performed well, reducing disease, as assessed by stem base lesion severity, by approximately 80% compared to the untreated control. The trial can therefore be considered valid.

Assessments of root vigour and discolouration were complicated by phytotoxicity effects in some of the treatments and cannot be clearly attributed to infection by *Pythium aphanidermatum*.

However, clear differences in stem base lesion severity allowed us to identify two effective products. AHDB 9958 and AHDB 9967 both reduced the severity of stem base lesions, although, as discussed above, AHDB 9958 was first applied later than scheduled which may have negatively impacted on its efficacy.

These two products did also have some negative impact on the plants. Root strength, plant height and fruit production were all slightly reduced by AHDB 9958, indicating a possible phytotoxic effect from the product. The application rate of this product should be reconsidered in future work. AHDB 9967 appeared to have a negative impact on root growth (% coverage of block) and fruit yield was slightly reduced. This is a biopesticide product and was applied 7 times on a weekly basis so future work should consider less frequent applications. Handling of this product was slightly less straight forward than others as it foamed a lot when mixed.

One treatment (AHDB 9963) gave severe phytotoxicity even after one application and whilst plants did survive, growth was severely checked and fruit production very poor. Stem base lesion severity was significantly higher with this treatment, possibly due to the weakening of the plant by the product leading to higher infection levels.

Other test products also appeared to negatively impact on plant growth, as seen in the agronomic assessments. Treatments AHDB 9963 and AHDB 9960 both reduced plant height, leaf area, stem diameter and fruit yield when compared to the untreated and standard treatments. AHDB 9959 also reduced fruit yield.

Conclusions

- Disease levels were low to moderate in the untreated plots.
- The standard product worked well, giving good reduction of stem base lesions.
- Two test products gave reductions in stem base lesions although they also negatively impacted on other aspects of plant growth.
- One product gave severe phytotoxicity effects and two others caused slight phytotoxicity.
- Calculating appropriate product rates for use as drenches in hydroponic systems can be challenging and if possible differential dose rates should be included, especially where there is limited prior knowledge available.
- Further work under higher disease pressure would be preferable before drawing firm conclusions and finalising product selection to pursue approved use.

Acknowledgements

We would like to thank AHDB and the participating crop protection companies for project funding. We would also like to thank Derek Hargreaves and Ian Bedford for providing inoculum for the trial and for technical advice and guidance.

Appendix A: Crop diary

Crop	Cultivar	Sowing date	Planting date
Cucumber	Shakira	01/08/2017	11/09/2017

Previous cropping

Year	Crop
2017	Cucumber

Pesticides applied to the trial area



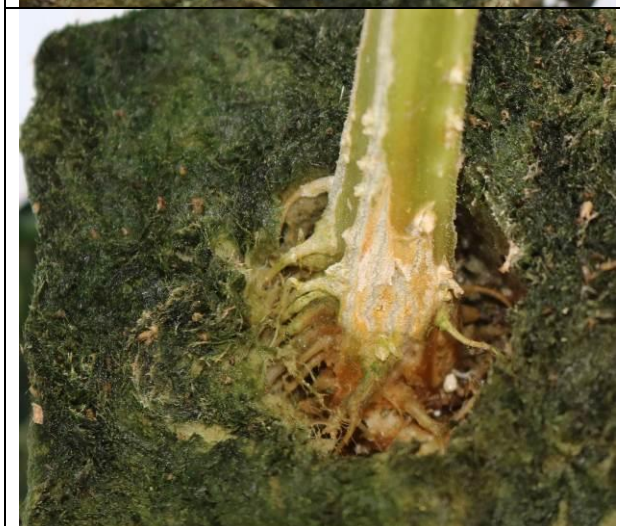
Date	Product	Rate	Unit
29/09/2017	Systhane	0.375	l/ha

Appendix B: Trial Diary

Date	Event
11/9/17	Application A
18/9/17	All symptoms due to phytotoxicity assessed
18/9/17	Application B
25/9/17	Application C
02/10/17	Harvest assessment- fruit count and weight (g) from each plot
02/10/17	Application D
09/10/17	Leaf 8 detached from each plant and area measured using Leaf Area Meter (cm ²)
09/10/17	Height of each plant measured (cm)
09/10/17	Harvest assessment- fruit count and weight (g) from each plot
10/10/17	Application E
16/10/17	Stem base lesions assessed, per plant, using 0-3 severity scale
16/10/17	Harvest assessment- fruit count and weight (g) from each plot
16/10/17	Application F
23/10/17	Harvest assessment- fruit count and weight (g) from each plot
23/10/17	Application G
30/10/17	Plant vigour and colour, per plot, assessed on 0-3 scale
30/10/17	Harvest assessment- fruit count and weight (g) from each plot
01/11/17	Stem diameter measured halfway between block and cotyledons (mm)
01/11/17	Stem base lesions assessed, per plant, using 0-3 severity scale
01/11/17	Rooting strength between block and slab assessed on 0-3 scale
01/11/17	Root discolouration on underside of block assessed on 0-3 scale
01/11/17	Root coverage on underside of block assessed, %
01/11/17	Root discolouration on underside of slab assessed on 0-3 scale
01/11/17	Root coverage on underside of slab assessed, %

Appendix C: Photographs

Stem base lesions severity (01.11.2017)

	Score = 0
	Score = 1
	Score = 2

No plants scored a 3 for stem base lesion.

Slab Root Discolouration (01.11.2017)



Appendix D: Climatological data

	Max temp	Min temp	Average RH
Date	°C	°C	%
01/09/2017	34.1	11.5	99.47
02/09/2017	30.5	12.52	99.39
03/09/2017	25.61	14.69	99.53
04/09/2017	26.08	16.3	99.53
05/09/2017	27.5	16.2	99.35
06/09/2017	26.21	14.72	99.37
07/09/2017	26.05	15	99.43
08/09/2017	28.16	15.32	99.34
09/09/2017	26.54	13	99.34
10/09/2017	25.08	12.08	99.46
11/09/2017	26.6	13.3	99.24
12/09/2017	25.99	13.99	69.91
13/09/2017	26.66	13.62	60.37
14/09/2017	26.65	19.28	59.81
15/09/2017	25.43	19.19	62.45
16/09/2017	26	19.42	64.15
17/09/2017	26.38	19.58	71.11
18/09/2017	27.21	19.54	69.08
19/09/2017	34.7	19.54	62.80
20/09/2017	29.44	19.71	72.35
21/09/2017	22.12	19.63	83.17
22/09/2017	32.17	19.6	66.69
23/09/2017	29.09	19.61	78.44
24/09/2017	31.16	19.7	72.96
25/09/2017	23.97	19.71	86.17
26/09/2017	26.1	19.56	85.97
27/09/2017	25.6	19.7	82.06
28/09/2017	32.18	19.7	79.09
29/09/2017	26.93	19.62	82.86
30/09/2017	28.85	19.58	78.21
01/10/2017	24.1	19.61	86.22
02/10/2017	27.54	19.5	76.30
03/10/2017	27.76	19.72	76.64
04/10/2017	21.41	19.49	80.82
05/10/2017	27.64	19.1	77.01
06/10/2017	28.31	19.7	76.96
07/10/2017	22.08	19.47	85.26
08/10/2017	28.75	19.6	84.65
09/10/2017	27.37	19.59	87.62
10/10/2017	25.27	19.72	88.42

	Max temp	Min temp	Average RH
Date	°C	°C	%
11/10/2017	22.15	19.62	87.22
12/10/2017	26.6	19.6	83.17
13/10/2017	27.72	19.71	88.61
14/10/2017	30.47	19.79	88.49
15/10/2017	29.43	19.7	85.82
16/10/2017	23.98	19.38	88.11
17/10/2017	25.56	19.69	82.33
18/10/2017	26	19.03	82.08
19/10/2017	21.09	19.52	80.11
20/10/2017	26.62	19.5	77.47
21/10/2017	24.21	19.32	72.47
22/10/2017	23.77	19.62	68.92
23/10/2017	24.64	19.6	75.24
24/10/2017	25.39	19.6	83.38
25/10/2017	24.33	19.48	80.83
26/10/2017	20.23	19.68	76.89
27/10/2017	27.62	19.3	69.35
28/10/2017	23.75	19.71	77.21
29/10/2017	25.48	19.33	74.04
30/10/2017	22.49	18.1	72.49
31/10/2017	20.4	14.3	80.35

Appendix E: Raw data from assessments
Assessments with 3 subsamples per plot

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
1	1	1	1	6	165	330.1	0	8.48	0	0	3	100
1	1	1	1	6	90	269.74	1	8.61	1	0	2	90
1	1	1	1	6	95	270.21	2	8.89	2	1	3	80
1	1	2	2	7	185	307.65	1	9.02	1	2	3	60
1	1	2	2	7	142	433.71	1	10.21	2	3	3	50
1	1	2	2	7	185	259.68	0	9.57	0	3	2	75
1	1	3	3	5	80	183.7	1	7.33	1	1	3	15
1	1	3	3	5	140	163.78	2	10.11	2	1	3	10
1	1	3	3	5	57	145.04	1	7.28	2	1	3	15
1	1	4	4	8	140	345.66	0	10.67	1	2	3	85
1	1	4	4	8	147	333.47	0	8.41	0	2	3	90
1	1	4	4	8	163	312.73	0	7.24	0	1	3	90
1	1	5	5	1	182	261.61	0	8.95	0	2	3	80
1	1	5	5	1	100	271.41	0	8.3	0	2	3	95
1	1	5	5	1	125	393.61	2	10.74	2	2	3	90
1	1	6	6	4	170	278.95	0	8.43	0	2	2	95
1	1	6	6	4	170	339.45	1	10.73	1	2	1	100
1	1	6	6	4	125	250.4	0	7.86	0	2	3	80
1	1	7	7	3	160	356.01	1	9.69	0	3	3	85
1	1	7	7	3	137	322.82	2	8.55	1	2	3	90

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
1	1	7	7	3	173	354.6	0	8.42	1	3	3	95
1	1	8	8	2	160	349.83	0	8.12	0	3	1	98
1	1	8	8	2	185	385.56	0	8.5	0	3	1	95
1	1	8	8	2	175	484.51	0	9.23	0	1	1	95
2	2	1	9	3	200	291.67	2	9.2	1	3	1	90
2	2	1	9	3	190	289.81	2	8.91	1	2	1	95
2	2	1	9	3	185	404.16	1	10.31	1	3	1	80
2	2	2	10	8	180	276.97	2	10.43	1	3	2	98
2	2	2	10	8	185	371.81	1	9.69	0	2	3	95
2	2	2	10	8	190	316.1	0	10.6	0	2	2	98
2	2	3	11	1	160	256.34	1	9.57	1	2	2	98
2	2	3	11	1	195	366.96	1	10.48	1	3	2	100
2	2	3	11	1	150	350.76	1	9.79	1	2	3	85
2	2	4	12	6	110	277.08	1	7.88	1	1	2	90
2	2	4	12	6	140	291.47	1	8.33	1	1	2	95
2	2	4	12	6	110	243.25	0	8.6	0	1	2	95
2	2	5	13	2	180	408.54	0	9.78	0	3	2	98
2	2	5	13	2	167	397.7	0	9.78	0	2	2	95
2	2	5	13	2	158	294.74	0	9.27	0	3	1	80
2	2	6	14	5	45	133.53	2	9.43	1	1	3	20
2	2	6	14	5	80	171.01	1	9.12	1	1	3	10
2	2	6	14	5	70	155.38	1	9.27	1	1	3	15

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
2	2	7	15	7	130	346.65	0	8.27	1	2	3	60
2	2	7	15	7	140	320.52	1	9.21	1	2	2	50
2	2	7	15	7	145	294.56	0	9.67	0	2	3	30
2	2	8	16	4	145	255.94	0	9.35	0	3	3	95
2	2	8	16	4	150	290.65	0	9.97	1	3	3	90
2	2	8	16	4	155	345.01	0	9.7	0	3	3	95
3	3	1	17	4	147	332.39	0	8.55	1	1	3	85
3	3	1	17	4	147	398.33	1	9.47	0	2	3	95
3	3	1	17	4	167	328.67	0	7.58	0	2	3	95
3	3	2	18	5	45	235.08	2	7.89	1	1	2	10
3	3	2	18	5	90	142.77	2	7.94	2	1	3	15
3	3	2	18	5	50	157.75	1	7.52	1	1	3	20
3	3	3	19	2	200	491.61	0	9.82	0	3	3	85
3	3	3	19	2	200	451.69	0	9.65	0	3	2	85
3	3	3	19	2	167	608.41	0	9.15	0	2	2	95
3	3	4	20	7	165	369.19	0	9.44	1	2	2	90
3	3	4	20	7	200	422.31	0	10.12	0	3	2	40
3	3	4	20	7	195	420.71	0	9.28	0	2	2	50
3	3	5	21	6	95	264.5	1	9.26	1	1	3	90
3	3	5	21	6	90	166.61	0	7.73	0	1	3	90
3	3	5	21	6	140	292.36	2	9.24	1	1	3	90
3	3	6	22	3	125	311.32	1	8.98	0	2	3	70

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
3	3	6	22	3	135	313.83	0	8.52	0	3	3	75
3	3	6	22	3	140	284.46	0	9.27	0	2	2	70
3	3	7	23	8	190	374.42	1	9.74	1	3	1	80
3	3	7	23	8	190	434.27	1	9.81	1	2	1	75
3	3	7	23	8	195	395.21	0	8.85	1	3	1	90
3	3	8	24	1	155	413.35	0	9.99	1	3	1	85
3	3	8	24	1	190	498.75	0	9.38	1	3	2	90
3	3	8	24	1	175	389.87	0	9.14	0	3	2	98
4	4	1	25	2	190	401.14	1	10.34	1	3	2	80
4	4	1	25	2	180	366.87	0	10.11	0	3	3	95
4	4	1	25	2	163	324.61	0	10.43	0	3	3	100
4	4	2	26	5	130	202.19	1	9.38	1	1	3	15
4	4	2	26	5	47	103.14	1	7.15	1	1	3	10
4	4	2	26	5	100	132.18	2	9.75	2	1	3	10
4	4	3	27	1	200	363.14	0	10.2	1	2	1	80
4	4	3	27	1	190	324.38	0	9.36	0	3	2	95
4	4	3	27	1	205	469.36	1	9.72	1	2	2	95
4	4	4	28	6	120	309.09	0	8.86	0	1	3	80
4	4	4	28	6	125	291.31	1	8.63	2	1	3	95
4	4	4	28	6	130	294.12	1	8.59	1	1	3	95
4	4	5	29	7	160	328.98	0	10.04	0	3	2	50
4	4	5	29	7	160	319.53	0	9.64	0	2	1	40

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
4	4	5	29	7	185	378.27	0	8.77	0	2	2	60
4	4	6	30	4	160	372.68	0	9.28	0	2	2	70
4	4	6	30	4	175	378.21	0	9.4	0	2	3	90
4	4	6	30	4	157	347.84	0	9.35	0	3	3	98
4	4	7	31	8	178	464.24	0	11.25	0	3	2	90
4	4	7	31	8	200	534.94	0	11.1	1	3	1	85
4	4	7	31	8	200	335.54	1	9.55	1	3	1	75
4	4	8	32	3	170	384.49	0	8.37	0	3	1	90
4	4	8	32	3	168	359.68	1	9.53	1	2	1	98
4	4	8	32	3	175	355.54	2	8.19	1	3	2	98
5	5	1	33	6	135	293.82	0	8.77	1	1	2	100
5	5	1	33	6	163	241.99	1	10.13	0	1	2	90
5	5	1	33	6	180	352.87	1	9.63	1	1	2	95
5	5	2	34	3	160	354.47	1	8.29	1	3	2	90
5	5	2	34	3	215	448.21	0	11.29	0	3	3	85
5	5	2	34	3	170	246.59	0	9.93	0	3	3	95
5	5	3	35	2	205	398.68	0	9.23	0	3	3	90
5	5	3	35	2	185	456.57	0	8.92	0	2	3	95
5	5	3	35	2	188	401.71	1	10.67	1	3	3	95
5	5	4	36	7	185	440.62	0	10.35	0	2	2	60
5	5	4	36	7	195	283.01	0	9.59	0	2	3	60
5	5	4	36	7	190	288.39	0	9.16	0	3	3	60

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
5	5	5	37	8	192	359.91	1	10.51	1	2	2	75
5	5	5	37	8	175	352.16	1	9.57	1	2	3	80
5	5	5	37	8	205	391.83	1	9.32	0	2	2	85
5	5	6	38	1	190	33.08	0	10.66	1	2	1	50
5	5	6	38	1	158	371.08	1	8.89	0	2	1	60
5	5	6	38	1	230	504.04	1	7.82	1	3	1	85
5	5	7	39	4	168	379.06	0	10.96	0	2	3	90
5	5	7	39	4	170	296.63	0	9.12	0	2	2	95
5	5	7	39	4	165	362.53	0	9.29	1	3	2	90
5	5	8	40	5	45	191.51	1	8.68	0	0	3	20
5	5	8	40	5	68	73.87	1	9.17	1	1	3	30
5	5	8	40	5	88	142.94	0	6.8	1	1	3	15
6	6	1	41	4	110	331.65	1	9.1	1	1	3	90
6	6	1	41	4	160	316.23	0	9.89	1	2	3	90
6	6	1	41	4	178	274.03	0	9.69	0	2	2	95
6	6	2	42	1	200	352.57	1	8.72	1	3	2	98
6	6	2	42	1	200	398.19	0	7.84	1	2	2	98
6	6	2	42	1	185	369.99	2	10.65	1	2	2	100
6	6	3	43	5	55	193.97	1	9.37	1	1	3	25
6	6	3	43	5	65	202.38	1	8.58	1	1	3	20
6	6	3	43	5	82	130.38	2	8.47	1	1	3	30
6	6	4	44	8	160	438.95	0	9.57	0	3	2	95

				Description	plant height (cm)	leaf area (leaf 8) (cm ²)	stem base lesion (0-3)	stem diameter (mm)	stem base lesion (0-3)	root vigour (0-3)	block root colour (0-3)	root coverage block %
				Rating Date	09/10/2017	09/10/2017	16/10/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017	01/11/2017
				Subsamples	3	3	3	3	3	3	3	3
Rep	Block	Column	Plot	Trt								
6	6	4	44	8	195	287.98	0	8.32	0	3	3	98
6	6	4	44	8	185	327.44	0	8.27	1	3	2	98
6	6	5	45	2	190	359.01	0	9.32	0	2	3	98
6	6	5	45	2	180	377.45	0	10.96	0	3	3	98
6	6	5	45	2	160	323.97	0	10.7	1	3	2	85
6	6	6	46	3	163	386.79	1	9.92	2	3	1	95
6	6	6	46	3	155	331.73	1	8.48	1	2	1	70
6	6	6	46	3	178	296.42	1	10.38	1	2	1	90
6	6	7	47	6	150	370.04	1	8.33	0	1	3	98
6	6	7	47	6	100	315.75	1	9.23	1	1	3	60
6	6	7	47	6	100	299.5	1	7.65	2	1	3	70
6	6	8	48	7	175	477.75	0	8.84	1	2	1	85
6	6	8	48	7	210	498.54	0	10.77	0	3	1	40
6	6	8	48	7	175	387.92	0	9.96	0	2	1	50

Appendix E (cont): Raw Data from assessments
Assessments with one subsample per plot

Description					Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Total fruit count	Total fruit yield (g)	disease index (0-100)	root coverage slab %	slab root colour (0-3)	disease index (0-100)
Rating Date					02.10.17	02.10.17	09.10.17	09.10.17	16.10.17	16.10.17	23.10.17	23.10.17	30.10.17	30.10.17			16.10.17	01.11.17	01.11.17	01.11.17
Subsamples					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rep	Block	Column	Plot	Trt																
1	1	1	1	6	3	1206	2	969	1	460	2	695	1	450	9	3780	33.33	5	3	33.33
1	1	2	2	7	3	989	4	1975	3	1274	3	1863	3	1530	16	7631	22.22	40	2	33.33
1	1	3	3	5	0	0	0	0	2	635	1	533	0	0	3	1168	44.44	50	3	55.56
1	1	4	4	8	3	1121	3	1361	0	0	4	2145	2	1060	12	5687	0	60	2	11.11
1	1	5	5	1	2	901	4	1930	1	554	2	1103	4	2140	13	6628	22.22	75	1	22.22
1	1	6	6	4	3	1298	4	1952	1	558	3	1981	2	1200	13	6989	11.11	70	2	11.11
1	1	7	7	3	2	842	4	1960	2	1027	1	666	4	2310	13	6805	33.33	60	3	22.22
1	1	8	8	2	3	1132	3	1325	3	1383	7	3536	3	1510	19	8886	0	80	1	0
2	2	1	9	3	3	1164	3	1578	3	1491	4	2294	4	2050	17	8577	55.56	65	2	33.33
2	2	2	10	8	3	1326	4	1976	3	1369	3	1971	5	2500	18	9142	33.33	50	2	11.11
2	2	3	11	1	3	1255	3	1551	2	883	4	2190	3	1730	15	7609	33.33	20	3	33.33
2	2	4	12	6	3	1209	3	1510	1	462	2	1279	1	370	10	4830	22.22	10	2	22.22
2	2	5	13	2	3	1304	3	1645	4	1893	3	2159	4	1880	17	8881	0	60	2	0
2	2	6	14	5	0	0	3	780	0	0	0	0	1	450	4	1230	44.44	40	3	33.33
2	2	7	15	7	3	1033	1	431	2	830	3	1483	4	1830	13	5607	11.11	60	2	22.22
2	2	8	16	4	3	1214	2	895	1	452	4	1964	3	1630	13	6155	0	15	3	11.11
3	3	1	17	4	3	1024	3	1491	3	1365	3	1622	3	1490	15	6992	11.11	70	2	11.11
3	3	2	18	5	0	0	2	651	0	0	1	224	1	250	4	1125	55.56	70	2	44.44

Description					Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Total fruit count	Total fruit yield (g)	disease index (0-100)	root coverage slab %	slab root colour (0-3)	disease index (0-100)
Rating Date					02.10.17	02.10.17	09.10.17	09.10.17	16.10.17	16.10.17	23.10.17	23.10.17	30.10.17	30.10.17			16.10.17	01.11.17	01.11.17	01.11.17
Subsamples					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rep	Block	Column	Plot	Trt																
3	3	3	19	2	2	778	4	1976	4	1868	5	2575	3	1550	18	8747	0	65	3	0
3	3	4	20	7	3	1260	3	1528	2	1119	4	2473	4	2210	16	8590	0	5	3	11.11
3	3	5	21	6	2	954	2	918	1	482	3	1068	1	390	9	3812	33.33	80	1	22.22
3	3	6	22	3	2	806	4	1676	1	425	3	1435	2	920	12	5262	11.11	30	3	0
3	3	7	23	8	3	996	4	2065	3	1397	3	1927	6	2950	19	9335	22.22	15	3	33.33
3	3	8	24	1	2	765	5	2206	2	928	5	2802	4	2190	18	8891	0	40	3	22.22
4	4	1	25	2	3	1385	4	1857	4	1986	5	3092	3	1230	19	9550	11.11	35	1	11.11
4	4	2	26	5	0	0	1	319	2	688	0	0	3	1080	6	2087	44.44	20	2	44.44
4	4	3	27	1	3	1349	3	1400	4	2137	4	2158	6	2760	20	9804	11.11	50	1	22.22
4	4	4	28	6	3	1182	3	1442	1	338	2	967	1	440	10	4369	22.22	10	3	33.33
4	4	5	29	7	3	1054	4	1364	4	1797	3	1583	4	1950	18	7748	0	45	1	0
4	4	6	30	4	3	1165	3	1632	1	416	5	2665	3	1300	15	7178	0	45	3	0
4	4	7	31	8	3	1283	3	1770	4	1934	4	2305	5	2520	19	9812	11.11	50	2	22.22
4	4	8	32	3	2	764	4	1722	3	1362	3	2112	4	1970	16	7930	33.33	50	3	22.22
5	5	1	33	6	3	1284	3	1520	4	1775	2	1169	2	970	14	6718	22.22	15	1	22.22
5	5	2	34	3	2	868	1	410	2	909	4	1897	5	2410	14	6494	11.11	50	2	11.11
5	5	3	35	2	3	1104	3	1395	2	807	6	2832	5	2290	19	8428	11.11	40	2	11.11
5	5	4	36	7	3	1186	3	1575	3	1436	4	2203	4	1940	17	8340	0	50	2	0
5	5	5	37	8	3	1258	4	1698	2	838	4	2128	7	3010	20	8932	33.33	45	2	22.22

Description					Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Harvest count	Harvest yield (g)	Total fruit count	Total fruit yield (g)	disease index (0-100)	root coverage slab %	slab root colour (0-3)	disease index (0-100)
Rating Date					02.10.17	02.10.17	09.10.17	09.10.17	16.10.17	16.10.17	23.10.17	23.10.17	30.10.17	30.10.17			16.10.17	01.11.17	01.11.17	01.11.17
Subsamples					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rep	Block	Column	Plot	Trt																
5	5	6	38	1	3	1179	3	1482	2	870	7	3416	4	1760	19	8707	22.22	70	1	22.22
5	5	7	39	4	3	1142	4	1985	2	893	6	3325	3	1430	18	8775	0	50	1	11.11
5	5	8	40	5	0	0	0	0	2	672	0	0	1	290	3	962	22.22	15	1	22.22
6	6	1	41	4	3	1092	2	945	2	746	3	1460	3	1240	13	5483	11.11	30	2	22.22
6	6	2	42	1	3	1167	4	1950	3	1202	4	2108	4	1900	18	8327	33.33	40	1	33.33
6	6	3	43	5	0	0	2	454	0	0	1	389	0	0	3	843	44.44	15	2	33.33
6	6	4	44	8	1	303	5	2173	3	965	4	1920	4	1690	17	7051	0	25	2	11.11
6	6	5	45	2	1	332	5	2202	1	352	2	874	3	1690	12	5450	0	60	1	11.11
6	6	6	46	3	1	335	4	1674	1	386	4	1913	5	2160	15	6468	33.33	60	1	44.44
6	6	7	47	6	2	630	4	1712	1	340	1	479	2	980	10	4141	33.33	10	1	33.33
6	6	8	48	7	1	359	4	1783	4	1753	5	2688	4	2130	18	8713	0	45	3	11.11

Appendix F. ORETO Certificate



Certificate of

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

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 Signatory

Certification Number

ORETO 372


Chemicals Regulation Division

 Department of
Agriculture and
Rural Development