SESSION 4

POTATO CYST NEMATODES

K3 Potato cyst nematodes and the future of potato production in Scotland
James Price (The JHI, Scotland, United Kingdom)

O14 Selection and optimisation of solanaceous trap crops used for the suppression of potato cyst nematodes
Matthew Back (Harper Adams University, United Kingdom)

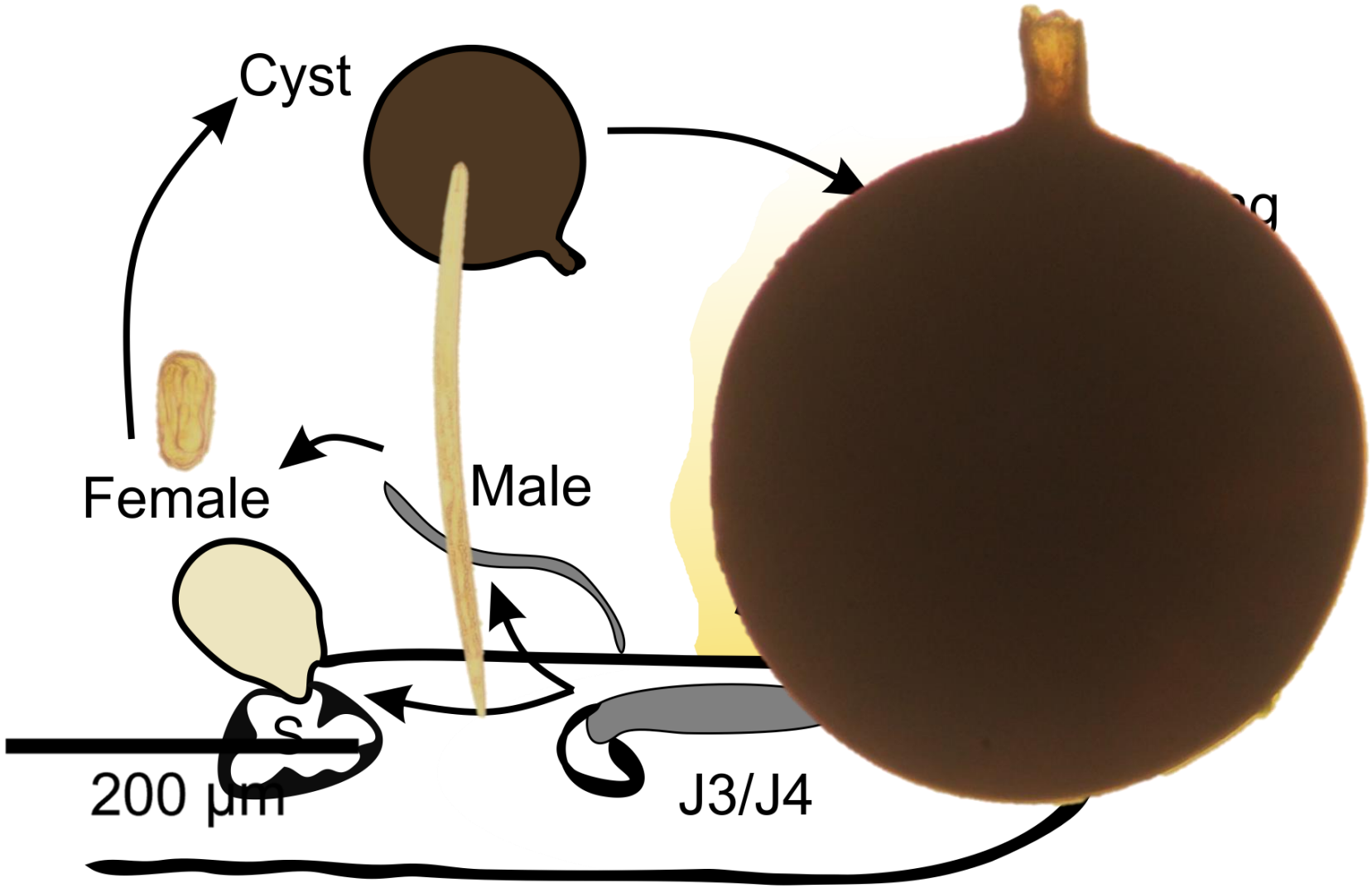
P21 A novel biocontrol strategy to manage potato cyst nematodes: « Suicide hatching »
Pauline Dewaegeneire (inov3PT, France)

Potato cyst nematodes and the future of potato production in Scotland

James Price

The James Hutton Institute

Potato cyst nematodes (PCN)



PCN in Scotland

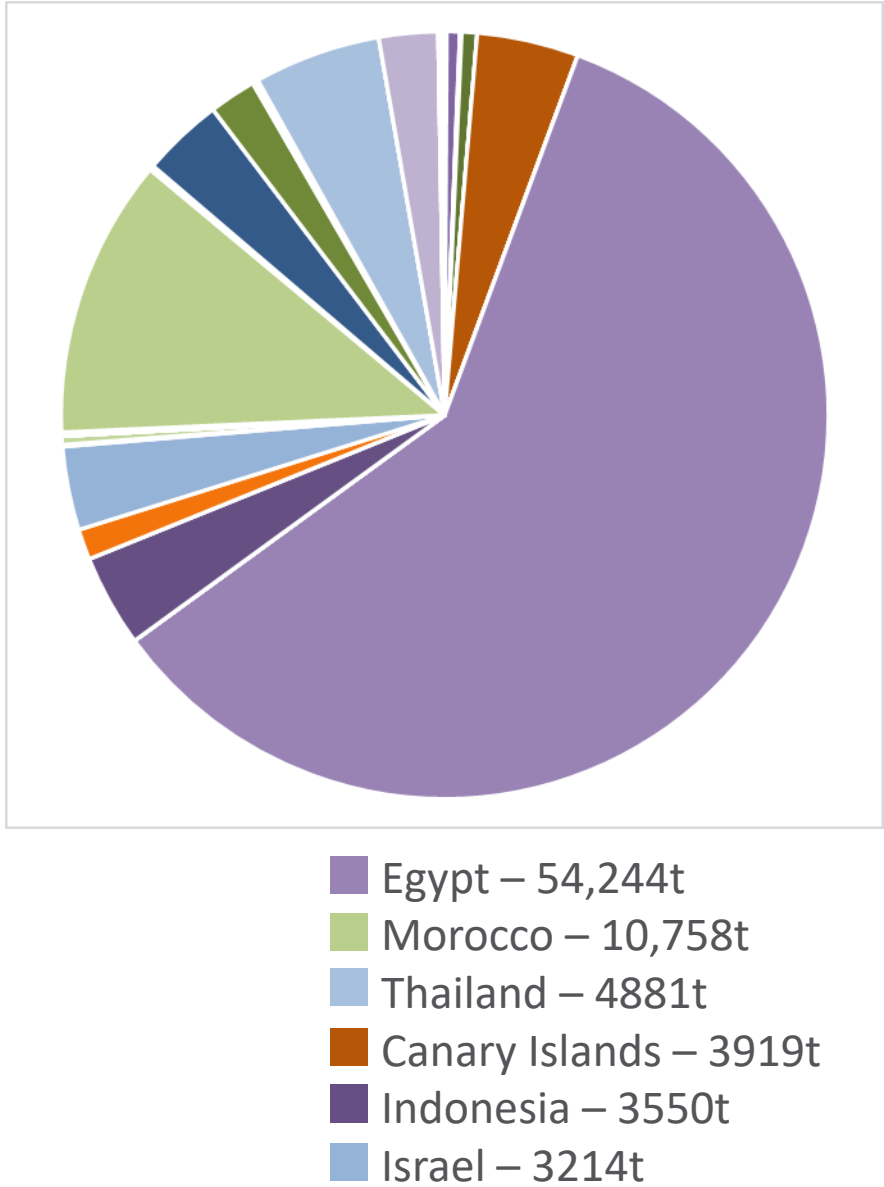
Globodera pallida	*Globodera rostochiensis*
	
Pale cyst nematode	Golden cyst nematode

PCN in Scotland

- As of July 2022, 20,800ha of Scottish land is officially infected with PCN.
- Estimate: over 50,000ha of total potato growing land (150,000ha) is infected
- PCN could see the end of the Scottish seed industry by 2050.
- 5 rotations away

Potatoes in Scotland

- The seed potato industry in Scotland is worth over £250 million pa
- Scotland supplies ~78% of the seed potatoes grown in the UK
- Significant exporter to non-EU market (~91,400t)



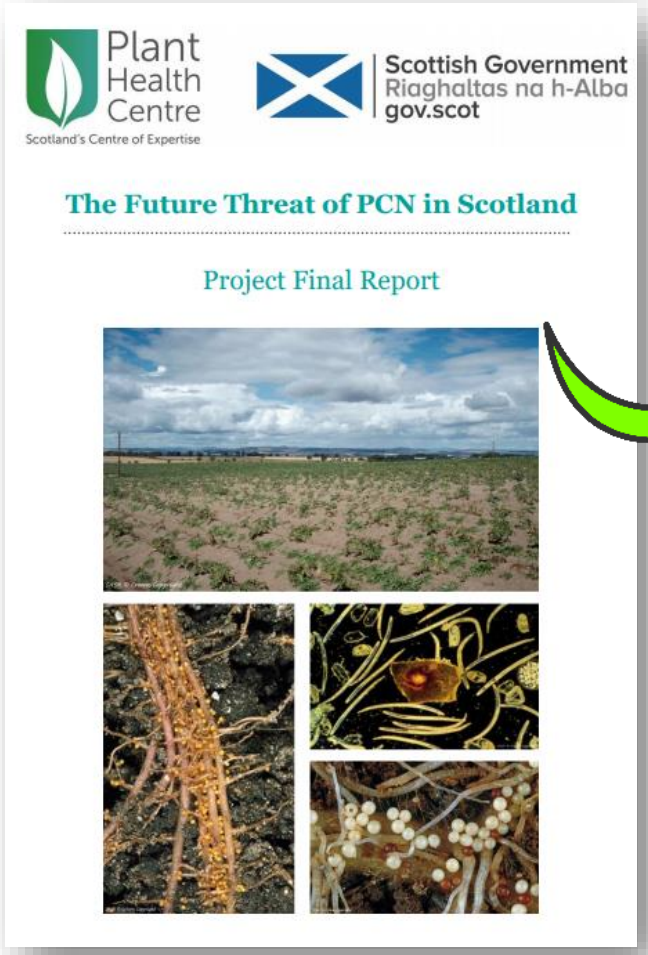
What does that mean for the UK?

- Scotland provides ~78% of the seed for the GB potato industry

- The UK is the 5th largest potato producer and exporter in Europe

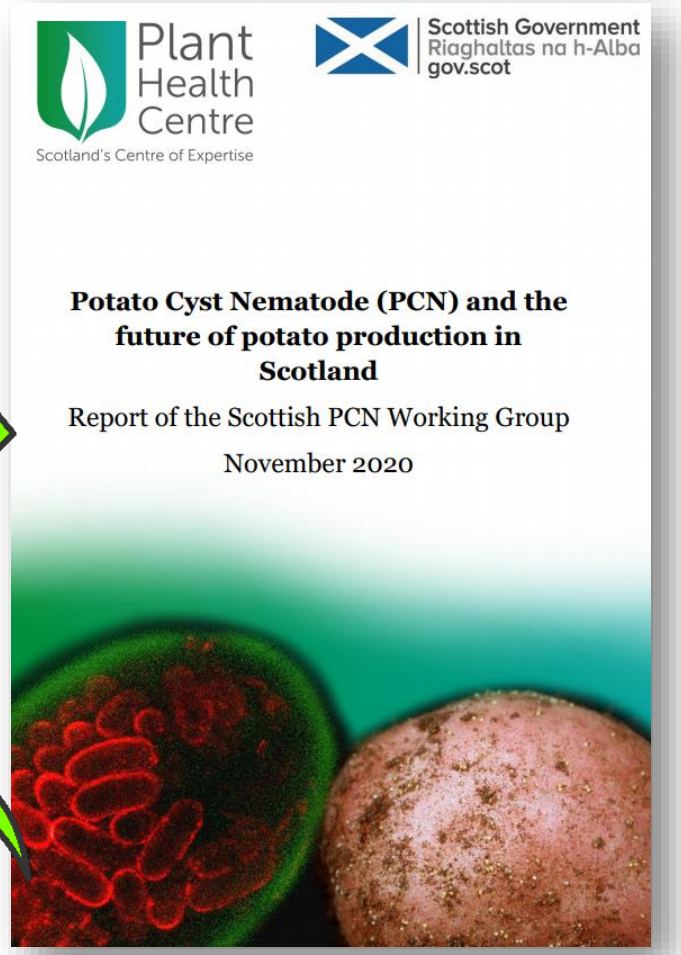
- Not just potatoes, bulb export not possible from PCN infected land

PCN Working Group Report



Scot Gov	Industry	Academia
15	31 NFUS AHDB BPTA PBGA STET SOAS FPSA	11

- £2.3M Scottish Government grant
- 5 years (2021-26)



PCN Working Group Report
4 key recommendations

1. Increase the potato sector's capability and motivation to implement change

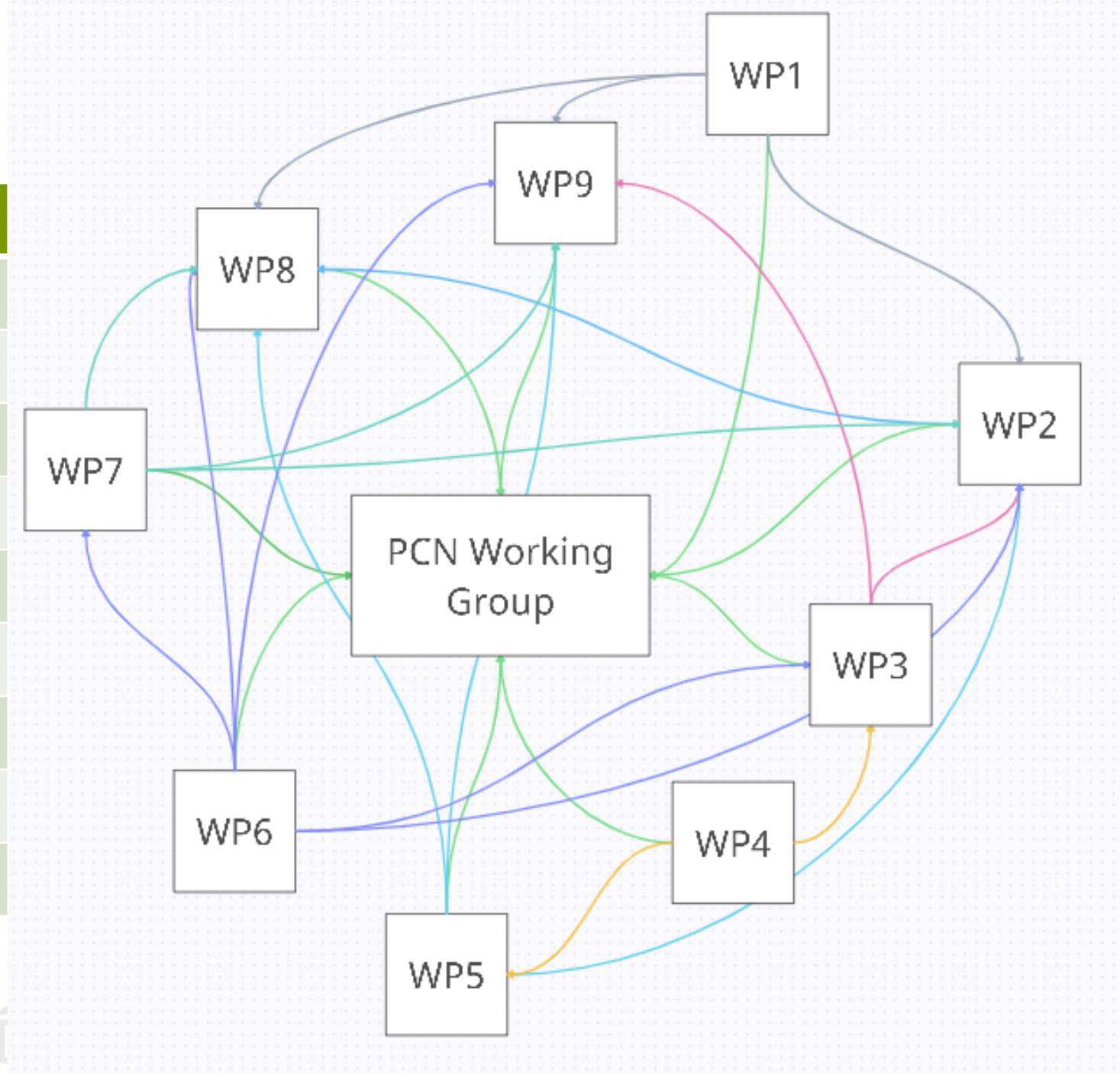
2. Preserve the land base for future generations

3. Control the epidemic

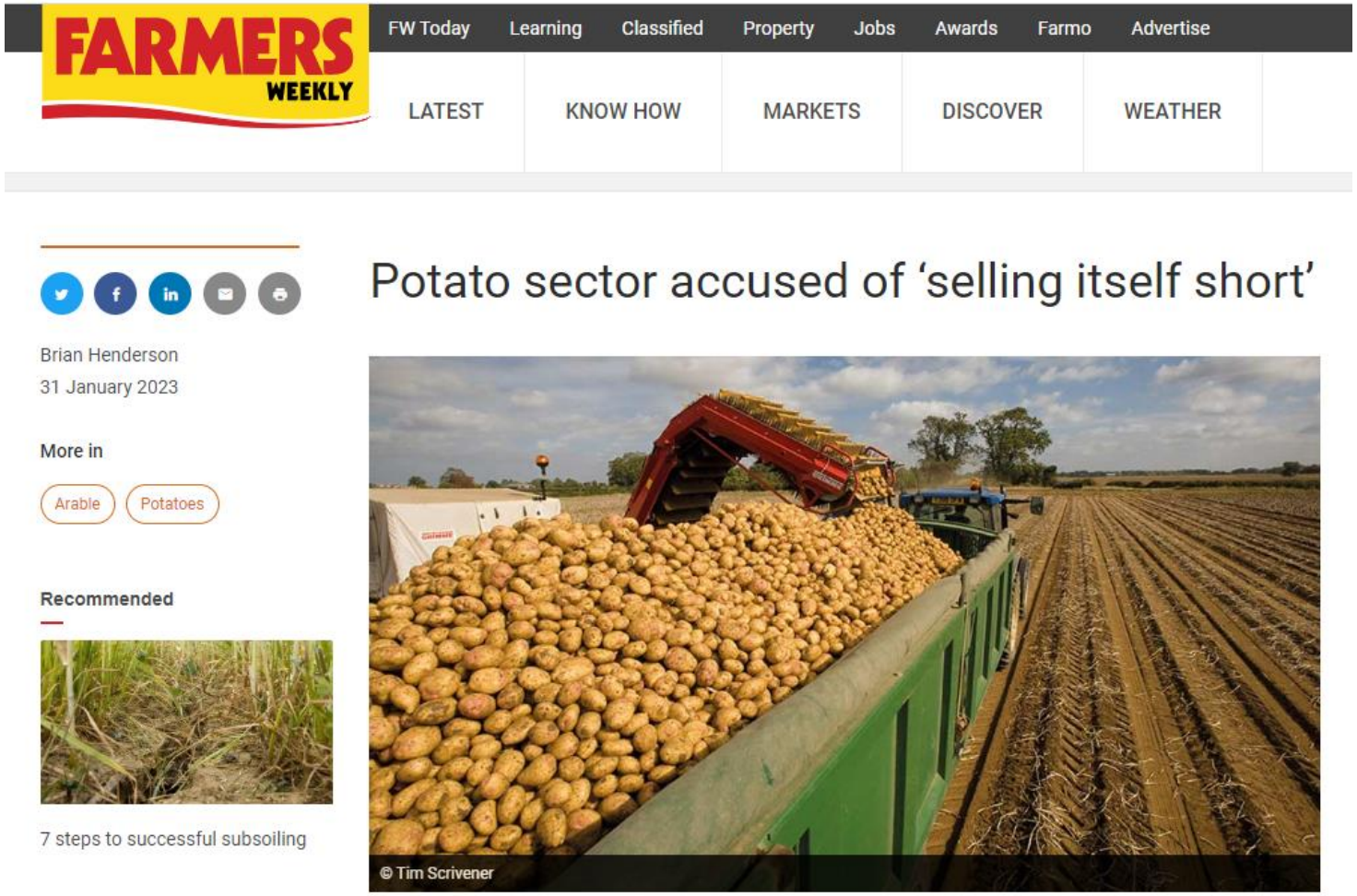
4. Recognise the investment needed to tackle the PCN problem

This talk

Work Package	Title
1	Economics
2	DSS
3	Resistance
4	Dihaploids
5	Tolerance
6	Groundkeepers
7	IPM
8	Knowledge exchange
9	Policy



WP1 – Economics



Spend on seed, fertiliser, machinery etc.

↓

Farmgate sales £765 million

↓

Downstream spending/purchasing

WP1 – Economics

- UK 70% self-sufficient in potatoes
- for every £1 of potatoes grown and sold in the UK, consumer expenditure is £3.70 through value chain and retail impacts

A £4.5bn industry is much more attractive to support than one worth £765mn

WP2 – Decision Support System (DSS)

soilessentials
precision farming solutions

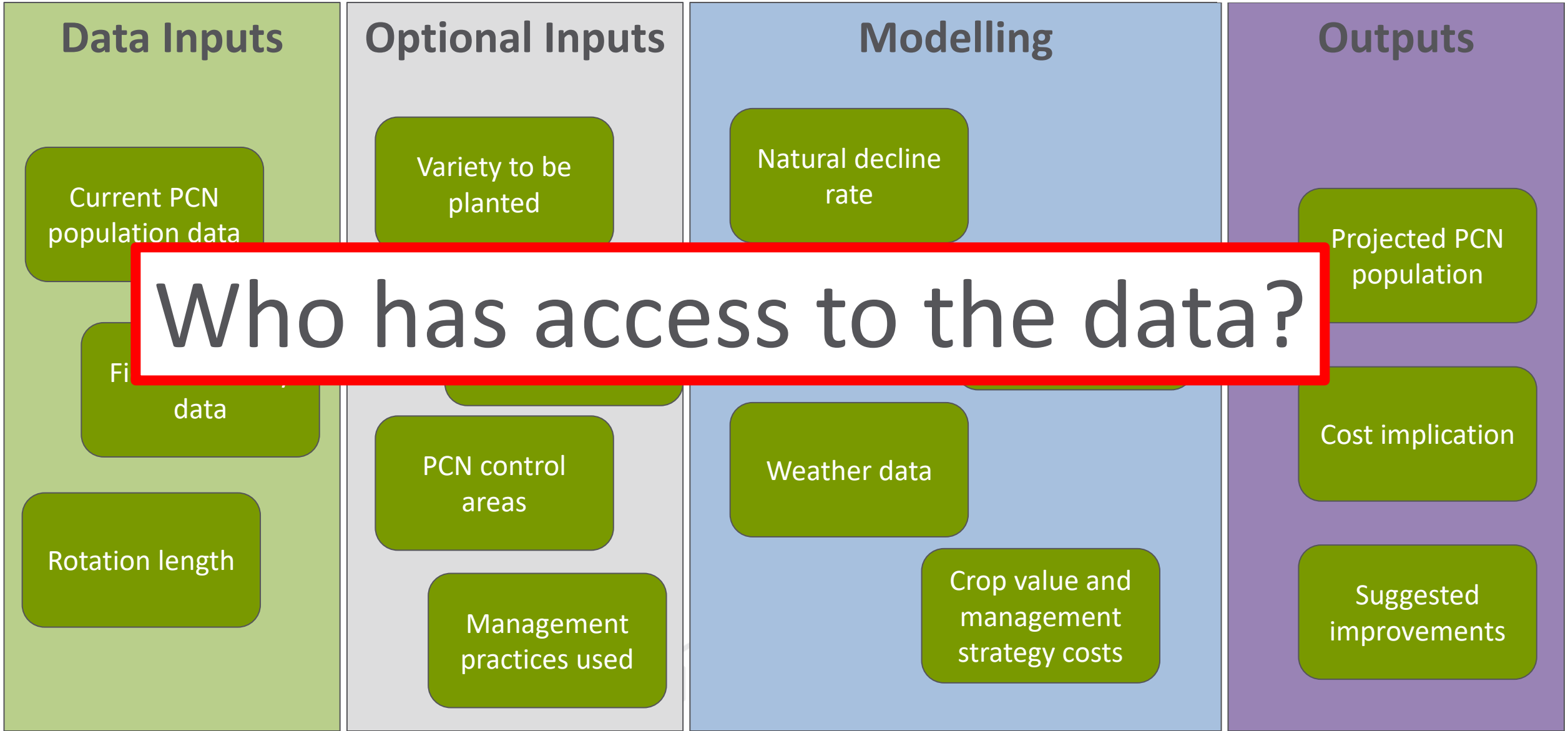
- An app that informs on PCN field population size over time, augmented by user specified scenarios

AHDB
AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

- Grower focussed

WP2 – DSS

soilessentials
precision farming solutions

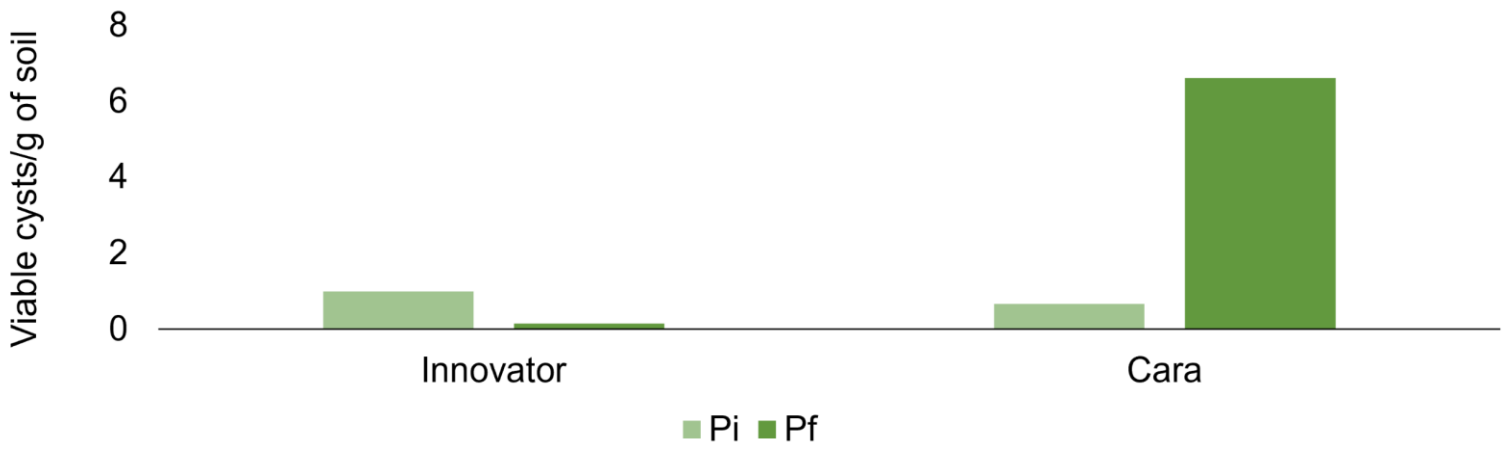


Who has access to the data?

WP3 – Resistance and marker development

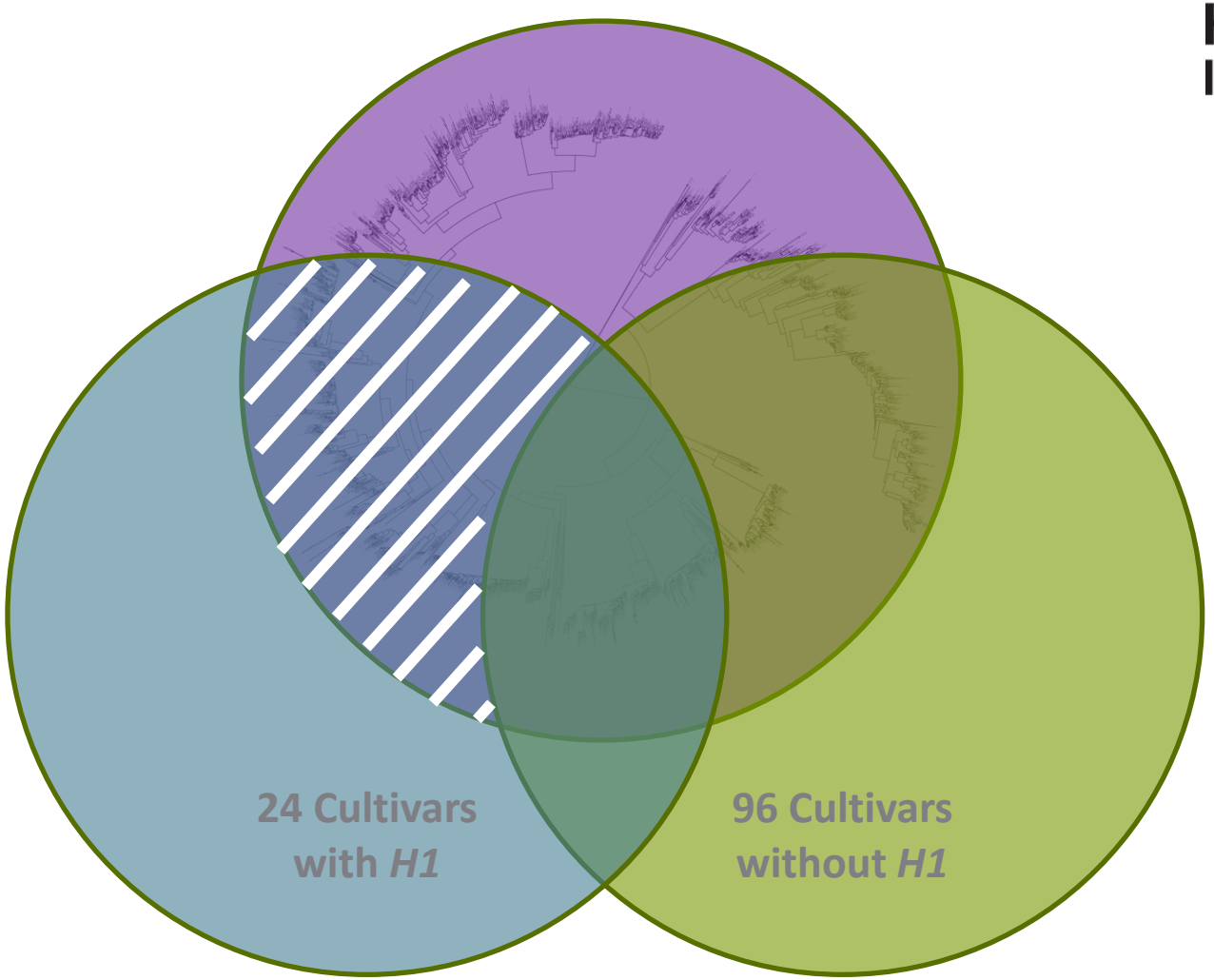
- During the growing season natural host resistance is **the best** control for PCN

- Phen time consu ull pictu



WP3 – Resistance and marker development

TBRADG 3520
S. tuberosum ssp. andigena
accession CPC 1673



AgRenSeq: RenSeq-based Association Genetics (H1)

WP3 – Resistance and marker development

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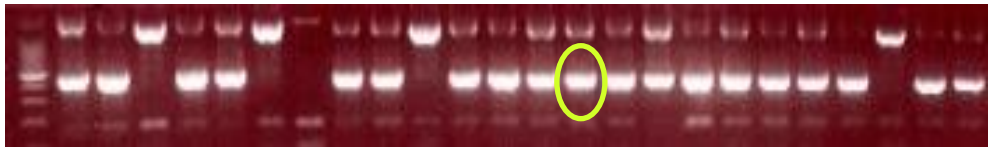
ORIGINAL H1 GENE PCR/GEL BASED ASSAY (57R MARKER)

FALSE POSITIVE

RRSRRSSRRSRRRRRRRRRRRRSRR

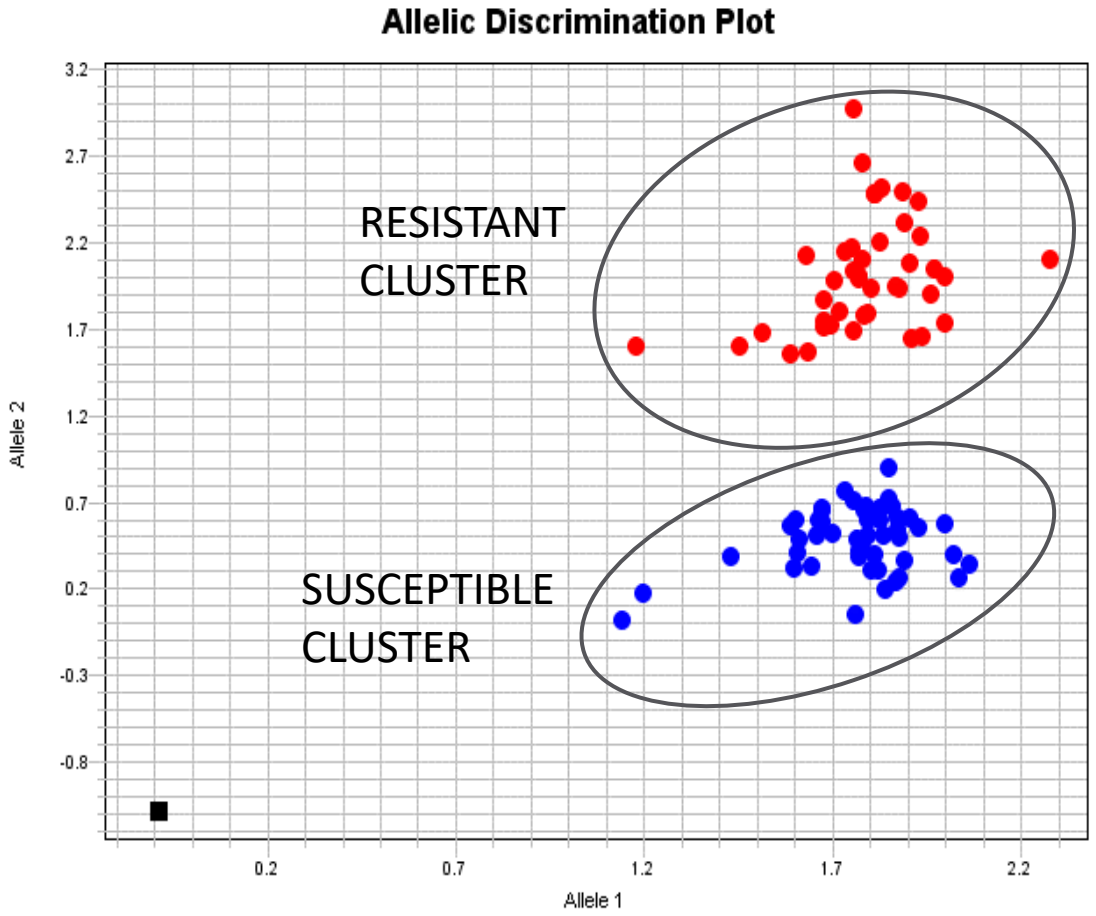


R = RESISTANT

S = SUSCEPTIBLE

57R MARKER

H1 GENE KASP ASSAY



WP3 – Resistance and marker development

The James Hutton Institute

Progress for H1, Gpa5 and H3

- New KASP markers have been validated on 200 varieties
- 100% correlation between marker and resistance
- Quicker to run, easier to analyse, copy number information

H3

WP4 – Dihaploids

- Help speed up breeding efforts by reducing ploidy complexity (4 → 2)

- Stacking resistance helps prevent resistance breakdown

WP4 – Dihaploids

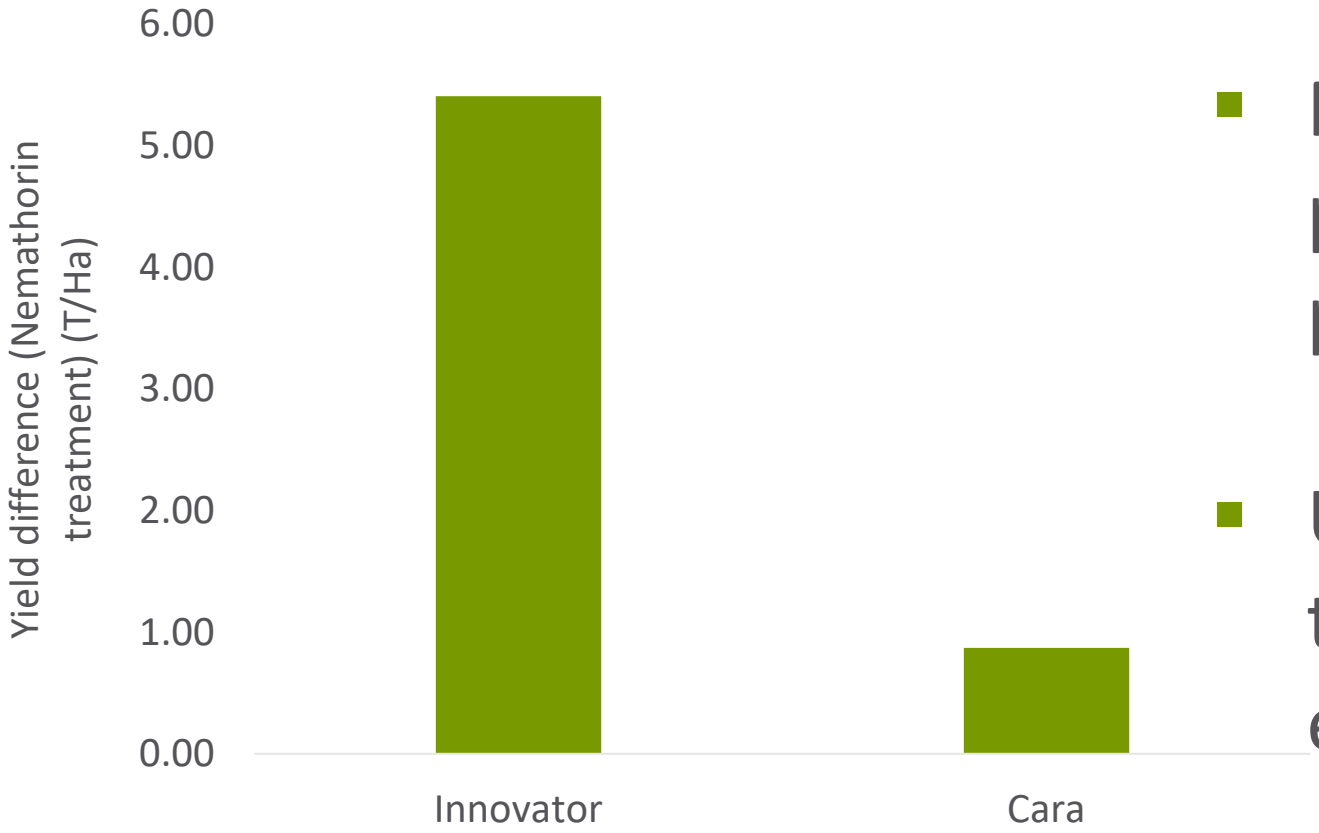
- Slow process as dihaploid plants are often sterile
- First screening of H1 dihaploids

WP5 – Tolerance

- Tolerance ≠ Resistance

WP5 – Tolerance

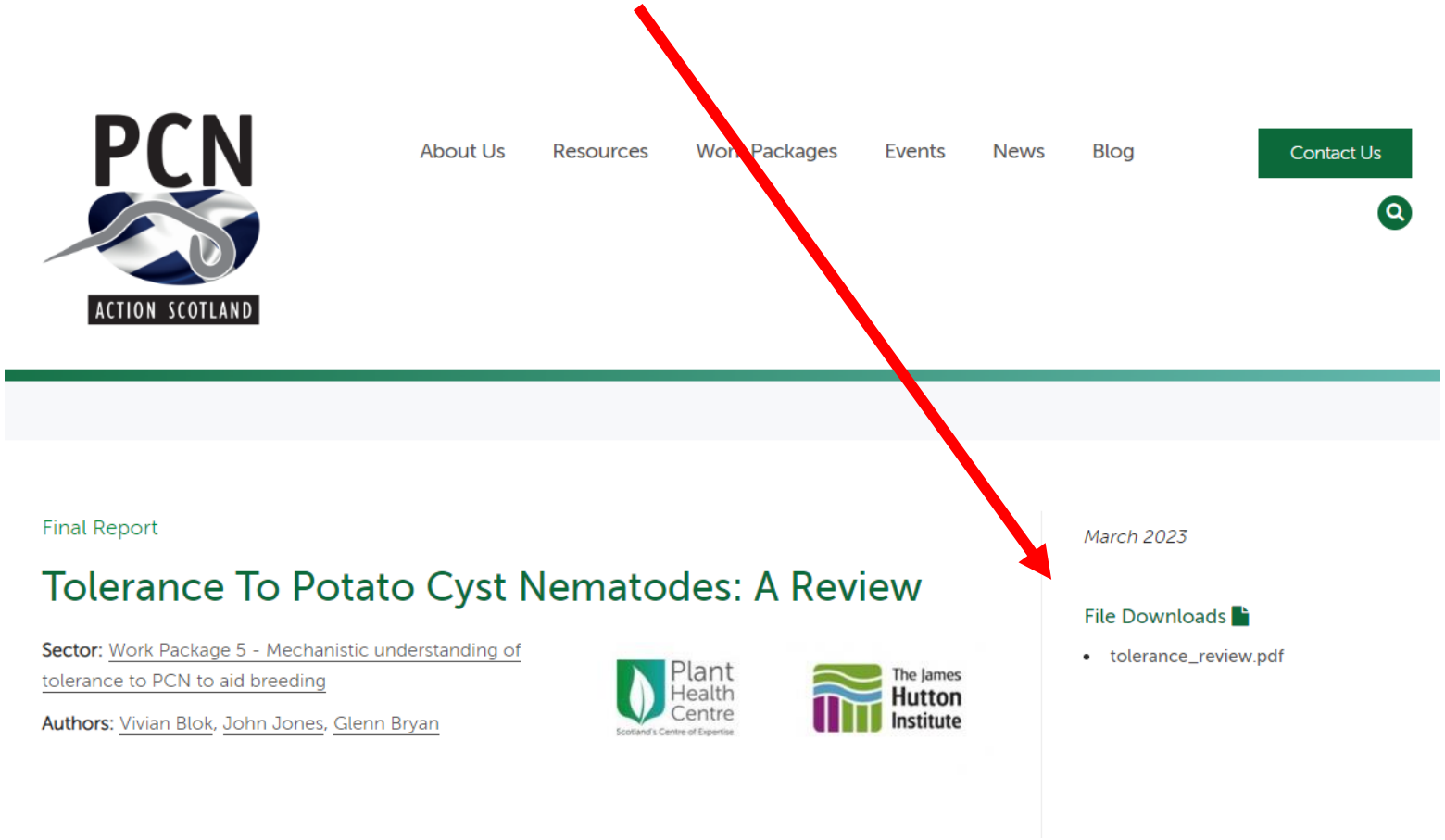
- Uncertain future of nematicides in the UK



- Nematicides mimic tolerance by protecting yield under infection pressure
- Understanding and breeding for tolerance will help mitigate the eventual loss of nematicides

WP5 – Tolerance

- Tolerance desk study available online

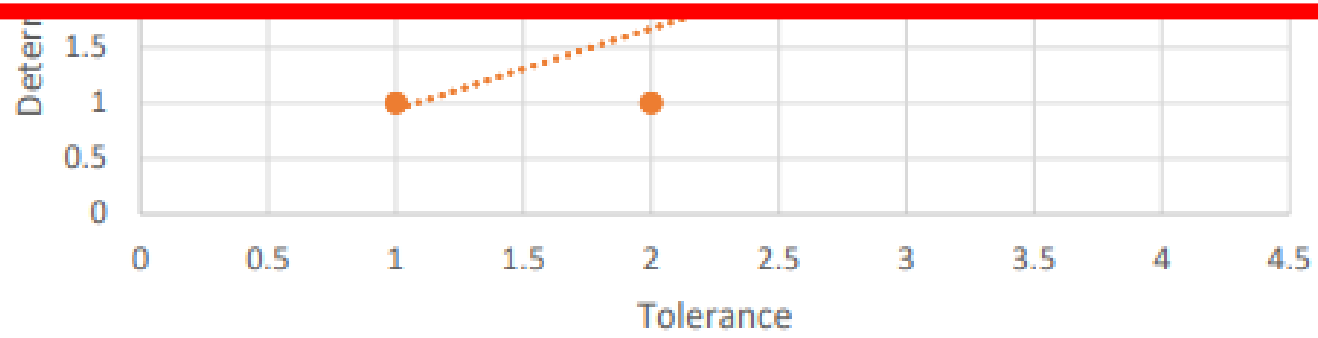


WP5 – Tolerance

- There are clear links between PCN-tolerance and determinacy

- Now testing genetic markers for determinacy

- Markers will screen through current commercial varieties of interest and feed into current breeding programmes



WP6 – Groundkeepers

- Groundkeepers offer PCN an option to multiply outside of rotation

At groundkeeper

1m away from groundkeeper

WP6 – Groundkeepers

soilessentials
precision farming solutions

Dedicated 12m SKAi sprayer build:

- Image acquisition via smart camera
- Individual nozzle control
- Capable of spot spraying

- 77% reduction in chemical use
- 95% of herbicides reach target species

WP6 – Groundkeepers

soilessentials
precision farming solutions

- Currently testing on groundkeepers in Onions (Holland)
- Image acquisition for groundkeepers in broccoli (Fife, Scotland)

WP7 – Integrated pest management (IPM)

- Developing new tools for managing PCN between growing seasons

- Trap cropping with *Solanum sisymbriifolium, S. scabrum* & *S. pimpinellifolium*

WP7 – Integrated pest management (IPM)

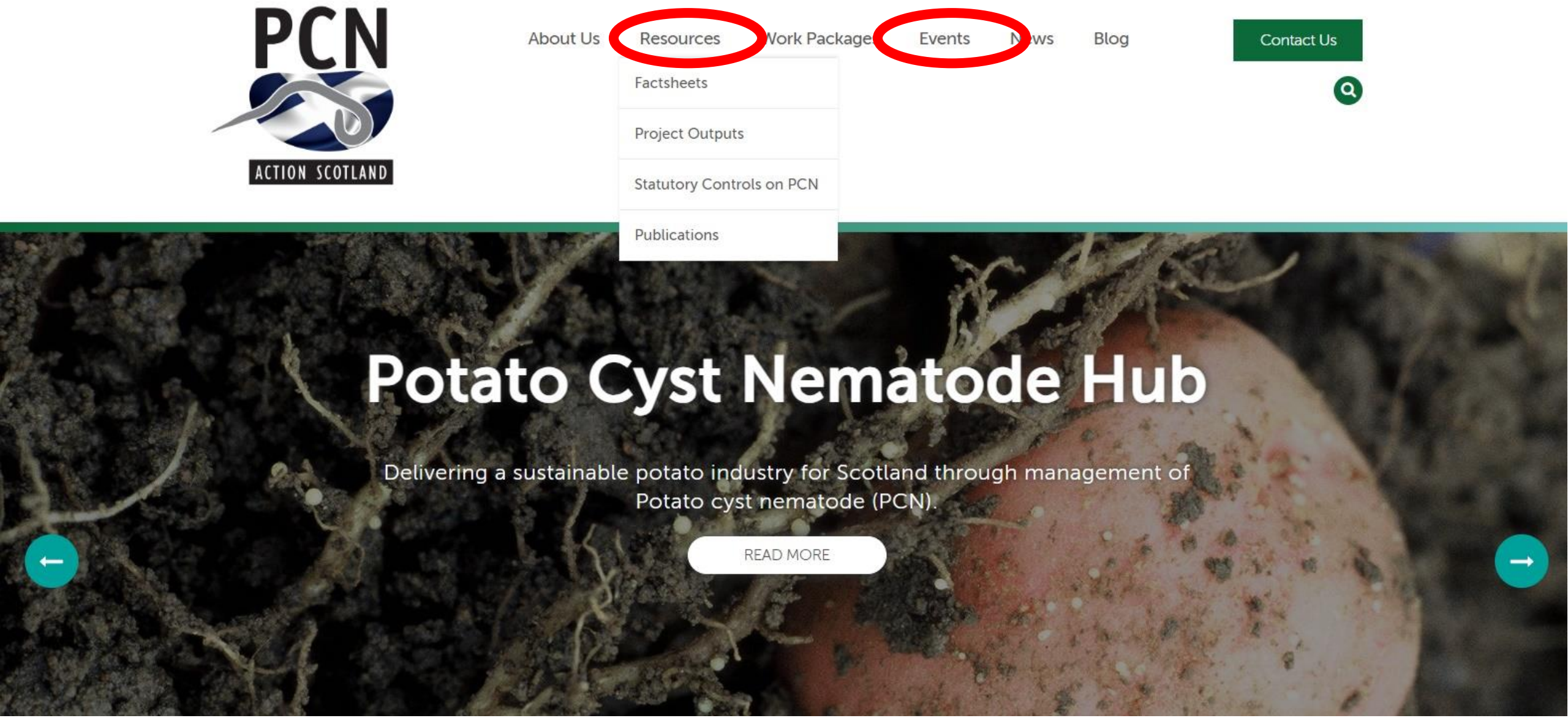
SCOTTISH AGRONOMY LTD

S. scabrum

S. pimpinellifolium

S. sisymbriifolium

WP8 - Knowledge exchange



WP8 – Knowledge Exchange

WP8 – Knowledge exchange

Potatoes in Practice

On average 600 attendees and 60 exhibitors

WHY BE INVOLVED?

Whole SUPPLY CHAIN represented at the event

VARIETY DEMONSTRATIONS, SEMINARS, static and moving MACHINERY DEMONSTRATIONS and RESEARCH and TRADE EXHIBITS

The LARGEST field-based potato event in the UK

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WP9 – Policy

- PCN eradication is an unrealistic target
- Policy to move towards containment, management & suppression
- What does that look like?

WP9 – Policy

WP9 – Policy

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What is PCN-free land?

Statutory testing of ware land?

Stricter land management enforcement?

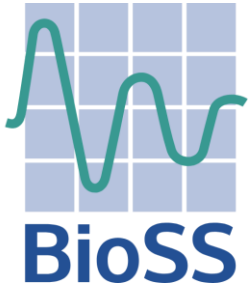
Who is responsible for change?

Increase soil sampling precision

Make resistant varieties compulsory

With thanks:

Ian Toth – JHI / PHC
Steven Thomson - SRUC
Ingo Hein - JHI
John Jones - JHI
Jim Wilson - SoilEssentials
Eric Anderson – Scottish Agronomy
Phil Burgess – SRUC/SAC/JHI
Kerry Leslie - SAC
Jon Pickup - SASA



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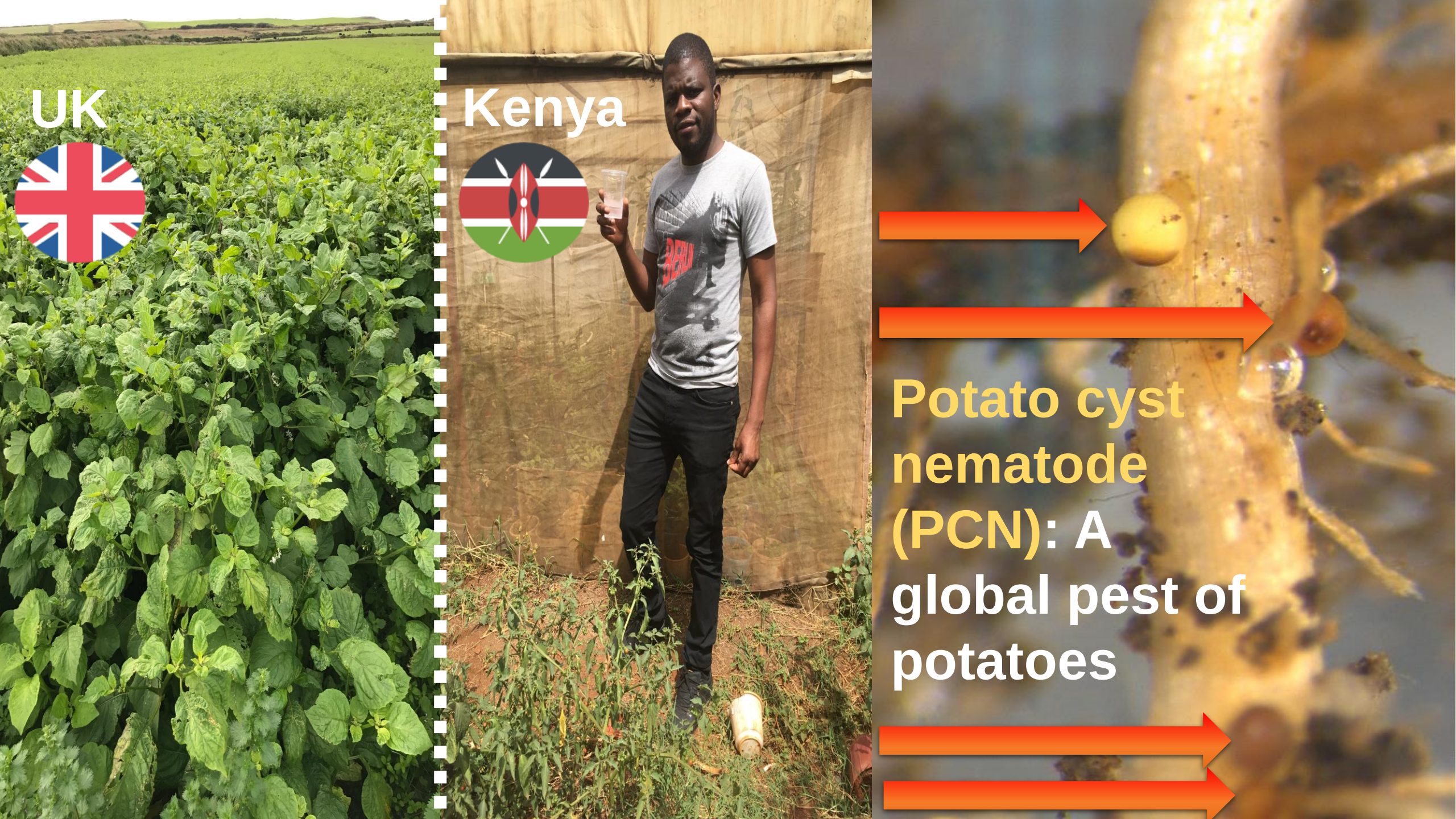
PCN

ACTION SCOTLAND

https://www.pcnhub.ac.uk/


UK
Kenya
Potato cyst nematode (PCN): A global pest of potatoes

Selection and optimisation of solanaceous trap crops used for the suppression of potato cyst nematodes

Matthew Back, Katarzyna Dybal, Ivan Grove, Graham Tomlin, James Lee, Richard Griffith, Tom Eyles, Graham Tomalin, Alex McCormack, James Godber and William Watts

Harper Adams University

PRODUCE SOLUTIONS

CHAP CROP HEALTH & PROTECTION

UKRI Innovate UK

Taylor Organic Farms

Attlefield Farm Machinery Ltd.

Innovate UK project: 10027156 *DeCyst* – *Developing Best Practice for PCN Trap Crops*

2 year project

Consortium of **industry**, **farmers**, **agronomists** & **academics**

Field & glasshouse experiments, farmer led demonstrations & knowledge exchange

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UKRI Innovate UK

WP7: Product Development & Marketing

- Exploit new knowledge/data to develop the 'DeCyst range'
  - Develop marketing to key customer segments
- Launch new innovative product 'DeCyst-Podium'

WP10: Project Management
Ensure the smooth running of the project, manage partners and their finances, along with ensuring clear communication between partners

WP1: Glasshouse - Efficacy
Compare efficacy of three STCS to the two UK PCN species

- Confidence in efficacy
- Variable establishment success
- Knowledge Gap and with no 'Best practice'
- Diminishing Nematicide 'Status quo'
- Optimum Agronomy
- Fit with existing equipment

Customer Barriers

WP4: Field – Establishment Method
Examine different equipment and farming practices to establish STCs

WP2: Field - Seed Rate
Examine how seed rate impacts crop establishment and efficacy

WP3: Field - Nutrition
Examine how crop nutrition impacts growth, biomass and efficacy

WP9: Knowledge Transfer
Produce a grower guide, to summarise knowledge, best practice and real-world case studies. Unlocking Potential.

WP5: Grower – Standard Practice
A group of five growers will establish STCs on farm using their own knowledge/practices

WP8: Knowledge Exchange
Exchange knowledge and raise awareness of STCs through industry events and press articles

WP6: Grower – Best Practice
A group of five growers will establish STCs on farm using combined knowledge to create 'Best Practice'

Objectives

1. **Evaluate** efficacy of **commercially available trap crops** for **PCN (*Globodera pallida*) management**

2. **Optimise trap cropping** through improved **establishment** and **crop agronomy**

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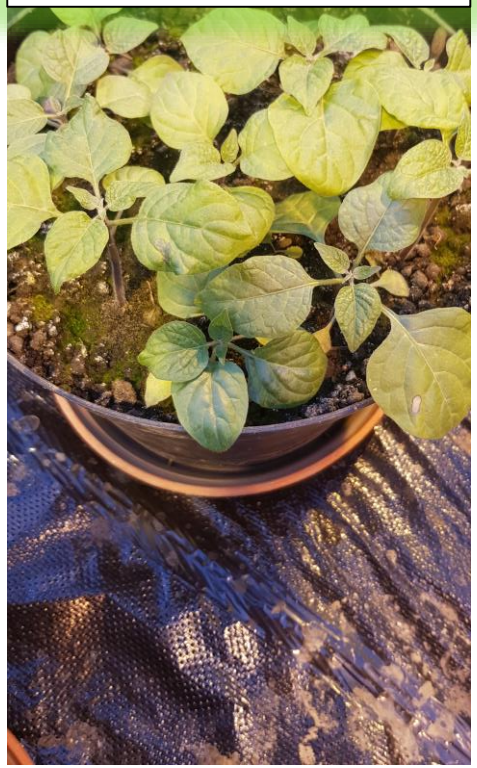
Glasshouse experiments: Species selection

Potato cv. Royal
Solanum tuberosum

DeCyst
Solanum sisymbriifolium

DeCyst Broadleaf
Solanum scabrum



DeCyst Podium
Solanum chenopodioides

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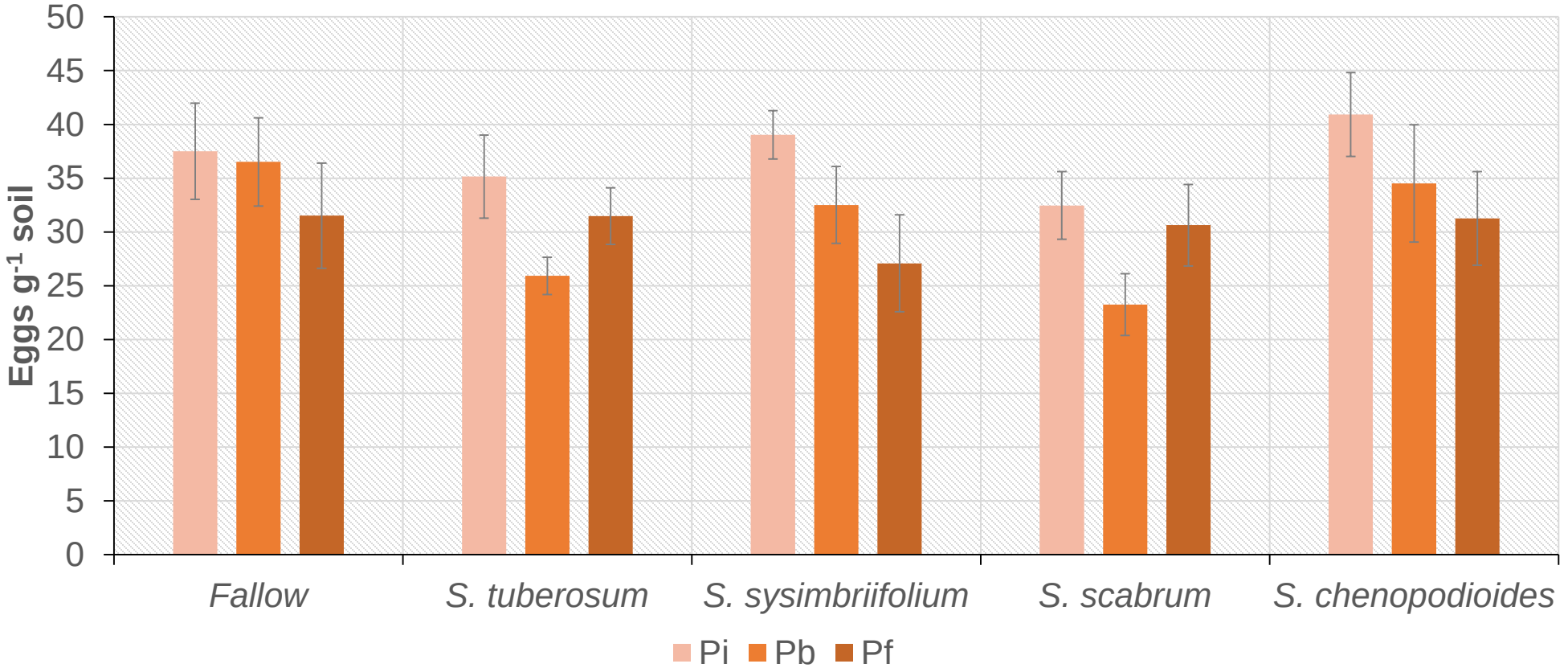
Glasshouse experiment 1: *G. pallida* P_i (initial), P_b (8 WAP) and P_f (final - 16 WAP)



***P*$_i$**
P value = 0.582
SED = 5.48
cv% = 25.6

***P*$_b$**
P value = 0.079
SED = 5.15
cv% = 29.2

***P*$_f$**
P value = 0.950
SED = 6.43
cv% = 36.6

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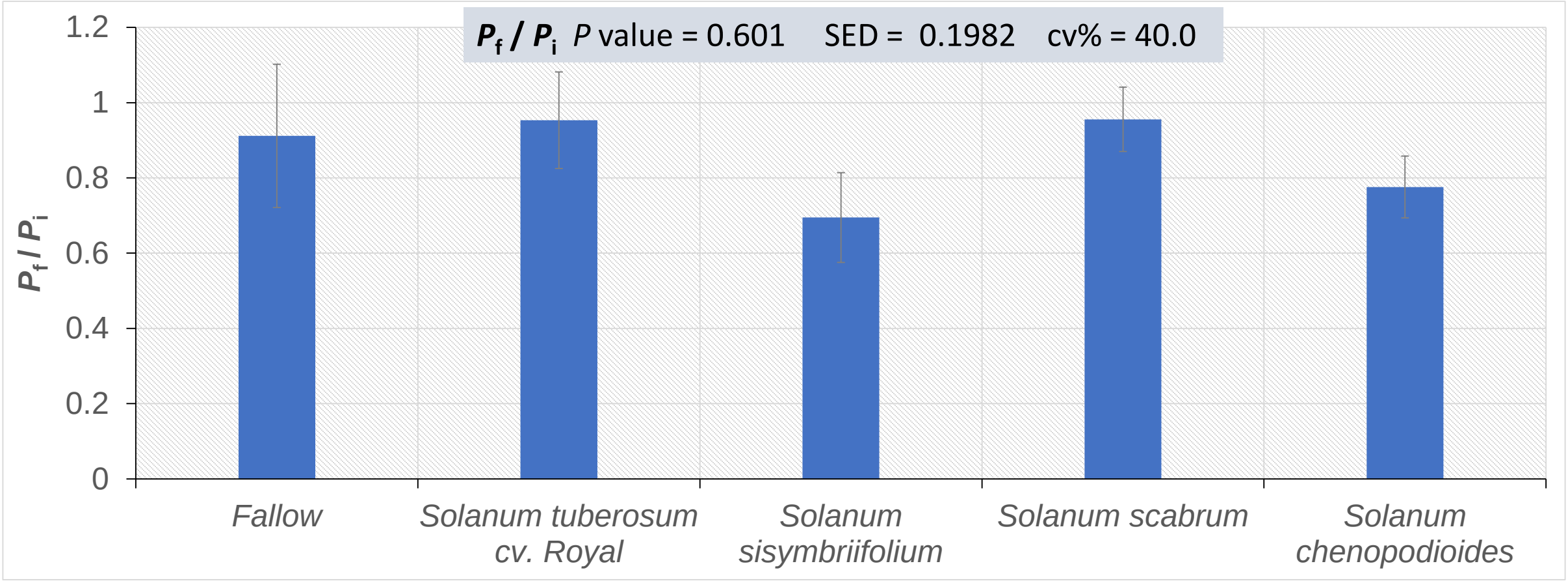
Glasshouse experiment 1: *G. pallida* multiplication rate (P_f / P_i)



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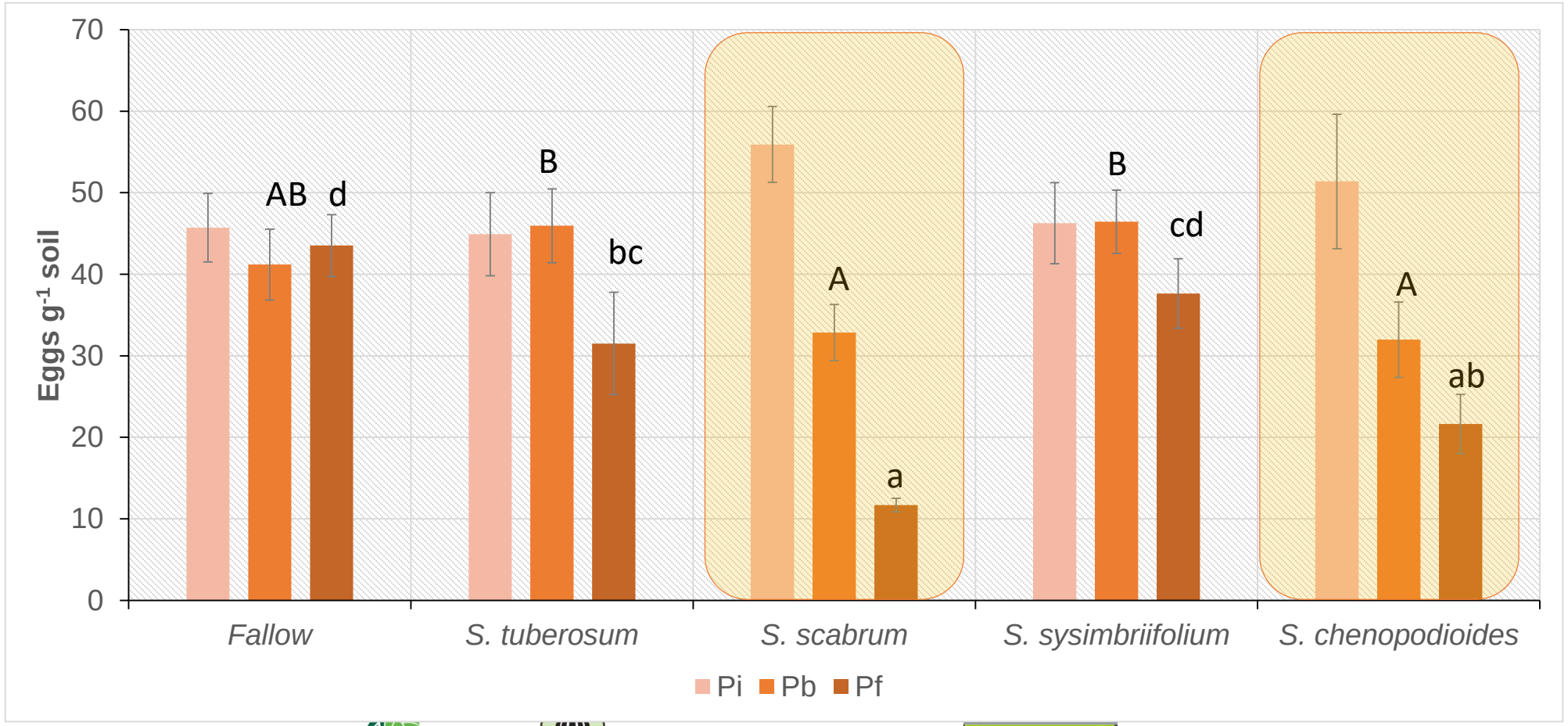
Glasshouse experiment 2: *G. pallida* P_i (initial), P_b (8 WAP) and P_f (final - 16 WAP)



***P*$_i$**
P value = 0.580
SED = 7.77
cv% = 27.5

***P*$_b$**
P value = 0.036
SED = 5.52
cv% = 24.1

***P*$_f$**
P value < 0.001
SED = 5.04
cv% = 29.9

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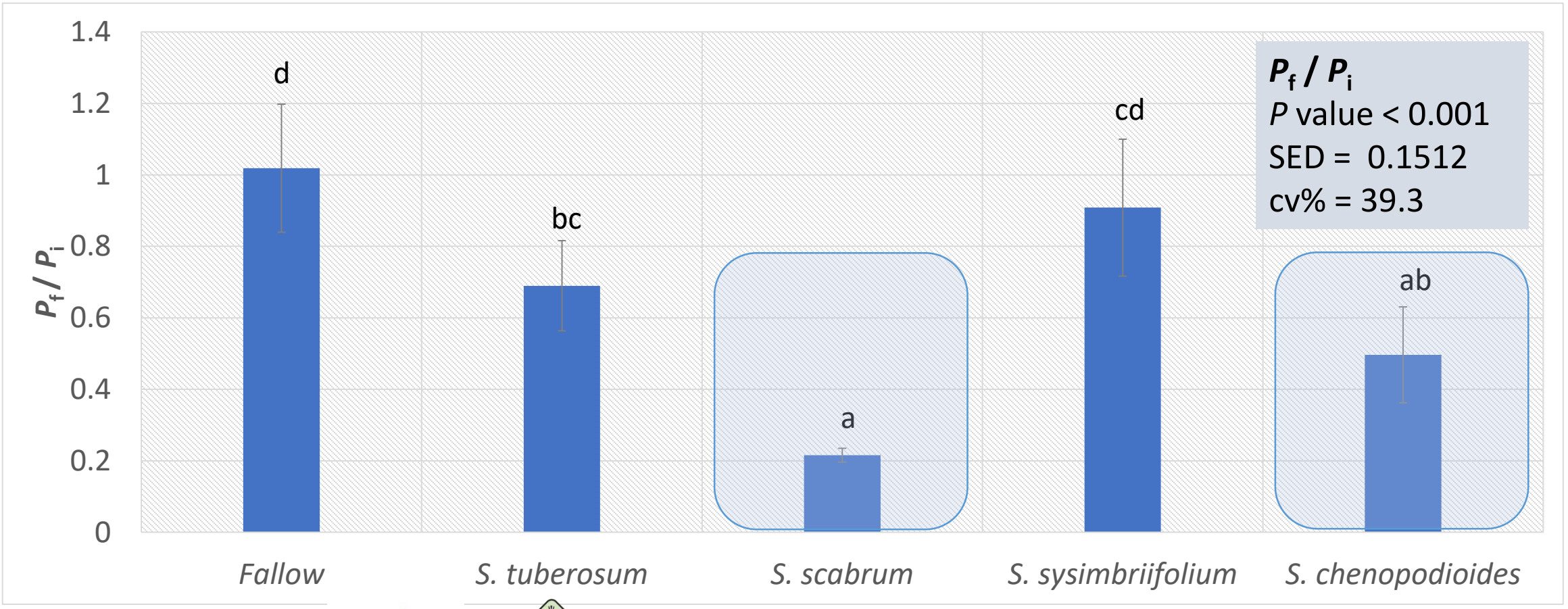
Glasshouse experiment 2: *G. pallida* multiplication rate (P_f / P_i)



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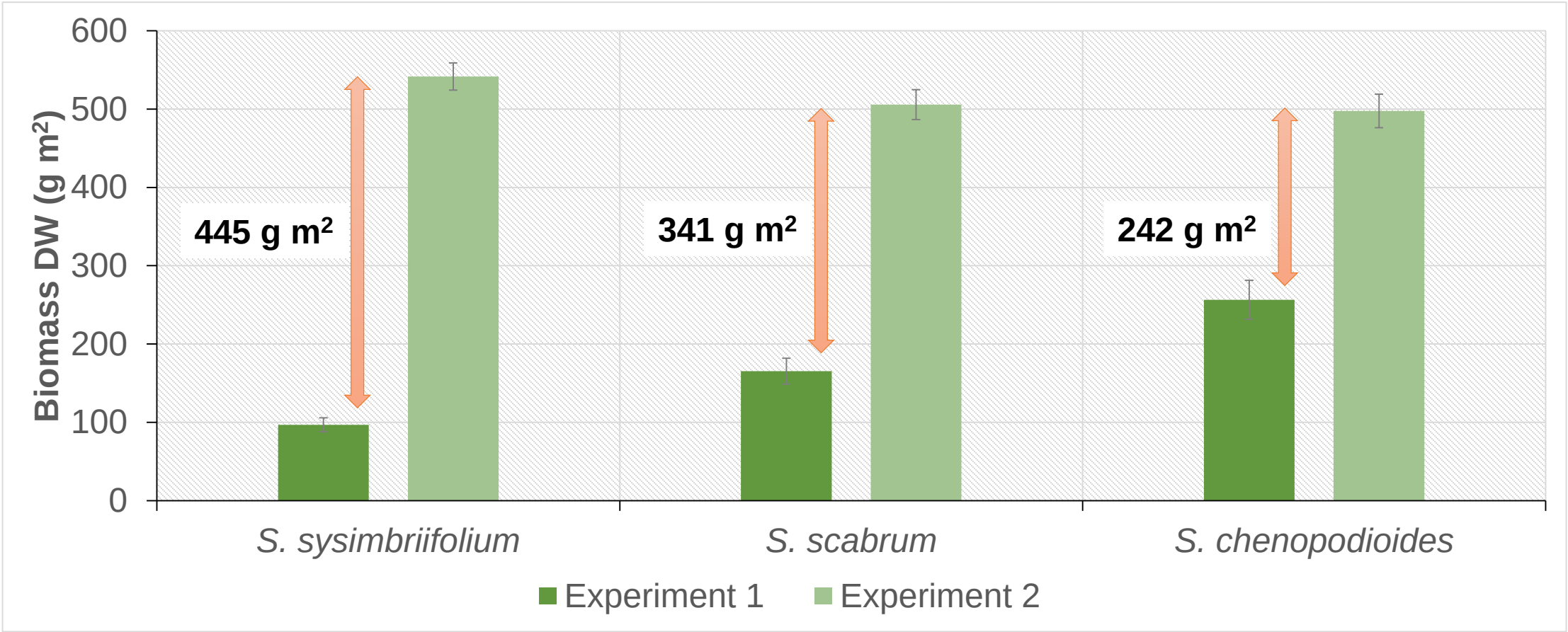
Glasshouse experiments: Plant biomass DW g m^2



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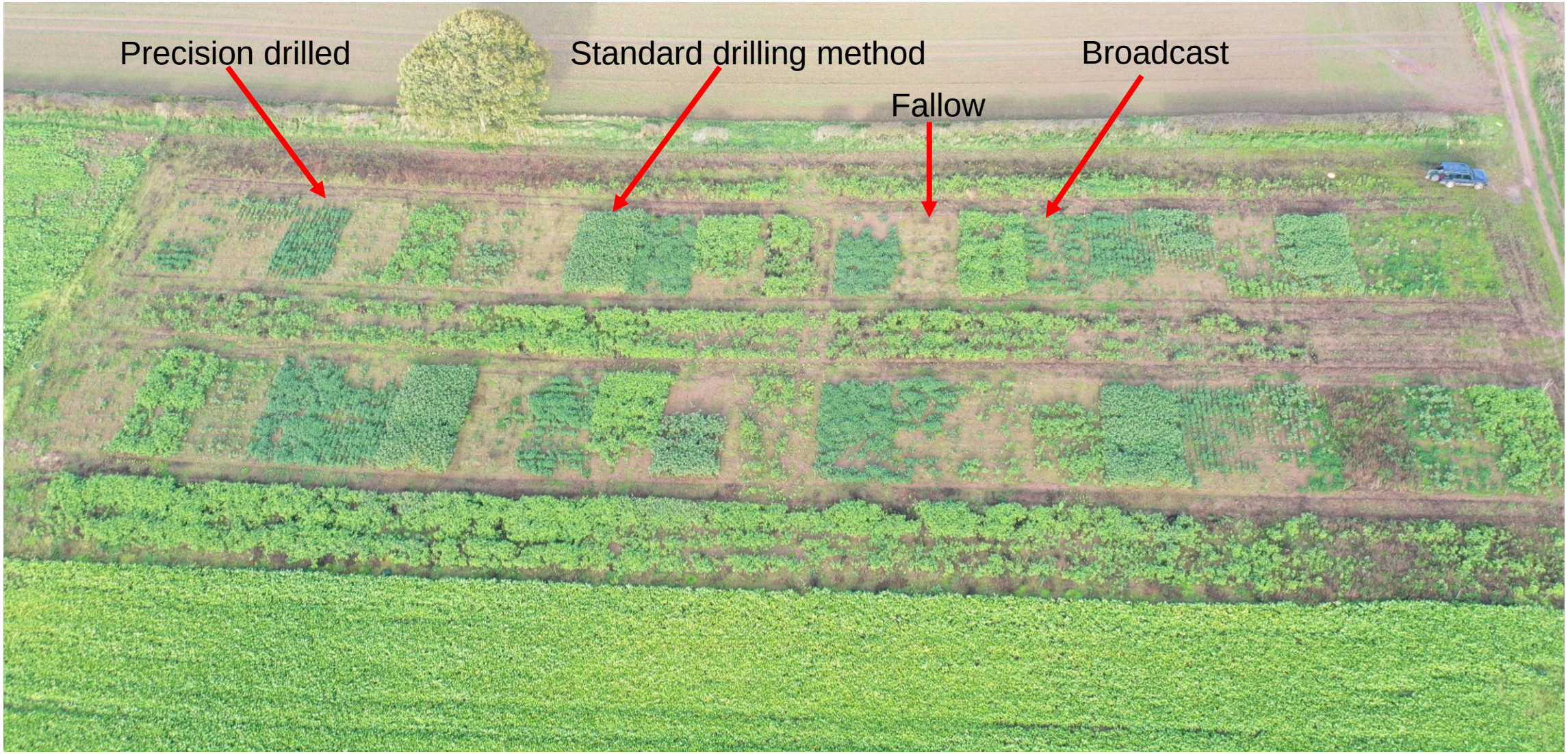
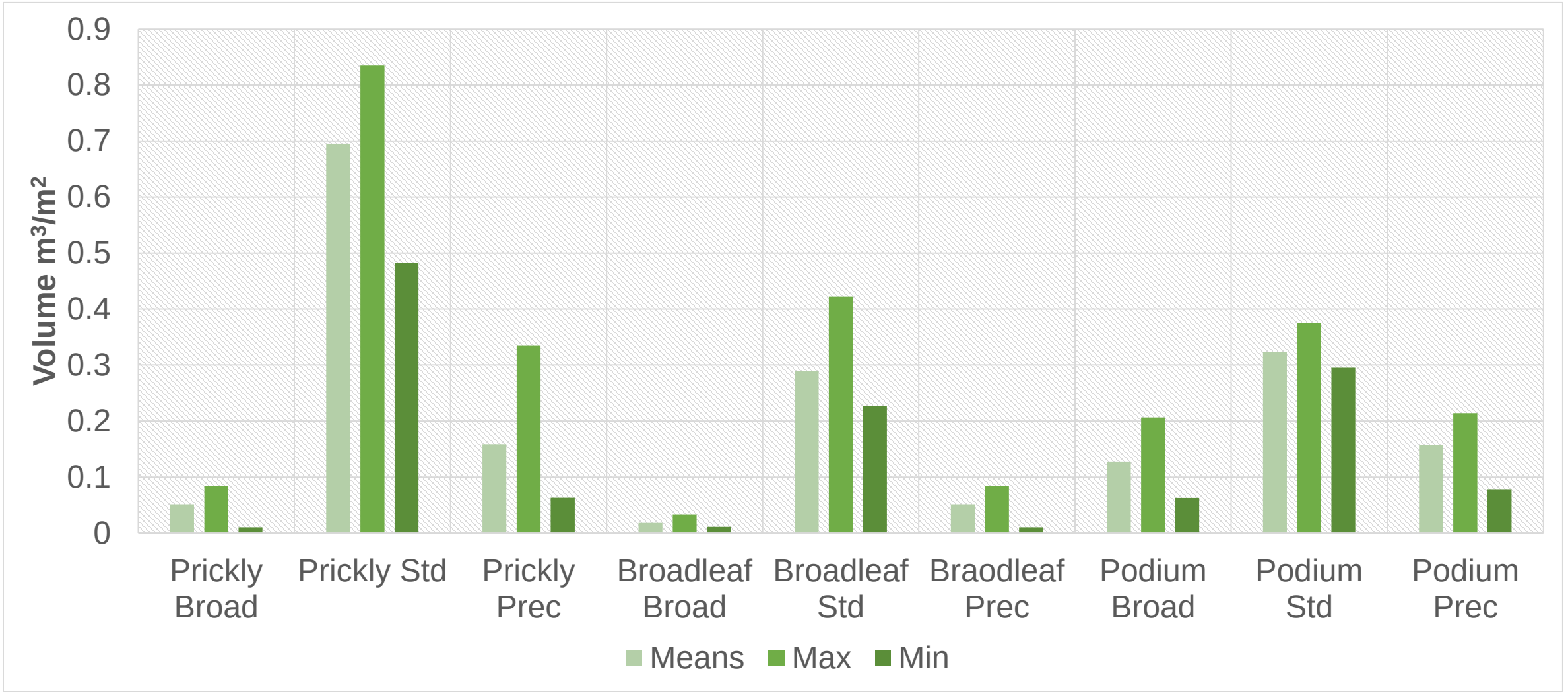
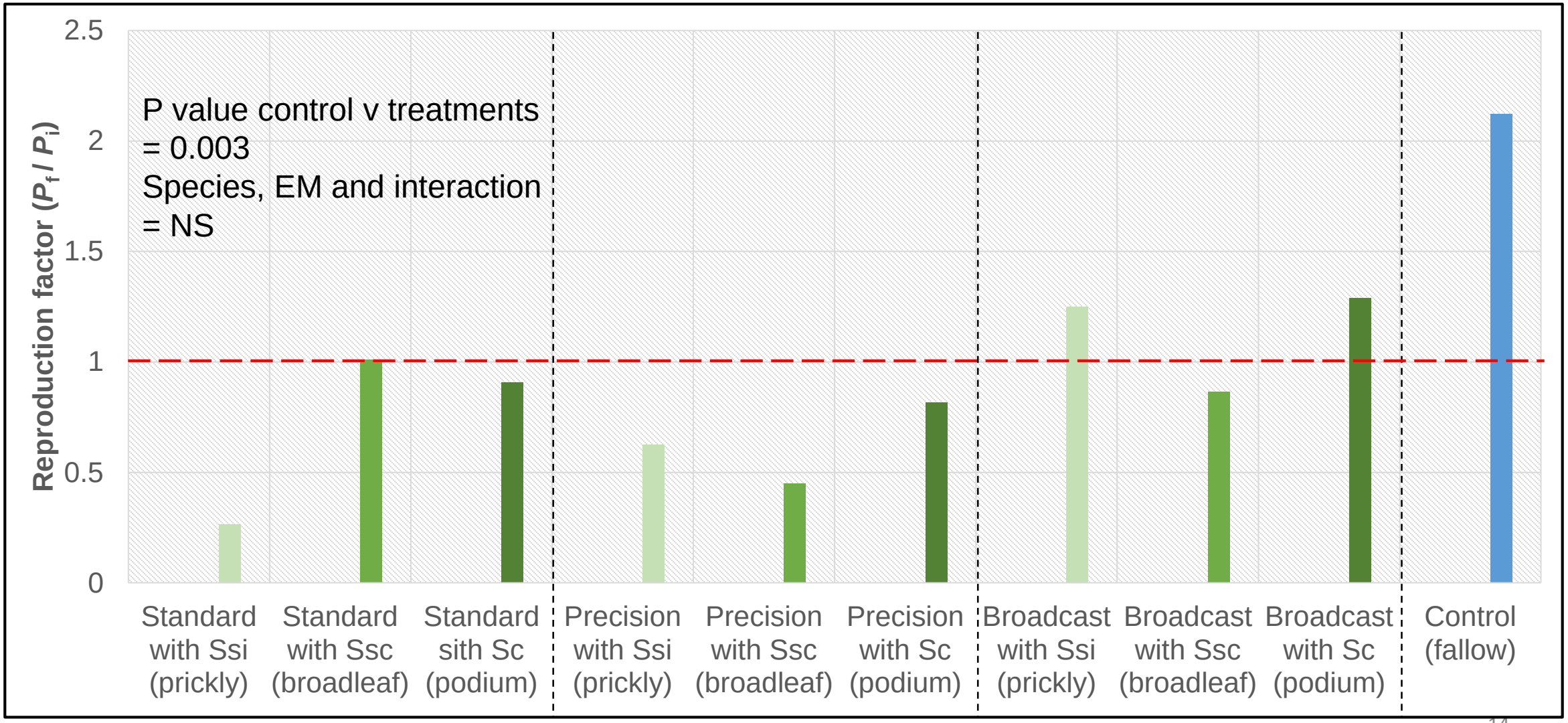
Field experiment: Effect of establishment method on the development of solanaceous trap crops



Field experiment: Effect of establishment method on the development of solanaceous trap crops – crop volume



Field experiment: Effect of establishment method and solanaceous trap crop on PCN reproduction factor (P_f / P_i)



Concluding remarks

i. Glasshouse results variable – biomass differences (temperature/radiation)

ii. GH Expt. 2 – Promising efficacy from *S. scabrum* and *S. chenopodioides*

iii. Field experiment – standard and precision drilling give better results

Solanum sisymbriifolium

Solanum scabrum

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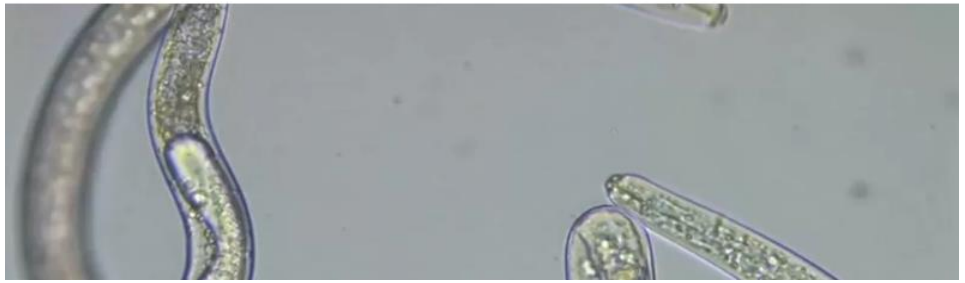
Prickly plant may be able to beat crop pest - Shropshire farmers

27 October 2022



Study set to improve potato cyst nematode trap crop success

FW

Acknowledgements

‘DeCyst - Factors affecting trap crop success against PCN’ is funded by UKRI - Innovate UK

Project partners are Produce Solutions, Harper Adams University, CHAP, VCS Potatoes Ltd, JM Bubb & Son, M. E. Furniss & Sons (FARMS), Taylor Organic Farms, James Foskett Farms Limited and Attlefield Farm Machinery. Curious Raven (Ivan Grove) is contracted on the project to provide aerial imagery and assistance with crop monitoring and data analysis

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