



The effect of biostimulant products applied to vining peas, combining peas and spring beans

2018
Year 1

For: PGRO
Date of project: Year 1, 2018
Date of report: January 2019

Objectives:

Yield potential is determined by environment, genetics and phenology versus yield loss and quality which is determined by abiotic and biotic stresses. Can a biostimulant produce a positive response to the effects of stress?

These trials aim to evaluate the effects of a biostimulant product in peas and beans. To assess the potential benefits they add to yield and disease tolerance.

To identify trends that show which product(s) and application method(s) are best suited to each crop. To improve decision making when using biostimulants in the field.

Summary:

In vining and combining peas the seed treated products gave the highest yield. In the spring beans the soil applied product gave the highest yield however the products performance varied vastly between crops.

We therefore can conclude that this year has not clearly identified any products that provided a statistically significant benefit to either yield or crop health. The prolonged drought and high temperatures may well have had an impact potentially affecting findings.

This is a three-year study looking at the same treatments within the same crops and further results on product performance will be obtained over the next two years.

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Introduction

The European biostimulants industry council (EBIC) defined biostimulants as “derived from natural or biological sources and can i) enhance plant growth and development when applied in small quantities; ii) help improve the efficiency of plant nutrients, as measured by either improved nutrient uptake or reduced nutrient losses to the environment, or both; or act as soil amendments to help improve soil structure, function, or performance and thus enhance plant response” (Biostimulant, 2013).

Soil-borne disease management is a key priority for legume production in the UK and Europe. New biological products may offer an opportunity to improve management of soil-borne diseases and our project aims to test a variety of biostimulants, biocontrol agents and nutritional products in field conditions. *Aphanomyces euteiches* (root rot) and *Peronospora viciae* (downy mildew) are soil-borne diseases that cause major yield losses, uneven maturity and quality reduction in peas and faba beans. They produce long-lasting resting spores which lead to a build-up of soil disease levels when legumes are grown regularly in rotations. Root rot is increasing in areas of the UK previously thought to be free of the disease and there are currently no chemical means of control. Current restrictions to the use of plant protection products may lead to difficulty for control of downy mildew in the future.

Previous work conducted by PGRO has shown some positive results on yield with using a bio stimulant product. Along with the increasing interest and demand for alternatives to pesticides, it was decided to conduct further investigation using the same products in several crops over three consecutive years. Two soil applied, five seed treated, four foliar and one soil + foliar products were selected with the aim to cover a range of application methods and active substances. The treatments will be applied on spring beans (*Vicia faba*), vining peas and combining peas over three growing seasons, 2018 – 2020.

Method:

Trial was a randomized complete plot design, untreated plots included within block.

Spray applications were made using a Handheld AZO plot spray, flat fan LD110 nozzles, operating at 2 bar. All applications were applied at 200l/ha except for treatment 13 which was applied at 300 l/ha.

Treated seed was treated using a Hege seed treating machine.

All trials received a pre-emergence herbicide application.

Treatment list:

Trt No.	Product name	Rate	Application Method	Number of applications	Application Timing		
					T0	T1	T2
1	Untreated (Check)	–	–	–			
2	TFP Pro Soil	1.0 l/ha	Soil	1	pre drilling	–	–
3	Serenade ASO	8.0 l/ha	Soil	1	pre/post drilling	–	–
4	Radiate	2.0 l/tonne	Seed	1	seed	–	–
5	Start-uP	2.0 l/tonne	Seed	1	seed	–	–
6	Take Off ST	1.0 l/tonne	Seed	1	seed	–	–
7	MultiMax GPA	200 ml/tonne	Seed	1	seed	–	–
8	KickOff	4.0 l/tonne	Seed	1	seed	–	–
9	TFP Pro-Tect	1.0l/ha	Foliar	2	–	4-5 leaf pairs	21DALA
10	Zynergy + Na13	1.0 l/ha + 0.1% sp/v	Foliar	2	–	early flower	10-14DALA
11	Foliar Tonic (Agrihit)	0.667 l/ha	Foliar	2	–	early flower	10-14DALA
12	Phorce	1.0 l/ha	Foliar	2	–	2nd node	pre flowering
13	Prestop	1.5kg/in 300 litres H2O	Soil + Foliar	2	pre-emergence	flower bud	

Treatment list and timings apply to all crops

Product	Ingredient(s)
TFP Pro Soil	Plant extracts, enzymes, minerals and metabolites
Serenade ASO	<i>Bacillus subtilis</i>
Radiate	Micronutrient blend
Start-uP	Calcium, sulphur and zinc
Take Off ST	Phosphite, manganese, zinc, biostimulant PGA
MultiMax GPA	Phosphite, manganese, zinc, biostimulant
KickOff	Phosphorous, manganese, potassium, nitrogen, zinc, sulphate, amino acid
TFP Pro-Tect	Plant extracts, enzymes, minerals and metabolites
Zynergy	Copper, zinc, sulphur
Foliar Tonic	Plant Extracts
Phorce	NPK 03:38:15
Prestop	<i>Gliocladium catenulatum</i> J1446

Trials diary:

Vining Peas, Holbeach – Downy Mildew

Variety Amalfi, target population 100 plants/m² at 25cm row spacings.

24th April: Drilled
 24th April: Trts 2, 3 & 13 applied
 15th May: Plant counts
 15th May: Trt 12 applied
 31st May: Trt 9 applied
 19th June: Downy mildew assessment
 20th June: Trts 9, 10, 11, 12, & 13 applied
 27th June: Trts 10, 11 applied
 9th July: Chlorophyll assessment
 10th July: Harvested

Vining Peas, Holbeach – Aphanomyces

Variety Naches, target population 100 plants/m² at 25cm row spacings.

5th June: Drilled
 5th June: Trts 2, 3 & 13 applied
 19th June: Trt 9 & 12 applied
 9th July: Trts 10, 11, 12 & 13 applied
 18th July: Trts 9, 10 & 11 applied
 1st August: Foot rot assessment

Combining Peas, Stubton PGRO Trial Ground 2018

Variety Crackerjack, target population 70 plants/m² at 25cm row spacings.

17th April: Drilled
17th April: Trts 2, 3 & 13 applied
8th May: Plant counts
10th May: Trt 12 applied
29th May: Trt 9 applied
11th June: Trts 10, 11, 12 & 13 applied
19th June: Trt 9 applied
22nd June: Trts 10 & 11 applied
26th June: Chlorophyll assessment
26th July: Harvested

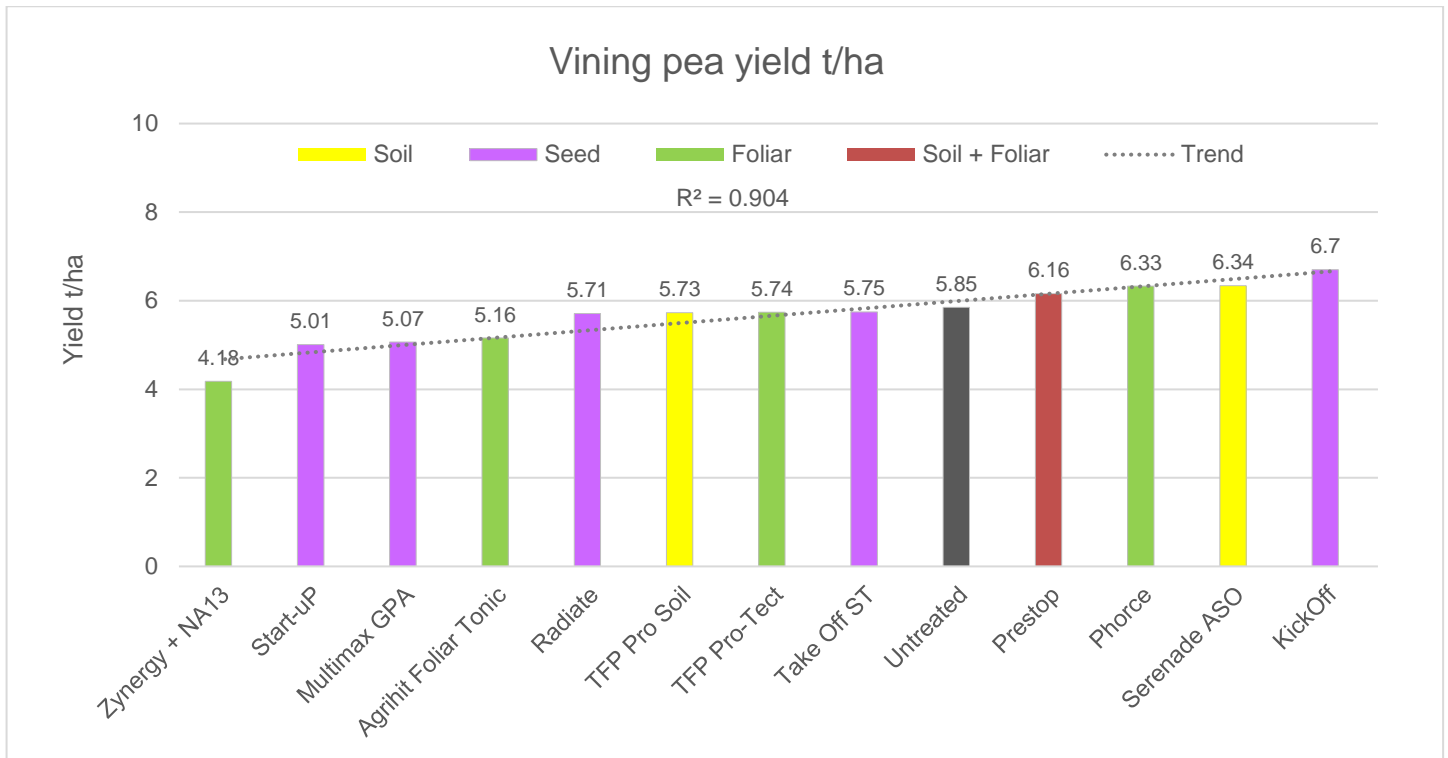
Spring Beans, Thistleton

Variety Fuego, target population 50 plants/m² at 25cm row spacings.

20th April: Drilled
20th April: Trts 2, 3 & 13 applied
15th May: Plant counts
21st May: Trts 9 & 12 applied
12th June: Trts 9 & 12 applied
15th June: Trts 10, 11 & 13 applied
25th June: Trt 10 & 11 applied
20th August: Harvested

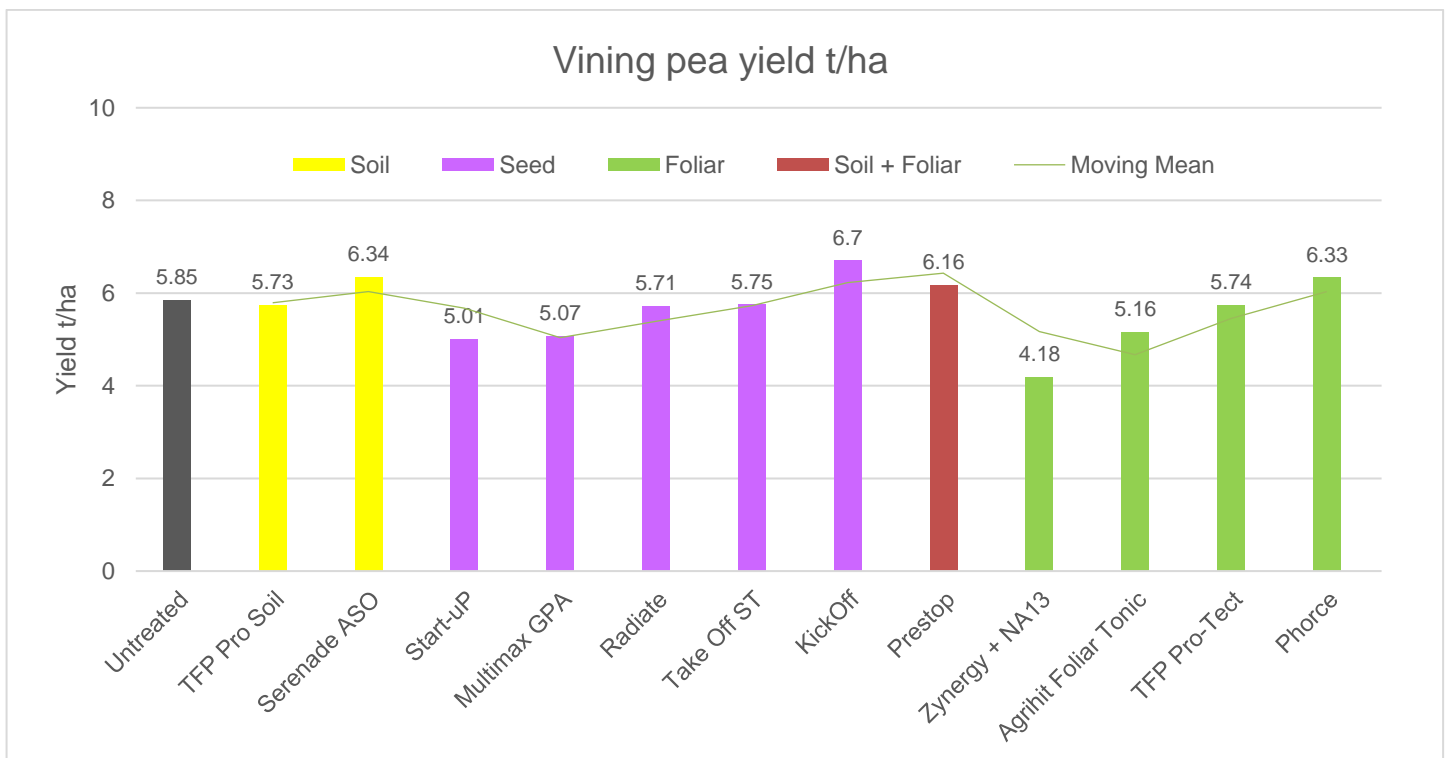
Results:

4 trials were conducted in 2018. 2 in vining peas, 1 in combining peas and 1 in spring beans. The trials had a total of 13 treatments with 4 application methods - 2 soil, 5 seed, 4 foliar and 1 soil + foliar. The treatments and application methods were identical for all 4 trials.



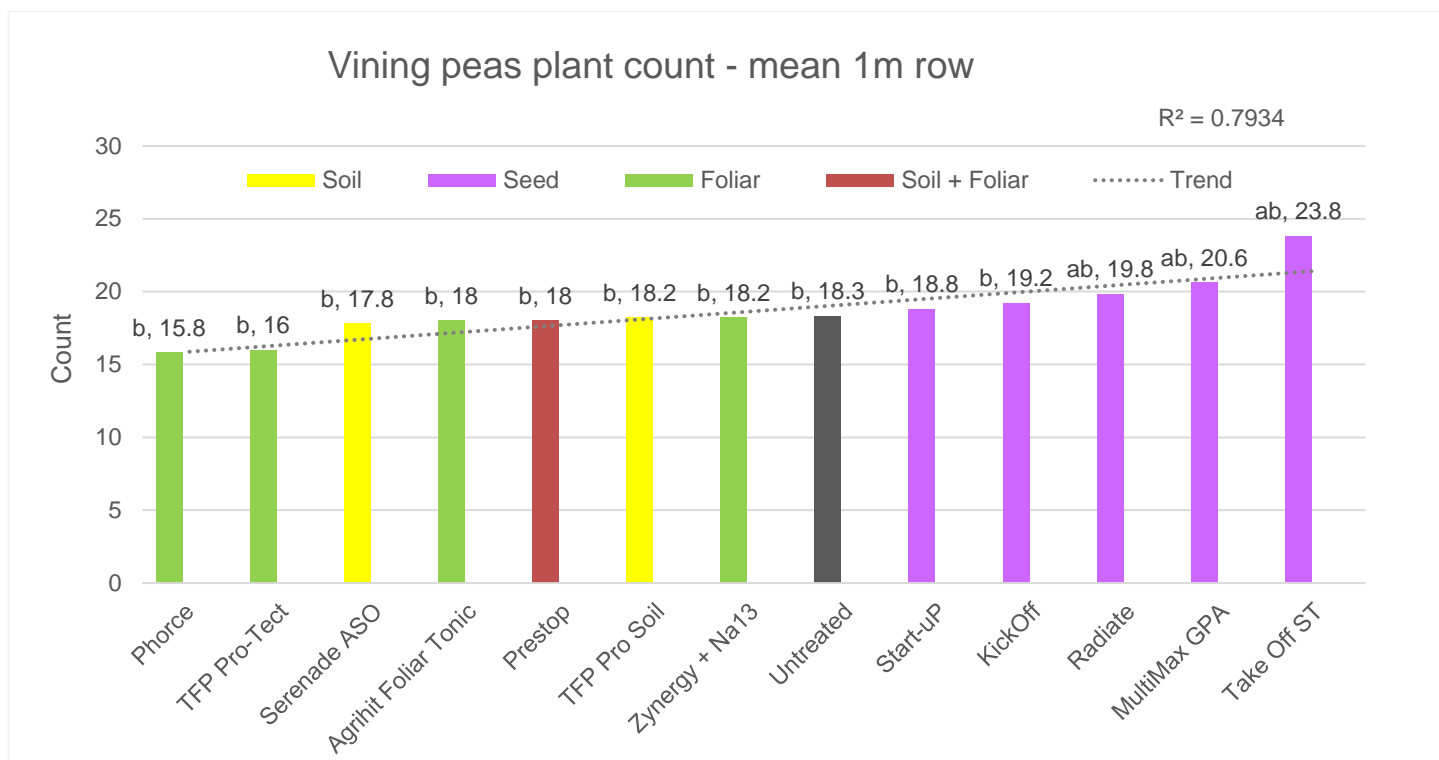
Graph 1
10th July - Mean harvested yield of threshed vining peas at Holbeach

All four application methods gave the four highest yields above the untreated.



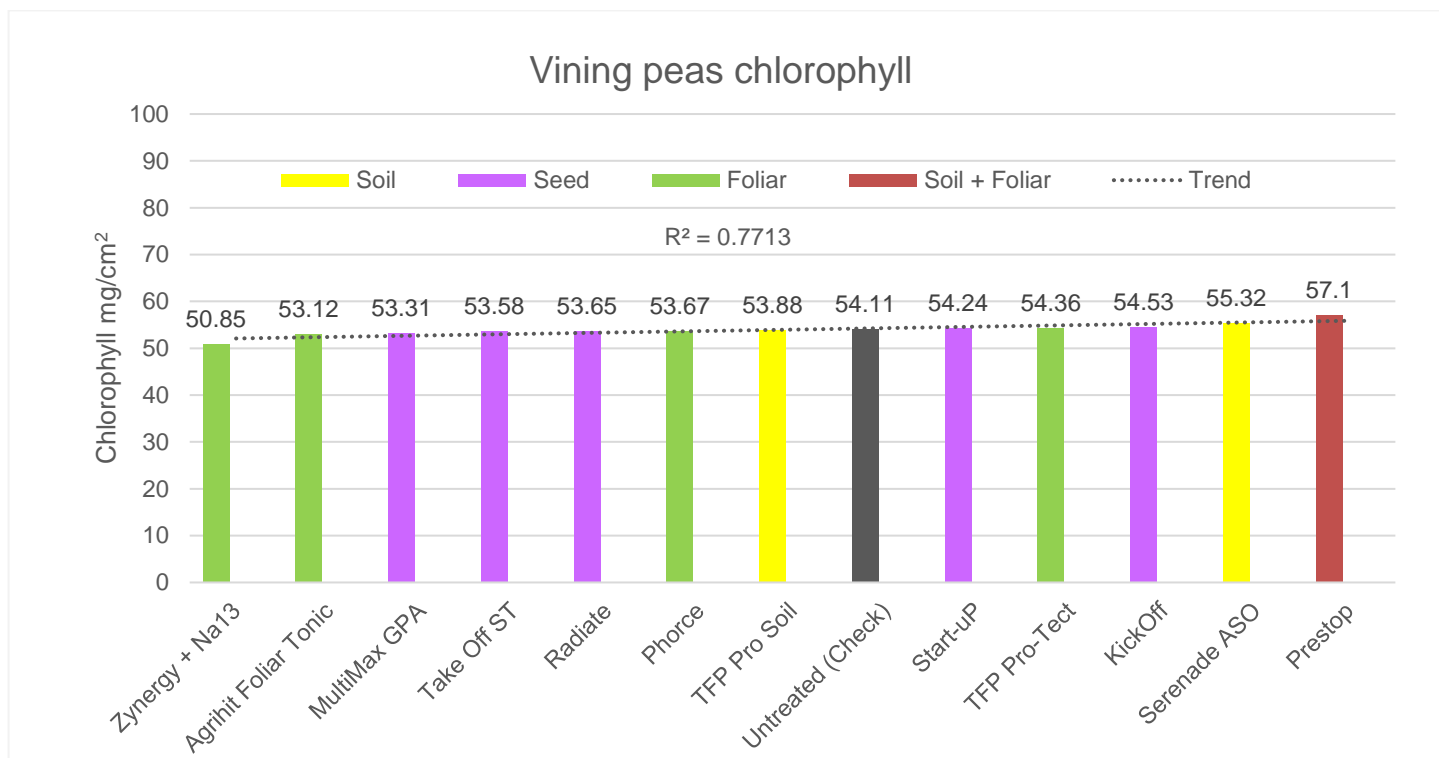
Graph 2
10th July - Ascending harvested yield of threshed vining peas at Holbeach grouped in application method

All seed applied treatments gave an increase in emergence compared to the untreated. The foliar treatments had not been applied at this time and no effects on emergence could be expected.



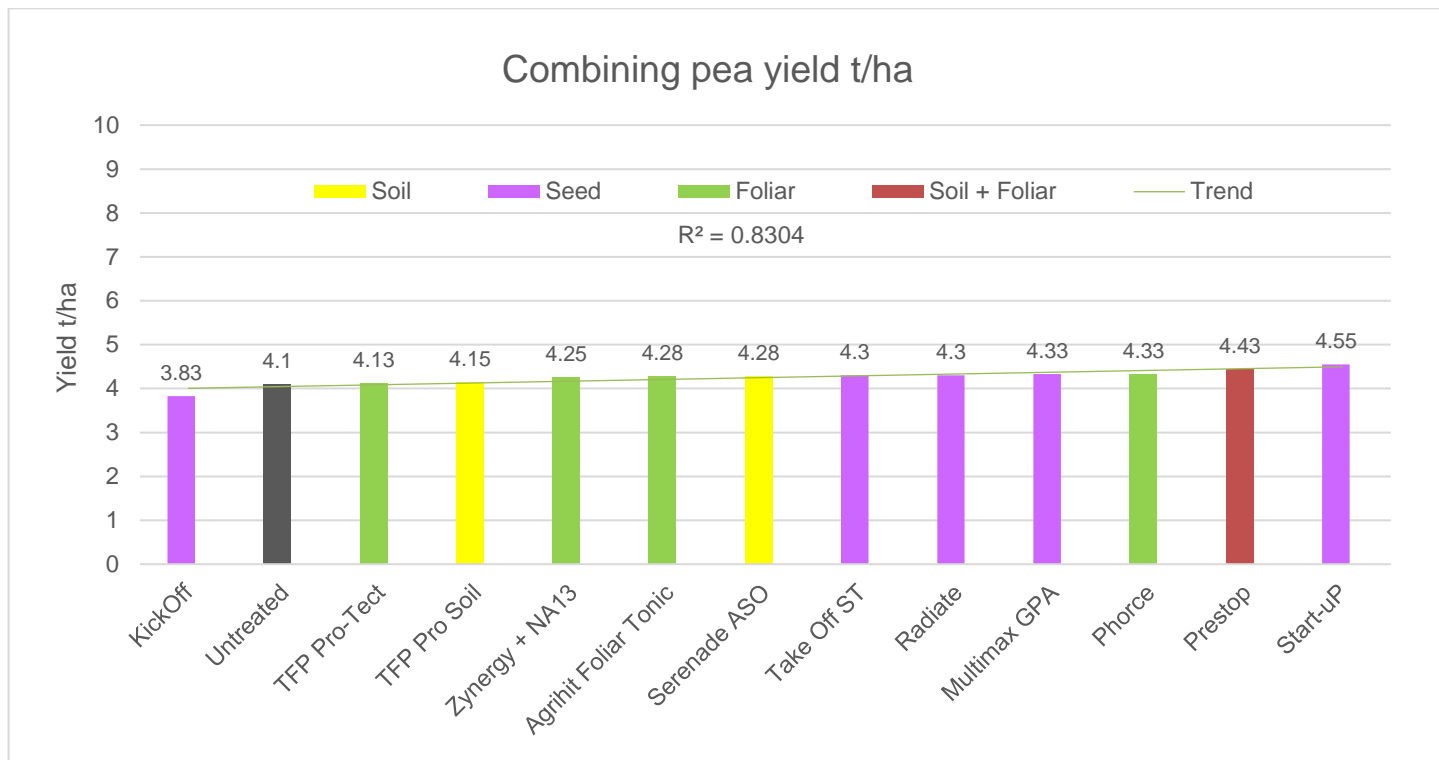
Graph 3
15th May - 100% emergence plant count at Holbeach

An increase in chlorophyll was observed on five treatments compared to the untreated. At least one treatment of the application methods gave an increase above the untreated.

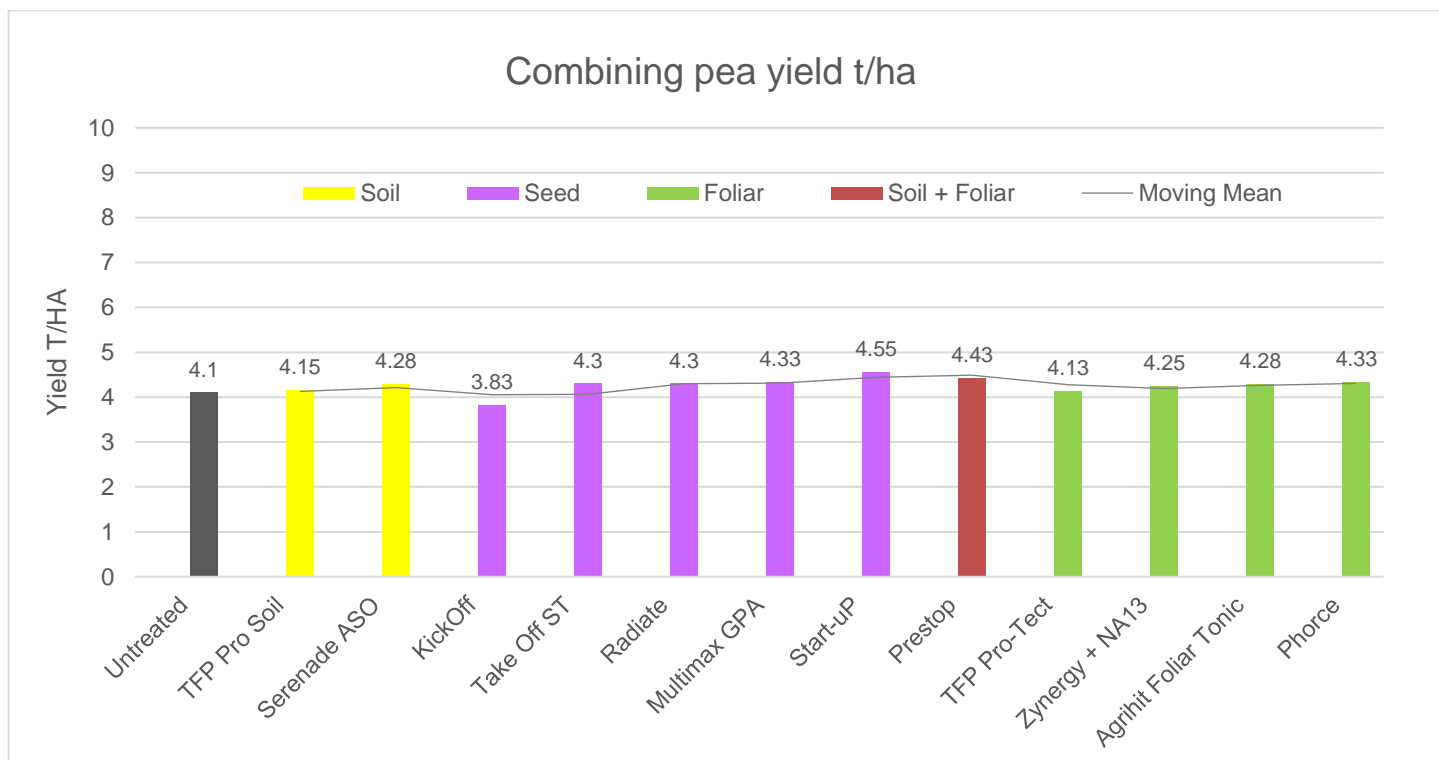


Graph 4
9th July - Chlorophyll mg/cm².
10 measurements taken per plot, for each rep. Graph shows mean score of 4 reps.

All treatments except for KickOff and Protect gave an increase in yield compared to the untreated.

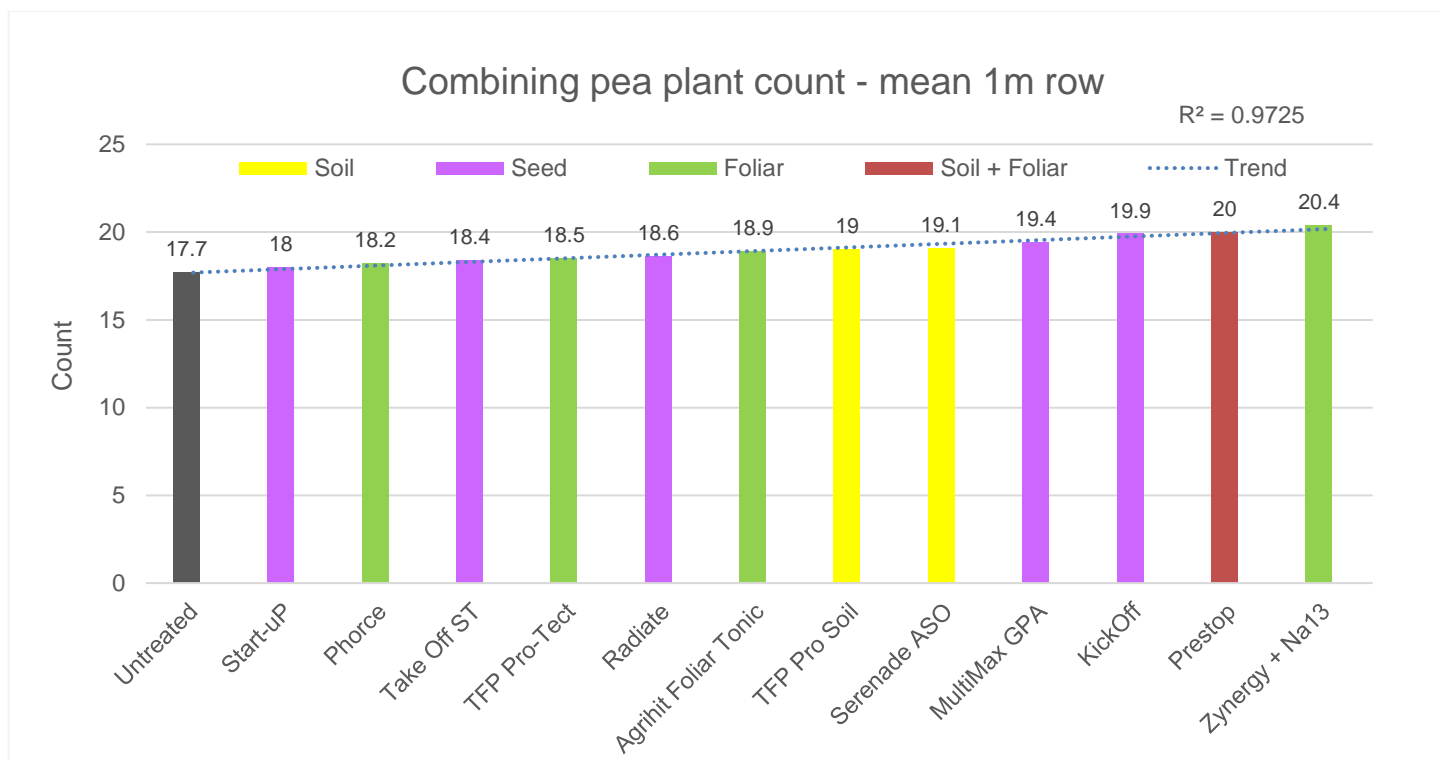


Graph 5
26th July - Mean harvested yield t/ha.



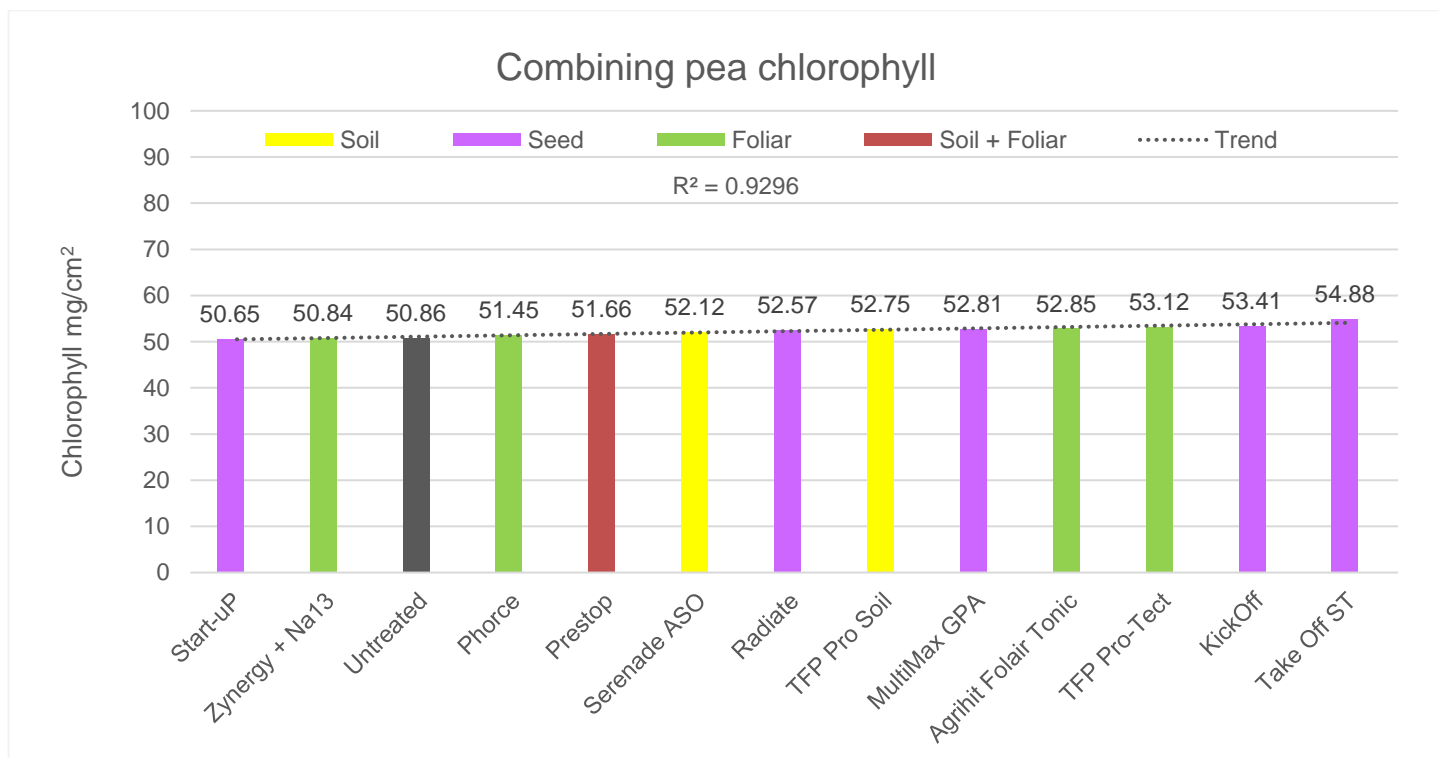
Graph 6
26th July - Ascending harvested yield of combining peas at Stubton grouped in application method

All plots had slightly higher emergence than the untreated although none of the foliar treatments had been applied. Differences are likely due to chance.



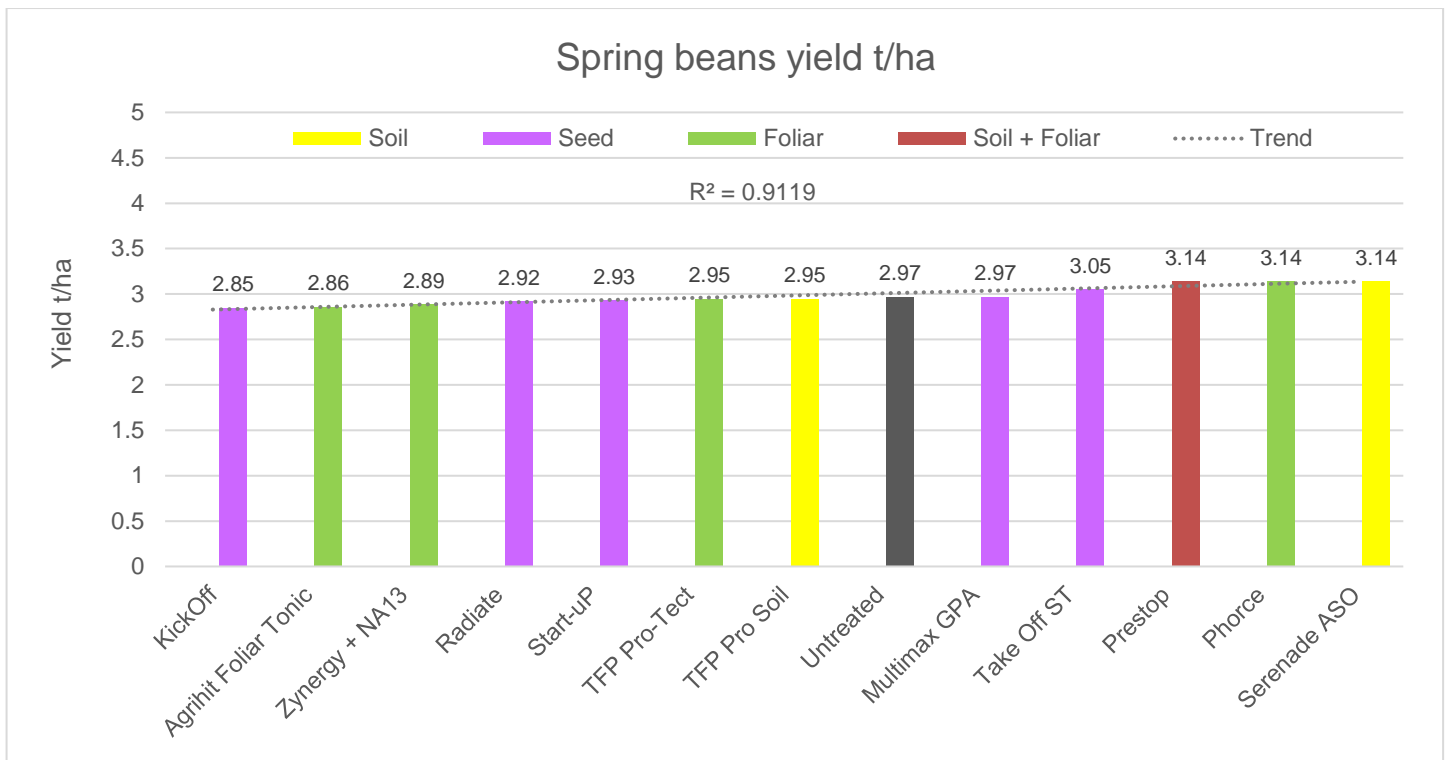
Graph 7
8th May - 100% emergence plant count

All treatments with the exception of Start-uP and Zynergy + Na13 showed an increase in chlorophyll compared to the untreated.

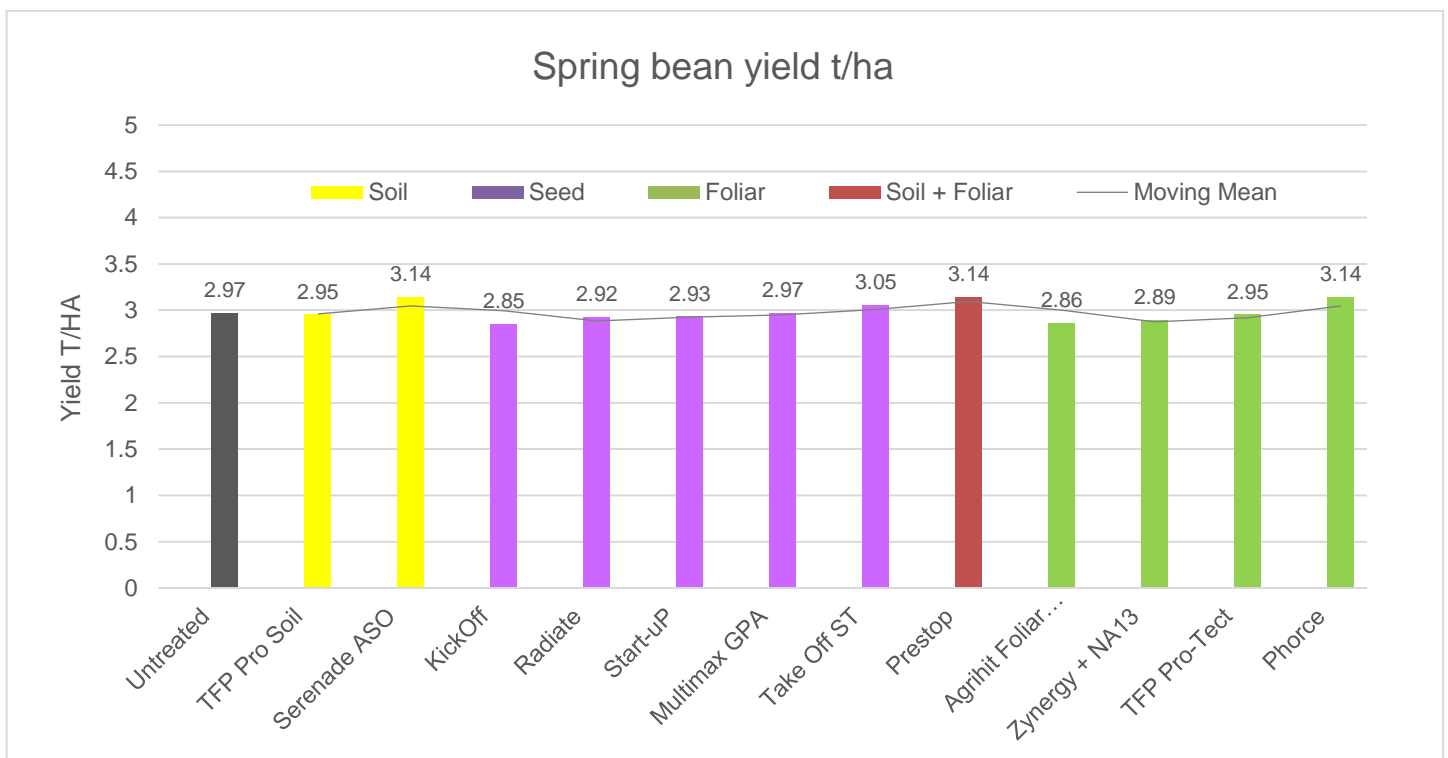


Graph 8
26th June - Chlorophyll mg/cm²
10 measurements taken per plot, for each rep. Graph shows mean score of 4 reps.

In spring beans, at least one treatment of the application methods gave an increase above the untreated.

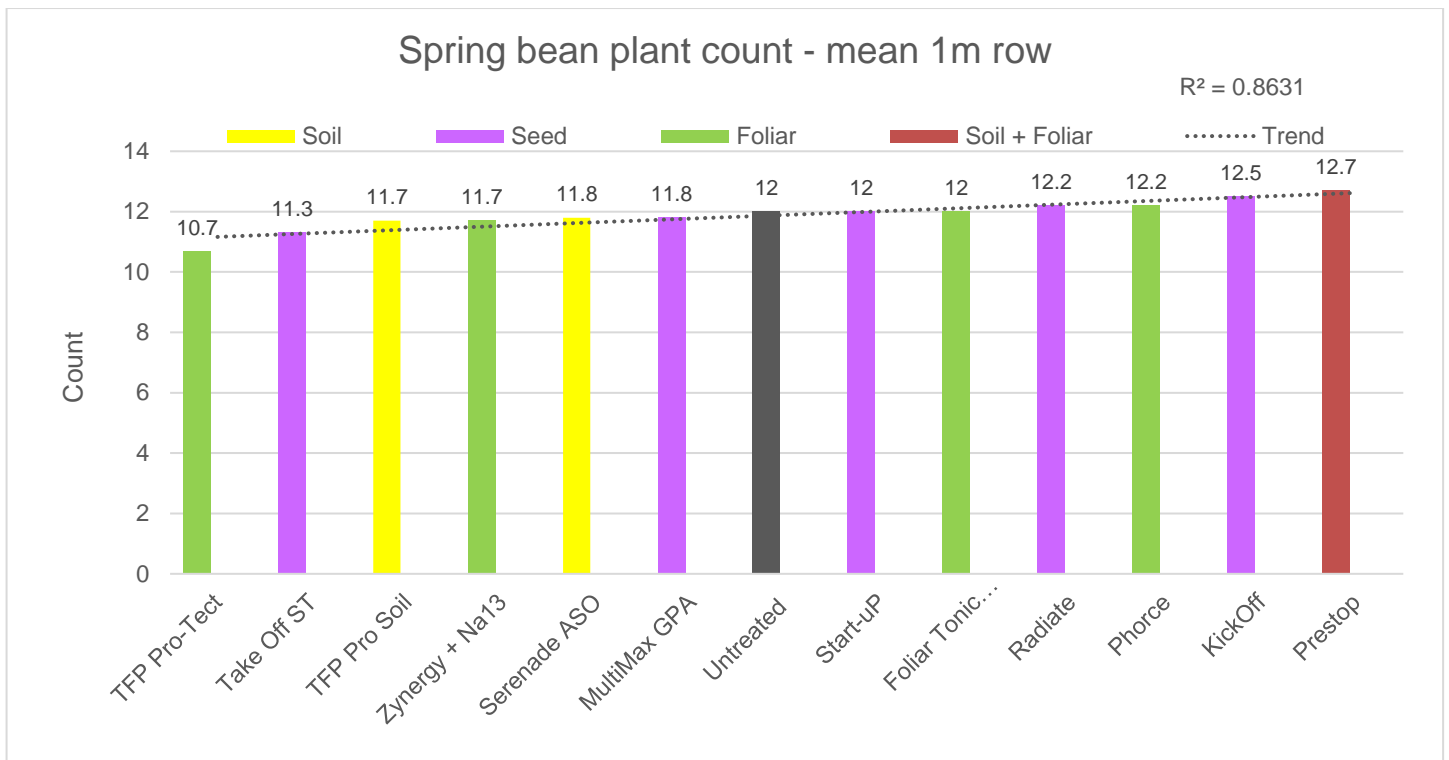


Graph 9
20th August - Mean harvested yield t/ha.



Graph 10
20th August - Ascending harvested yield of spring bean grouped in application method

Emergence of spring beans was not affected by any treatment.



Graph 11
15th May – 100% emergence plant counts

Discussion:

All applications were made at the correct timings and trials were taken to yield except for the vining pea *Aphanomyces* trial which was late drilled and suffered poor established due to prolonged drought.

There was no significant effect on yield by any of the products in any trial.

There was no significant effect on chlorophyll where recorded.

There was little to no disease development due to prolonged drought and high temperatures.

Phorce consistently ranked in the top 3 and Prestop ranked in the top 5 in all crops.

In vining and combining peas the seed treated products gave the highest yield. In the spring beans the soil applied product gave the highest yield however the products performance varied vastly between crops.

We therefore can conclude that this year has not clearly identified any products that provided a statistically significant benefit to either yield or crop health. The prolonged drought and high temperatures may well have had an impact potentially affecting findings.

This is a three-year study looking at the same treatments within the same crops and further results on product performance will be obtained over the next two years.

Appendix

Weather

Holbeach
ILINCSH02 Station

Date	Temperature			Humidity			Precipitation
	High	Avg	Low	High	Avg	Low	Sum
01/04/2018	7.4	5.5	3.7	97%	94%	89%	0.02 mm
02/04/2018	11.6	7.5	3.4	97%	94%	90%	0.34 mm
03/04/2018	15.7	11.8	8.0	97%	88%	69%	0.02 mm
04/04/2018	13.7	9.4	5.3	95%	88%	70%	0.02 mm
05/04/2018	12.2	7.7	3.3	89%	68%	40%	0 mm
06/04/2018	13.6	8.8	4.2	90%	78%	62%	0 mm
07/04/2018	18.1	11.8	5.7	95%	84%	70%	0 mm
08/04/2018	14.2	10.6	7.0	97%	94%	89%	0.13 mm
09/04/2018	9.5	8.2	6.8	98%	97%	94%	0.09 mm
10/04/2018	10.9	8.6	6.3	98%	96%	94%	0.23 mm
11/04/2018	7.6	6.6	5.6	99%	98%	97%	0 mm
12/04/2018	6.7	6.3	6.0	99%	98%	98%	0.02 mm
13/04/2018	11.8	9.1	6.4	99%	94%	81%	0.12 mm
14/04/2018	16.1	12.3	8.6	96%	81%	62%	0 mm
15/04/2018	15.4	11.7	8.1	96%	88%	75%	0.07 mm
16/04/2018	14.8	11.4	8.1	95%	79%	58%	0 mm
17/04/2018	18.7	14.2	9.7	87%	74%	54%	0 mm
18/04/2018	23.7	17.7	11.8	91%	74%	49%	0 mm
19/04/2018	28.0	19.1	10.1	88%	66%	35%	0 mm
20/04/2018	22.8	16.9	11.0	94%	77%	56%	0 mm
21/04/2018	22.6	16.1	9.6	96%	78%	50%	0 mm
22/04/2018	22.5	16.9	11.4	91%	77%	52%	0.05 mm
23/04/2018	15.7	11.8	7.9	91%	73%	57%	0.01 mm
24/04/2018	13.3	11.7	10.0	96%	86%	66%	0.31 mm
25/04/2018	13.7	10.4	7.2	94%	84%	67%	0.11 mm
26/04/2018	14.1	9.9	5.8	92%	75%	48%	0 mm
27/04/2018	8.6	7.2	5.7	96%	92%	81%	0.24 mm
28/04/2018	8.4	7.6	6.7	96%	94%	91%	0.29 mm
29/04/2018	7.9	7.2	6.5	94%	87%	80%	0.01 mm
30/04/2018	9.2	7.4	5.6	86%	80%	72%	0 mm
01/05/2018	15.1	8.1	1.2	94%	71%	46%	0 mm
02/05/2018	13.4	9.8	6.3	94%	80%	56%	0.27 mm
03/05/2018	15.9	9.6	3.4	93%	75%	55%	0 mm
04/05/2018	18.1	12.4	6.7	93%	80%	67%	0 mm
05/05/2018	22.7	15.2	7.7	91%	70%	40%	0 mm
06/05/2018	23.7	15.9	8.2	91%	70%	49%	0 mm
07/05/2018	23.2	16.6	10.0	91%	69%	43%	0 mm
08/05/2018	25.5	18.2	10.8	87%	69%	34%	0 mm
09/05/2018	20.2	14.6	8.9	93%	70%	45%	0 mm
10/05/2018	16.6	12.9	9.1	93%	68%	43%	0.06 mm
11/05/2018	17.7	12.4	7.1	94%	69%	45%	0 mm
12/05/2018	19.3	14.6	9.9	95%	81%	61%	0.37 mm
13/05/2018	19.0	14.6	10.2	96%	81%	45%	0.02 mm
14/05/2018	19.1	13.2	7.2	94%	74%	52%	0 mm
15/05/2018	19.7	14.0	8.2	93%	78%	51%	0 mm

16/05/2018	13.2	10.4	7.7	89%	79%	73%	0 mm
17/05/2018	12.7	8.4	4.0	96%	81%	68%	0 mm
18/05/2018	16.3	10.1	3.9	97%	78%	51%	0 mm
19/05/2018	18.3	11.7	5.0	93%	68%	33%	0 mm
20/05/2018	20.7	13.6	6.5	96%	81%	56%	0 mm
21/05/2018	17.8	12.9	8.1	96%	83%	62%	0 mm
22/05/2018	17.9	13.0	8.1	96%	82%	65%	0 mm
23/05/2018	13.2	11.5	9.8	93%	88%	83%	0 mm
24/05/2018	16.8	13.3	9.9	94%	87%	72%	0.06 mm
25/05/2018	17.9	14.7	11.6	98%	96%	91%	0.5 mm
26/05/2018	17.9	14.6	11.3	98%	91%	77%	0.02 mm
27/05/2018	25.2	19.0	12.8	94%	83%	56%	0.04 mm
28/05/2018	20.1	16.4	12.7	97%	92%	82%	0 mm
29/05/2018	15.0	13.3	11.6	98%	96%	92%	0 mm
30/05/2018	17.1	14.7	12.4	98%	96%	92%	0.11 mm
31/05/2018	18.8	16.1	13.3	98%	95%	87%	0 mm
01/06/2018	22.9	18.1	13.2	99%	92%	73%	0 mm
02/06/2018	20.9	17.8	14.8	98%	94%	85%	0.45 mm
03/06/2018	22.7	18.2	13.7	98%	91%	72%	0.01 mm
04/06/2018	14.8	13.6	12.4	97%	93%	88%	0 mm
05/06/2018	14.6	12.4	10.2	95%	86%	78%	0 mm
06/06/2018	18.6	13.1	7.6	97%	86%	68%	0 mm
07/06/2018	16.6	14.4	12.3	90%	83%	74%	0 mm
08/06/2018	16.3	14.3	12.4	94%	86%	75%	0 mm
09/06/2018	16.4	14.3	12.2	92%	86%	76%	0 mm
10/06/2018	17.3	13.7	10.1	95%	84%	72%	0 mm
11/06/2018	21.3	14.8	8.2	97%	79%	59%	0 mm
12/06/2018	16.7	14.0	11.2	96%	84%	66%	0 mm
13/06/2018	21.6	16.0	10.4	92%	75%	57%	0 mm
14/06/2018	21.2	16.7	12.1	91%	69%	43%	0 mm
15/06/2018	20.9	15.1	9.3	92%	68%	48%	0 mm
16/06/2018	20.3	16.2	12.3	92%	77%	56%	0.22 mm
17/06/2018	18.6	14.6	10.6	93%	82%	63%	0 mm
18/06/2018	23.8	19.3	14.9	94%	75%	48%	0 mm
19/06/2018	24.2	20.0	15.8	92%	80%	66%	0 mm
20/06/2018	24.3	18.9	13.6	94%	76%	58%	0 mm
21/06/2018	18.4	14.2	10.0	85%	66%	42%	0 mm
22/06/2018	18.7	13.9	9.2	87%	66%	43%	0 mm
23/06/2018	22.2	15.3	8.3	88%	72%	39%	0 mm
24/06/2018	23.9	16.4	9.0	94%	69%	45%	0 mm
25/06/2018	24.6	18.1	11.6	91%	68%	41%	0 mm
26/06/2018	22.3	16.7	11.1	97%	81%	57%	0 mm
27/06/2018	18.2	15.8	13.3	90%	81%	73%	0 mm
28/06/2018	18.9	15.7	12.4	93%	87%	75%	0 mm
29/06/2018	21.3	16.8	12.3	94%	81%	42%	0 mm
30/06/2018	21.2	17.7	14.2	92%	80%	55%	0 mm
01/07/2018	26.6	20.2	14.0	93%	75%	42%	0 mm
02/07/2018	22.6	18.4	14.4	91%	72%	49%	0 mm
03/07/2018	19.1	15.7	12.2	94%	79%	59%	0 mm
04/07/2018	20.8	15.3	9.7	95%	80%	62%	0 mm
05/07/2018	27.2	20.4	13.8	96%	71%	37%	0 mm
06/07/2018	25.0	20.1	15.3	96%	78%	57%	0 mm
07/07/2018	27.7	21.7	15.7	93%	76%	46%	0 mm
08/07/2018	25.9	19.6	13.4	97%	75%	54%	0 mm
09/07/2018	24.6	20.1	15.6	95%	80%	65%	0 mm

Stubton
Onsite weather station

Date	Rainfall (mm)				
15/04/2018	2.8	01/06/2018	0	01/07/2018	0
16/04/2018	0	02/06/2018	23.4	02/07/2018	0
17/04/2018	0	03/06/2018	0	03/07/2018	0
18/04/2018	0	04/06/2018	0	04/07/2018	0
19/04/2018	0	05/06/2018	0	05/07/2018	0
20/04/2018	0	06/06/2018	0	06/07/2018	0
21/04/2018	0	07/06/2018	0.2	07/07/2018	0
22/04/2018	1	08/06/2018	1.6	08/07/2018	0
23/04/2018	0	09/06/2018	0	09/07/2018	0
24/04/2018	9.6	10/06/2018	0	10/07/2018	0
25/04/2018	4.2	11/06/2018	12.8	11/07/2018	0
26/04/2018	0	12/06/2018	0	12/07/2018	0
27/04/2018	5.8	13/06/2018	0	13/07/2018	0
28/04/2018	2.8	14/06/2018	0	14/07/2018	0
29/04/2018	0	15/06/2018	0	15/07/2018	0
30/04/2018	0	16/06/2018	0.8	16/07/2018	0
01/05/2018	0	17/06/2018	0	17/07/2018	0
02/05/2018	7.6	18/06/2018	0	18/07/2018	0
03/05/2018	0	19/06/2018	0	19/07/2018	1.2
04/05/2018	0	20/06/2018	0	20/07/2018	1
05/05/2018	0	21/06/2018	0	21/07/2018	0.2
06/05/2018	0	22/06/2018	0	22/07/2018	0
07/05/2018	0	23/06/2018	0	23/07/2018	0
08/05/2018	0	24/06/2018	0	24/07/2018	0
09/05/2018	0	25/06/2018	0	25/07/2018	0
10/05/2018	2.2	26/06/2018	0	26/07/2018	0
11/05/2018	0	27/06/2018	0	27/07/2018	5.8
12/05/2018	11.4	28/06/2018	0	28/07/2018	5
13/05/2018	0.4	29/06/2018	0	29/07/2018	7
14/05/2018	0	30/06/2018	0	30/07/2018	0
15/05/2018	0			31/07/2018	0.8
16/05/2018	0				
17/05/2018	0				
18/05/2018	0				
19/05/2018	0				
20/05/2018	0				
21/05/2018	0				
22/05/2018	0				
23/05/2018	0				
24/05/2018	1				
25/05/2018	15				
26/05/2018	0				
27/05/2018	0				
28/05/2018	0				
29/05/2018	0	May			
30/05/2018	7.4	total			
31/05/2018	0	45			
			June		
			total		
			38.8		
				July	
				total	
				21	

Date	(MAX) (°C)	(MIN) (°C)	Date	MAX	MIN
15/04/2018	13.8	6.6	12/06/2018	17.3	8.8
16/04/2018	14.7	8.1	13/06/2018	21	8.8
17/04/2018	16	9.7	14/06/2018	19.9	8.9
18/04/2018	22.8	12.6	15/06/2018	19.9	8
19/04/2018	26.5	11.8	16/06/2018	18.8	9.8
20/04/2018	21	9.3	17/06/2018	18.3	10
21/04/2018	21.5	6.1	18/06/2018	22.4	14.8
22/04/2018	20.2	9.1	19/06/2018	23.5	14.8
23/04/2018	15.5	7.2	20/06/2018	22.9	11.8
24/04/2018	13.3	8.6	21/06/2018	18.9	8.5
25/04/2018	13.9	6.4	22/06/2018	21.1	5.4
26/04/2018	13.9	5.5	23/06/2018	21.1	6.1
27/04/2018	8.5	4.8	24/06/2018	24.9	5.7
28/04/2018	7.8	5.3	25/06/2018	27.7	8.7
29/04/2018	8.5	4.8	26/06/2018	26.1	7.5
30/04/2018	10	3.4	27/06/2018	23.4	11
01/05/2018	14.6	0.1	28/06/2018	24.6	10.9
02/05/2018	13	4.4	29/06/2018	24.8	9.2
03/05/2018	14.8	4.2	30/06/2018	24	11.5
04/05/2018	17.7	6	01/07/2018	26.2	9.9
05/05/2018	21.6	7.3	02/07/2018	25.3	10.7
06/05/2018	23.1	7.7	03/07/2018	21.5	9.4
07/05/2018	24.8	8.4	04/07/2018	25.1	8.8
08/05/2018	23.8	9.6	05/07/2018	28.1	11.5
09/05/2018	18.3	6.8	06/07/2018	27.6	13.4
10/05/2018	15.7	7.1	07/07/2018	26.9	13.9
11/05/2018	16.5	5	08/07/2018	26.7	12.5
12/05/2018	16	8.6	09/07/2018	21.7	12.6
13/05/2018	18.3	8.5	10/07/2018	22.7	10.7
14/05/2018	19.8	4.5	11/07/2018	23.6	10.7
15/05/2018	21.8	7.7	12/07/2018	22	11.8
16/05/2018	12.8	4.7	13/07/2018	24	8.7
17/05/2018	14.2	2	14/07/2018	28.3	12.1
18/05/2018	17	1.6	15/07/2018	28.8	11.7
19/05/2018	20	3.7	16/07/2018	27.8	11.4
20/05/2018	21.3	7.1	17/07/2018	22.5	13.5
21/05/2018	22.5	6.7	18/07/2018	24.6	13.7
22/05/2018	19.3	8.6	19/07/2018	27	14.3
23/05/2018	15.9	8.8	20/07/2018	27.5	12.6
24/05/2018	19.7	8.7	21/07/2018	25	13.1
25/05/2018	15	10.4	22/07/2018	26.2	15
26/05/2018	19.8	10.4	23/07/2018	31.5	15.6
27/05/2018	23	10.3	24/07/2018	29	14.6
28/05/2018	22.3	12.2	25/07/2018	27.6	13.4
29/05/2018	18	11.8	26/07/2018	33.3	14.3
30/05/2018	15	13	27/07/2018	31.5	18.3
31/05/2018	20.9	14.1	28/07/2018	21.2	12.8
01/06/2018	22.1	13	29/07/2018	21.3	14
02/06/2018	22.9	14.4	30/07/2018	24.6	13.1
03/06/2018	23.9	11.5	31/07/2018	23.7	13.7
04/06/2018	14.6	11.4			

05/06/2018	17.3	7.3
06/06/2018	16.7	7
07/06/2018	18.6	8.2
08/06/2018	17.4	10.4
09/06/2018	16.3	9.1
10/06/2018	20.7	7.1
11/06/2018	24.2	6.7

Thistleton
ILINCOLN40 Station

Date	Temperature			Humidity			Precipitation
	High	Avg	Low	High	Avg	Low	Sum
01/03/2018	-1.4 °C	-3.3 °C	-5.2 °C	93 %	85%	77%	14 mm
02/03/2018	-0.1 °C	-1.2 °C	-2.4 °C	96 %	84%	75%	4.3 mm
03/03/2018	0.8 °C	-0.7 °C	-2.3 °C	97 %	95%	94%	0 mm
04/03/2018	5.9 °C	3.2 °C	0.4 °C	98 %	97%	96%	3 mm
05/03/2018	10.4 °C	6.5 °C	2.6 °C	98%	92%	71%	2.8 mm
06/03/2018	9.2 °C	5.6 °C	1.9 °C	97%	87%	68%	1.5 mm
07/03/2018	9.6 °C	5.4 °C	1.1 °C	95%	84%	56%	1 mm
08/03/2018	8.6 °C	4.9 °C	1.2 °C	96 %	86%	60%	2.5 mm
09/03/2018	9.8 °C	5.3 °C	0.8 °C	97%	89%	72%	6.1 mm
10/03/2018	13.7 °C	10.4 °C	7.1 °C	98%	94%	88%	6.3 mm
11/03/2018	11.8 °C	8 °C	4.3 °C	98%	92%	70%	3.6 mm
12/03/2018	7.6 °C	6.2 °C	4.7 °C	98%	97%	95%	5.1 mm
13/03/2018	10.8 °C	7.6 °C	4.4 °C	96%	86%	71%	0.8 mm
14/03/2018	12.3 °C	7.1 °C	1.9 °C	96%	81%	62%	0 mm
15/03/2018	10.2 °C	8.2 °C	6.1 °C	97%	91%	78%	3.6 mm
16/03/2018	14.7 °C	8.7 °C	2.7 °C	98%	87%	49%	2.3 mm
17/03/2018	2.6 °C	0.7 °C	-1.3 °C	96 %	80%	58%	2.5 mm
18/03/2018	0.8 °C	-0.7 °C	-2.1 °C	92 %	79%	69%	0 mm
19/03/2018	3.8 °C	1.8 °C	-0.2 °C	83 %	70%	62%	0 mm
20/03/2018	8.2 °C	5.1 °C	1.9 °C	93 %	81%	57%	0.5 mm
21/03/2018	9.7 °C	4.6 °C	-0.6 °C	93 %	75%	50%	0 mm
22/03/2018	11.2 °C	8.9 °C	6.6 °C	84%	75%	64%	0 mm
23/03/2018	11.8 °C	9.2 °C	6.5 °C	90%	75%	58%	0 mm
24/03/2018	9.9 °C	7.4 °C	4.9 °C	94%	87%	76%	0.5 mm
25/03/2018	13.2 °C	9.2 °C	5.1 °C	95%	72%	42%	0.3 mm
26/03/2018	12.5 °C	7.2 °C	2.1 °C	91%	70%	46%	0 mm
27/03/2018	11.9 °C	8.3 °C	4.7 °C	96%	85%	70%	5.1 mm
28/03/2018	8.9 °C	5.7 °C	2.4 °C	94%	84%	66%	2.3 mm
29/03/2018	10.3 °C	5.2 °C	0.2 °C	95 %	87%	63%	4.8 mm
30/03/2018	9.3 °C	5.6 °C	1.8 °C	98%	94%	81%	14.7 mm
31/03/2018	6.8 °C	5.2 °C	3.6 °C	98%	95%	89%	3.8 mm
01/04/2018	5.9 °C	4.6 °C	3.3 °C	96%	92%	86%	1.8 mm
02/04/2018	10.8 °C	6.5 °C	2.2 °C	98%	96%	91%	12.2 mm
03/04/2018	14.7 °C	11.5 °C	8.2 °C	96%	85%	64%	2 mm
04/04/2018	12.9 °C	9.2 °C	5.4 °C	96%	89%	71%	1.5 mm
05/04/2018	12.3 °C	7.3 °C	2.4 °C	91 %	64%	33%	0.3 mm
06/04/2018	14.7 °C	8.8 °C	2.8 °C	92%	76%	60%	0 mm
07/04/2018	17.6 °C	11 °C	4.4 °C	96%	85%	69%	0 mm
08/04/2018	10.4 °C	9 °C	7.6 °C	97%	93%	87%	3.8 mm
09/04/2018	9.6 °C	8.1 °C	6.5 °C	98%	96%	91%	4.6 mm

10/04/2018	10.7 °C	8.2 °C	5.8 °C	98%	97%	93%	8.4 mm
11/04/2018	9.1 °C	7.2 °C	5.3 °C	99%	98%	98%	0.8 mm
12/04/2018	6.4 °C	5.8 °C	5.3 °C	99%	99%	98%	0.8 mm
13/04/2018	10.7 °C	8.2 °C	5.7 °C	99%	93%	83%	2.3 mm
14/04/2018	16.8 °C	12.6 °C	8.4 °C	93%	79%	58%	0 mm
15/04/2018	14.3 °C	10.1 °C	5.9 °C	97%	90%	79%	0.5 mm
16/04/2018	14.6 °C	11.2 °C	7.9 °C	93%	80%	54%	0 mm
17/04/2018	17.9 °C	13.8 °C	9.6 °C	87%	74%	54%	0 mm
18/04/2018	23.7 °C	18.4 °C	13 °C	89%	73%	50%	0 mm
19/04/2018	27.4 °C	18.1 °C	8.8 °C	94%	66%	37%	0 mm
20/04/2018	22.8 °C	17.5 °C	12.3 °C	89%	70%	39%	0 mm
21/04/2018	22.9 °C	15.7 °C	8.6 °C	84%	74%	52%	0 mm
22/04/2018	21.4 °C	16.4 °C	11.4 °C	90%	74%	56%	0.8 mm
23/04/2018	15.1 °C	11.4 °C	7.7 °C	90%	74%	59%	0 mm
24/04/2018	13.1 °C	11.3 °C	9.5 °C	97%	86%	68%	8.9 mm
25/04/2018	13.3 °C	10.1 °C	6.9 °C	93%	82%	62%	5.6 mm
26/04/2018	14.3 °C	10.1 °C	5.8 °C	90%	70%	44%	0.3 mm
27/04/2018	7.9 °C	6.9 °C	6 °C	96%	90%	73%	10.4 mm
28/04/2018	7.5 °C	6.7 °C	5.9 °C	96%	94%	92%	2.5 mm
29/04/2018	7.6 °C	6.3 °C	5 °C	95%	87%	79%	0 mm
30/04/2018	10.2 °C	7.3 °C	4.4 °C	89%	74%	55%	0 mm
01/05/2018	15.4 °C	9.1 °C	2.7 °C	92%	67%	39%	0 mm
02/05/2018	13.3 °C	10 °C	6.7 °C	94%	76%	49%	1.5 mm
03/05/2018	15.9 °C	10.1 °C	4.4 °C	90%	71%	47%	2 mm
04/05/2018	18.1 °C	13.2 °C	8.4 °C	87%	75%	62%	0 mm
05/05/2018	23 °C	15.1 °C	7.2 °C	96%	71%	38%	0 mm
06/05/2018	24.8 °C	16 °C	7.3 °C	94%	67%	39%	0 mm
07/05/2018	25.4 °C	17.3 °C	9.3 °C	94%	69%	44%	0 mm
08/05/2018	25.3 °C	17.4 °C	9.6 °C	94%	73%	36%	0 mm
09/05/2018	19.2 °C	14 °C	8.8 °C	93%	69%	47%	0 mm
10/05/2018	17.2 °C	12.9 °C	8.5 °C	93%	65%	38%	1.8 mm
11/05/2018	17.6 °C	10.9 °C	4.3 °C	92%	66%	46%	0 mm
12/05/2018	16.7 °C	12.7 °C	8.8 °C	95%	82%	60%	11.7 mm
13/05/2018	18.5 °C	13.9 °C	9.3 °C	96%	73%	43%	0.5 mm
14/05/2018	19.9 °C	13.6 °C	7.3 °C	81%	58%	45%	0 mm
15/05/2018	21.9 °C	15.6 °C	9.3 °C	78%	62%	43%	0 mm
16/05/2018	12.8 °C	9.7 °C	6.7 °C	86%	75%	63%	0 mm
17/05/2018	14.8 °C	9.2 °C	3.6 °C	94%	75%	52%	0 mm
18/05/2018	17.3 °C	10.1 °C	3 °C	94%	72%	46%	0 mm
19/05/2018	20.4 °C	12.3 °C	4.3 °C	94%	65%	38%	0 mm
20/05/2018	22.2 °C	14.7 °C	7.1 °C	94%	70%	45%	0 mm
21/05/2018	22.8 °C	15 °C	7.2 °C	97%	73%	44%	0 mm
22/05/2018	20.1 °C	14.7 °C	9.4 °C	92%	76%	55%	0 mm
23/05/2018	15.6 °C	12.4 °C	9.2 °C	91%	84%	72%	0 mm
24/05/2018	20.7 °C	14.8 °C	8.9 °C	94%	82%	51%	1.5 mm
25/05/2018	17 °C	14.1 °C	11.3 °C	98%	96%	92%	19 mm
26/05/2018	19.6 °C	15.7 °C	11.7 °C	98%	85%	60%	0 mm
27/05/2018	25.8 °C	18.5 °C	11.3 °C	93%	81%	55%	0 mm
28/05/2018	23.4 °C	17.9 °C	12.4 °C	97%	87%	68%	0 mm
29/05/2018	16.7 °C	14.3 °C	11.8 °C	98%	94%	86%	0 mm
30/05/2018	15.3 °C	14.9 °C	14.6 °C	96%	95%	93%	4.3 mm
31/05/2018	21.1 °C	17.6 °C	14.1 °C	98%	94%	82%	0 mm
01/06/2018	23.1 °C	18.2 °C	13.3 °C	99%	91%	74%	0.3 mm
02/06/2018	23.2 °C	19.5 °C	15.8 °C	96%	86%	66%	0 mm
03/06/2018	24.5 °C	19.1 °C	13.6 °C	97%	83%	59%	3.3 mm

04/06/2018	15.6 °C	13.8 °C	12.1 °C	98%	93%	85%	0.3 mm
05/06/2018	17.1 °C	13.2 °C	9.4 °C	96%	84%	67%	0.3 mm
06/06/2018	18.5 °C	13.5 °C	8.5 °C	94%	82%	65%	0 mm
07/06/2018	18.9 °C	15.6 °C	12.2 °C	91%	80%	67%	0 mm
08/06/2018	16.7 °C	14.4 °C	12.1 °C	92%	83%	71%	0 mm
09/06/2018	16.7 °C	14.1 °C	11.4 °C	92%	85%	75%	0 mm
10/06/2018	20.8 °C	14.9 °C	9.1 °C	96%	81%	60%	0 mm
11/06/2018	24.4 °C	16.2 °C	8 °C	97%	72%	41%	0 mm
12/06/2018	16.7 °C	13.7 °C	10.6 °C	95%	81%	63%	0 mm
13/06/2018	21.9 °C	15.8 °C	9.8 °C	91%	74%	55%	0 mm
14/06/2018	21.2 °C	17.2 °C	13.3 °C	91%	68%	44%	0.3 mm
15/06/2018	20.8 °C	15.6 °C	10.3 °C	83%	65%	44%	0 mm
16/06/2018	19.6 °C	15.9 °C	12.2 °C	88%	74%	57%	1 mm
17/06/2018	18.6 °C	14.7 °C	10.9 °C	90%	79%	59%	0.3 mm
18/06/2018	23.3 °C	19.1 °C	14.9 °C	92%	73%	47%	0 mm
19/06/2018	23.8 °C	20.1 °C	16.3 °C	89%	78%	64%	0 mm
20/06/2018	23.9 °C	18.2 °C	12.6 °C	93%	75%	59%	0 mm
21/06/2018	19.3 °C	14.5 °C	9.7 °C	83%	60%	37%	0 mm
22/06/2018	21.1 °C	15 °C	9 °C	87%	58%	27%	0 mm
23/06/2018	21.3 °C	15.6 °C	9.8 °C	81%	60%	32%	0 mm
24/06/2018	25.3 °C	16.8 °C	8.4 °C	90%	63%	39%	0 mm
25/06/2018	26.9 °C	19.8 °C	12.7 °C	86%	56%	31%	0 mm
26/06/2018	26.3 °C	18.3 °C	10.3 °C	96%	72%	36%	0 mm
27/06/2018	22.3 °C	16.6 °C	11 °C	96%	76%	42%	0 mm
28/06/2018	24.1 °C	18.2 °C	12.3 °C	93%	77%	58%	0 mm
29/06/2018	24.9 °C	18.3 °C	11.6 °C	94%	75%	42%	0 mm
30/06/2018	23.9 °C	18.2 °C	12.4 °C	93%	71%	37%	0 mm
01/07/2018	26.8 °C	19.5 °C	12.2 °C	95%	70%	44%	0 mm
02/07/2018	25.2 °C	18.8 °C	12.4 °C	93%	64%	32%	0 mm
03/07/2018	20.9 °C	16.2 °C	11.6 °C	90%	72%	48%	0 mm
04/07/2018	26.2 °C	18.5 °C	10.8 °C	92%	69%	32%	0 mm
05/07/2018	29.1 °C	21.2 °C	13.4 °C	92%	61%	20%	0 mm
06/07/2018	28.7 °C	22 °C	15.2 °C	92%	67%	36%	0 mm
07/07/2018	28.2 °C	22.1 °C	15.9 °C	90%	67%	38%	0 mm
08/07/2018	27.2 °C	21.1 °C	14.9 °C	91%	66%	44%	0 mm
09/07/2018	24.6 °C	19.9 °C	15.1 °C	87%	74%	58%	0 mm
10/07/2018	21.9 °C	17 °C	12.1 °C	90%	72%	53%	0 mm
11/07/2018	22.6 °C	17.7 °C	12.7 °C	91%	81%	61%	0 mm
12/07/2018	22.6 °C	17.7 °C	12.7 °C	91%	81%	57%	0 mm
13/07/2018	24.3 °C	17.4 °C	10.5 °C	95%	76%	52%	0 mm
14/07/2018	27.9 °C	20.1 °C	12.4 °C	94%	66%	37%	0 mm
15/07/2018	29.1 °C	22 °C	14.9 °C	84%	56%	30%	0 mm
16/07/2018	28.7 °C	22 °C	15.3 °C	81%	56%	29%	0 mm
17/07/2018	22.9 °C	18.6 °C	14.2 °C	86%	62%	43%	0 mm
18/07/2018	24.7 °C	19.2 °C	13.7 °C	77%	60%	44%	0 mm
19/07/2018	26.8 °C	20 °C	13.2 °C	85%	60%	36%	0 mm
20/07/2018	26.9 °C	20.3 °C	13.8 °C	86%	60%	38%	0 mm
21/07/2018	26.3 °C	20.8 °C	15.2 °C	87%	67%	46%	0 mm
22/07/2018	25.8 °C	21 °C	16.2 °C	82%	69%	56%	0 mm
23/07/2018	31.7 °C	24.3 °C	17 °C	89%	63%	41%	0 mm
24/07/2018	28.8 °C	23 °C	17.2 °C	88%	66%	38%	0 mm
25/07/2018	27.9 °C	21.6 °C	15.4 °C	82%	62%	40%	0 mm
26/07/2018	33.3 °C	23.9 °C	14.5 °C	89%	62%	31%	0 mm
27/07/2018	32 °C	25.1 °C	18.3 °C	93%	67%	39%	6.1 mm
28/07/2018	21.6 °C	17.8 °C	14 °C	92%	76%	39%	6.9 mm

29/07/2018	20.7 °C	17.3 °C	13.9 °C	94%	89%	83%	1.8 mm
30/07/2018	23.6 °C	18.8 °C	14.1 °C	94%	78%	58%	0 mm
31/07/2018	24.4 °C	19.2 °C	14 °C	94%	67%	40%	3 mm
01/08/2018	24.9 °C	18.8 °C	12.7 °C	87%	63%	42%	0 mm
02/08/2018	29.2 °C	22.3 °C	15.3 °C	83%	66%	47%	0 mm
03/08/2018	28.7 °C	22.9 °C	17.1 °C	92%	71%	51%	0 mm
04/08/2018	25.7 °C	20.9 °C	16.1 °C	88%	68%	44%	0 mm
05/08/2018	29.9 °C	21.9 °C	13.9 °C	88%	64%	37%	0 mm
06/08/2018	29.9 °C	23.2 °C	16.5 °C	80%	56%	36%	0 mm
07/08/2018	30.2 °C	23.2 °C	16.1 °C	84%	58%	24%	0 mm
08/08/2018	23.8 °C	19.3 °C	14.7 °C	78%	61%	39%	0 mm
09/08/2018	17.5 °C	15.1 °C	12.7 °C	93%	81%	69%	1.3 mm
10/08/2018	17.7 °C	14.1 °C	10.4 °C	90%	75%	53%	0 mm
11/08/2018	22.4 °C	15.8 °C	9.3 °C	95%	69%	38%	4.3 mm
12/08/2018	20.7 °C	18.2 °C	15.7 °C	95%	88%	75%	2.8 mm
13/08/2018	23.9 °C	19.8 °C	15.6 °C	96%	85%	60%	9.9 mm
14/08/2018	23.7 °C	18.7 °C	13.7 °C	91%	76%	56%	0.3 mm
15/08/2018	24.7 °C	19.5 °C	14.3 °C	92%	74%	56%	0 mm
16/08/2018	20.6 °C	17.3 °C	14.1 °C	94%	74%	46%	5.1 mm
17/08/2018	20.9 °C	15.9 °C	10.9 °C	91%	70%	50%	0 mm
18/08/2018	23.8 °C	19.8 °C	15.8 °C	86%	75%	57%	0 mm
19/08/2018	22.6 °C	19.9 °C	17.1 °C	90%	80%	66%	0 mm
20/08/2018	24.2 °C	20.6 °C	17 °C	88%	77%	62%	0 mm
21/08/2018	25.2 °C	21.6 °C	18 °C	90%	74%	52%	0 mm
22/08/2018	25.8 °C	20.3 °C	14.9 °C	94%	76%	55%	0 mm
23/08/2018	20.6 °C	16.2 °C	11.9 °C	95%	78%	59%	8.4 mm
24/08/2018	17.8 °C	13.6 °C	9.5 °C	92%	75%	49%	6.1 mm
25/08/2018	18.9 °C	13.9 °C	9 °C	91%	74%	47%	2.8 mm
26/08/2018	16.6 °C	13.2 °C	9.8 °C	97%	89%	78%	6.6 mm
27/08/2018	19.3 °C	16 °C	12.8 °C	92%	78%	62%	0 mm
28/08/2018	18.3 °C	16.1 °C	13.9 °C	88%	76%	64%	0 mm
29/08/2018	20.2 °C	16.2 °C	12.2 °C	93%	77%	57%	1 mm
30/08/2018	19.5 °C	14.6 °C	9.7 °C	88%	69%	42%	0 mm
31/08/2018	21.6 °C	14.3 °C	7.1 °C	95%	74%	41%	0 mm

References

Biostimulant Coalition, 2013. What are biostimulants? <http://www.biostimulantcoalition.org/about/>