HMC

TECHNICAL MEETING 2024

Tech Meeting Agenda

- 09:30 Allen Giles – Season overview and contract updates
- 09:45 Jack Harris – Seed rate trial results
- 10:15 Dr Lizzie Sagoo (ADAS) – PeaSat update
- 10:30 Stuart Ashton – (Greenyard Frozen) - Season overview and market update from Greenyard
- 10:45 Break
- 11:00 Dr Becky Howard (PGRO) – Pesticide updates/pea and bean seed fly
- 11:30 Richard Binks – (Koppert) – IPM and biological solutions in legume crops
- 12:00 Allen Giles – Importance of traceability and customer requirements

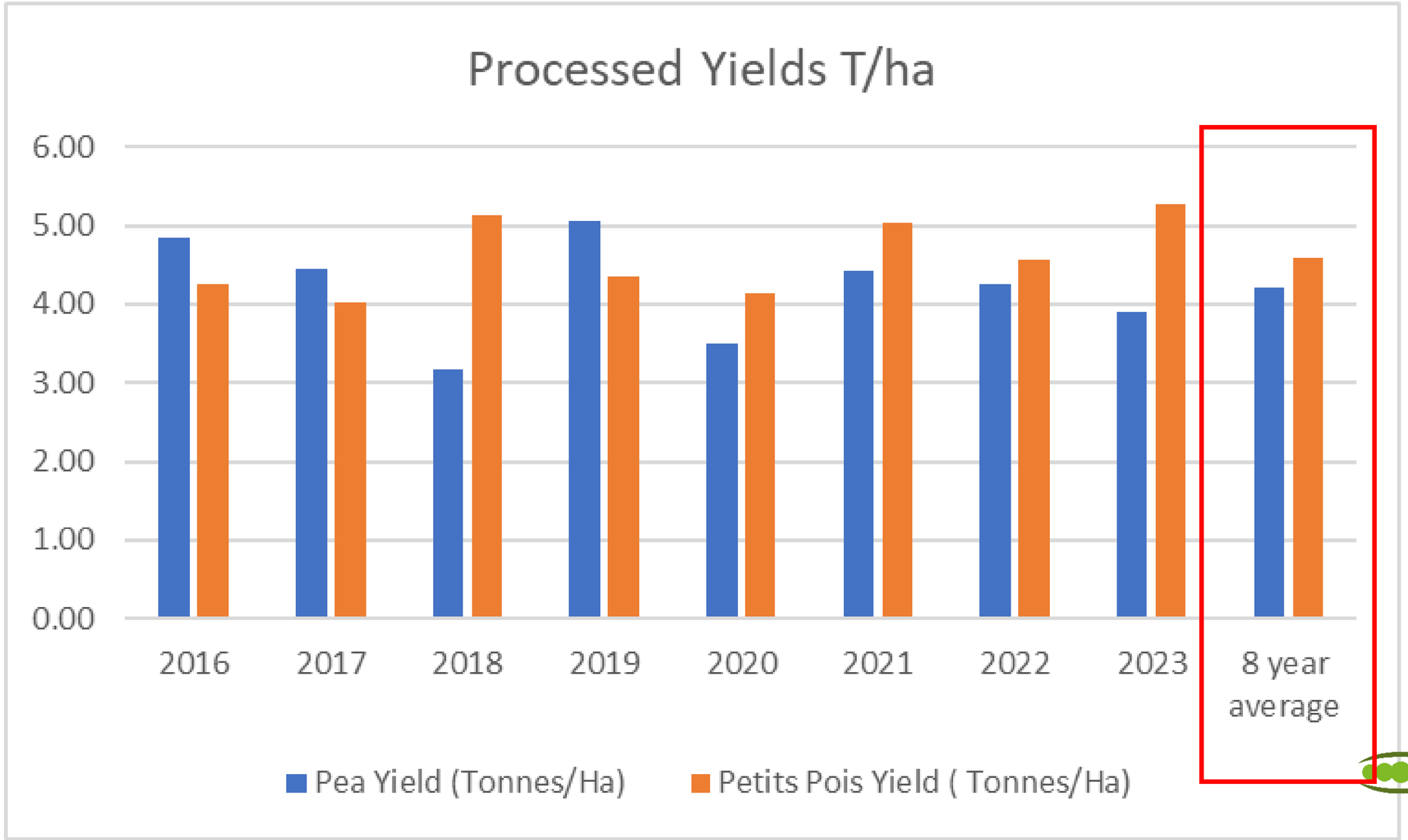
Allen Giles

2023 Recap

- Harvested 5,873 Tonnes Peas Total
- 4% over contract
- Harvested 3,967 Tonnes Petits Total
- 4% over contract

- 88% A-AA on Petits
- 73% A-AA on Standards
- Bypass 17.5ha 0.8% Crop (14ha no crop due to pigeon damage, 3.5ha high TR headland)

Processed Yields T/ha



Contracts 2024

Greenyard Frozen

- Peas 4800 Tonnes
- Petits Pois 4300 Tonnes
- Prices for 2024 no change on 2023 prices
- No Edamame

Princes

- Peas 900 Tonnes
- Petits Pois 0 Tonnes
- Prices for 2024 no change on 2023 prices

Drilling Programme

- Area 2,215 ha
- Need average yield of 4.5 tonnes / ha to achieve contracts.
- All growers should had received an updated copy of the programme.
- Widespread seed availability issues in 2024 reduced to 9 varieties this year
- 1st / 2nd Earlies in Norfolk. Starting on Petits when returning to the silts.
- Petits on silts
- Finish on Holbeach/Lutton Marsh and organics at Sandringham
- Currently no organics required for 2024 at this stage

Trials 2024

- Continuing with seed rate trials over 5 varieties and sites
- Norfolk variety trials (5 in total)
- Norfolk bio stimulants trial (3 in total)
- Petits variety trials (7 in total)
- Late Standard variety trials (3 in total)

New Growers

- E & M Hurn
- Mike Neverson

Machinery & Personnel Update

- New viner for 2024 season on wheels
- All viners now fitted with high level safety rail and working well
- Couple of staff changes in 2023 (Aiden in sampling team and Josh on nights as viner driver)
- Mark came in as relief viner driver which worked well
- Currently looking to replace Oliver on day shift who is not returning for 2024
- Implementation of more robust near miss and accident reporting system which worked well

Housekeeping

- Washdown Areas
- Grower field visits (Highest near misses in 2023)
  - High viz
  - Sign in
  - Make yourself known to shift supervisor
- Access to fields – Clear gateways and cut low trees
- Field information for following season – complete with all back cropping details and new columns for field hazards.
- Imperative that field risk assessment is filled out accurately and fully

Jack Harris

Seed Rate Trials – Year 1 results

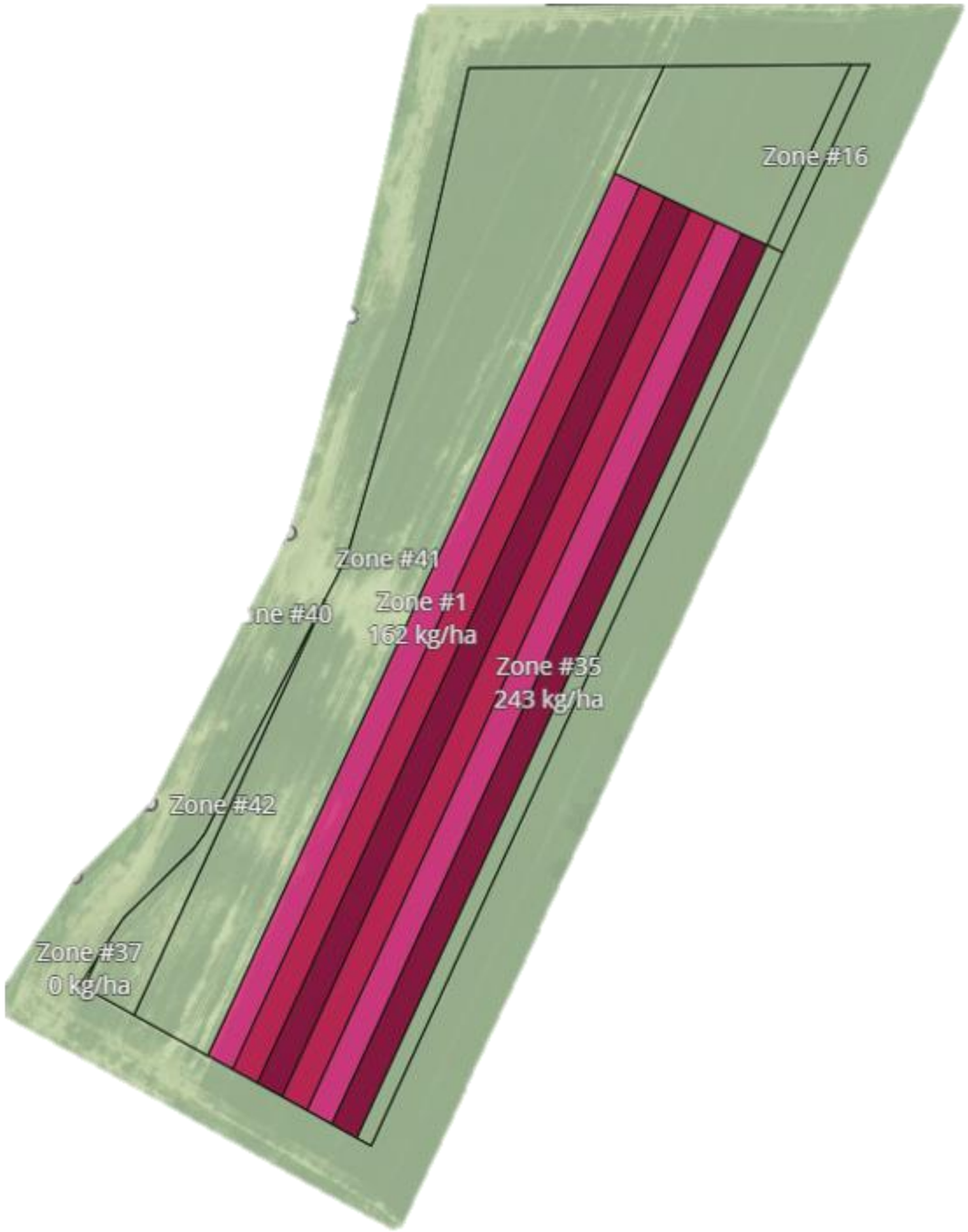
- Aim was to see if increasing seed rates would have a benefit on yield
- Does it affect quality and TR?
- Does the extra seed cost cover the return?
- 4 trails over different periods in the season with different varieties
- Does it affect harvest timing?

Worth Farms - Amalfi

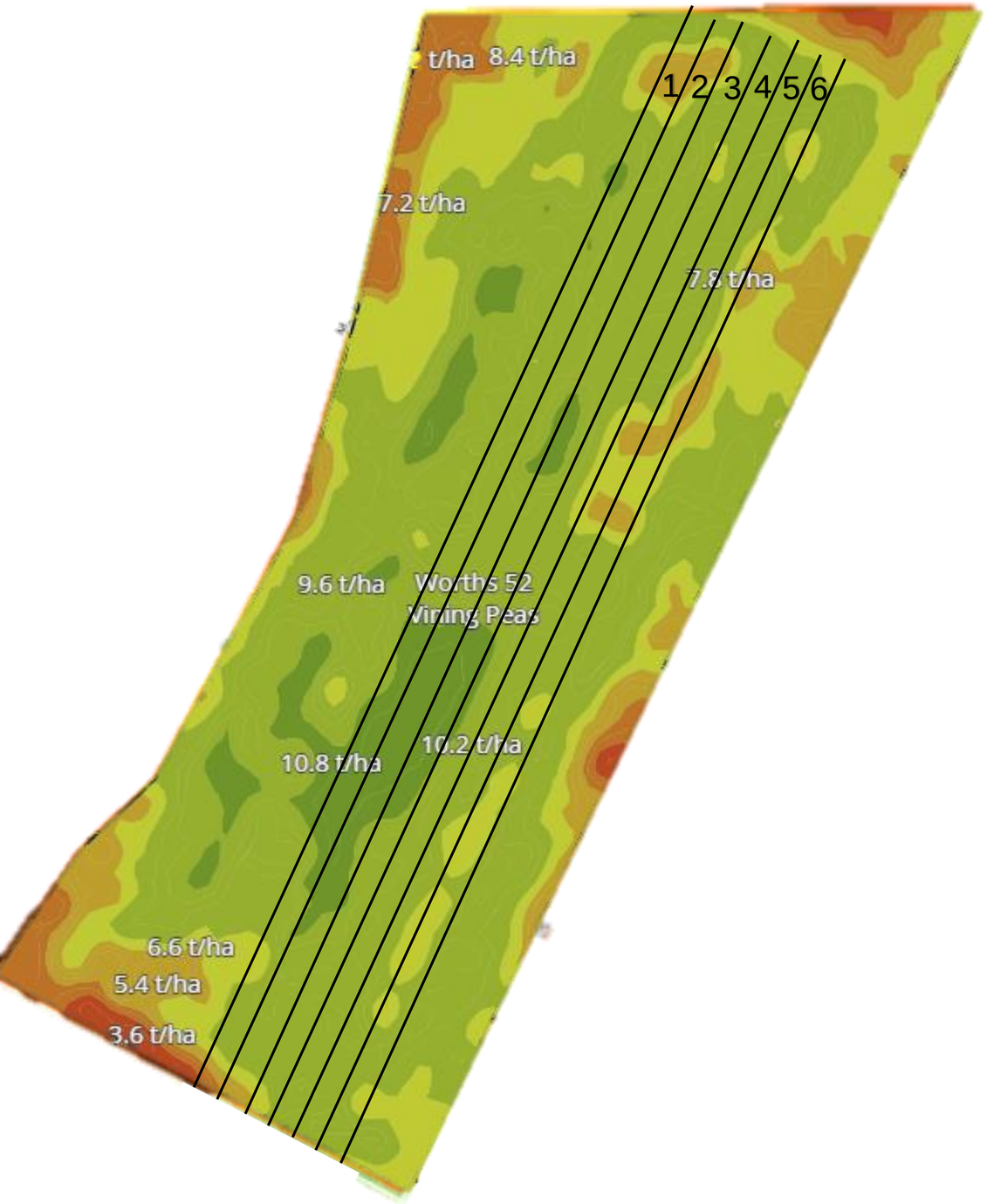
- 3 different seed rates / replicated over field

- Field rate 162 kg/ha
- Increased 25% 203 kg/ha
- Increased 50% 243 kg/ha

- Drilled 20/04/2023
- Harvested 09/07/2023
- Rainfall 142mm approx



- Scanned with Soil Optix scanner to reveal a number of layers.
- Aimed to get different soil zones through each rate
- Trial was then designed around direction of drilling and soil zone changes

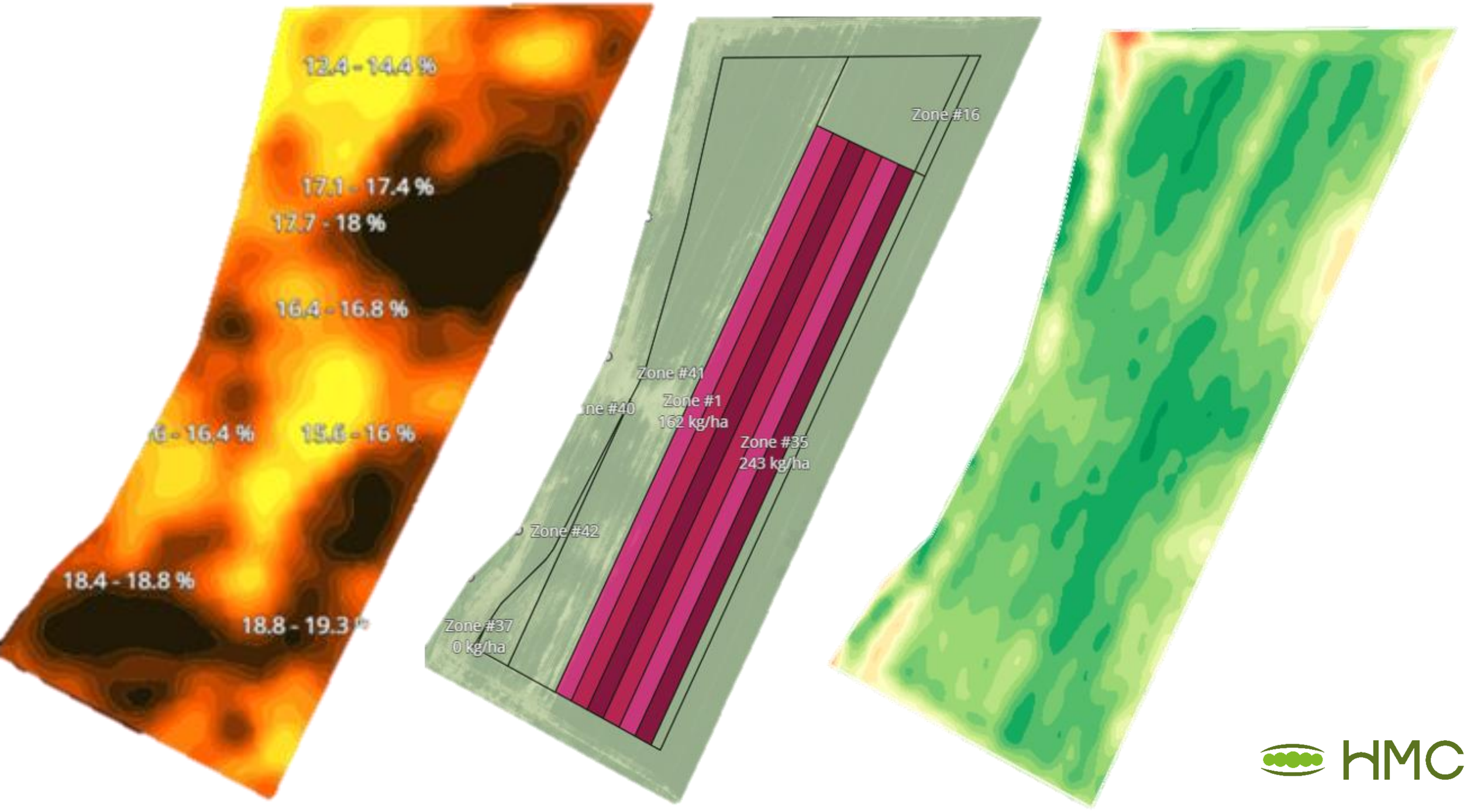


- Upon visual inspection you could clearly see the difference in emergence of seed rates
- Satellite imagery slightly shows plots, but soil texture has a bigger affect

PLOT NUMBER	RATE KG/HA	PLANT COUNT	TR Before Harvest
1	203	150	79
2	162	111	84
3	243	125	82
4	162	129	79
5	243	192	81
6	203	183	87

HMC

FARM	RATE KG/HA	RATE AS PERCENTAGE	FROZEN YIELD	FRESH YIELD T/HA	YIELD INCREASE OVER STANDARD T/HA	RETURN FOR THAT FIELD PER TON	RETURN PER HECTARE	SEED COST PER HECTARE	BALANCE	DIFFERENCE
WORTHS	162	100	8.6	10.57		£611.41	£5,258.13	£327.18	£4,930.95	£0.00
WORTHS	203	125	8.3	10.21	-0.36	£611.41	£5,074.70	£409.86	£4,664.84	-£266.10
WORTHS	243	150	9.38	11.53	1.32	£611.41	£5,735.03	£490.62	£5,244.41	£313.46

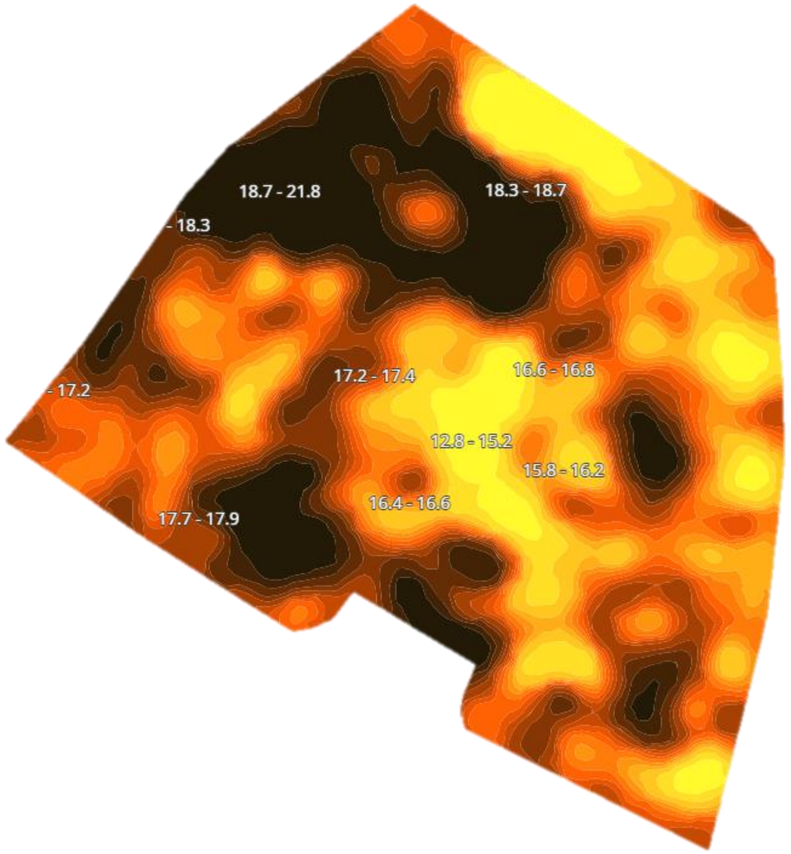

12.4 - 14.4 %
17.1 - 17.4 %
17.7 - 18 %
16.4 - 16.8 %
15.6 - 16 %
18.4 - 18.8 %
18.8 - 19.3 %
Zone #16
Zone #41
Zone #1
162 kg/ha
Zone #35
243 kg/ha
Zone #42
Zone #37
0 kg/ha

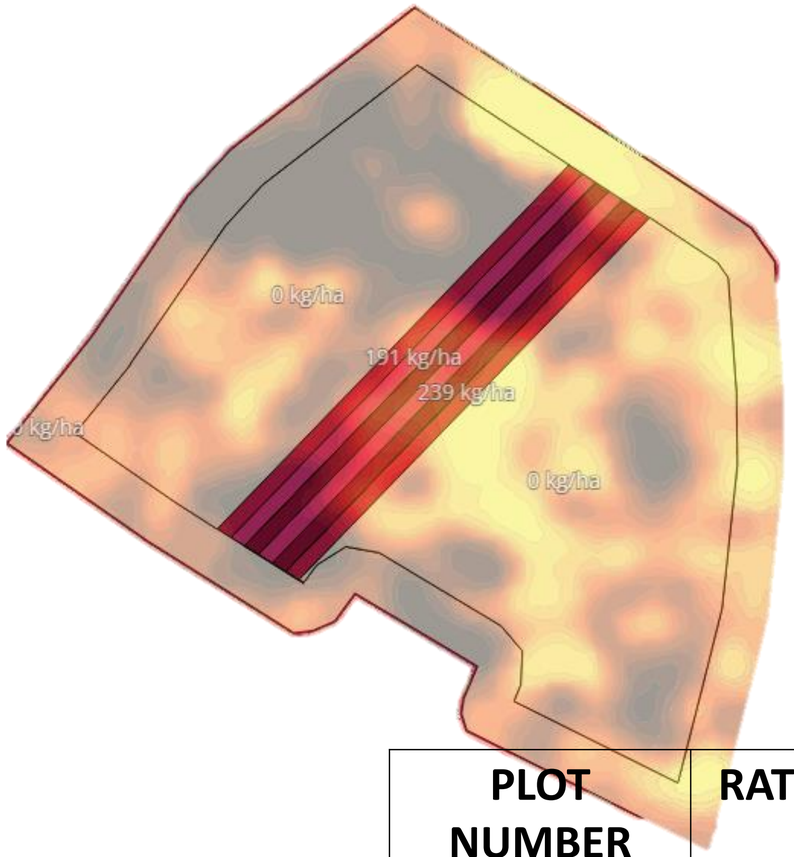
Robinson Farms - Tomahawk

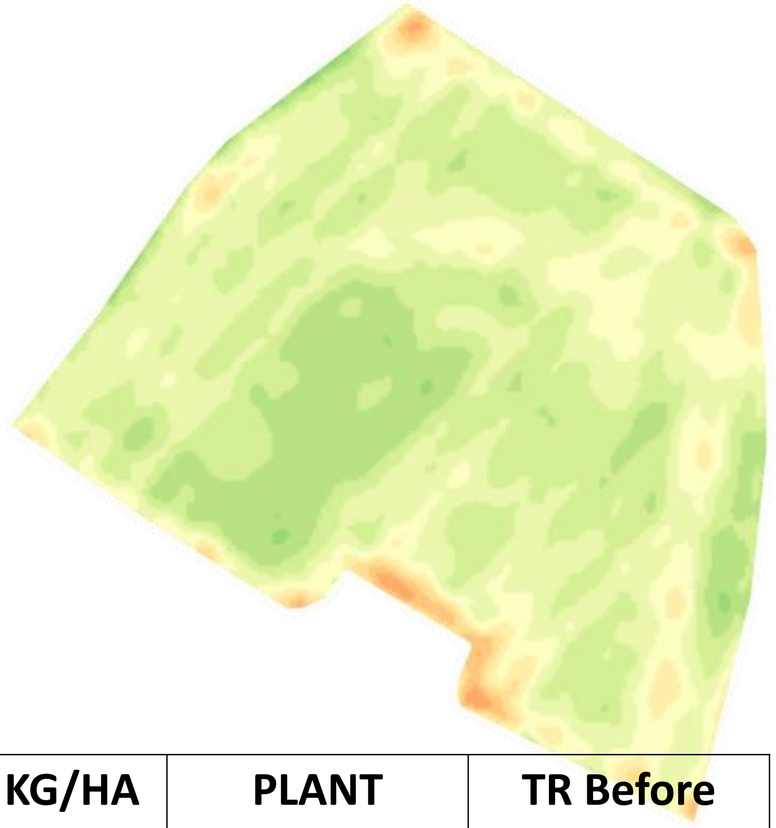
- 3 different seed rates / replicated over field

- Field rate 191 kg/ha
- Increased 25% 239 kg/ha
- Increased 50% 287 kg/ha

- Drilled 09/04/2023
- Harvested 26/06/2023
- Rainfall 139mm approx







PLOT NUMBER	RATE KG/HA	PLANT COUNT	TR Before Harvest
1	239	116	101
2	191	127	107
3	287	150	112
4	191	108	106
5	287	131	109
6	239	104	107

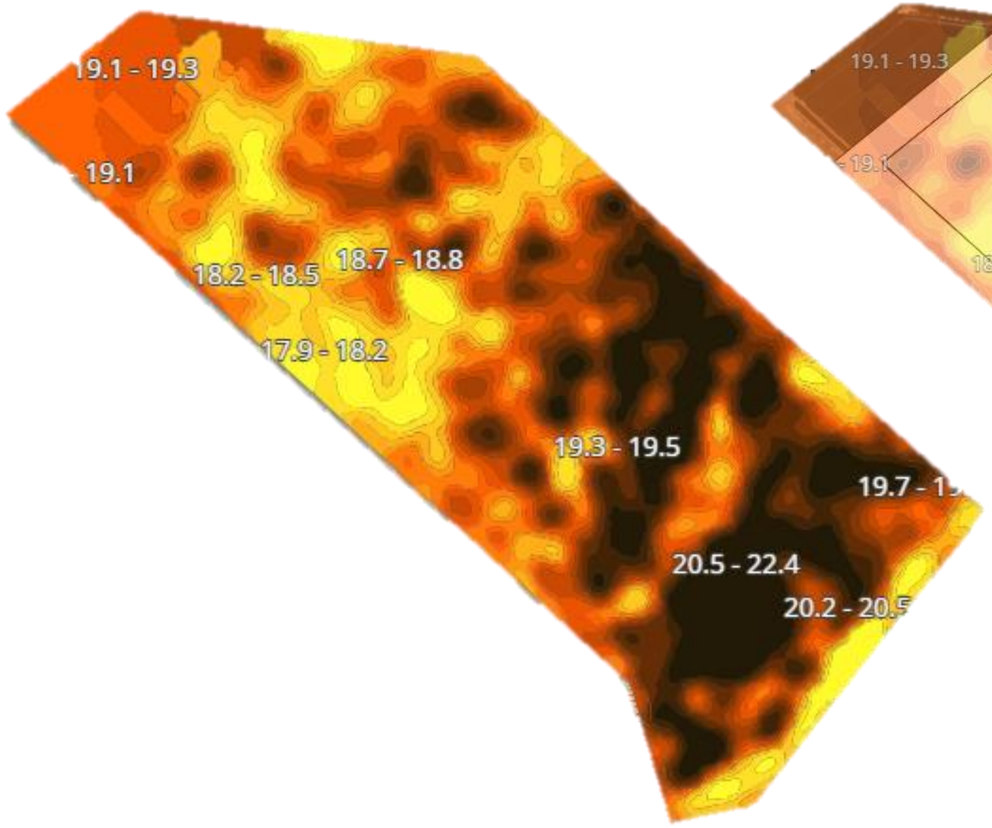
FARM	RATE KG/HA	RATE AS PERCENTAGE	FROZEN YIELD	FRESH YIELD T/HA	YIELD INCREASE OVER STANDARD T/HA	RETURN FOR THAT FIELD PER TON	RETURN PER HECTARE	SEED COST PER HECTARE	BALANCE	EXTRA INCOME
ROBINSONS	191	100	2.18	2.75		£561.61	£1,224.31	£256.70	£967.61	£0.00
ROBINSONS	239	125	2.3	2.9	0.15	£561.61	£1,291.70	£321.21	£970.49	£2.88
ROBINSONS	287	150	2.49	3.15	0.4	£561.61	£1,398.41	£385.73	£1,012.68	£45.07

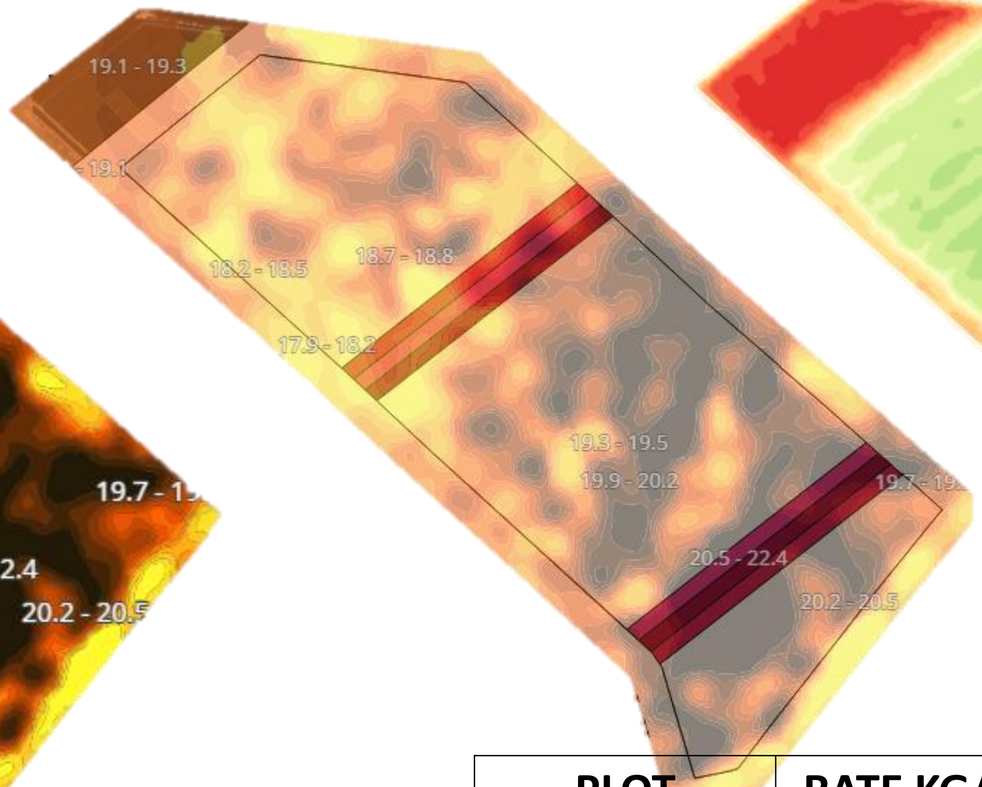
L SYMINGTON Farms - OASIS

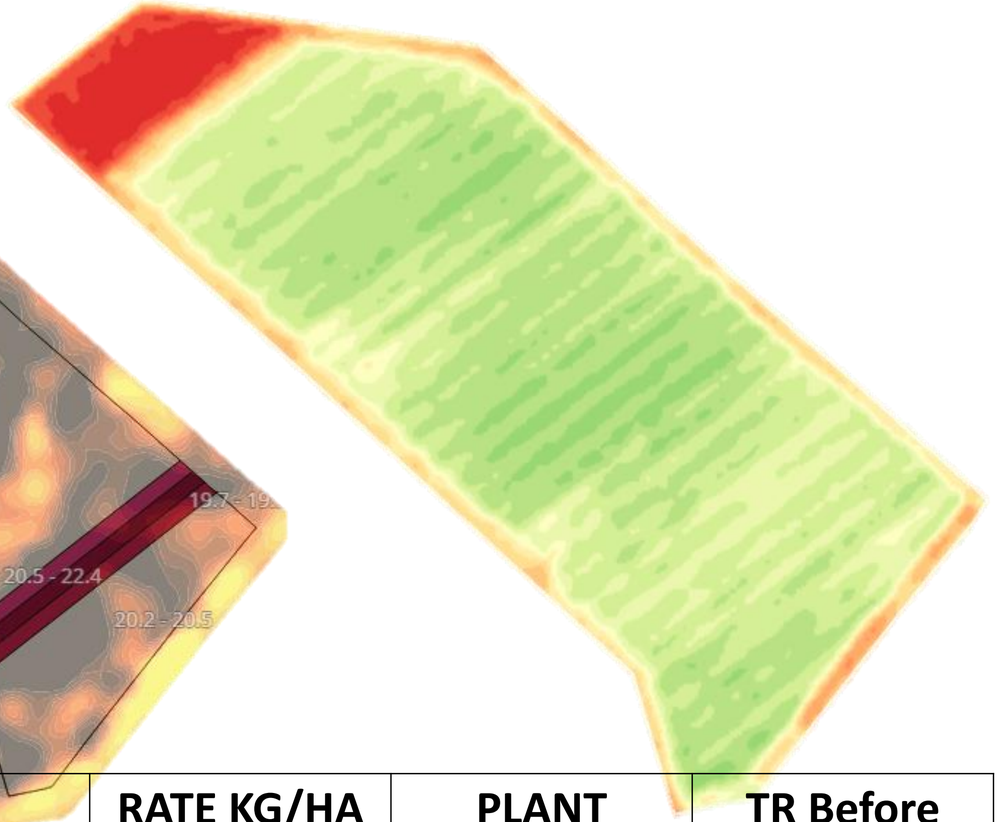
- 3 different seed rates / replicated over field

- Field rate 222 kg/ha
- Increased 25% 278 kg/ha
- Increased 50% 333 kg/ha

- Drilled 23/05/2023
- Harvested 04/08/2023
- Rainfall 196mm approx







PLOT NUMBER	RATE KG/HA	PLANT COUNT	TR Before Harvest
1	278	70.38	92
2	222	72.45	92
3	333	103	89
4	222	74.52	97
5	333	115.92	102
6	278	128.34	93

HMC

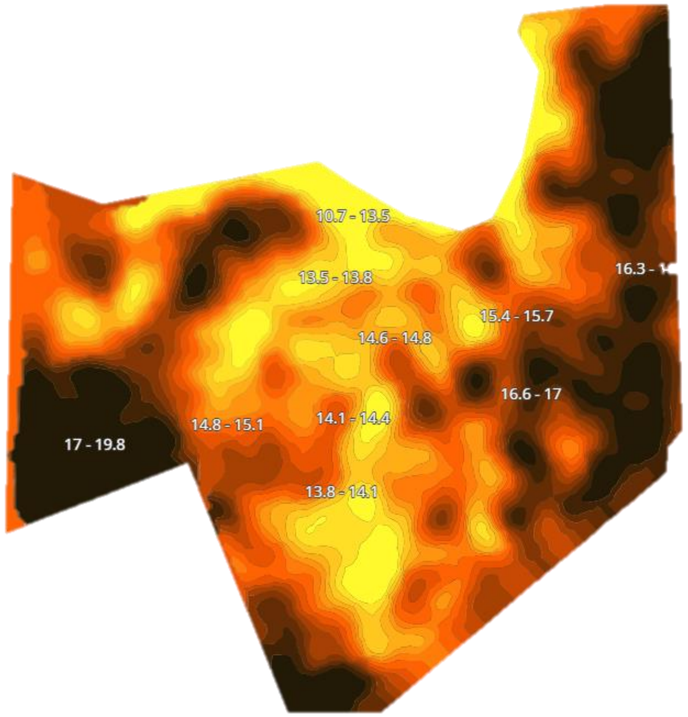
FARM	RATE KG/HA	RATE AS PERCENTAGE	FROZEN YIELD	RETURN FOR THAT FIELD PER TON	RETURN PER HECTARE	EXTRA SEED COST PER HECTARE	BALANCE	EXTRA INCOME
SYMINGTON	222	100	6.52	£534.77	£3,486.70	223.11	£3,263.59	£0.00
SYMINGTON	278	125	6.98	£534.77	£3,732.69	279.94	£3,452.75	£189.16
SYMINGTON	333	150	7.6	£534.77	£4,064.25	334.665	£3,729.59	£466.00

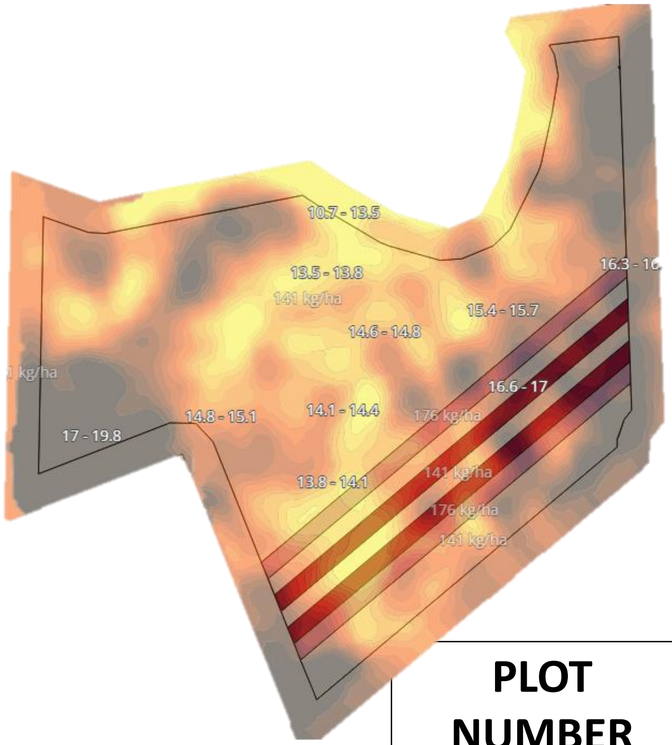
G H HOYLES Farms - TROPHEE

- 3 different seed rates / replicated over field

- Field rate 141 kg/ha
- Increased 25% 176 kg/ha
- Increased 50% 212 kg/ha

- Drilled 19/05/2023
- Harvested 25/07/2023
- Rainfall 133mm approx





PLOT NUMBER	RATE KG/HA	PLANT COUNT	TR Before Harvest
1	176	116	95
2	141	126	99
3	212	149	96
4	141	108	94
5	212	130	97
6	176	104	94

HMC

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G H HOYLES	141	100	8.12	£686.33	£5,573.00	301.48	£5,271.52	£0.00
G H HOYLES	176	125	8.71	£686.33	£5,977.93	376.28	£5,601.65	£330.13
G H HOYLES	212	150	9.31	£686.33	£6,389.73	453.255	£5,936.48	£664.96

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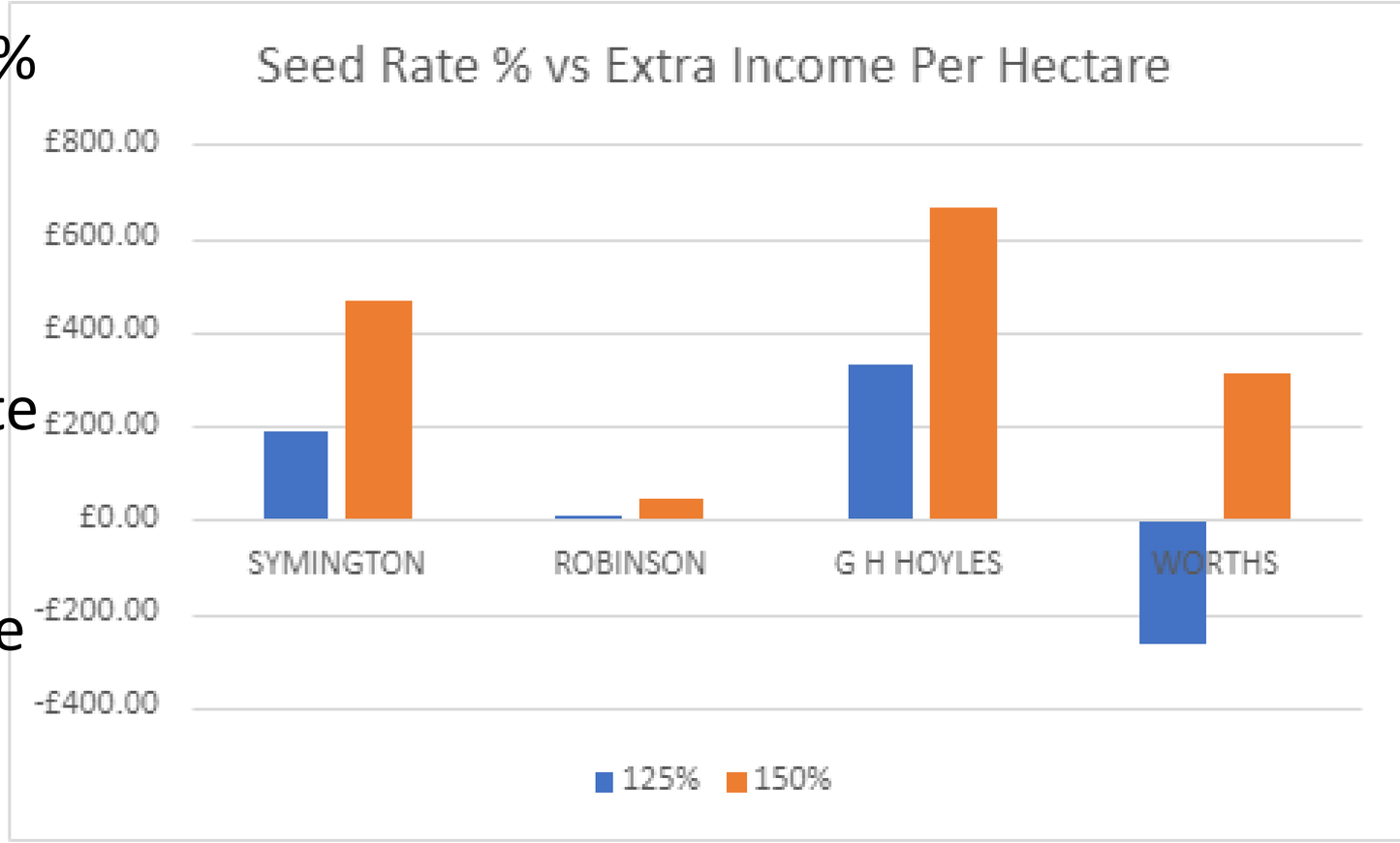
SYMINGTON	333	150	7.6	£534.77	£4,064.25	334.665	£3,729.59	£466.00

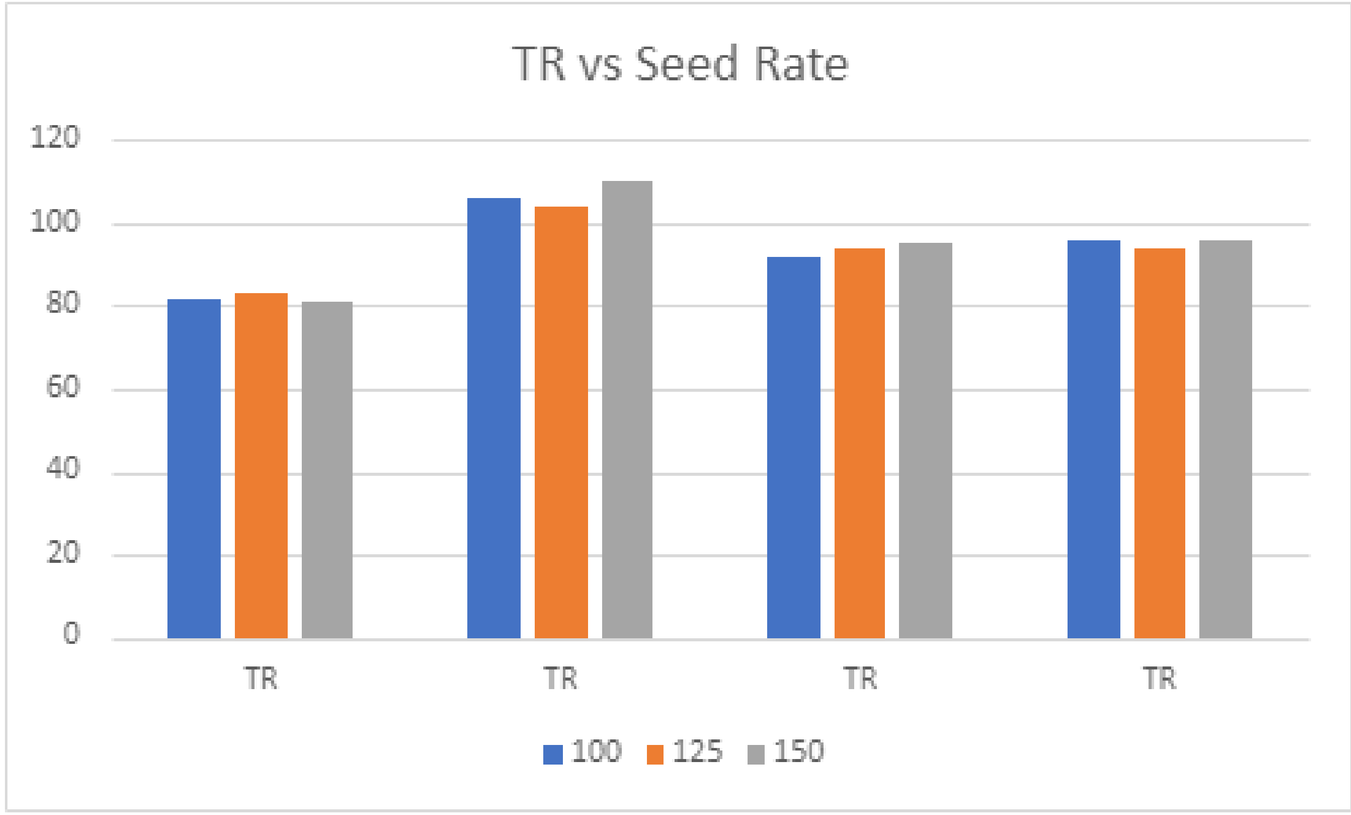
Observations

- Initial results showed us that increasing the seed rate by 50% did have a positive effect in yield and returns.
- 3 out of the 4 trials showed a positive effect on yield and returns increasing the seed rate by 25%
- Viner drivers also commented the higher seed rate plots were thicker to vine which will improve the efficiency of the machines.



Observations

- Increases were seen across all trials but best returns were on the best land with the highest value crops.
- TR wasn't affected a great deal by seed rate
- Yield increase from 25% seed to 50% seed not massive, but were we able to harvest more peas due to thicker crop?
- Will repeat trials this year



Dr Lizzie Sagoo

PeaSat

Using satellite imagery to estimate final yield of vining peas to maximise the efficiency and profitability of harvest and processing

HMC Technical Meeting 26th February 2024

European Space Agency Feasibility project

- **ESA Feasibility projects** aim to support development of products or services that use space assets
- **Project aim**: to use existing HMC yield maps & satellite data to develop a **yield prediction package** to allow vining pea growers and processers to forecast intake volumes around 2 weeks before harvest.
- **Project duration:** 9 months
  Nov 2023 – Jun 2024

Project plan

Stakeholder engagement

- Workshop & survey with other growers & processors

Technical feasibility

- Selection of satellite data
- Develop yield prediction model
- Validate yield prediction model

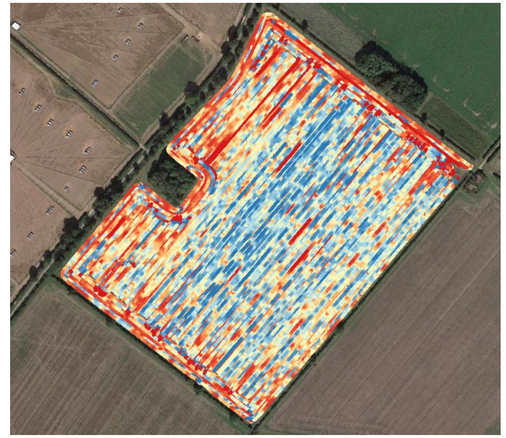
Viability assessment

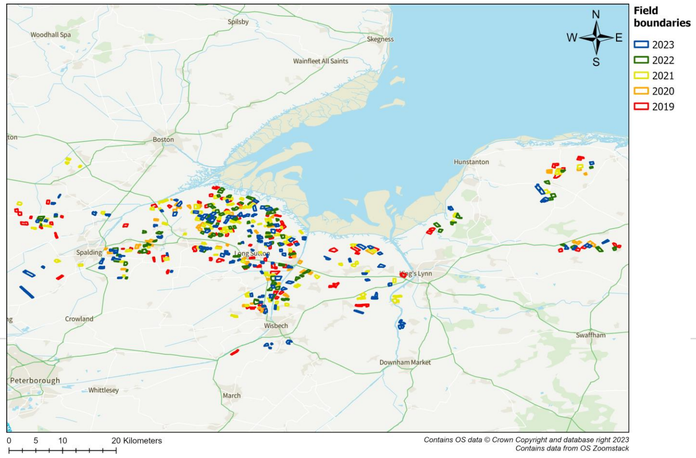
- Calculate benefit of accurate yield prediction from model
- Calculate ongoing cost of running model




Developing the yield prediction model

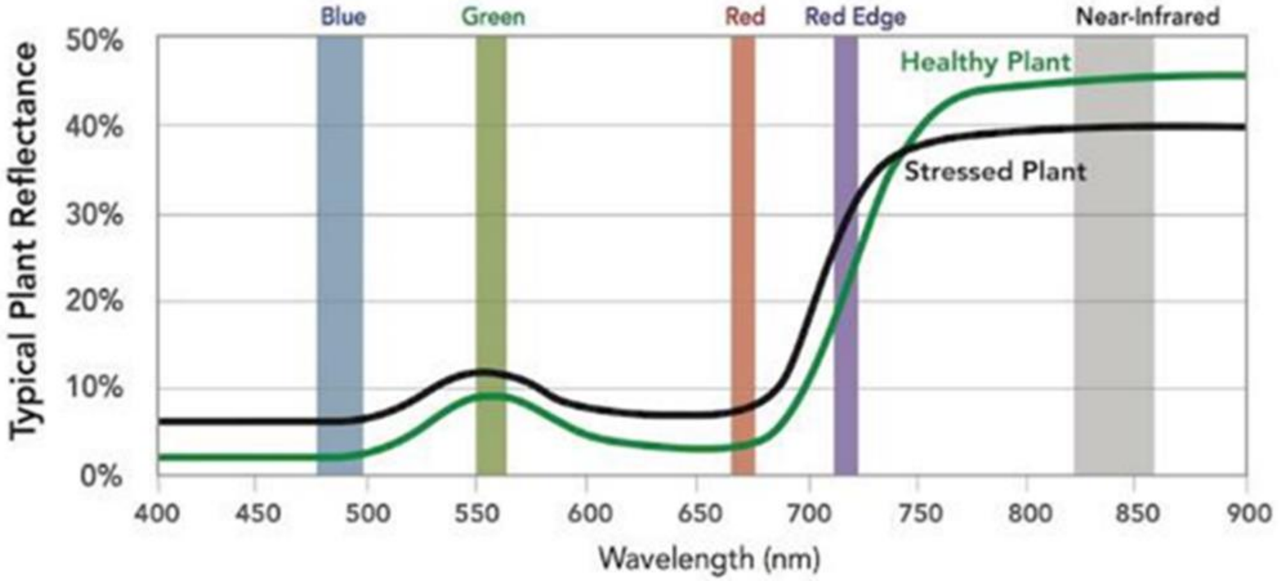
- Yield maps from HMC
- Satellite imagery search – range of dates and resolutions
- Other data
  - Crop information (variety, sowing date)
  - Weather data
  - Harvest date prediction
  - Field boundaries
- Exploration of relationships (VI and yield)
  - Impact of variety
- Development of yield model

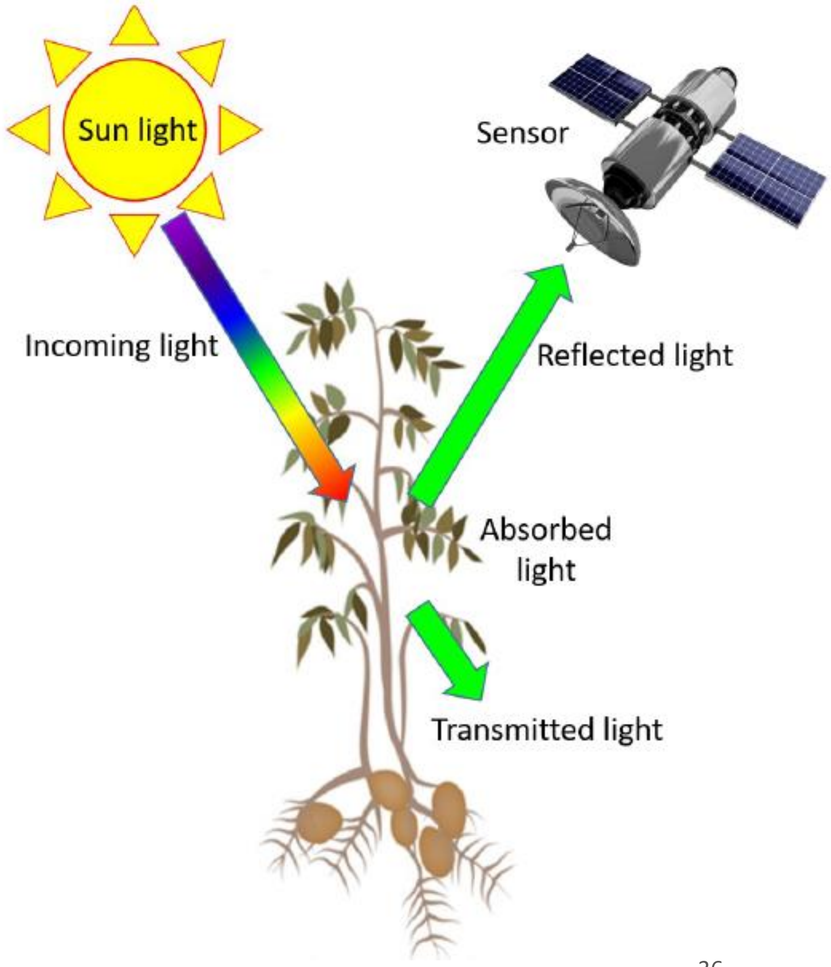




What is crop sensing?

- Capturing reflected light in different wavelengths
- Using this data to provide information on crop growth and vigour

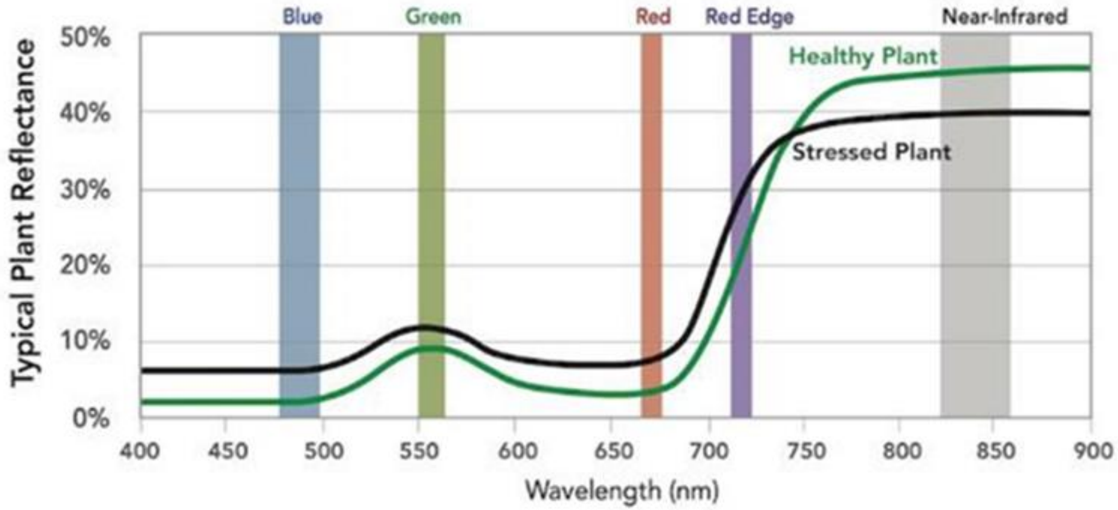




What is a vegetation index?

- Number calculated from reflectance measurements
- Calculated using two or more spectral bands
- Use bands that are sensitive to plant biomass & vigour
- NDVI (Normalised difference vegetation index)

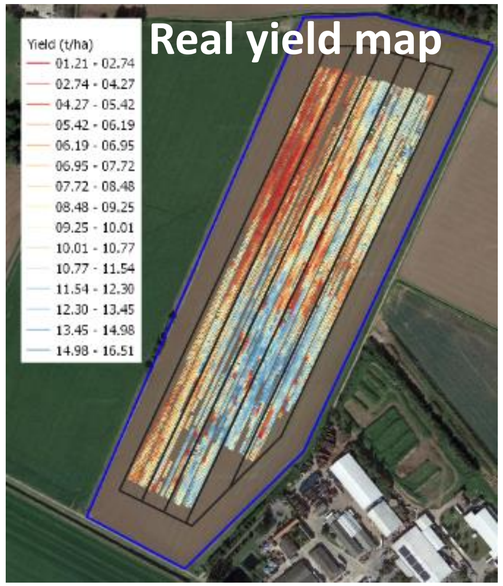
$$NDVI = \frac{NIR - Red}{NIR + Red}$$

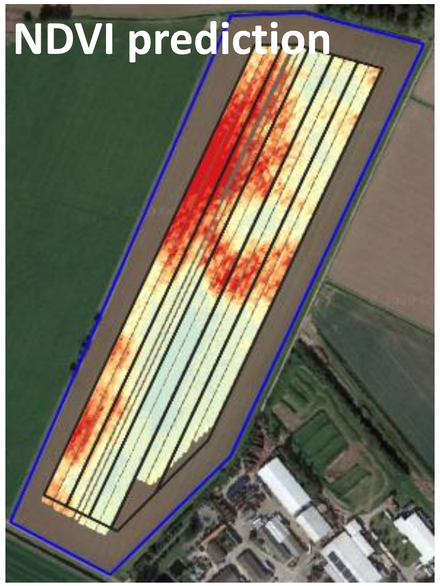


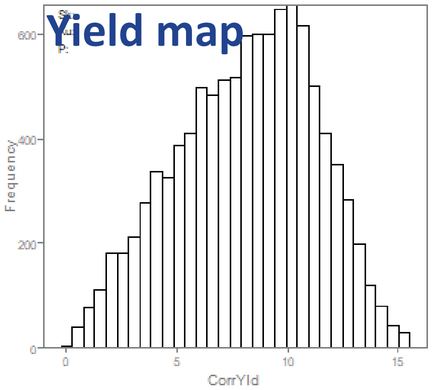
Choice of vegetation index

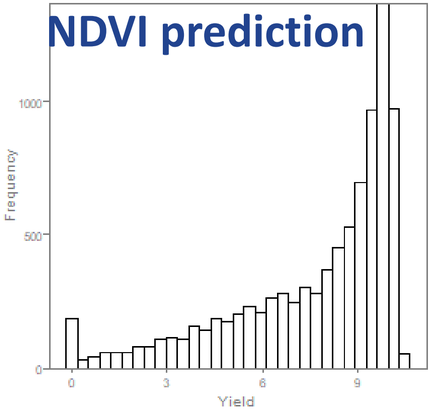
Vining peas – real vs predicted yield maps

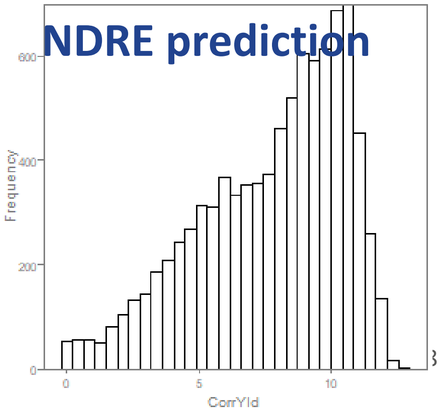
- NDVI prediction underestimates high yields due to saturation.
- NDRE prediction appears closest to real yield map.







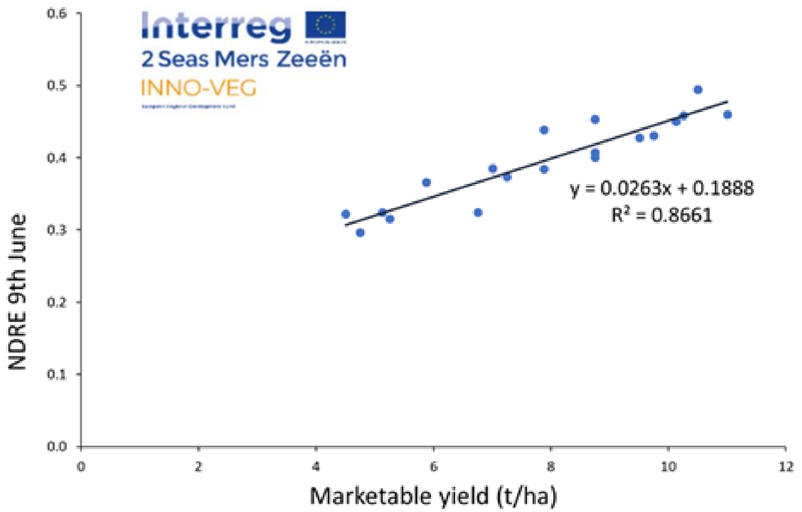




Proof of concept

- HMC and ADAS have demonstrated good correlations between Vegetation Indices and vining pea yields
- Focus on satellite data – only practical & cost effective method of collecting data over larger areas

	1st flight (9 June)	2nd flight (25 June)
NDVI	0.86	0.70
MCARI2	0.83	0.77
Clgreen	0.85	0.71
Clrededge	0.85	0.71
MTCI	0.81	0.67
NDRE	0.87	0.70
REIP	0.85	0.62



Challenges/questions to be addressed

- Utilise available yield map and satellite data to produce the most accurate yield prediction model(s) possible
- How accurate is the yield prediction model across fields and years?
- What is the impact of variety? Do we need separate yield prediction models?
- How sensitive is the model to crop growth stage when image is taken?
- Explore use of data from different satellites – impacts of spatial and temporal resolution
- Calculate a range of difference Vegetation Indices to assess which best correlates with yield

Work in progress

- Development of yield prediction algorithms (end April)
- Viability assessment
  - Calculate benefit of yield model
  - Costs of running model
  - Potential commercial partners to deploy as service
- Proof of concept (run through using 2023 data)
  - Communication of cropping info
  - Collect & process satellite data
  - Yield predictions to HMC
  - Evaluate effectiveness
- If successful identify next steps to implement & run as a service

Stuart Ashton

FROZEN

HMC 2023 Pea Season

26th February 2024

2023 Season Overview

FROZEN

Budget Frozen Tonnes	Actual Frozen Tonnes	Achieved Percentage %
33,345	35,082	105%

Planned Fresh Tonnes	Delivered Fresh Tonnes	Fulfilment Percentage %
49,069	41,240	84%

This highlights the space we have in capacity

BOSTON PLAN AVERAGED 81% FULFILMENT

FROZEN

PLANNED 21,714

DELIVERED 17,691

GREENYARD

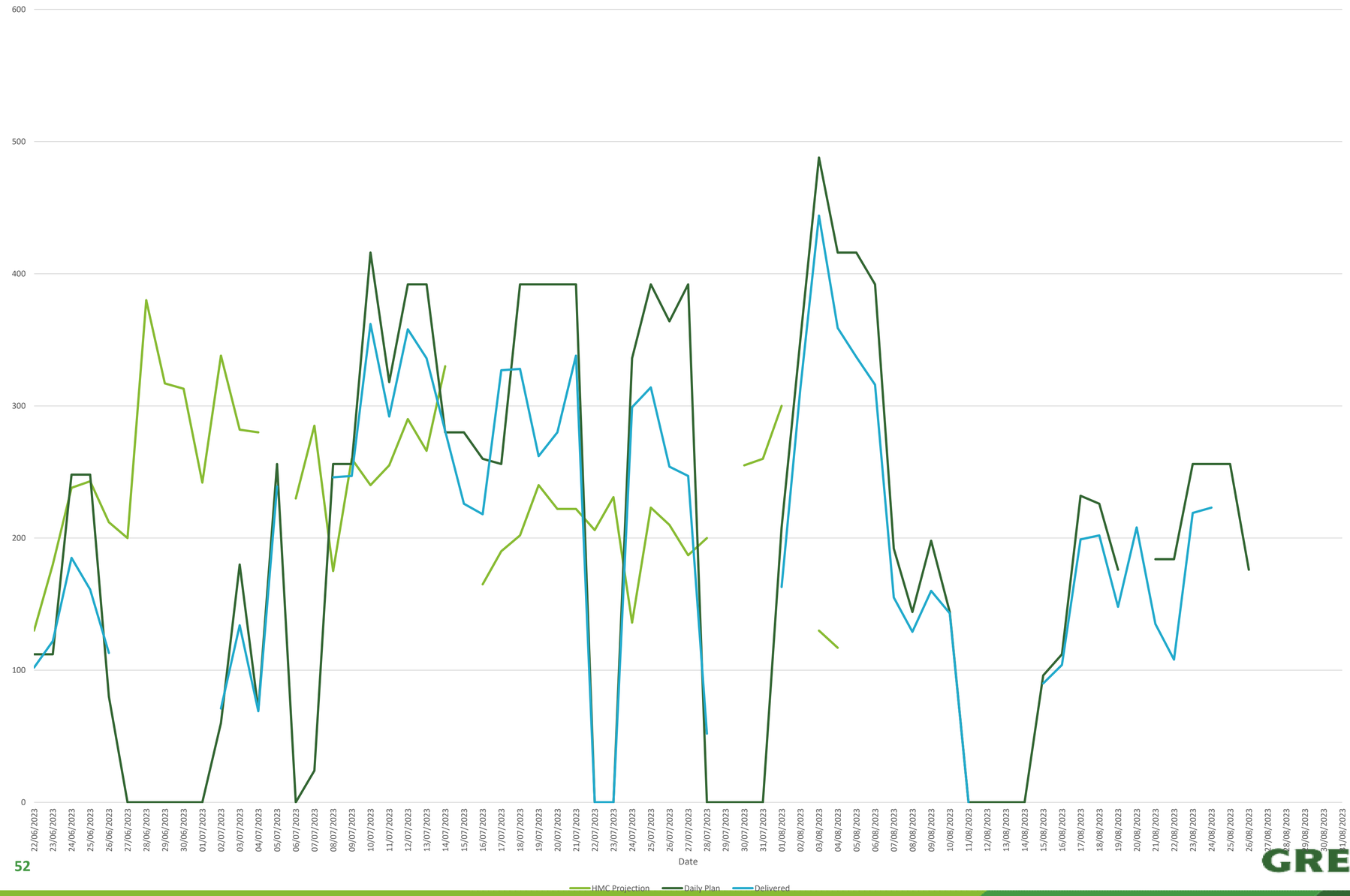
KING’S LYNN PLAN AVERAGED 86% FULFILMENT

PLANNED 27,355

DELIVERED 23,549

Programmed Tonnage vs Planned vs Delivered

FROZEN



GREENYARD

Learnings for 2024

1. Communication
    - What's app group next year, more selective members
    - Must first be a phone call, then SMS or What'sApp to follow up
    - Pictures of quality concerns sent direct to pea group
    - Great focus on time communication during speedy peas
2. Quality
    - We must focus on quality
    - Reducing FM contamination – weeds, stones, snails
3. Harvest Plan
    - Longer harvest plan
    - Collaborative drilling/reduce gaps in harvesting
4. Double Loads for Pea/Petits Switching
5. Weekly report
    - Continue this, and add in reasons for difference i.e. grower or factory
6. Get plant room engineers in from the start of the season at BN

LEAF

FROZEN

- Currently to supply Waitrose and M&S produce must be LEAF accredited
- Tesco recently announced that all their fresh produce growers must have LEAF accreditation, we are waiting for that to filter into the frozen category…
- LEAF audits must be done at grower level, unfortunately HMC can’t hold LEAF status to cover its members
- As we book in product against HMC we will have to say that the crop is non-LEAF, and so we can’t capture those growers who are LEAF
- What are your barriers to becoming LEAF?

GREENYARD

AOB

FROZEN

Any questions?

GREENYARD

Thank you
Any question please contact:

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Agriculture Manager

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BREAK

Dr Becky Howard

Crop protection update and bean seed fly management 2024

Becky Howard

Crop protection update for vining peas

- **Herbicides**
- Existing herbicide approvals in vining peas

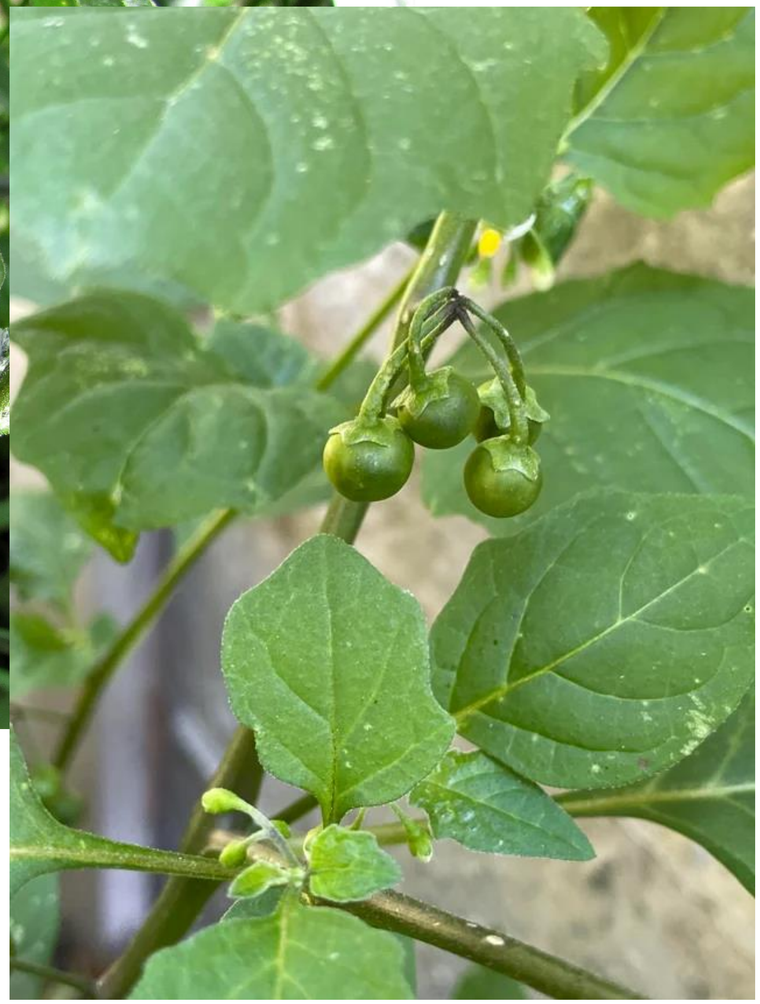
Pre-emergence:

- Pendimethalin (25%) + imazamox (1.67%) (Nirvana/ On-label)
- Pendimethalin (33.3%) + clomazone (3%) (Stallion Sync Tec/ On-label)
- Clomazone (36%) (Centium etc./ On-label)
- PDM (36.5-45.5%) (EAMU's, will be reapplied for after renewal)
- Prosulfocarb (Defy/ EAMU's)
- S-metolachlor (Dual Gold/ EAMU)

Post-emergence

- Bentazone (Basagran etc./ On-label)
- MCPB (Tropotox/ On-label unless for seed production)
- Clethodim (Centurion Max etc./ EAMU's)
- Flumioxazine (Digital, Guillotine/ EAMU's)

Black nightshade



- Branched, bushy plant with dark leaves, grows up to 1m tall. Flowers resemble small white potato flowers and are in groups of 5-10. Fruit is spherical and starts off green, turning black as it matures.
- Widespread distribution, preferring loose, free-draining soils that are nutrient rich and pH 5-7.
- Can germinate from 5.5cm depth although more germinate in the top 2.5cm and needs soil temperatures at 5cm of 15-17°C.
- Berries contaminate vining peas and can be toxic to humans and animals due to glycoalkaloids. Toxicity declines a berries mature.
- Time to maturity depends on temperature and growing degree days.

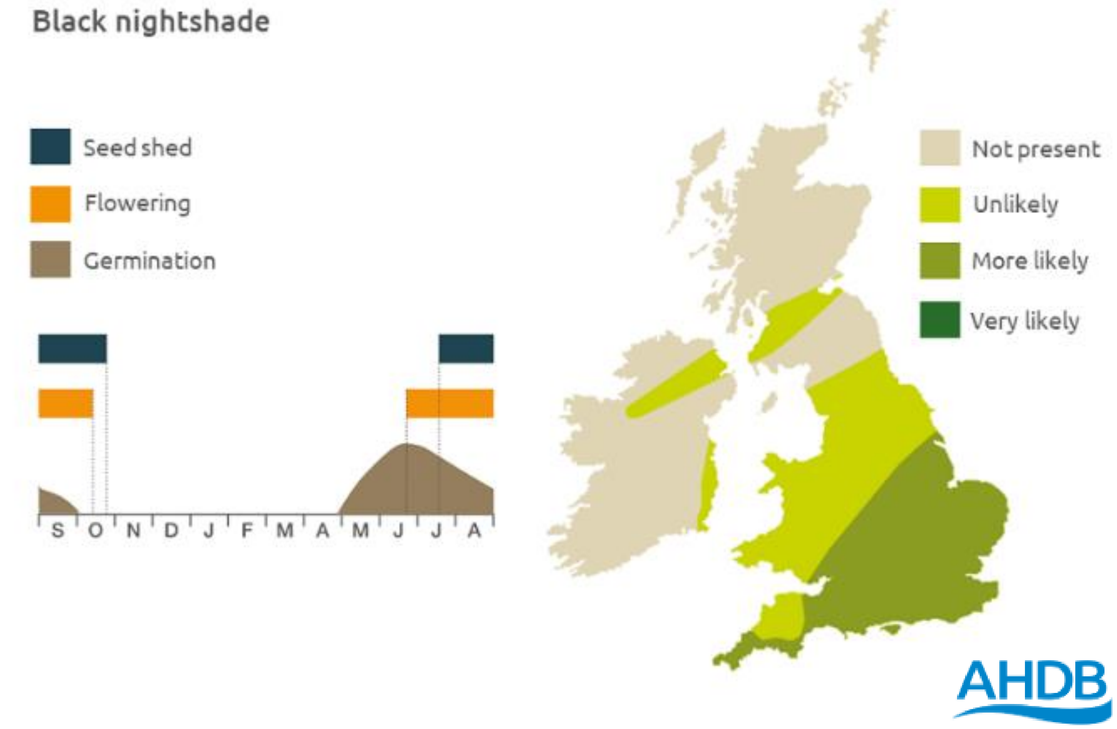
TIMING – Early summer flush, peaking at the end of May and early June

Table 3: Germination periods of common weeds

Timing	Common weeds	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spring	black bindweed, black mustard, charlock, common orache, fat hen, fool's parsley, hedge mustard, hemp-nettle, knot-grass, pale persicaria, redshank, spring wild-oat, volunteer oats												
Early summer	black nightshade, scarlet pimpernel, sun spurge												
Mainly autumn with significant spring flush	cleavers, common poppy, field pansy, forget-me-not, scentless mayweed, small nettle, thistles, volunteer barley, volunteer oilseed rape, volunteer peas, volunteer wheat, wild radish												
Mainly autumn	barren brome, black-grass, Italian rye-grass, loose silky bent, meadow brome, volunteer beans, winter wild-oat												
All the year	annual meadow-grass, common chickweed, common field speedwell, crane's-bill, fumitory, groundsel, mayweeds, red dead-nettle, shepherd's-purse, thistles												

Germination: under 5% | 5%-20% | over 20%

Location and life cycle



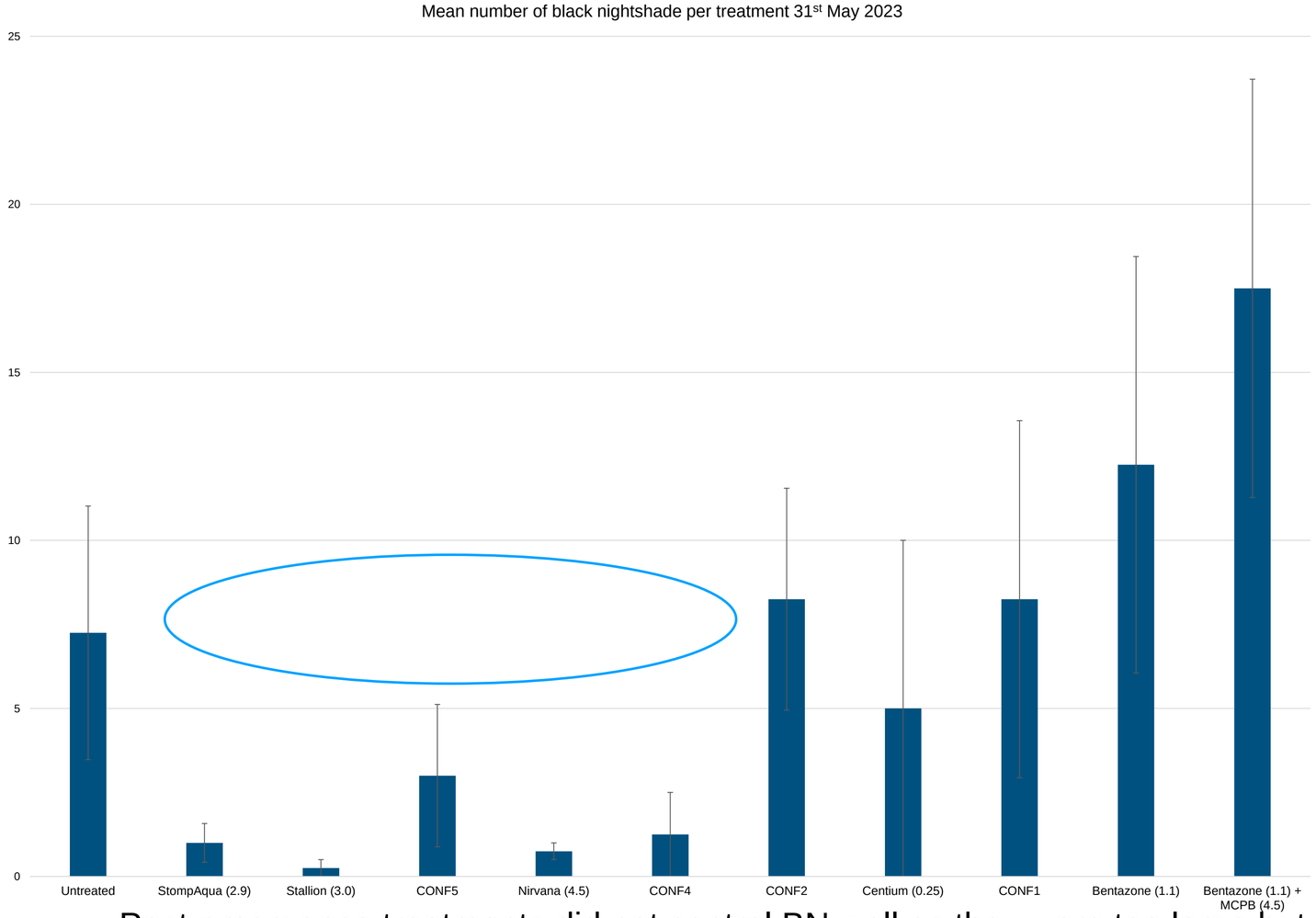
Stallion Sync Tec (PDM (33.3%) + clomazone (3%))

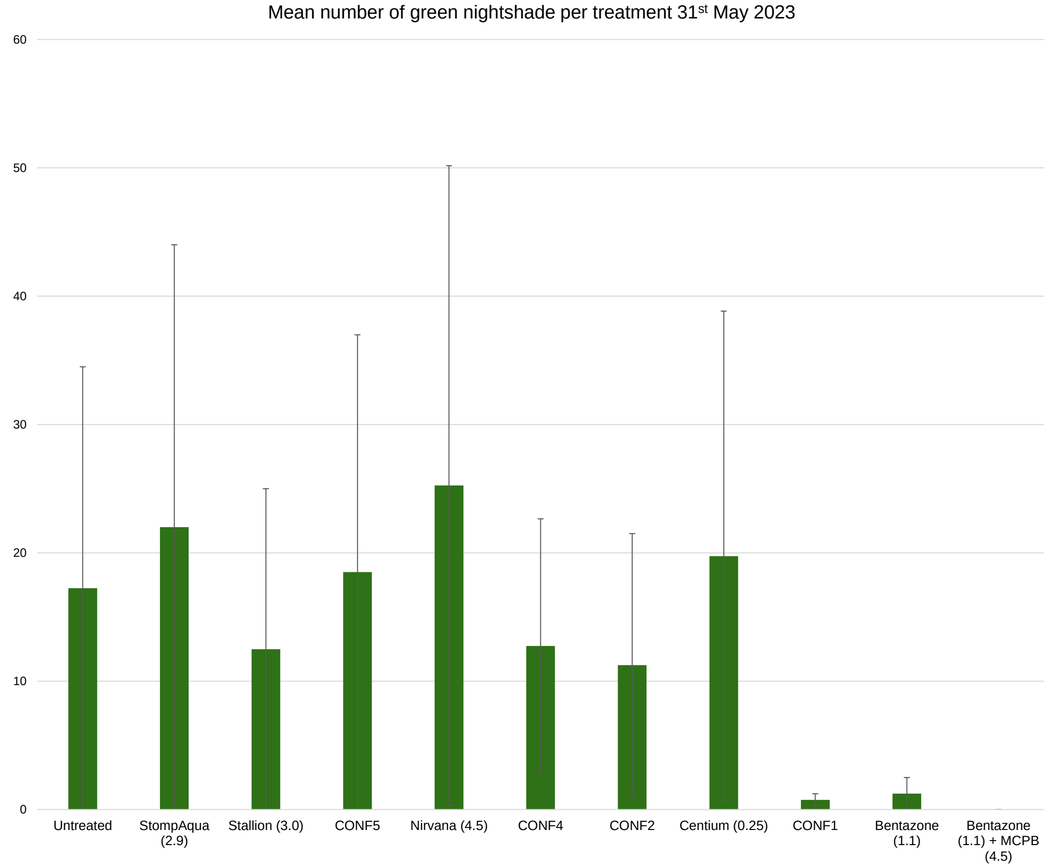
WEED CONTROL: The following weeds are susceptible to STALLION Sync^{Tec} when applied pre-emergence to a moist, firm seedbed free from clods:

Timing	**Pre-emergence**		
Rate of application:	**3.0 L product/ha**		
Broad-leaved weeds			
CHEAL	*Chenopodium album*	Fat hen	Susceptible
GALAP	*Galium aparine*	Cleavers	Moderately susceptible
LAMPU	*Lamium purpureum*	Red deadnettle	Susceptible
MATCH	*Matricaria chamomilla*	Scented mayweed	Moderately susceptible
MATSS	*Matricaria spp.*	Mayweed species	Moderately susceptible
MYOAR	*Myosotis arvensis*	Field forget-me-not	Susceptible
POLAV	*Polygonum aviculare*	Knotgrass	Susceptible
POLPE	*Polygonum persicaria*	Redshank	Moderately susceptible
SOLNI	*Solanum nigrum*	Black nightshade	Susceptible
STEME	*Stellaria media*	Common chickweed	Susceptible
VERAR	*Veronica arvensis*	Wall speedwell	Susceptible
VERHE	*Veronica hederifolia*	Ivy-leaved speedwell	Susceptible
VERPE	*Veronica persica*	Common field speedwell	Susceptible
VIOAR	*Viola arvensis*	Field pansy	Susceptible

Where: S – Susceptible (>85% control), MS – Moderately Susceptible (75 – 85% control)

(Combining) Pea herbicides
Drilled 5th April 2023
Pre-emergence application 14th April 2023 – good levels of soil moisture due to rainfall the day before
Post-emergence application 16th May 2023





- Post-emergence treatments did not control BN well as they were too large but did control smaller green nightshade weeds.
- Stomp Aqua rate in vining peas is 2.2 l/ha
- Rates of 2.5 to 3.0 l/ha Nirvana recommended for vining peas according to soil type, 2.5l/ha when mixing with clomazone

WEED SUSCEPTIBILITY TO HERBICIDES FOR VINING PEAS

Weed Species Common Name	PRE clomazone	PRE pendimethalin	PRE pendimethalin + clomazone	PRE pendimethalin + imazamox	PRE prosulfocarb	PRE S-metolachlor	POST bentazone	POST bentazone + MCPB	POST flumioxazine	POST MCPB	POST clethodim	POST cycloxydim	POST fluazifop-p-butyl	POST quizalofop-p-ethyl
Annual meadow-grass	MS		MS	MS	MS	S	R	R	MS	R	S	R	R	R
Annual mercury	MS		MS	MS										
Barren brome	R		R				R	R		R			S	S
Black-bindweed	MS		MS	S			MS	MS		S*				
Black-grass	R		R	MR			R	R	MR	R	S	MR	S	S
Black-nightshade	MS		S	MS	S	MR	S	S		R				
Charlock	MR			S	S		S	S		MS				
Chickweed, common	S		S	S	S	MS	S	S	S	R				
Cleavers	S		MS	MS~	MS		MS	S	MS	R				
Corn marigold		S					S							
Couch, common	R		R				R	R		R		S	(S)	S
Creeping thistle					MR		MS	MS		MS				
Dead-nettle, red	MS	S	S	S	S	S	MR	R	MS	R				
Dock							R	R		S				
Fat-hen	MS	S	S	S		MS	MR	S		S				
Fool's parsley	S			MR			S	S		R				
Forget-me-not		S	S		S		S							
Fumitory, common	MR		MS	S	S		MS	S		MS				
Groundsel	MS		S	MR	S		MS	S		R				
Hemp-nettle, common	MR	S	S				R	MS		S*				
Henbit dead-nettle		S	S	S			MS							
Knotgrass	MS	S	S	S	MR		R	MS		MR				
Mayweeds	MR		MS	MS		S	S	S	S	R				
Nettle, small	MS	S	S	MS			S	S		S				
Orache, common	MS			S			MS	MS		MR				
Pale persicaria	MS				MR		S	S						
Pansy, field	MR	S	S	MR	MR		R	MS	S	S*				
Parsley piert		S												
Poppy, common	MR	S		S			MS	MS		MS				
Redshank	MS		MS	S	MR	R	S	S		S*				
Scarlet pimpernel		S		S			S	S		MR				
Shepherd's purse	S	MS	S	MR	S		S	S	S	S				
Sow-thistle, smooth	MS	S	S	MS	S	S	MS	MS		S*				
Speedwell, common field	MS	S	S	S	S	S	R	R	S	R				
Volunteer cereals	R		R				R	R		R	S	S	S	S
Volunteer oilseed rape	R	MS		MS~	MR		S	S	S	MS				
Wild-oats	R		R				R	R		R		S	S	S
Wild radish				MS			MS			R				

S	Susceptible	MS	Moderately Susceptible	MR	Moderately Resistant	R	Resistant
---	---	---	---	---	---	---	---

- Pre-emergence applications need to go on when soil moisture is sufficient to control black nightshade
- Post-emergence applications are not effective when black nightshade plants are larger – bentazone is useful at full rate up to 6 leaves and using split dose up to 2 leaves

Crop protection update for vining peas

- **Fungicides**
- No losses in peas in 2023.

Additions:

Fludioxonil ST – Prepper (25g a.i. /L).

- 4 litres per tonne of seed.
- Label claims for reduction of *Fusarium* spp. in peas and beans and *Ascochyta pisi* in peas.
- Approved in all combinable and fresh legumes.

Sulphur – Microthiol Special in vining peas and combining peas, **Vertipin** in vining peas, combining peas and broad beans.

- Powdery mildew in peas.
- Downy mildew in broad beans (Vertipin).

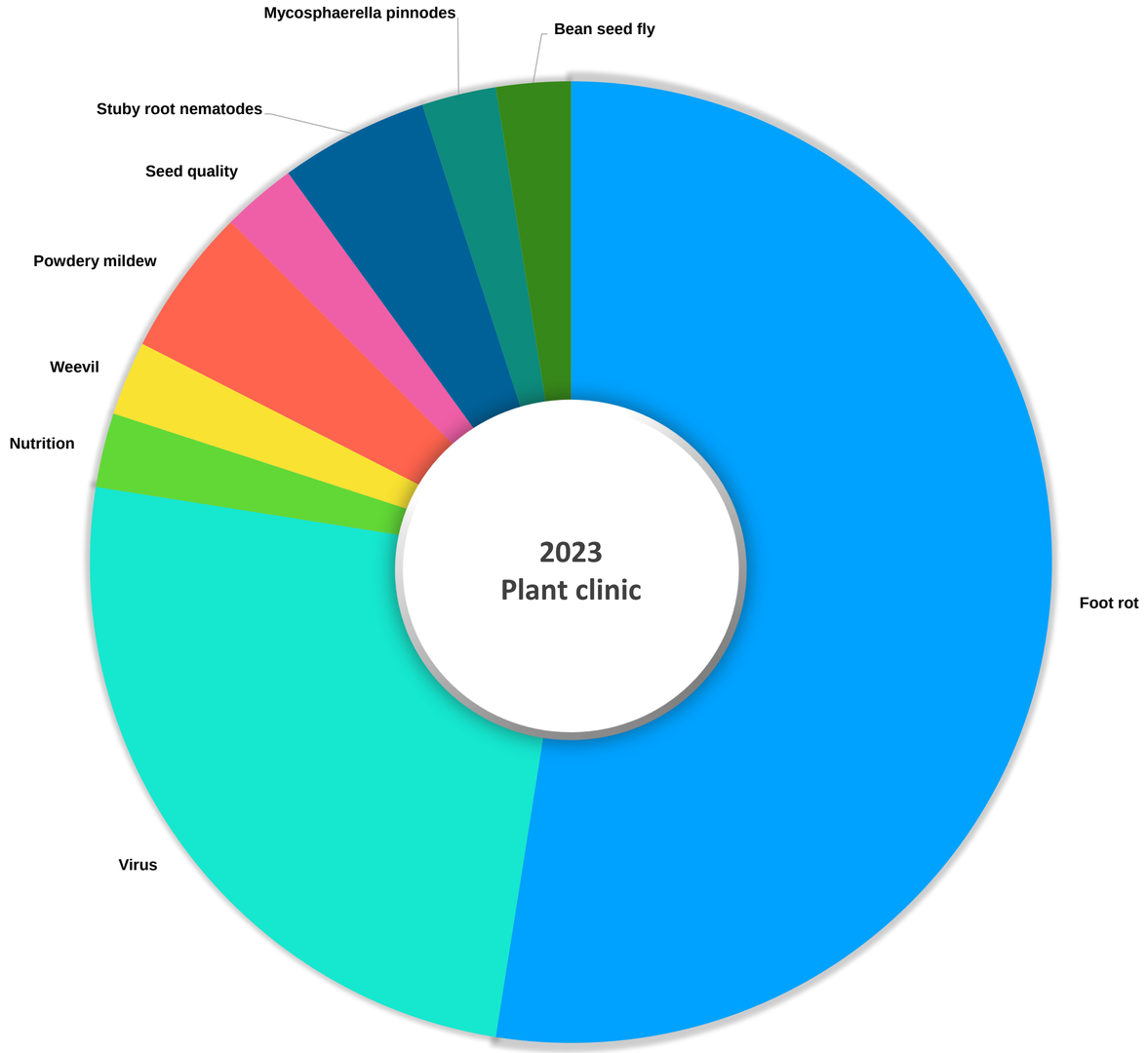
Crop protection update for vining peas

- **Insecticides**
- No losses in vining peas in 2023.

Addition:

Insyst – acetamiprid.

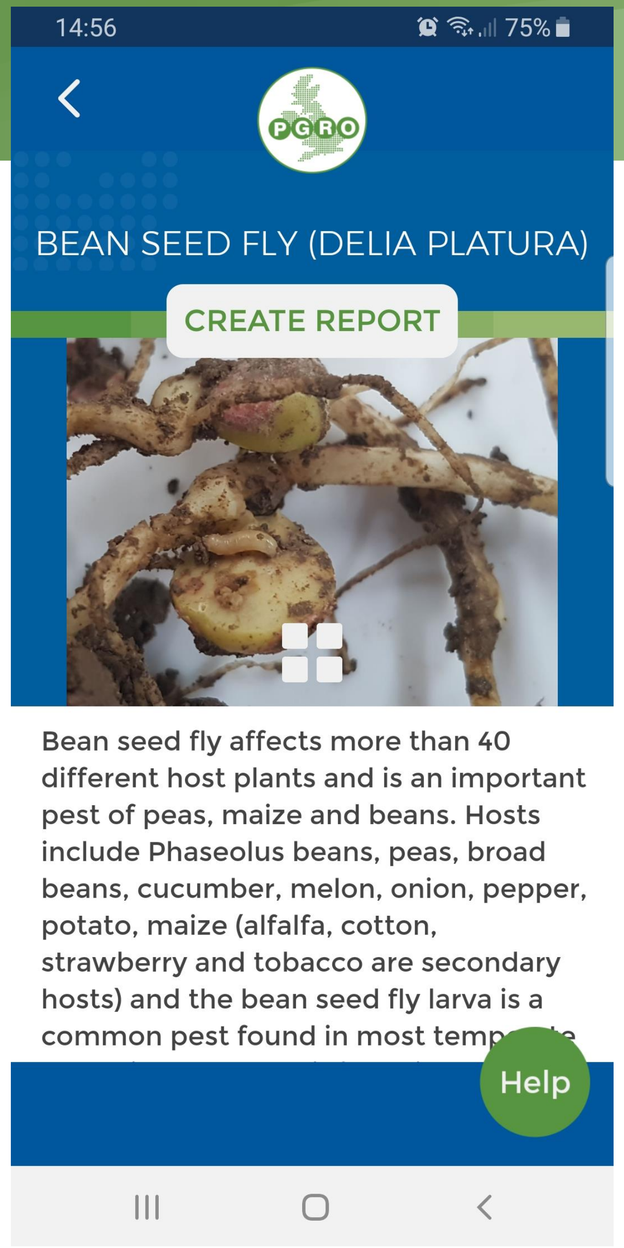
- Approved under EAMU 1285/23 in all legumes apart from field beans.
- For aphid control in peas and broad beans and bruchid in broad beans.
- Earliest time of application is enclosed bud stage.
- Latest time of application is BBCH 75 (50% pods at final length).
- Harvest intervals vining peas – 14 days.



Bean Seed fly (*Delia platura*)




- Wide host range, affecting over 40 plant species, distributed widely across the world
- Flies are often associated with soils containing high levels of organic material such as farmyard manure and plant debris
- They prefer recently cultivated soil
- Damage is seed and stem tunnelling by larvae
- Reduces establishment (up to 60% in worst cases) and plant growth



- The bean seed fly reporting app is available
- For further information go to https://www.pgro.org/agronomy-app-tools/

2019, 2020, 2021 and 2022 Survey in Yorkshire and Lincolnshire

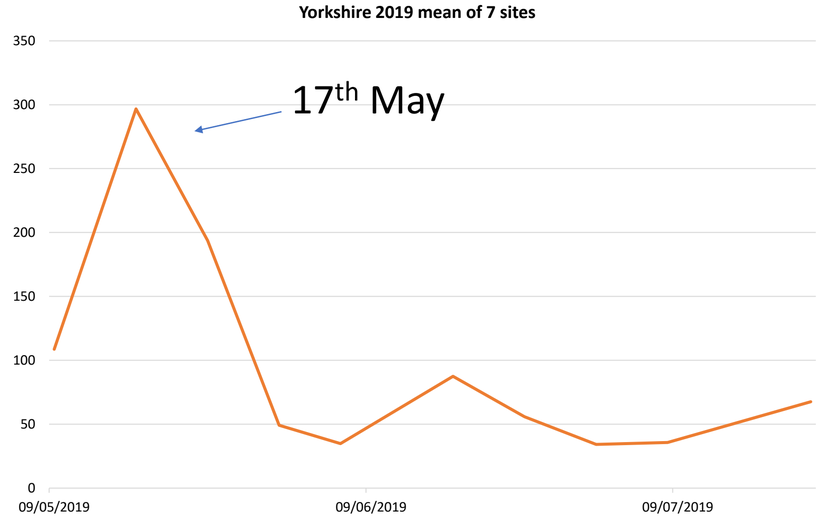
- Attractant traps to monitor peak pest presence (34 sites 2019 to 2022)
- Sowing timing both general and related to period following cultivation
- Cultivation techniques – drill type/ direct drilling/ min-till/ drilling depth
- Foot rot risk in BSF damaged plants
- Preliminary look at nematodes for control (*Steinernema feltiae*) at field scale

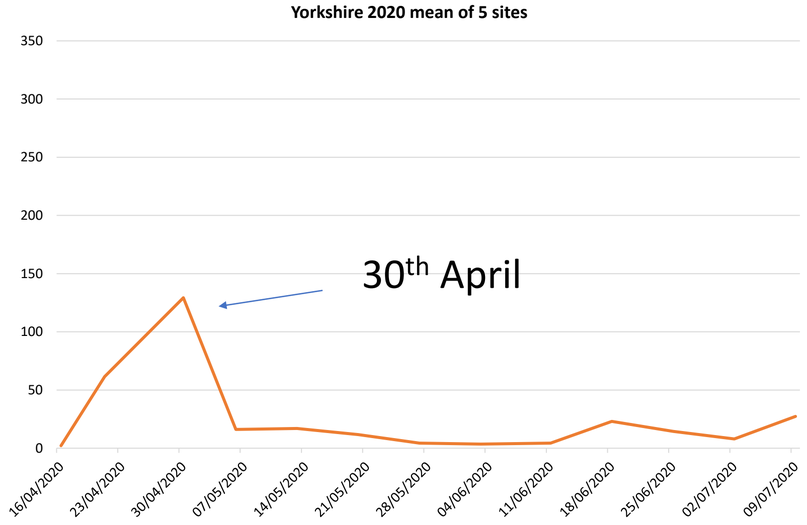
Monitoring

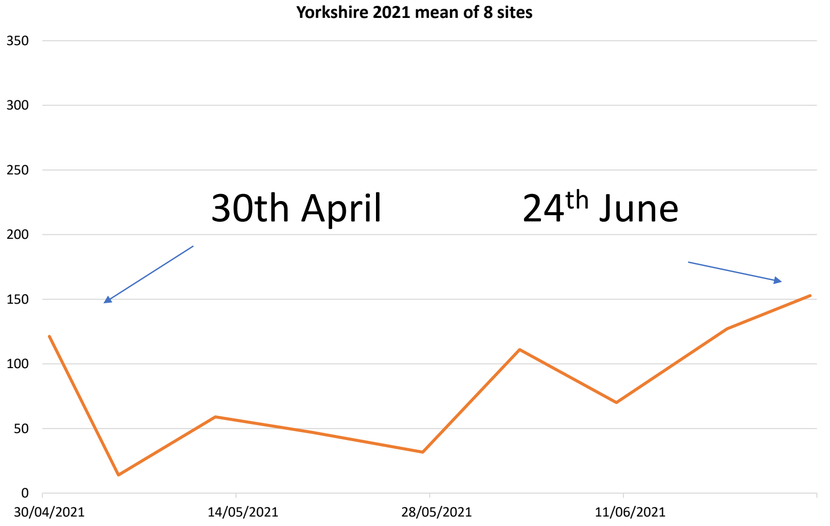
Swaythorpe GROWERS LTD.

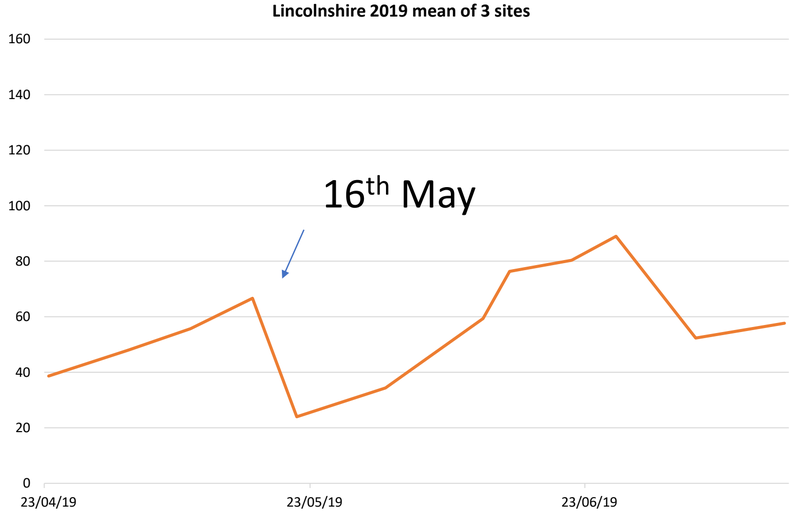
Stemgold Peas

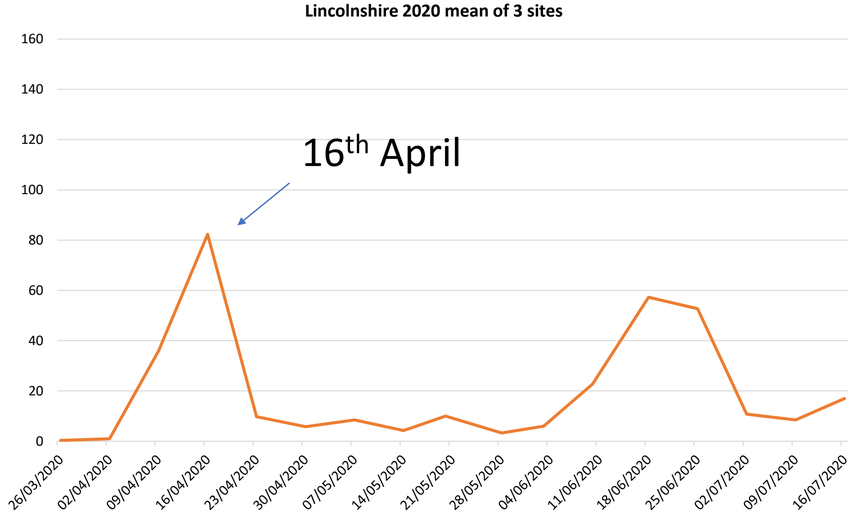
Proudly growing Lincolnshire peas for over 15 years

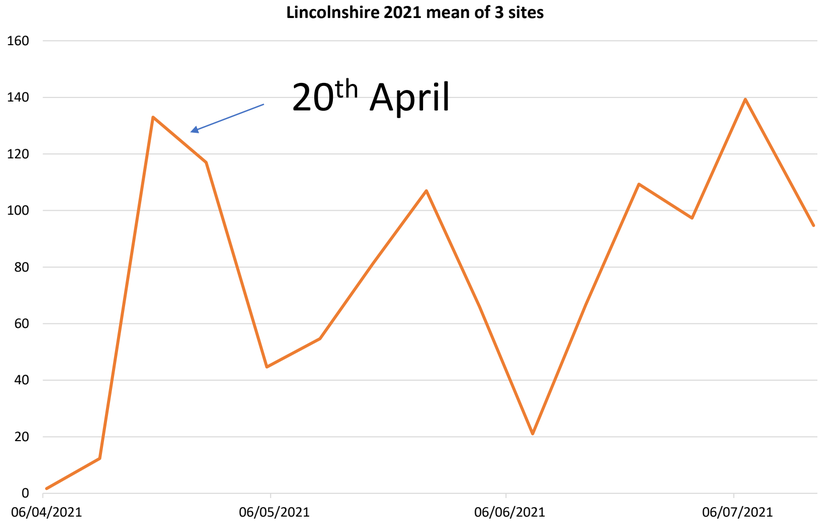

Yorkshire 2019 mean of 7 sites
17th May
350
300
250
200
150
100
50
0
09/05/2019
09/06/2019
09/07/2019


Yorkshire 2020 mean of 5 sites
30th April
350
300
250
200
150
100
50
0
16/04/2020
23/04/2020
30/04/2020
07/05/2020
14/05/2020
21/05/2020
28/05/2020
04/06/2020
11/06/2020
18/06/2020
25/06/2020
02/07/2020
09/07/2020

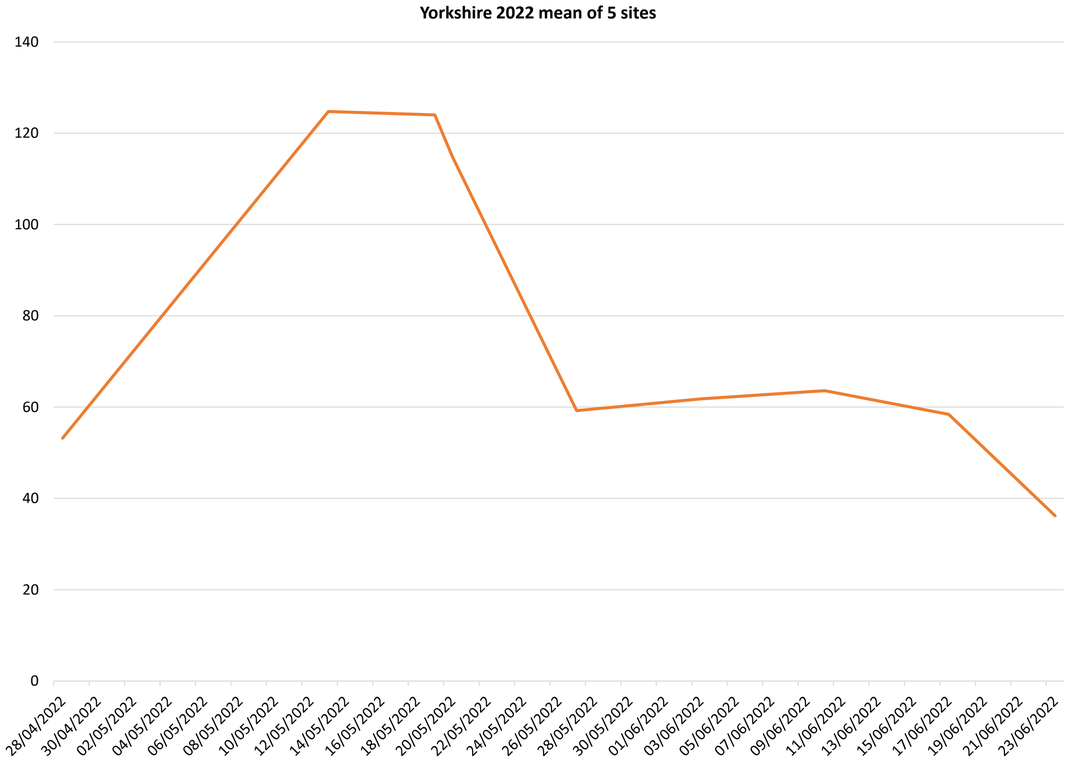

Yorkshire 2021 mean of 8 sites
30th April
24th June
350
300
250
200
150
100
50
0
30/04/2021
14/05/2021
28/05/2021
11/06/2021


Lincolnshire 2019 mean of 3 sites
16th May
160
140
120
100
80
60
40
20
0
23/04/19
23/05/19
23/06/19


Lincolnshire 2020 mean of 3 sites
16th April
160
140
120
100
80
60
40
20
0
26/03/2020
02/04/2020
09/04/2020
16/04/2020
23/04/2020
30/04/2020
07/05/2020
14/05/2020
21/05/2020
28/05/2020
04/06/2020
11/06/2020
18/06/2020
25/06/2020
02/07/2020
09/07/2020
16/07/2020


Lincolnshire 2021 mean of 3 sites
20th April
160
140
120
100
80
60
40
20
0
06/04/2021
06/05/2021
06/06/2021
06/07/2021

2022


Yorkshire 2022 mean of 5 sites
140
120
100
80
60
40
20
0
28/04/2022
30/04/2022
02/05/2022
04/05/2022
06/05/2022
08/05/2022
10/05/2022
12/05/2022
14/05/2022
16/05/2022
18/05/2022
20/05/2022
22/05/2022
24/05/2022
26/05/2022
28/05/2022
30/05/2022
01/06/2022
03/06/2022
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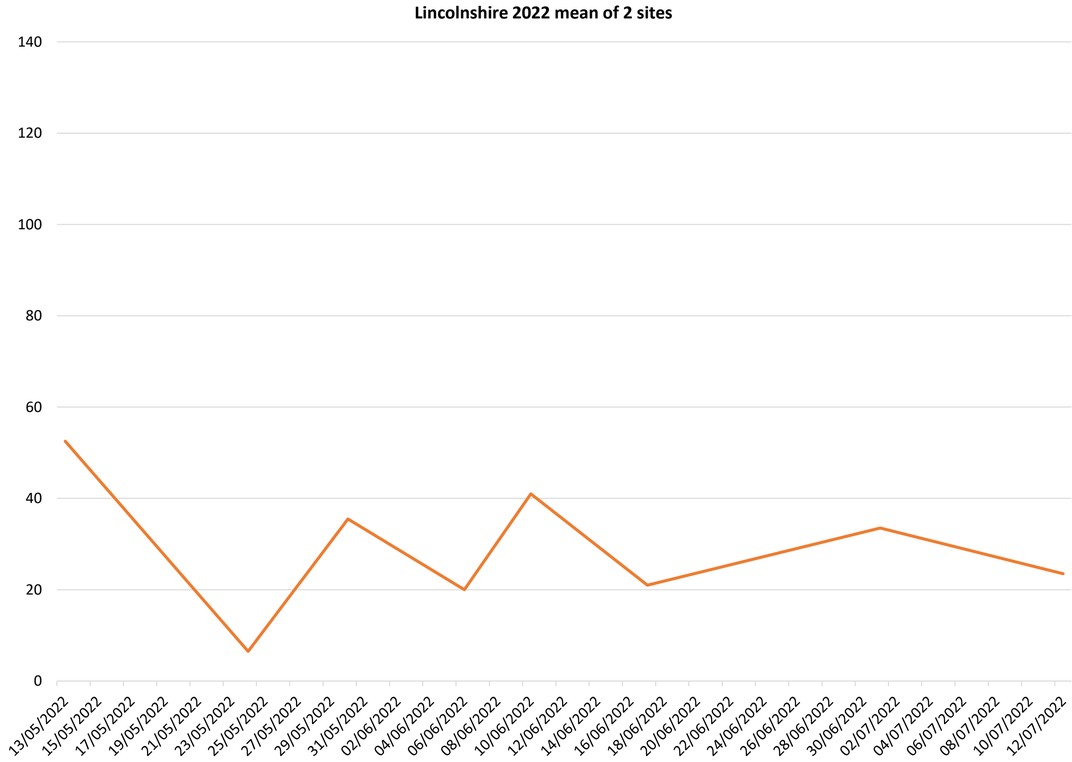
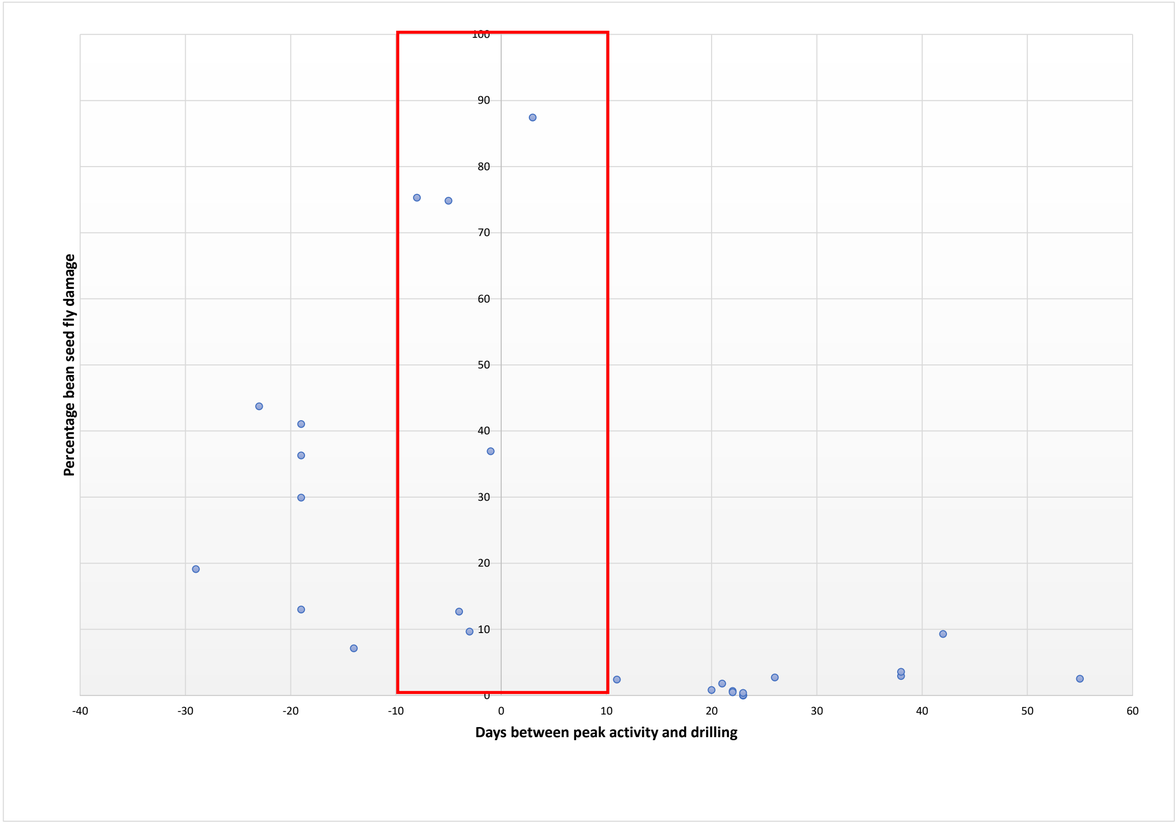
17/06/2022
19/06/2022
21/06/2022
23/06/2022

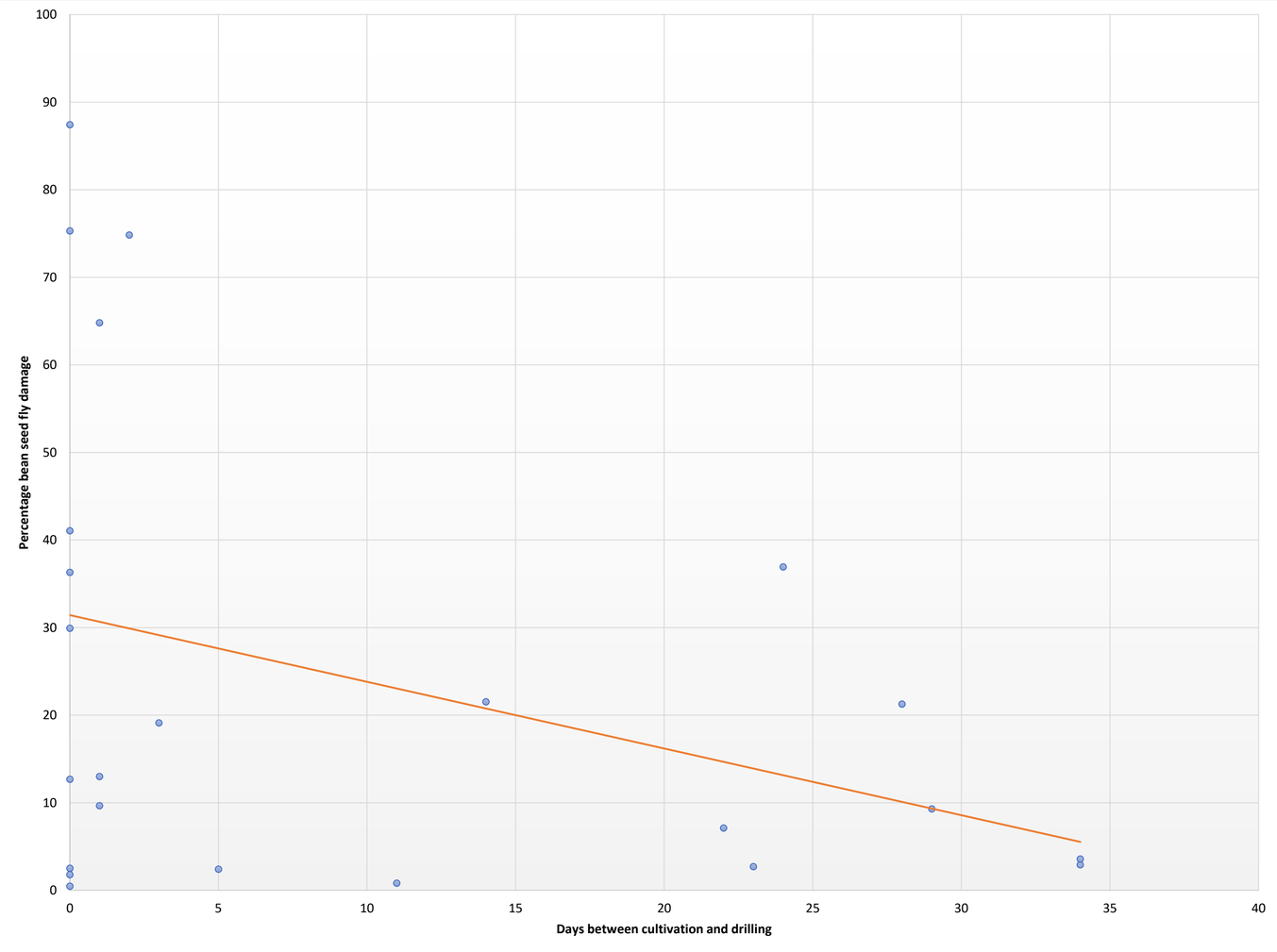

Lincolnshire 2022 mean of 2 sites
140
120
100
80
60
40
20
0
13/05/2022
15/05/2022
17/05/2022
19/05/2022
21/05/2022
23/05/2022
25/05/2022
27/05/2022
29/05/2022
31/05/2022
02/06/2022
04/06/2022
06/06/2022
08/06/2022
10/06/2022
12/06/2022
14/06/2022
16/06/2022
18/06/2022
20/06/2022
22/06/2022
24/06/2022
26/06/2022
28/06/2022
30/06/2022
02/07/2022
04/07/2022
06/07/2022
08/07/2022
10/07/2022
12/07/2022

2019-2021 survey

- **Survey work indicated the following:**
- There were differences in timing of peak adult activity in different regions
- The period 10 days before and after peak activity was high risk for drilling
- the period between cultivation and drilling seemed to have an effect on damage levels
- Damage levels varied significantly between years



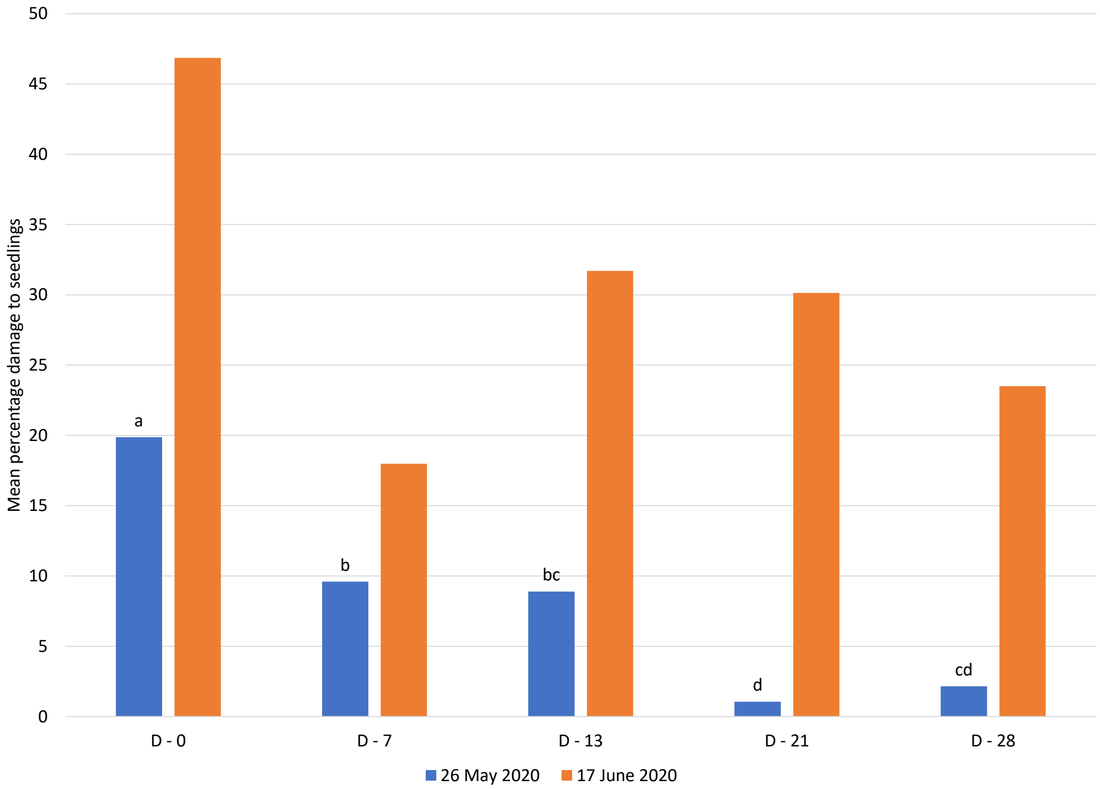
2019-2021 survey



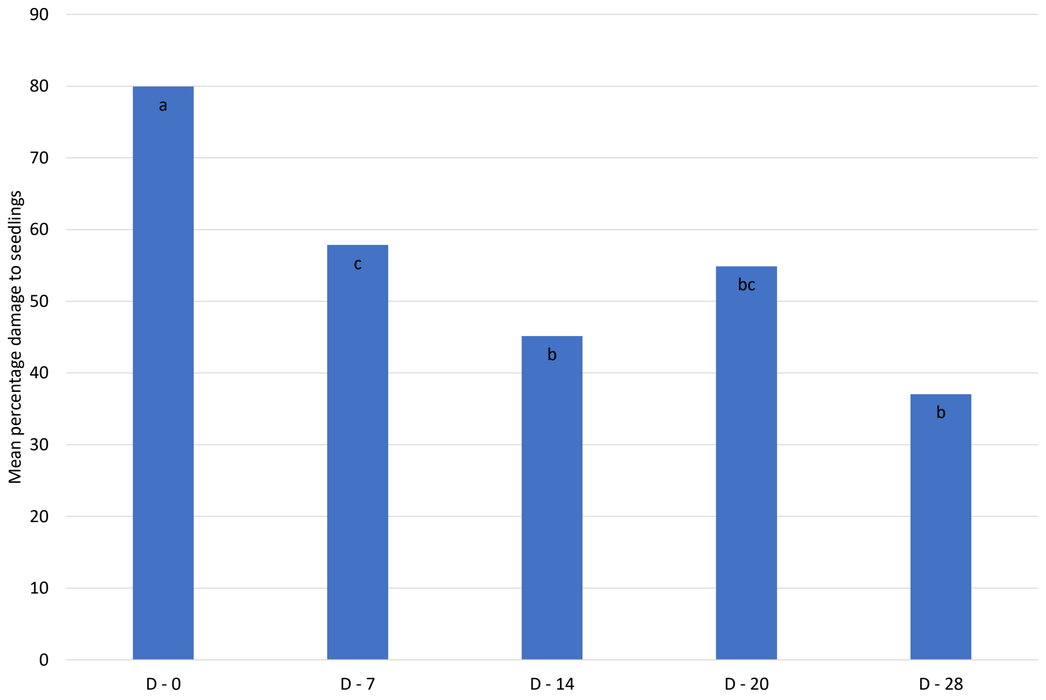
Cultivation trial, Stubton, 2020 and 2021

Drilled 27th April in both years

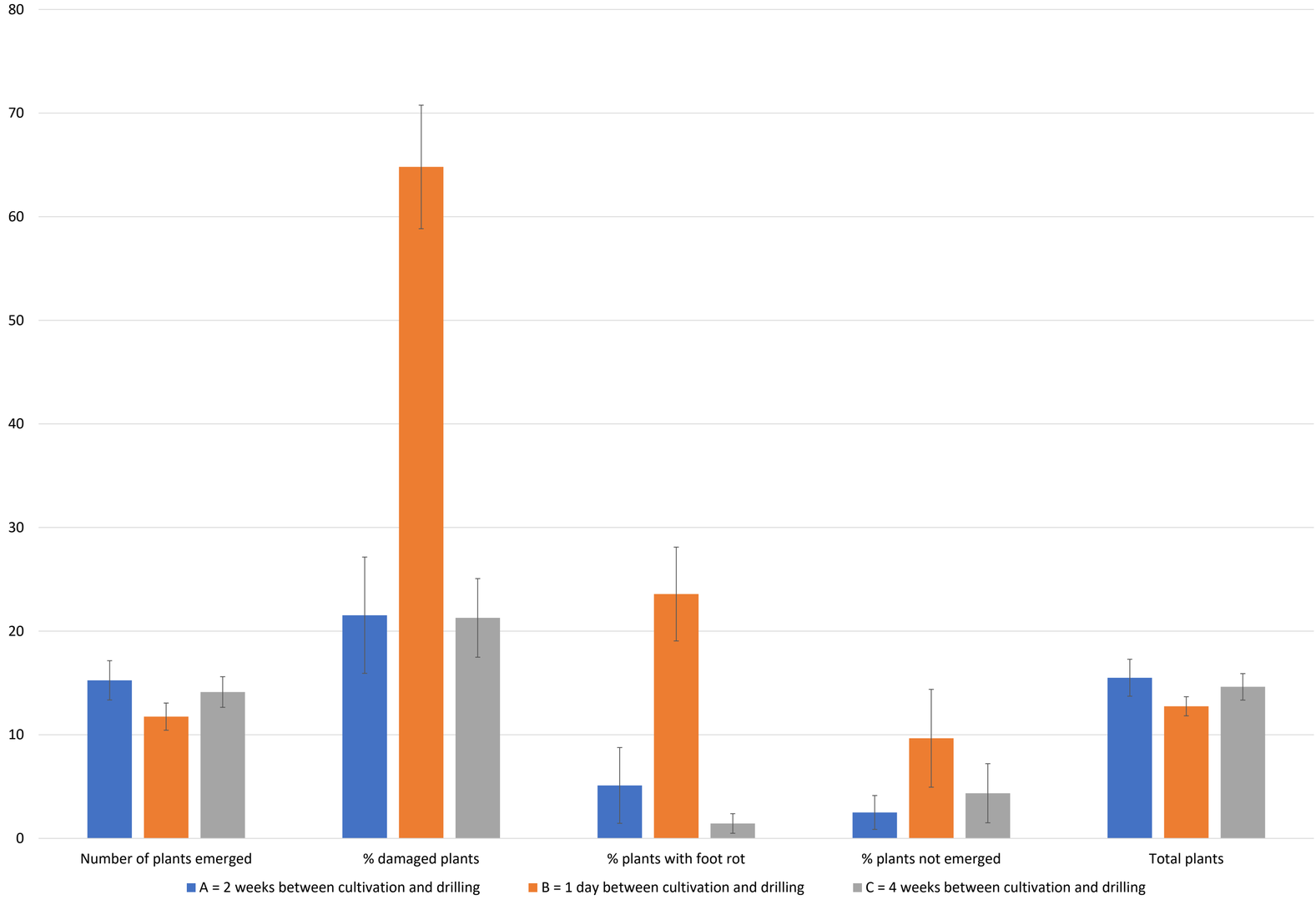
Bean seed fly larval damage 2020



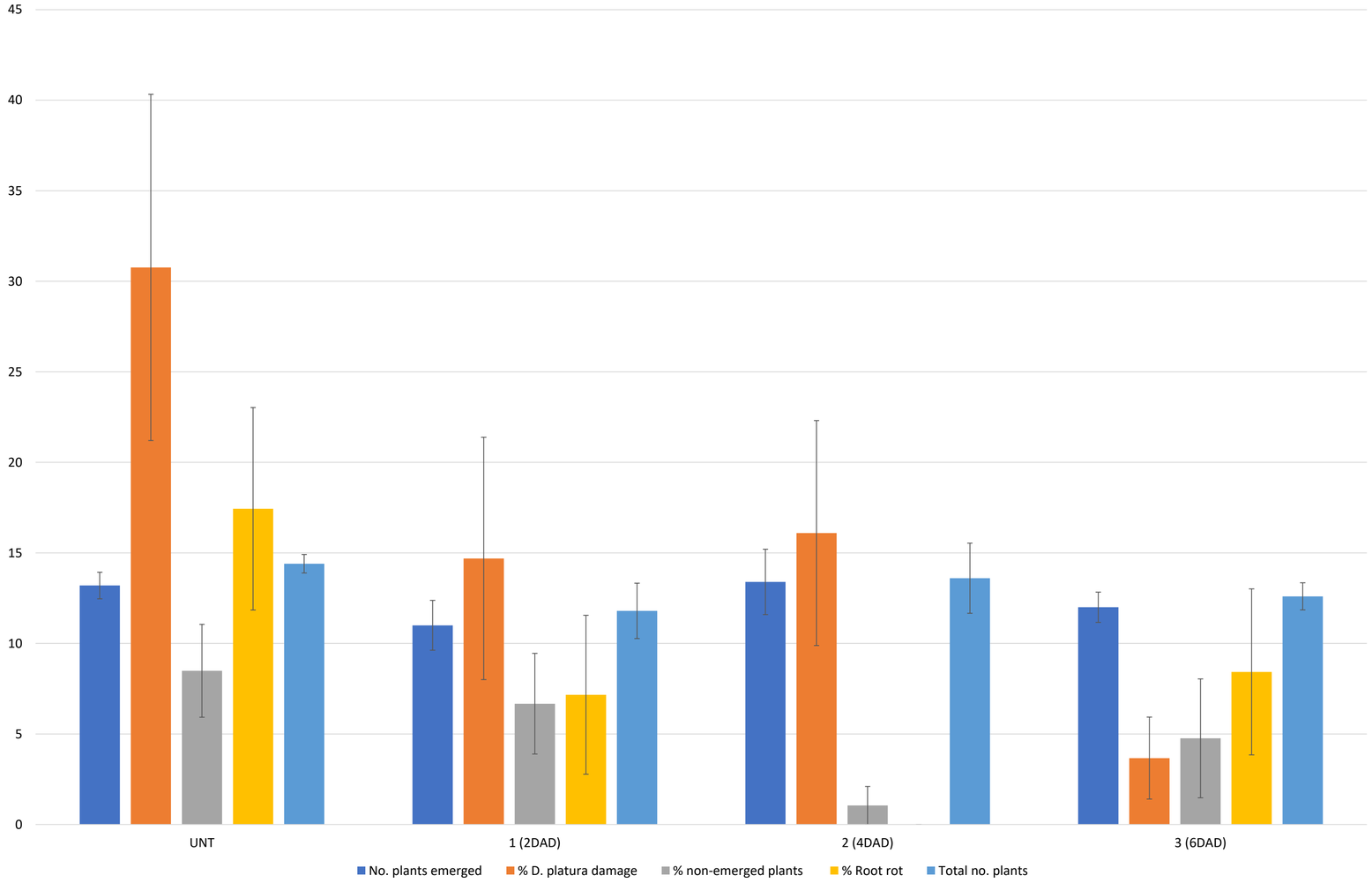
Bean seed fly larval damage 2021



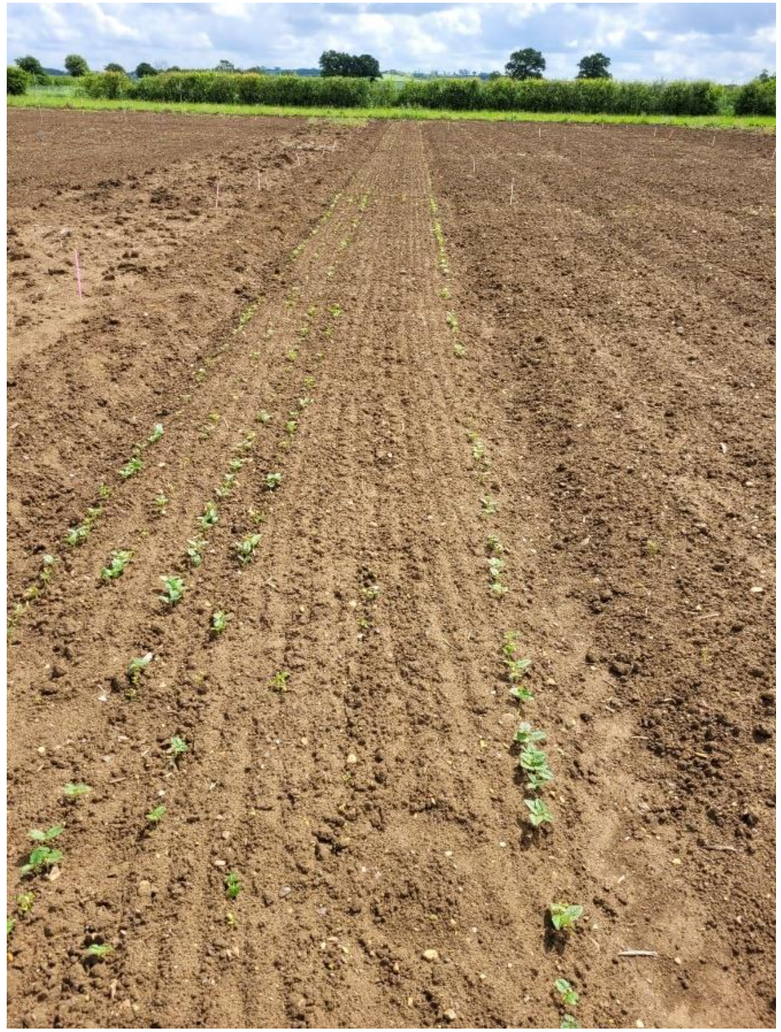
Cultivation trial, Yorkshire 2021 (field-scale)

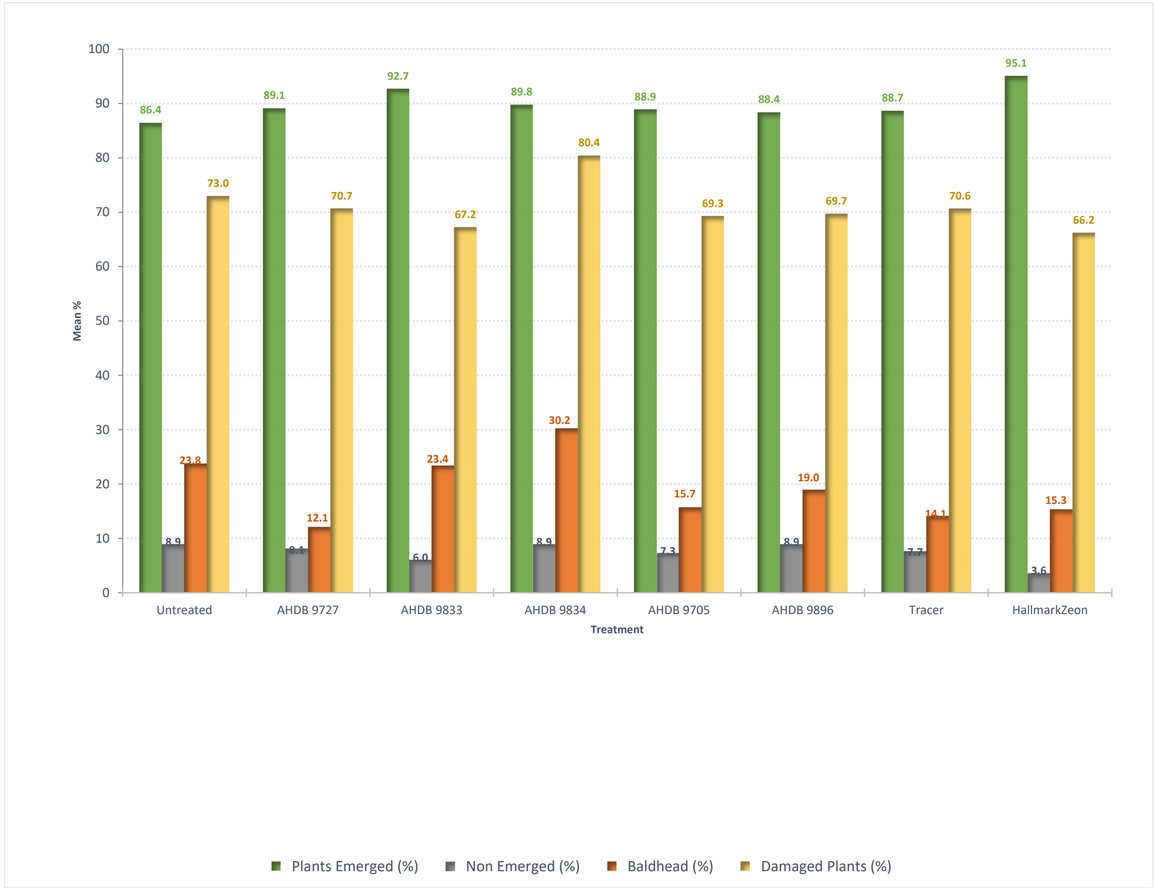


Entomopathogenic nematodes, Lincolnshire 2021 (field-scale)



2022 efficacy trial Stubton

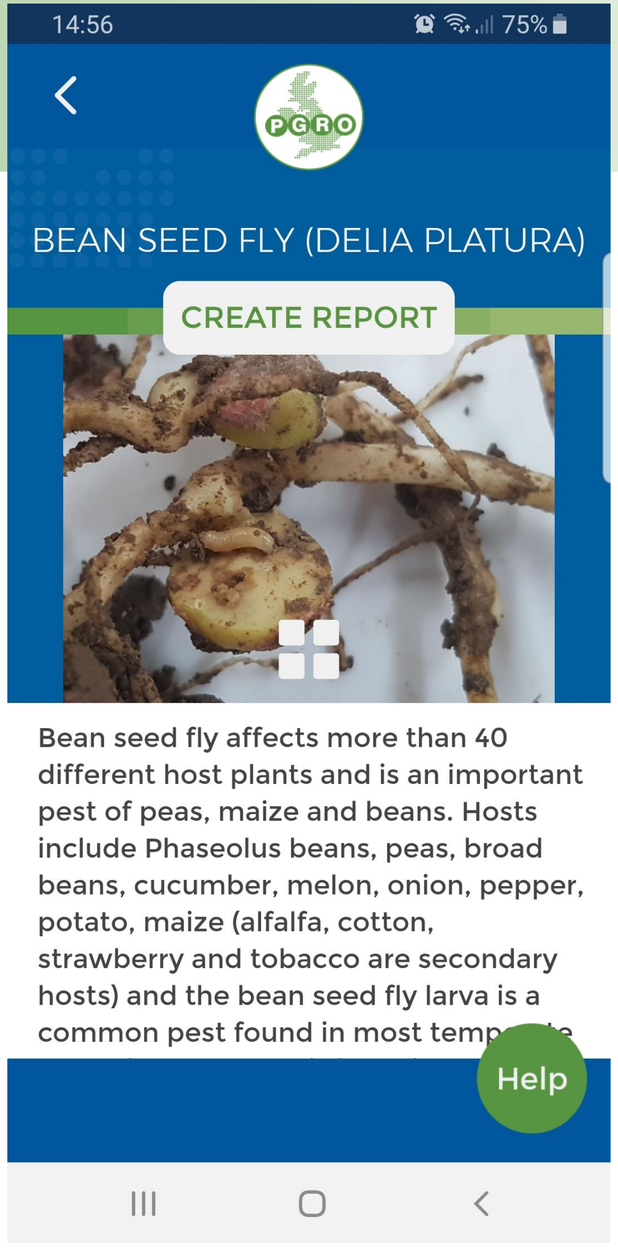




1st drilled 5th May 2022 – failed due to high levels of damage and redrilled on 17th June 2022.

Thank you for listening

- Thanks to Dyson Farming for hosting trials and Warwick Crop Centre for conducting the second French bean trial
- Thanks to Liz Johnson, Phil Langley, Swaythorpe Growers and Stemgold Peas for monitoring and reporting, and Jo Arden for fly identification
- For further information go to www.pgro.org
- becky@pgro.org
- Or call 01780 782585
- Download the App from Google and Apple stores



Richard Binks

Koppert

Koppert at a glance

Global market leader

In biological crop protection and pollination

Family company

Established in 1967

390 million

Turn over 2022

30

Subsidiaries

2750

Employees worldwide

11

Production sites

100

Countries using our solutions

>400

Advisors

120

Natural solutions

Our history

Foundation Koppert Biological Systems

1967

First parasitic wasp

1972

Encarsia formosa on cards

1979

Start producing microbiological products

1980

Company goes international

1981

First researcher is hired

1981

From on-leaf to shaker delivery

1982

Producing bumblebees for pollination

1988

First overseas plant

1993

Large-scale trials

1993

Introducing Trianum

2001

Breakthrough for ornamentals

2005

New headquarters

2010

Introducing NatuGro

2011

Overtake Brazilian company Itaforte

2012

Introducing Panoramix

2015

Update series of hives

2016

50 year anniversary

2017

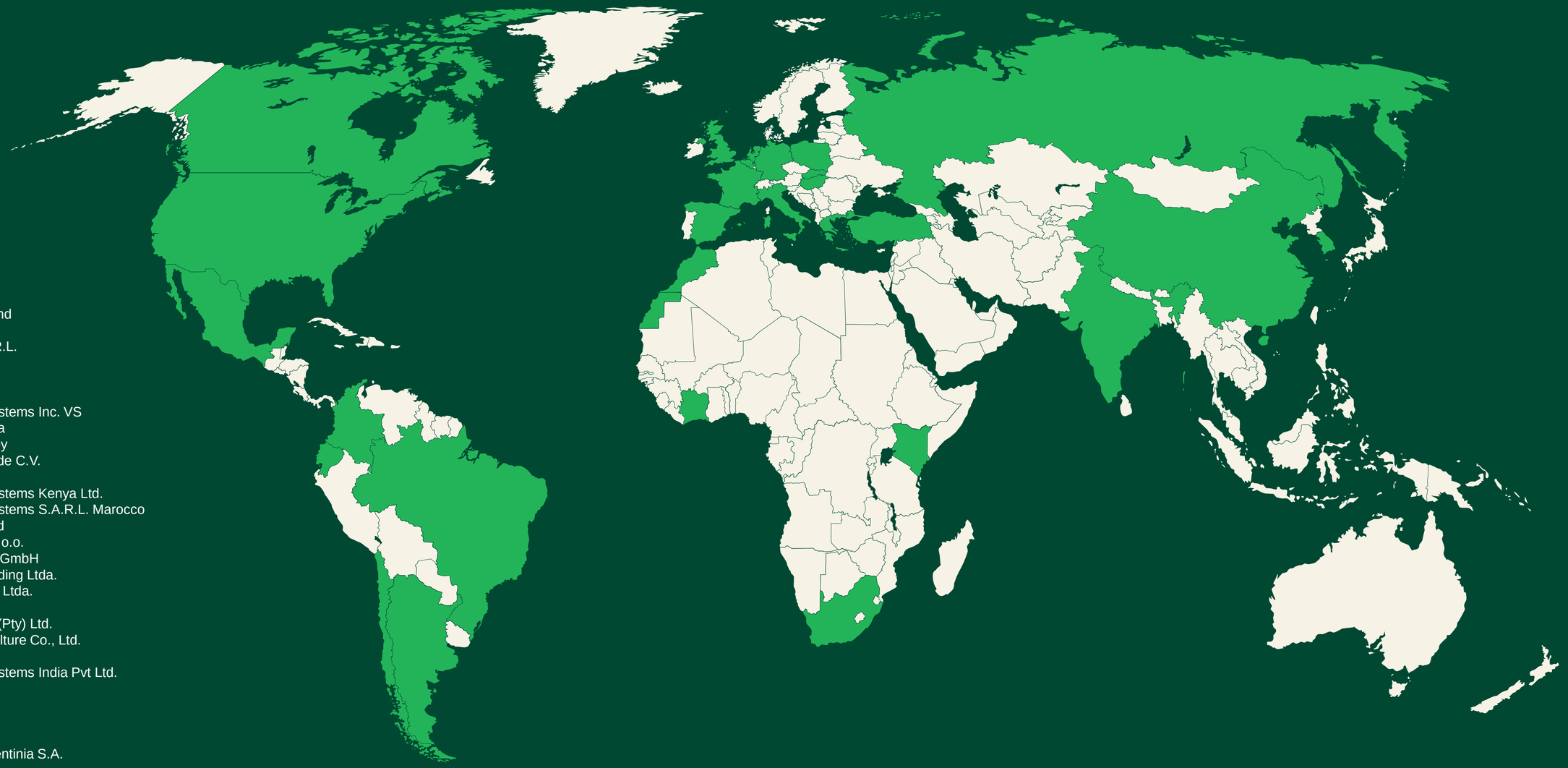
Expanding the board

2018

Next generation of leaders in charge

2022

Subsidiaries



1967 Koppert B.V. Nederland
1981 Koppert UK Ltd.
1984 Koppert France S.A.R.L.
1990 Koppert Iralia S.r.l.
1993 Koppert Canada Ltd.
1994 Koppert Espana S.L.
1994 Koppert Biological Systems Inc. VS
1997 Koppert s.r.o. Slovakia
1997 Koppert Ltd. Sti Turkey
1997 Koppert Mexico S.A. de C.V.
2001 Koppert Belgïe bvba
2006 Koppert Biological Systems Kenya Ltd.
2007 Koppert Biological Systems S.A.R.L. Marocco
2007 Koppert Korea Co. Ltd
2007 Koppert Polska Sp. Z o.o.
2009 Koppert Deutschland GmbH
2009 Koppert do Brasil Holding Ltda.
2009 Koppert Ecuador Cia. Ltda.
2009 Koppert Chile S.A.
2012 Koppert South Africa (Pty) Ltd.
2012 Koppert Beijng Agriculture Co., Ltd.
2012 Koppert Hellas
2013 Koppert Biological Systems India Pvt Ltd.
2015 Koppert Colombia
2015 Koppert Rus, LLC
2017 Koppert West Africa
2020 Koppert Peru
2021 Koppert Nitrasoil Argentinia S.A.
2021 Koppert Hungary

Legume insect

MONITORING

Pea moth

Trap System: Koppert Pherodis trap + pheromone lure

- PGRO model – Perry and Wall, 1984
- Pheromone traps should be placed in pea crops in early to mid-May and monitored three times each week.
- In combining peas, a threshold is reached when 10 or more moths are caught in a trap on two consecutive occasions.
- In vining peas a lower threshold of damage is tolerated and traps should be used as an indication of moth presence.
- Evidence that EPN’s can reduce larvae populations
- Camera traps can be useful

Pea and Bean Weevil

Trap system: Adapted boll weevil trap + pheromone lure

- Five traps per system placed in field margins of previous years legumes by mid-February
- If you haven’t grown legumes before, place them in the margins of the current crop
- Check traps 3 times each week
- Threshold is an average of 30 weevils per trap
- Susceptible crops are those that have emerged in the last 10 days, or will emerge in the next 10 days

Bruchid Beetle

Trap system: Boll weevil trap on a cane + floral attractant

- Place trap on a 1 metre cane
- Place one trap on the north edge and one trap on the south edge of the field
- Floral (semiochemical) attractant NOT Pheromone
- Bruchid beetle traps are NOT reliable during the flowering period of field beans and may not be suitable for use in earlier flowering winter beans.
- Possible use within trap crops
- Bruchid trap and lures placed in trap crops from mid-March. Beetle emerge in April and stay in trap crop.

Bean Seed fly

Trap system: Yellow stick card + attractant lure

- Place trap on a 1 metre cane
- Place one trap on the north edge and one trap on the south edge of the field
- Attractant (onion pulp extracts)
- Evidence that EPN’s can reduce damage

Pea midge

Trap system: Koppert Pherodis trap + Pherosyn pheromone lure

- Available in 2022
- Four traps per system placed in previous years pea field (cereals?) by end of May
- Check traps 3 times each week
- Threshold is an average of 500 midges per trap
- Susceptible crops are those at enclosed bud

Summary

- Trapping systems and lures available for the most important pea and bean pests
- Pea midge monitoring system available

The natural move towards biocontrol in agri crops

Entomopathogenic or Beneficial Nematodes (EPNs)

Features

THE ORGANISM

What do beneficial nematodes do?

1

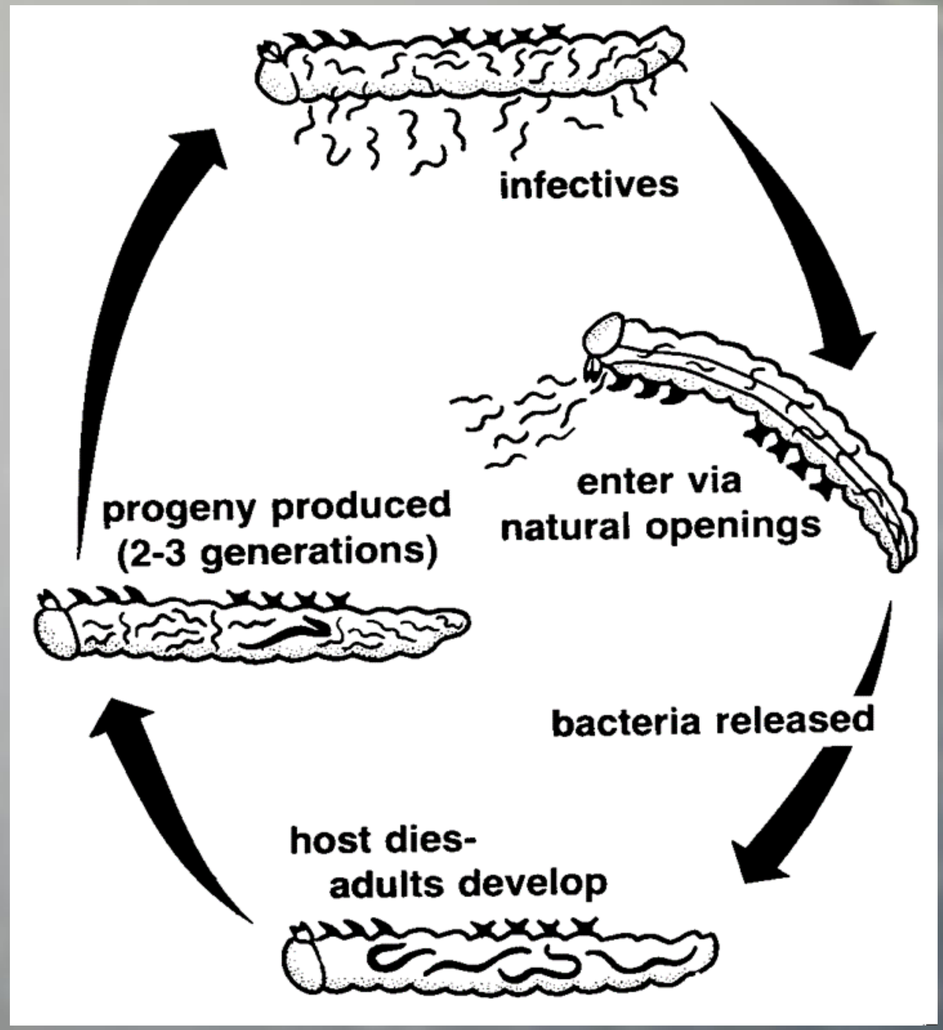
Nematodes (L3) seek out and penetrate larvae

2

They release symbiotic bacteria that infect the host

3

The nematodes consume the liquified insect and multiply



Why use nematodes?

Efficacy: no resistance can develop.

Selectivity: no impact on non-target organisms.

No PHI, no REI, no unsprayed buffer zone

Suitable for use in organic agriculture (EU)

Kingdom:	Phylum:	Class:	Order:	Family:	Genus:
Animals	*Nematoda* (roundworms)	*Chromadorea*	*Rhabditida*	*Steinernematidae*	***Steinernema***
Animals	*Nematoda* (roundworms)	*Chromadorea*	*Rhabditida*	*Heterorhabditidae*	***Heterorhabditis***

General features

- Entomopathogenic:

  entomo = insect

  pathogenic = causing disease
- Soft-bodied, non-segmented roundworms that parasitize insects
- Soil-borne
- Extensively studied in academia
- Used for decades in agriculture to control soil borne pests
- Important species:

  Steinernema feltiae
  Steinernema carpocapsae
  Heterorhabditis bacteriophora

PRODUCT CHARACTERISTICS

CAPIREL | Product characteristics

Cold tolerant

Name
Steinernema feltiae

Biogeography
Global presence

Length
736-950 microns (0.7 to 0.95 mm)

Dominant behaviour
Mixed: cruiser/ambusher

Large format 4 x 750 million
Flexibility and biggest pack on the market

Fit for **foliar & soil** applications

Still active at low temperature
can withstand “cold” shocks (short period of time with very low temperature from 5°C)

Active from 10°C/41°F
Optimal efficacy between
14-26°C (55-80°F)
Total range 5-35°C (41-95°F)

FORMULATION


State-of-the art factory
Production in vessels ranging from 250 to 20,000 litres

Formulation

No visible spray residue on leaf and fruit

Compact formulation

Good solubility and low viscosity

(Dosatron compatible)

Long shelf life

For organic USA

products available OMRI LISTED For Organic Use

Methods, requirements and compatibility

APPLICATION

Can be applied with many devices

10 golden rules for applying nematodes

1 For a Long storage

Immediately upon receipt, take the boxes out of the shipment parcel and keep refrigerated (2-6°C / 35-43°F), in a dark and ventilated place.

2 Dilute and Stir

When preparing the nematode suspension, always keep the nematode suspension in motion to avoid them sinking to the bottom and suffocating.

3 Evening Light

Nematodes are susceptible to UV light; do not apply in direct/intense sunlight.

4 Temperature

Nematodes can withstand temperatures between 5 and 35 °C (41-95°F), with an optimum range depending on the nematode species.

5 Humidity

Nematodes need moisture. Pre-irrigation and keeping the substrate moist for 2 weeks after application enhance their efficacy. For foliar application a relative humidity of >75% is needed for at least 10 hours after treatment.

6 Spraying Systems

Avoid sprayers fitted with piston or centrifugal pump. Maximum pressure 20 bar / 290 psi. Remove all filters, especially if finer than 0.3 mm / 50 mesh.

7 Tank-Mix

Nematodes can be mixed with many crop protection products, please check the compatibility on our side effect list/app https://sideeffects.koppert.com/. Always add the nematodes at the end into the tank containing the diluted products.

8 Use Rapidly

Apply the nematode suspension directly after preparation. Beware of the spray tank temperature in summer (not above 25°C / 77°F). Stir the spray mix during the entire application.

9 Beneficials

Nematodes are safe to most predatory mites and parasitoids. For other beneficials, check with your local consultant or https://sideeffects.koppert.com/.

10 Relax

The millions of nematodes start hunting pests for you once you have followed the above-mentioned recommendations!

STORAGE

Logistics and Storage

Take the nematode boxes out of the shipment parcel and refrigerate at 2-6°C (36-42°F) immediately upon receipt.

Never keep the boxes in a sealed shipment coolbox; if you cannot do this for space reasons, keep the shipment cool box open, and stack them up as shown in picture.

Store in a well-ventilated refrigerator/cold room.

Store the product in the original box, away from direct sunlight.

Average* shelf life for CAPIREL & CASEA : 3 months at 4°C**

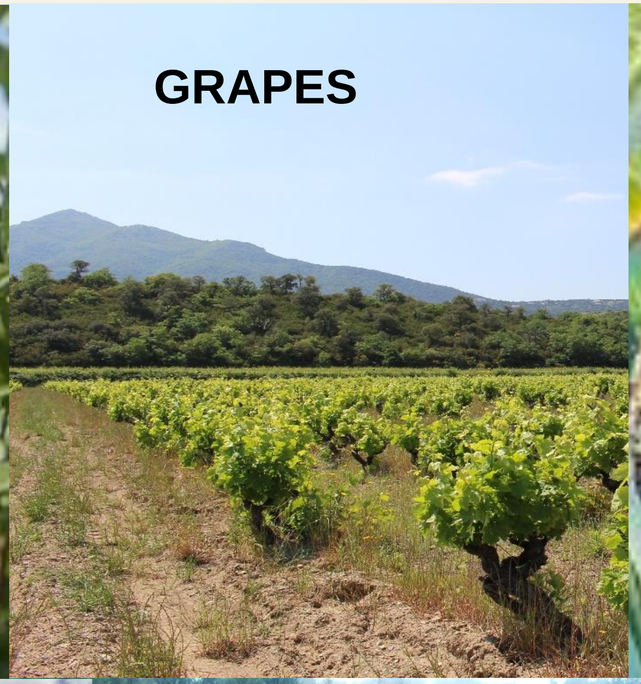
Check for expiry date on packaging

**may slightly vary from batch to batch*

*** 2 Months at 4°C in its OMRI version*

TARGET PESTS

Nematodes can be applied in many crops




Outdoor vegetables

Koppert

Target pests - entomopathogenic nematodes

Koppert Beneficial nematodes in Potatoes & Outdoor vegetables

	Crop	Pest	Latin Name	Capirel *S. feltiae*	Casea *S. carpocapsae*	When to apply	Where to apply	Targeted pest instar(s)	Dose
Others	Asparagus	Common asparagus beetle	*Crioceris asparagi*	✓	✓	Early summer: 1st generation Late summer: 2nd generation	Foliar	Larvae	1,5 billion/ha
	Beans & Peas / Spinach	Bean seed fly	*Delia platura*	✓		At sowing, if fly presence confirmed before sowing (monitoring recomended) - Non tillage fields are more susceptible. Repeat every 7 to 10 days, to cover the risk period.	Soil	Larvae	3 billion/ha
	Peas	Pea moth	*Cydia nigricana*	✓	✓	Apply once caterpillars detected. Repeat 2 to 3 times - 3 to 5 days apart.	Foliar	Larvae	1-2 million/L spray until run off
	Various	Thrips	*Frankliniella occidentalis*	✓		Apply once thrips detected. Apply 2 to 3 times - 7 days apart - repeat if necessary.	Soil	Soil dwelling instars: larvae, prepupae and pupae	5 billion/ha
		Caterpillars	Various species	✓	✓	Apply once caterpillars detected. Apply 2 to 3 times - 3 to 5 days apart.	Foliar	Larvae	1-2 million/L spray until run off
Bulbs / Roots / Tubers	Onions	Onion fly	*Delia antiqua*	✓		Apply 7 to 14 days after first fly detection (monitoring). Repeat every 7 to 10 days to cover the risk period.	Soil	Larvae	3 billion/ha
	Onions/Leek	Onion thrips	*Thrips tabaci*	✓		Apply once thrips detected. Low pressure: 2 applications 7 to 14 days apart. High pressure: 3 applications at 7 days interval.	Soil	Soil dwelling instars: larvae, prepupae and pupae	1,5 billion/ha
	Potatoes	Wireworms	*Agriotes* spp.		✓	From planting to harvest, covering the risk period - 4 to 8 applications.	Soil	Larvae	500 - 1000 million/ha
	Various	Crane flies	*Tipula* spp.		✓	Apply once crane flies detected. Two applications 7 days apart.	Soil	Larvae	2,5 billion/ha
Leafy	Rucola/Roquette (babyleaves)	Flea beetles	*Phyllotreta* spp.		✓	Apply at sowing - repeat if necessary with 7 to 14 days interval.	Soil	Larvae	1,5 to 3 billion/ha
	Lettuce	Caterpillars	Various species	✓	✓	Apply once caterpillars detected. Repeat 2 to 3 times - 3 to 5 days apart.	Foliar	Larvae	1-2 million/L spray until run off

Bean Seed fly control using EPN’s

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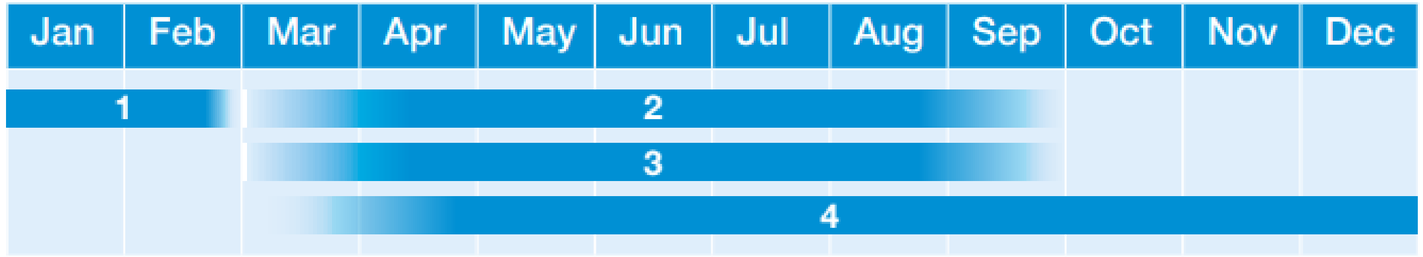
Bean seed fly in Legumes

- Bean seed fly affects more than 40 different host plants and is an important pest of peas, maize and beans. Hosts include Phaseolus beans, peas, broad beans, cucumber, melon, spinach, onion, pepper, potato, maize (alfalfa, cotton, strawberry and tobacco are secondary hosts) and the larva is a common pest found in most temperate countries.

- In severe infestations plant loss at seedling stage may be high, often resulting in re-drilling and loss of production of high value crops at an early growth stage.

- Bean seed fly has been identified as a high priority for UK vining peas, picking peas and Phaseolus beans (green and runner beans), as well as in alliums, asparagus and leafy salads, due to increasing incidents of damage, the loss of key active insecticidal substances and the increased use of cover crops in rotations.

Bean seed fly life cycle



1. Bean seed flies overwinter as pupae in the soil.
2. Adults emerge and females lay eggs just below the soil surface – generally singly – and up to 40 eggs in one day. Typically, a period of several days elapses before a further batch of eggs is laid.
3. The larvae feed on the buried seed or the cotyledons of the seedling (prior to sprouting). In the absence of a suitable host plant, larvae feed on decomposing organic matter.
4. The larvae pupate in the soil at varying depths.

Ag Dev Trials 2021

Determining the efficacy of Capirel at two rates and timings on control of bean seed fly larvae in vining peas

The study was conducted by PGRO in a commercial crop situated in Burgh on Bain, Lincolnshire

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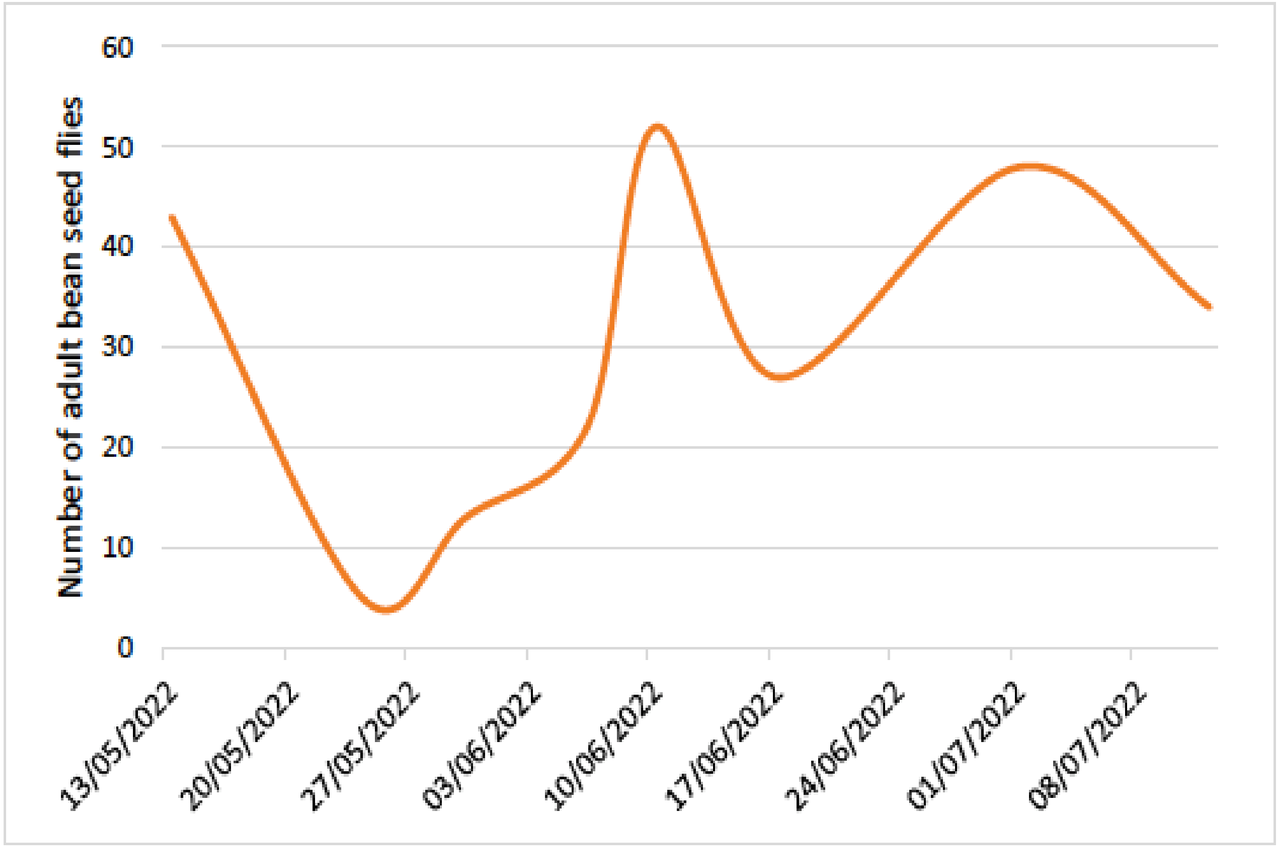
Treatments and Application

Trt	Code	Treatment	Rate (b/ha)	Treatment	Rate (mls/ha)	Spray volume (l/ha)
1		Untreated Control				
2		Entonem 3.0 billion/ ha	3.0			
3		Entonem 3.0 billion/ ha	3.0	Humectant 0.5% (of water volume)	1500 ml/ha	300 l/ha
4		Entonem 1.5 billion/ ha	1.5			
5		Entonem 1.5 billion/ ha	1.5	Humectant 0.5% (of water volume)	1500 ml/ha	300 l/ha

Monitoring

The number of adult bean seed flies recorded during the period of the trial was moderate, with a maximum of fifty-two recorded on 10th June 2022 (Figure 3).



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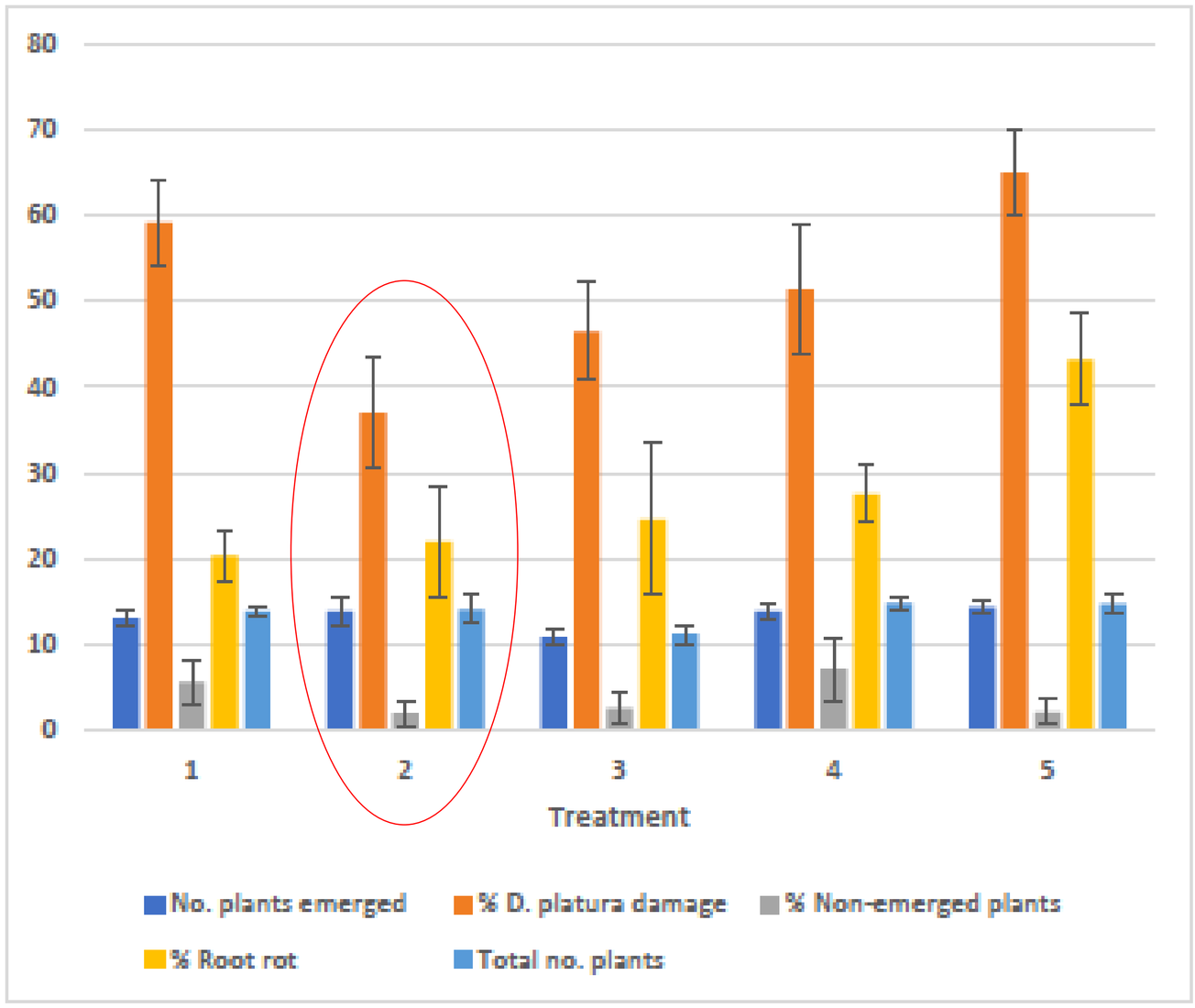
CRO trial 2021



There was a significant difference in the percentage damage caused by *D. platura* larvae between treatments

The full rate of Entonem, 3 billion nematodes per hectare, without the humectant (treatment 2) gave a significantly lower level of damage compared to the untreated control (treatment 1) and the lower rate of Entonem with humectant (treatment 5

Summary / Conclusions

• In a replicated small plot trial, the full rate of Entonem (3 billion nematodes per hectare) without the humectant, provided significant control of *D. platura* larval damage compared to the untreated control and the lower rate of Entonem (1.5 billion nematodes per hectare) with humectant.

• The addition of the humectant provided no additional control of *D. platura* larval damage.

• The trial indicated that treatment with Entonem provided some control of *D. platura* larvae

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Recommendation

Delia antiqua	3 billion/hectare	500 litres/hectare minimum	1-2 hectare(s) (one 750 million sachet for 2500-5000 m²)	Application 7-14 days after flies detected (monitoring highly recommended) Repeat every 7-10 days to cover the risk period	Soil/compost application Pre- and post-irrigation highly recommended Soil temperature from 5°C/41°F, with several hours above 14°C/57°F a day, following application
Delia platura				If flies already present before sowing: apply directly at sowing If flies are detected for the first time around sowing: apply at approx 6 days after sowing (Monitoring highly recommended) Non-tillage fields are more susceptible to (*Delia platura)* Repeat every 7-10 days during the risk period	

Acknowledgements

PGRO & Dr Becky Howard

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How do you partner with nature?

Koppert

Allen Giles

Traceability & Customer Requirements

- HMC are being asked for more in-depth information about how crops are grown (cultivations, weed/pest/disease control, environmental strips etc)
- We have been asked to become organic certified
- We have been asked about growers not currently LEAF certified becoming LEAF certified
- Due to weed seed contamination of frozen peas in 2023 there will be a lot more focus on field risks with weeds and allergens with more potential liability being placed on HMC and members
- We will need completed field risk assessments before we can drill fields
- We will need completed field application records before we can harvest fields

Back to Basics

- Long Rotation
- Previous Cropping
- Suitable and Best Land
- Cultivations
- Pest Control and Pigeon Control

HMC

THANK YOU