



# PGRO Final Report

## DOWNY MILDEW ON COMBINING PEAS

### SLOT TRIALS 2022

Determining the efficacy of four fungicides to control downy mildew in combining peas.

Project title	Determining the efficacy of four fungicides control downy mildew in combining peas.
Sponsor project reference	
Country / Region / EPPO zone	United Kingdom EPPO Maritime zone
Target crop	Combining peas ( <i>Pisum sativum</i> )
Target pest	Downy mildew ( <i>Peronospora viciae</i> )
Experimental permit reference	
GEP	Yes
Report author	Dina Gomez
Date issued	October 2022
Trial year	2022
Trials by	PGRO Research Ltd Great North Road Thornhaugh Cambridgeshire PE8 6HJ United Kingdom
Sponsor	Several

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## Declarations

We the undersigned hereby declare that the report submitted constitutes the Final Report of the study above and that all data reported here represent a true and accurate record of the results obtained. Every reasonable effort was made to ensure that disease, insect, weed pressures and crop husbandry were as relevant to the trial aims as possible.



Dina Gomez,  
Technical Officer

## Objectives

To determine,

- The efficacy of four fungicides to control downy mildew in combining peas.
- How the efficacy of four confidential products compared with the standards Revus, Phorce and Amistar.

## Summary

- All the standards and confidential products tested in this trial, provided significant reduction of downy mildew after the first application compared to the untreated plots of combining peas.
- The efficacy of the treatments after the T2 application was not confirmed due to the low levels of downy mildew infection observed in the untreated plots. This due to the influence of the weather conditions during late June and early July.

## Test items and treatments

**Table 1.** Test items

Name	Active(s)	Conc.	Formulation	Batch/lot	MAPP
Amistar	azoxystrobin	250 g/l	SC	GRA2A00002	18039
Revus	mandipropamid	250 g/l	SC	na	17443
Phorce	N:P2O5: K2O	5-38-15	SC	na	na

**Table 2.** Treatment list

Trt	Description	Rate(s)	Ai(s)	Timing
1	Control, Untreated	n/a	n/a	n/a
2	Revus	0.6 l	150 g	T1 + T2
3	Phorce	1.0 l	N:P <sub>2</sub> O <sub>5</sub> :K <sub>2</sub> O (5:38:15)	T1 + T2
4	Amistar	1.0 l	250 g	T1 + T2
5	Confidential 1	n/a	n/a	T1 + T2
6	Confidential 2	n/a	n/a	T1 + T2
7	Confidential 3	n/a	n/a	T1 + T2
8	Confidential 4	n/a	n/a	T1 + T2
9	Confidential 5			T1 + T2
10	Confidential 6	n/a	n/a	T1 + T2
11	Confidential 7	n/a	n/a	T1 + T2
12	Confidential 8	n/a	n/a	T1 + T2

**Table 3.** Description of application timings

Timing	Growth stage or description of timing	BBCH
T1	20 % full open flower	62
T2	25% of pods at final length	69-72

## Methods

**Trial design** - Plots measured 18 m<sup>2</sup> (1.8x10 m) and were arranged in a randomised complete block layout with four replications according to EPPO guideline PP1/152(4).

**Sprayer details** - Treatments were applied using a hand operated compressed air boom sprayer with a width of two meters. Lurmark 02F110 nozzles were used, operating at a pressure of 2 bar for a fine/medium droplet quality. Spray volumes were 200 l/ha.

**Assessments** - Downy mildew was assessed as percentage leaf area infection on 25 plants per plot (based on EPPO guidelines PP1/65(4)). Assessments were made just prior each treatment application and 8 days and 14 days after T1 application and 6 days after T2 application (Table 4). Phytotoxicity was scored 8 days after T1 application and 6 days after T2 application. For the phytotoxicity evaluation, a scale from 0 to 10 was used, where 10 = No phytotoxicity and 0 denoted dead crop according to EPPO guideline PP1/135(4).

**Analysis** - data were analysed using Analysis of Variance in STAR.

**Table 4.** Trials diary

Activity	Timing	BBCH	Date
Applications	T1	62	07-Jun-22
	T2	69-72	28-Jun-22
Assessments	A1	62	07-Jun-22
	A2 (+ phyto)	65-70	15-Jun-22
	A3	67-72	21-Jun-22
	A4	69-75	27-Jun-22
	A5 (+ phyto)	80-89	04-Jul-22

## Trial site

**Table 5.** Site details for Stubton trial 2022

Test site information	
Town	Stubton
Postcode	NG23 5JH
N	52°59'20.16"
W	0°49'52.53"
Site description	Low weed pressure, mid-field.
Soil analysis	pH: 7.6; P: index 1, K: index 1, Mg: index 2; OM: 4.7%(LOI); Sand: 60%, Silt: 18%. Clay: 22%
Crop	Combining peas ( <i>Pisum sativum</i> )
Variety	Sakura
Drill date	17 March 2022
Inputs	Nirvana (4.4 l/ha) pre-emergence (30-Mar), Benta 480 SL 1.8 l/ha + Butoxone 1.8 l/ha post-emergence (26 Apr) and Aphox (279g/ha)(1-Jun)



a



b

**Figure 1.** a. Evaluation plot. b. Downy mildew symptoms on leaves, stems, and pods.

## Results

During preparation and application one of the confidential products (Treatments 10, 11, 12) showed signs of precipitation and took longer to mix in water.

All data are shown in Table 6 and Figures 2 to 6 below.

Downy mildew infection recorded in untreated plots at the time of T1 application was 4.21% of the leaf infected area (Table 6).

At A2, 8 days after T1 application, all treatments gave a significant reduction of downy mildew infection compared to the untreated control, apart from treatment 5.

At A3, 14 days after T1, there were no significant differences in downy mildew infection between any of the treatments, and the untreated control plots.

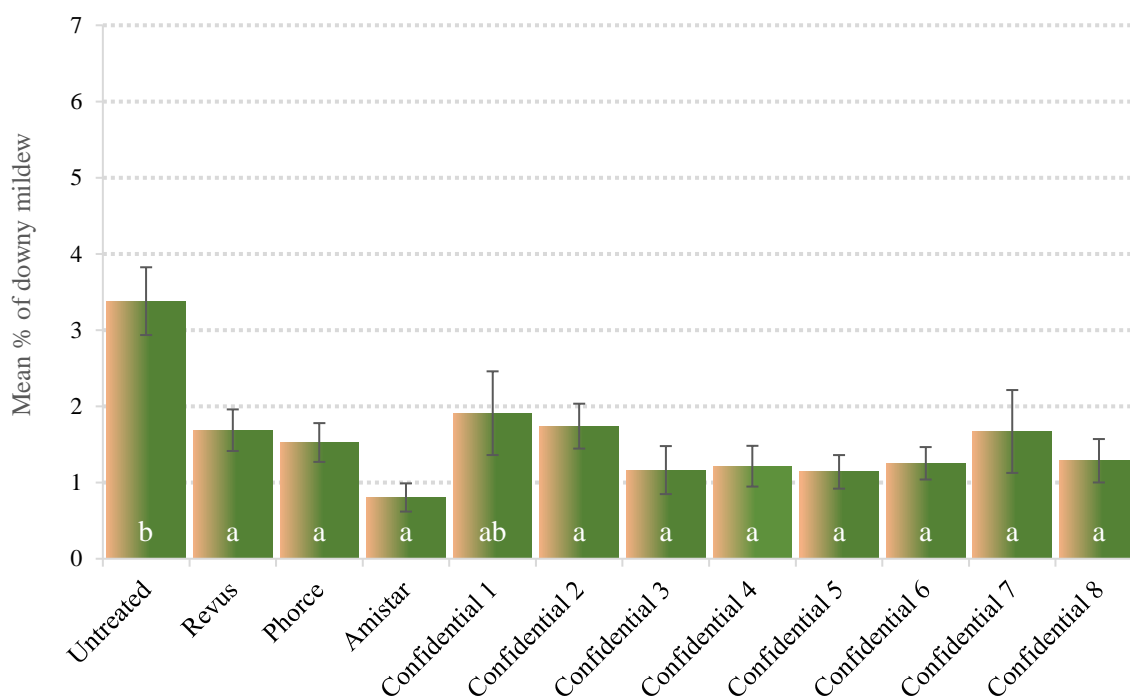
At A4, the day before T2, the percentage leaf area infection in untreated plots was similar to the treated plots.

At A5, 6 days after T2, the level of foliar downy mildew in the untreated plots was slightly lower than the treated plots, showing not significant differences of the treatments compared with the control treatment. The percentage of pod infection did not show any significant effect of the treatments compared to the untreated treatment.

There was not phytotoxicity symptoms observed in any of the plots, showing that all the products tested in this trial are safe to use in this crop.

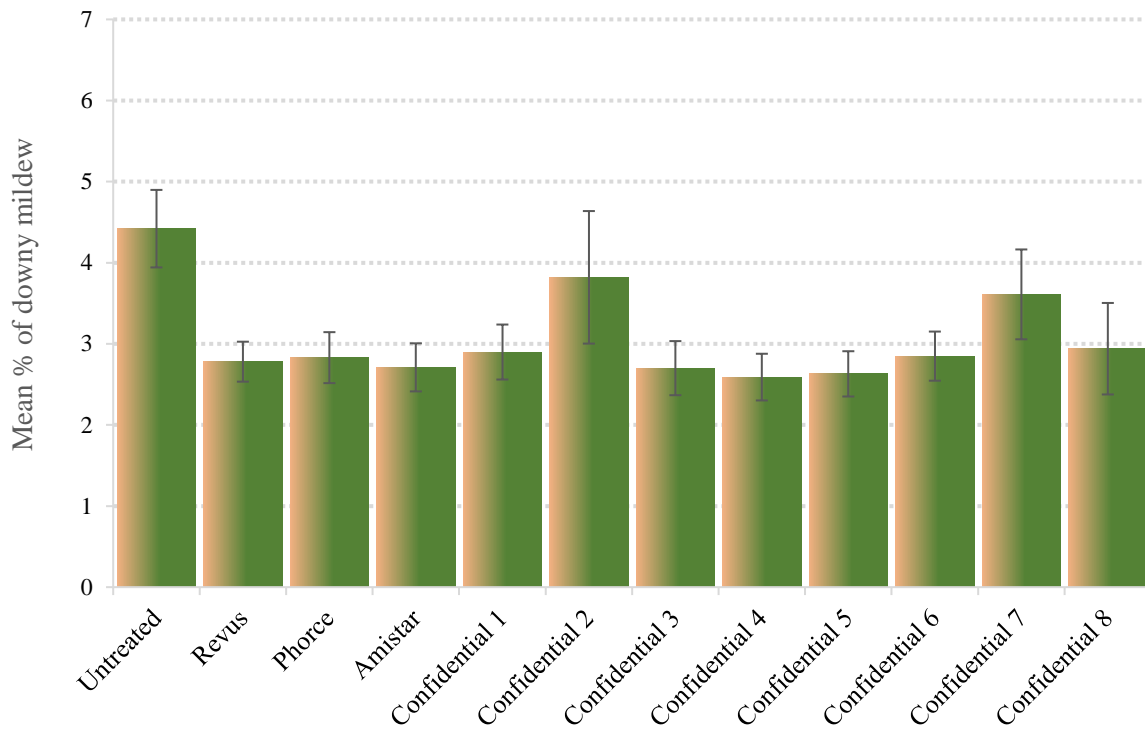
**Table 6.** Mean % leaf area infection with pea downy mildew at all assessment timings and mean percentage pod infection (4 July 22)

No.	Treatment	07-Jun (A1)	15-Jun (A2)	21-Jun (A3)	27-Jun (A4)	04-Jul (A5)	Pod infection %
1	Control, Untreated	4.21	3.38 b	4.42	2.93 ab	4.39 abc	23.83
2	Revus		1.69 a	2.78	2.82 ab	5.04 abc	28.70
3	Phorce		1.53 a	2.83	3.13 ab	5.73 c	20.65
4	Amistar		0.80 a	2.71	2.87 ab	4.01 abc	29.36
5	Confidential 1		1.91 ab	2.90	3.37 ab	4.20 abc	23.74
6	Confidential 2		1.74 a	3.82	2.36 a	3.47 ab	20.81
7	Confidential 3		1.16 a	2.70	2.06 a	4.32 abc	25.74
8	Confidential 4		1.21 a	2.59	2.22 a	3.73 abc	20.12
9	Confidential 5		1.14 a	2.63	2.66 ab	5.26 bc	22.89
10	Confidential 6		1.25 a	2.85	2.62 ab	3.78 abc	26.01
11	Confidential 7		1.67 a	3.61	4.10 b	4.46 abc	23.19
12	Confidential 8		1.29 a	2.94	2.84 ab	3.07 a	19.62
	F-value		3.657	1.751	2.169	2.946	1.315
	P-value		4.02e-05 ***	0.0579 not significant (ns)	0.014 *	0.000737 ***	0.21 ns

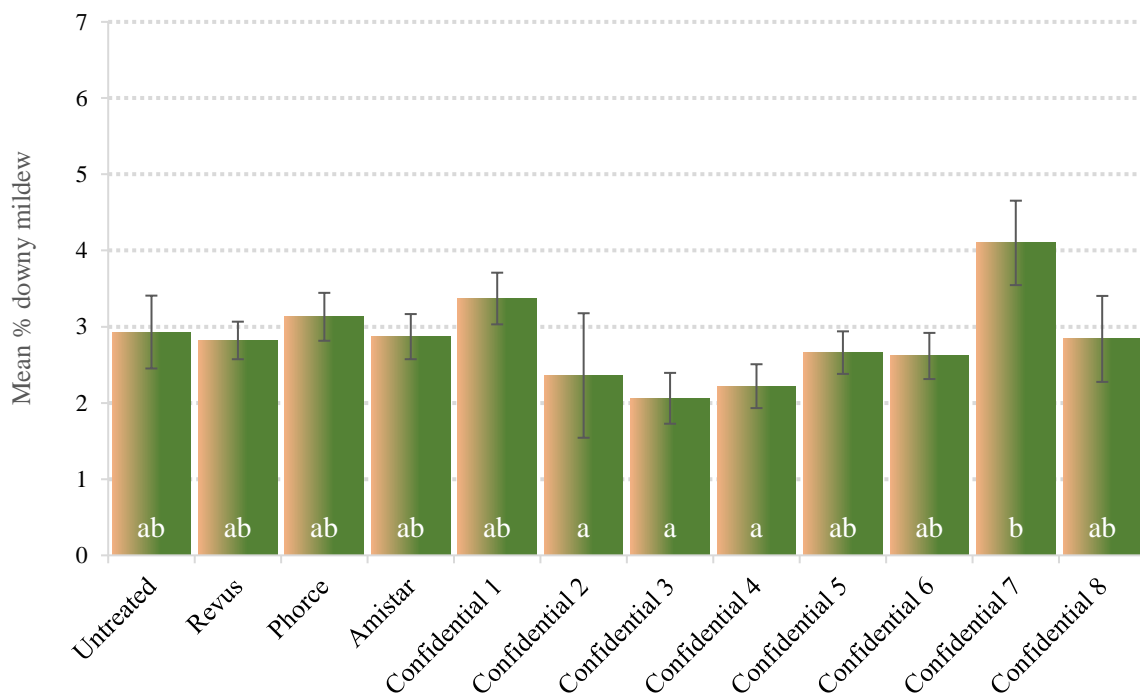


**Figure 2.** Mean % downy mildew leaf area infection per plant at A2 on 15 June 2022.

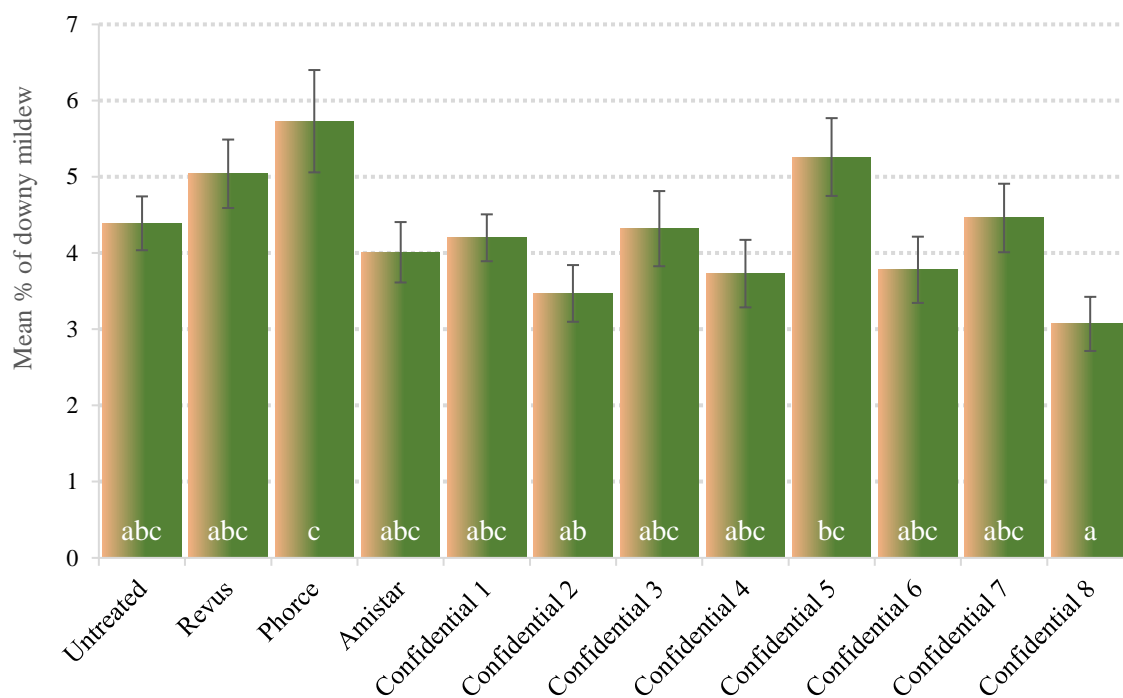




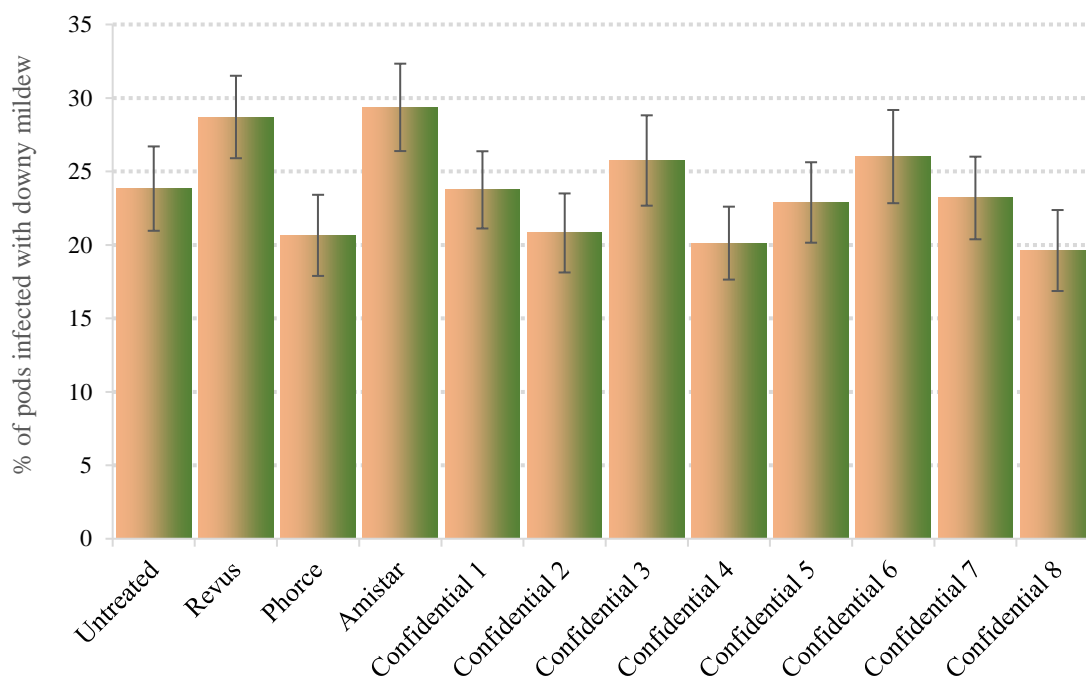
**Figure 3.** Mean % downy mildew leaf area infection per plant at A3 on 21 Jun 2022.



**Figure 4.** Mean % downy mildew leaf area infection per plant at A4 on 27 Jun 2022.



**Figure 5.** Mean % downy mildew leaf area infection per plant at A5 on 04 Jul 2022.



**Figure 6.** Mean % pods infected with downy mildew at A5 on 4 Jul 2022.

**Phytotoxicity:**

No phytotoxic symptoms were observed in any of the treatments at either assessment (Table 7).

**Table 7.** Mean phytotoxicity after T1 and T2 application. 10 = no phytotoxicity 0 = dead plant

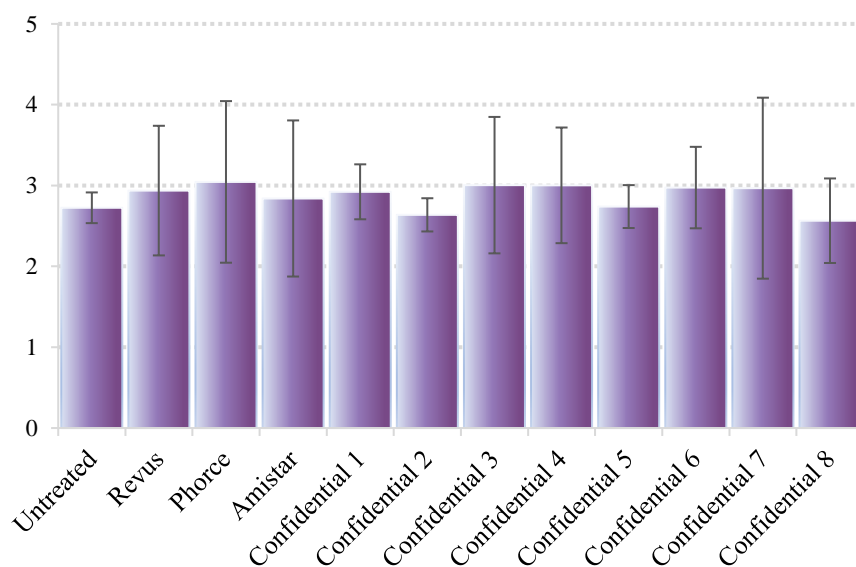
No.	Treatment	15-Jun	04-Jul
1	Control, Untreated	10	10
2	Revus	10	10
3	Phorce	10	10
4	Amistar	10	10
5	Confidential 1	10	10
6	Confidential 2	10	10
7	Confidential 3	10	10
8	Confidential 4	10	10
9	Confidential 5	10	10
10	Confidential 6	10	10
11	Confidential 7	10	10
12	Confidential 8	10	10

**Yield:**

There were no significant differences in yield (t/ha) at 15% moisture content between any of the treatments (Table 8, Figure 7).

**Table 8.** Mean yield (t/ha) at 15% moisture content.

	Treatment	t/ha
1	Untreated	2.73
2	Revus	2.94
3	Phorce	3.05
4	Amistar	2.84
5	Confidential 1	2.92
6	Confidential 2	2.64
7	Confidential 3	3.01
8	Confidential 4	3.00
9	Confidential 5	2.74
10	Confidential 6	2.98
11	Confidential 7	2.97
12	Confidential 8	2.57
F-value		1.305
P-value		0.261 ns



**Figure 7.** Mean yield (t/ha) at 15% moisture content.

## Discussion

This trial was performed in combining peas, variety Sakura, selected for its susceptibility to downy mildew (PGRO Descriptive List 2022), to evaluate the efficacy of several fungicides on the control of downy mildew.

The weather in 2022 led to moderate levels of downy mildew; 2022 had dry May and July months compared to 2021 and higher temperatures (average °C) from April onwards in 2022 contrasted with the 2021 season (Appendix graphs).

All the products tested against downy mildew in combining peas performed well after the first application at A2 compared to the control treatment.

There was not significant effect of any of the treatments at A3 14 days after T1 application. At A4 (one day before T2 application) the untreated plots had similar level of downy mildew compared to the treated plots. The same tendency was observed at A5, 6 days after T2 application. Possible causes of the low percentage of downy mildew infection during this trial could be affected by the warm and dried weather conditions during late June and early July.

No phytotoxicity or any unusual events were recorded in this trial. All products appeared to be crop safe.

There were no significant differences in yield between any of the treatments, possibly due to the moderate levels of disease observed in this trial and the short life cycle of the crop this season. The conditions in July were a combination of high mean maximum temperature 25.9 °C (high maximum of 40.78°C on 19<sup>th</sup> July), low mean accumulated precipitation 0.6 mm and low mean relative humidity 77.8%, that prompted very rapid crop senescence (Appendix).

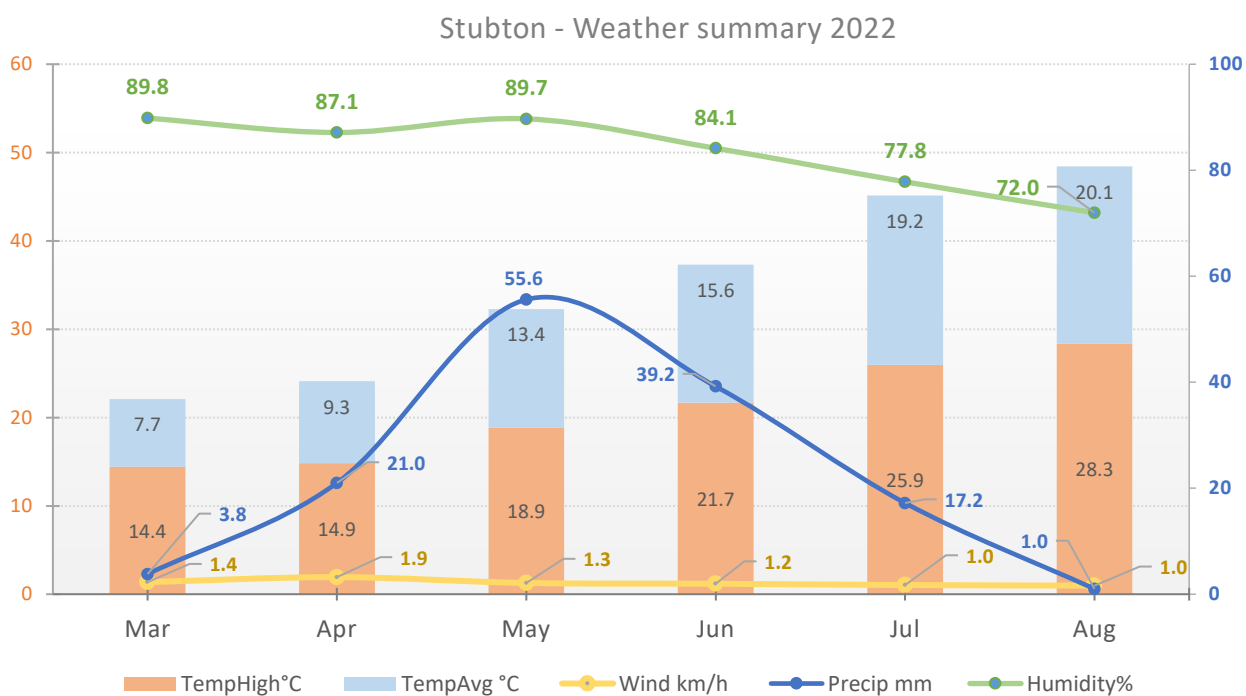
## Appendix

Weather data Stubton 2022					
Date	Temperature		Humidity	Wind Speed	Precipitation Accum.
	High °C	Avg °C	Avg %	Avg km/h	Sum mm
17-Mar	13.14	7.53	96.42	1.8	0
18-Mar	15.49	7.96	96.74	1	0.2
19-Mar	14.59	8.17	91.49	3	0
20-Mar	10.72	5.68	89.16	1.9	0
21-Mar	13.07	5.61	84.65	0.9	0.2
22-Mar	18.38	11.14	88.22	1.6	0
23-Mar	19.34	10.71	82.52	0.6	0
24-Mar	18.18	10.32	73.45	0.7	0
25-Mar	18.42	9.18	76.7	0.4	0
26-Mar	18.2	8.78	85.13	1	0
27-Mar	14.7	8.04	99.71	1.3	0
28-Mar	16.68	8.97	87.59	0.6	0
29-Mar	10.15	6.16	99.8	1.4	0
30-Mar	8.52	4.56	99.78	1.7	1.6
31-Mar	6.9	2.15	96.05	2.6	1.8
01-Apr	7.75	2.78	99.56	1.7	3.6
02-Apr	8.67	2.21	93.96	0.7	1.2
03-Apr	11.35	4.09	82.85	1.2	0.2
04-Apr	13.55	9.98	99.01	2.9	5.8
05-Apr	13.69	11.45	95.52	2.5	0
06-Apr	14.32	10.69	95.75	3.5	1.2
07-Apr	10.79	6.85	99.67	3.4	5.6
08-Apr	11.46	5.26	85.62	1.3	0.2
09-Apr	11.45	4.75	80.73	1.4	0.2
10-Apr	13.09	6.53	75.65	0.8	0
11-Apr	16.06	10.42	70.18	3	0
12-Apr	19.94	12.61	94.91	1.2	1.2
13-Apr	17.6	12.39	98.09	1.5	1.6
14-Apr	17.29	10.48	93.77	0.6	0.2
15-Apr	20.87	14.3	86.15	1.1	0
16-Apr	20.58	13.6	85.56	2	0
17-Apr	19.65	12.88	74.89	1.8	0
18-Apr	16.88	11.92	80.06	1.1	0
19-Apr	16.82	10.42	94.26	1.4	0
20-Apr	16.7	10.55	76.72	2.3	0
21-Apr	17.92	10.29	80.72	2.6	0
22-Apr	16.4	10.87	81.2	4	0
23-Apr	15.83	10.75	93.03	4.3	0
24-Apr	16.1	10.81	81.84	3.8	0
25-Apr	13.79	8.38	91.35	1.8	0
26-Apr	14.98	8.13	87.62	1.4	0

Weather data Stubton 2022					
Date	Temperature		Humidity	Wind Speed	Precipitation Accum.
	High °C	Avg °C	Avg %	Avg km/h	Sum mm
27-Apr	10.6	7.63	81.99	1.4	0
28-Apr	9.96	8.08	99.49	1.6	0
29-Apr	13.11	8.54	79.98	1.1	0
30-Apr	18.38	10.02	73.31	0.6	0
01-May	14.06	11.52	99.87	0.6	0
02-May	16.72	12.41	93.68	0.7	0.4
03-May	13.62	10.57	99.85	0.8	2.6
04-May	17.44	11.77	99.82	1.1	3.6
05-May	20.85	13.17	85.32	0.5	0
06-May	19.16	13.41	93.24	1.1	3.2
07-May	17.74	12.99	99.66	1.5	1
08-May	17.89	11.96	86.21	1.2	0
09-May	20.42	14.58	78.16	2	0
10-May	20.7	16.26	74.25	2.2	0
11-May	16.25	12.31	96.35	1.7	8.6
12-May	17.08	11.89	82.03	1.5	0
13-May	20.17	14.49	80.05	2.1	0
14-May	22.9	15.66	76.83	0.8	0
15-May	21.44	14.96	95.82	2.2	0.6
16-May	23.22	16.23	95.11	1.7	4.6
17-May	24.12	17.79	84.64	1.7	0.6
18-May	21.25	15.86	85.05	1.4	9.8
19-May	20.53	14.91	87.24	0.6	0
20-May	18.11	13.81	94.81	1.2	0.4
21-May	19.19	13.7	88.91	1.1	0
22-May	22.02	15.61	87.39	1.2	0
23-May	18.69	14.49	91.24	0.6	4.6
24-May	18.29	12.78	87.42	1	2
25-May	19.39	13.44	91.9	1.8	0
26-May	19.89	13.92	99.28	1.7	2
27-May	17.99	13.09	74.85	1.6	0.2
28-May	17.65	11.22	83.58	1	0
29-May	16.39	10.19	89.68	1.3	0
30-May	15.8	9.84	98.41	0.9	3.2
31-May	16.14	10.51	99.78	0.6	8.2
01-Jun	18.8	11.3	96.95	0.5	2.4
02-Jun	19.84	13.08	81.5	0.7	0.2
03-Jun	19.78	13.82	93.09	2	0
04-Jun	15.25	12.19	99.88	2.8	0
05-Jun	11.34	10.43	99.73	1.6	19.8
06-Jun	14.35	11.6	99.77	0.6	3.4
07-Jun	21.68	14.23	90.08	0.7	0

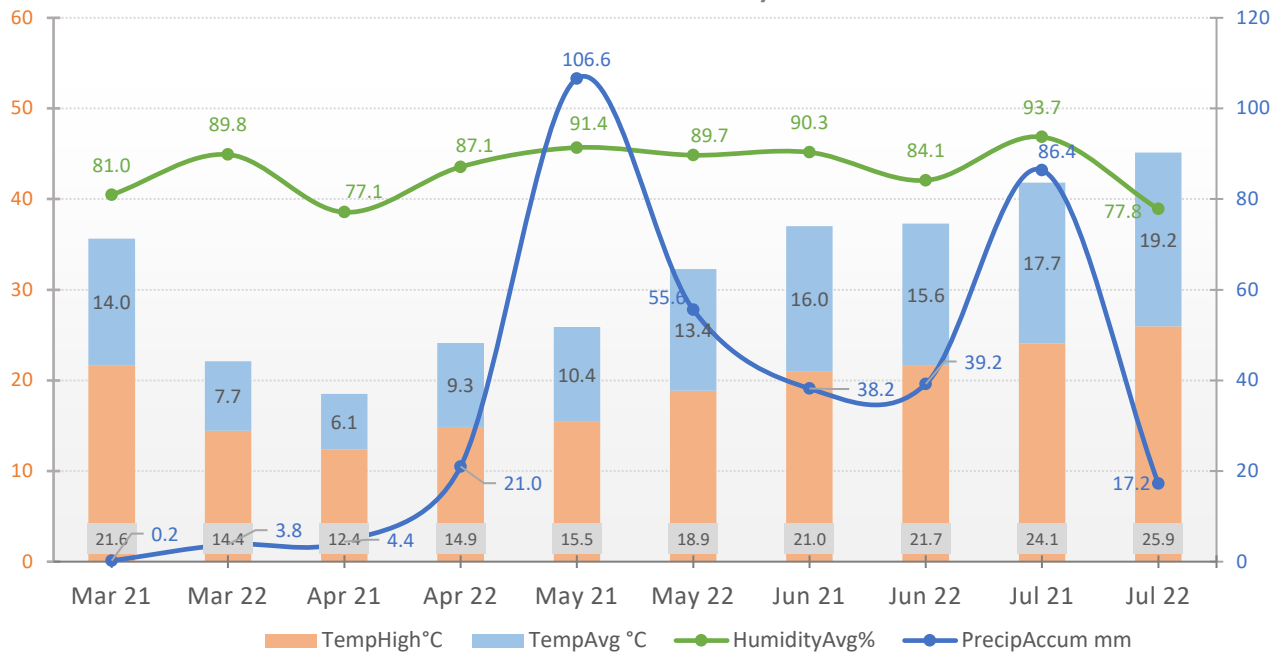
Weather data Stubton 2022					
Date	Temperature		Humidity	Wind Speed	Precipitation Accum.
	High °C	Avg °C	Avg %	Avg km/h	Sum mm
08-Jun	21.4	16.18	94.46	1.2	3.4
09-Jun	19.89	14.81	91.62	1.5	0.2
10-Jun	22.35	17.02	80.46	1.9	0
11-Jun	21.92	15.99	82.81	2	0.6
12-Jun	21.2	14.98	75.84	1.3	0
13-Jun	18.66	14.36	85.74	0.7	0
14-Jun	23.94	16.34	80.27	0.5	0
15-Jun	27.51	17.45	80.3	0.3	0
16-Jun	26.98	19.11	74.95	0.4	0
17-Jun	31.03	23.18	69.44	1.4	0
18-Jun	16.93	13.86	99.78	0.4	7
19-Jun	19.91	13.19	90.82	0.7	0.2
20-Jun	21.73	14.76	81.55	0.7	0
21-Jun	25.51	17.98	69.48	0.5	0
22-Jun	27.96	19.67	75.51	0.3	0
23-Jun	24.98	19.08	76.24	0.6	0
24-Jun	23.17	17.26	90.87	1.3	0
25-Jun	22.45	16.86	71.49	2.4	0
26-Jun	22.74	16.36	69.55	2.6	0
27-Jun	21.45	14.68	81.93	1.5	0.6
28-Jun	22.6	15.8	73.84	2.1	0
29-Jun	23.8	17.42	80.39	1.6	1.4
30-Jun	21.15	15.73	85.73	0.7	0
01-Jul	22.03	15.25	85.93	1.1	0
02-Jul	19.8	14.61	99.06	1.8	2.8
03-Jul	22.21	14.96	88.95	0.8	0
04-Jul	21.95	14.89	79.25	1.1	0
05-Jul	22.47	15.61	78.28	0.9	0
06-Jul	23.06	17.26	93.19	1.3	0
07-Jul	26.42	19.05	79.04	0.9	0
08-Jul	28.64	19.87	74.75	0.8	0
09-Jul	26.93	19.55	73.32	0.7	0
10-Jul	30.07	20.43	68.86	0.6	0
11-Jul	31.68	22.39	67.24	0.4	0
12-Jul	27.7	22.71	72.19	0.5	0
13-Jul	26.95	19.98	67.87	0.6	0
14-Jul	22.88	15.77	78.77	0.6	0.2
15-Jul	24.78	16.71	79.16	1	0
16-Jul	27.79	18.46	70.65	0.3	0
17-Jul	31.1	22.48	60.14	1	0
18-Jul	36.67	27.07	41.27	0.7	0
19-Jul	40.78	29.32	42.76	1.2	0

Weather data Stubton 2022					
Date	Temperature		Humidity	Wind Speed	Precipitation Accum.
	High °C	Avg °C	Avg %	Avg km/h	Sum mm
20-Jul	28.21	23.09	74.16	1.3	0
21-Jul	21.24	18.74	84.11	1	0
22-Jul	21.05	16.81	91.45	1.1	0.6
23-Jul	25.8	20.22	78.92	1.7	0
24-Jul	28.11	21.94	84.77	3.1	0.4
25-Jul	23.65	18.66	89.04	1.8	0.4
26-Jul	21.78	16.06	84.08	0.6	0.2
27-Jul	22.82	17.48	77.2	1.2	0.4
28-Jul	24.42	17.66	74.5	1.1	3.2
29-Jul	24.72	18.46	77.73	0.9	0
30-Jul	25.39	19.75	96	1	0.4
31-Jul	23.28	19.34	99.48	1.1	8.6
01-Aug	26.27	19.73	69.45	0.7	0
02-Aug	28.12	22.49	91.09	2.5	1
03-Aug	27.87	21.76	80.57	1.6	0
04-Aug	24.68	17.26	72.92	0.8	0
05-Aug	22.55	15.05	72.41	0.8	0
06-Aug	24.1	15.71	72.28	0.6	0





Stubton - weather summary 2021 and 2022





# Certificate of

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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**

Date of issue: 9 January 2018  
Effective date: 1 January 2018  
Expiry date: 31 December 2022

Signature

  
*Authorised signatory*

Certification Number

ORETO 384

