Annual results day

Strategic Potato Farm West

Heal Farms

POTATOES

Welcome and introduction

Richard Laverick, AHDB / Matthew Wallace, Heal Farms

Spot Results Day

A review of potato cyst nematode management in Great Britain

Dr Matthew Back, Harper Adams University

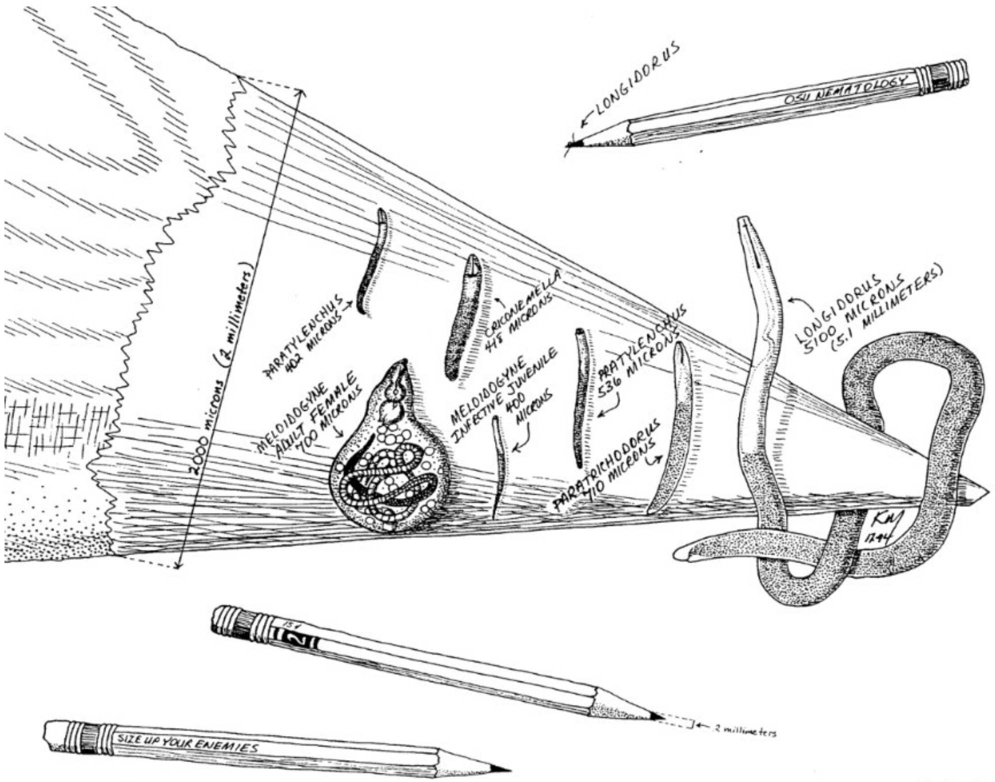
Outline

- Nematology Group at HAU
- Introduction: PCN
- Integrated management of PCN
- Nematicides
- Trap crops
- Biofumigation
- Variety choice
- Summary

Nematology Group at Harper Adams University

- Main research interests include potato cyst nematodes, root lesion nematodes and *Ditylenchus* spp.
- Biology (E.g. virulence, decline, interactions with fungi) and distribution
- Diagnostics
- Pest management strategies

Plant parasitic nematodes (PPN)



Kathy Merrifield

Circa **27,000 nematode species described** – range of feeding habits

Global losses attributed to PPNs is **ca. £58 BN per annum**

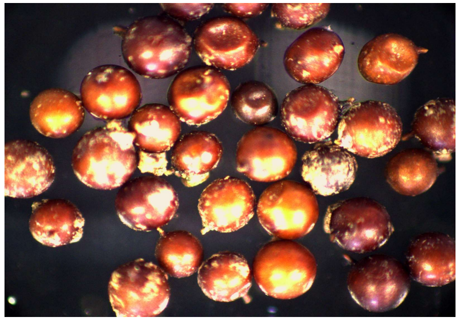
1 acre of soil from arable land contains **ca. 3 x10^9 nematodes**

Sandy soils (60% + sand) have higher numbers of PPN

Potato cyst nematodes

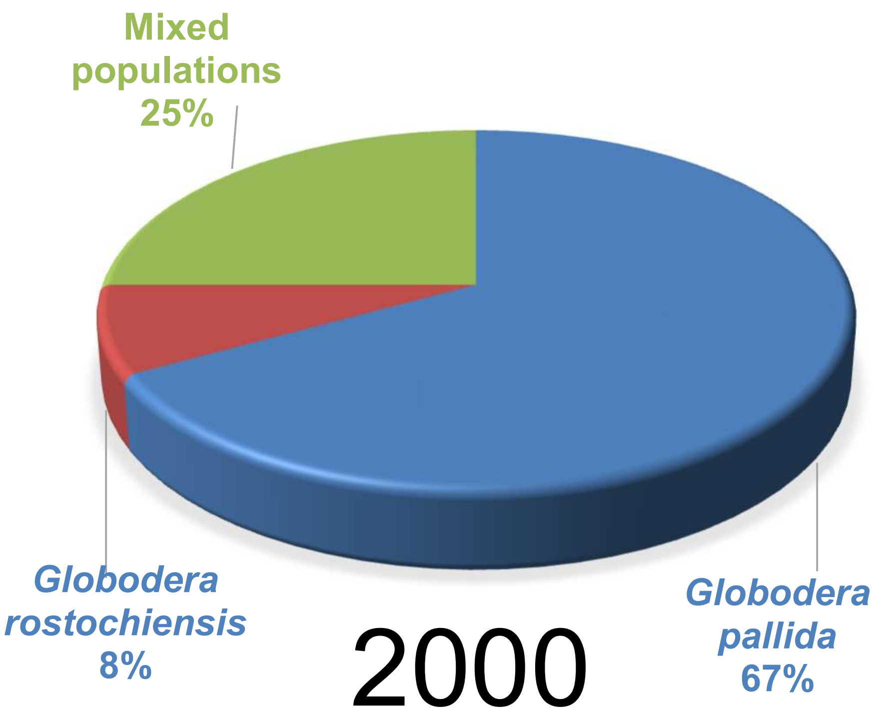
9% Annual global yield loss

Crop damage equates to £26-50M each year



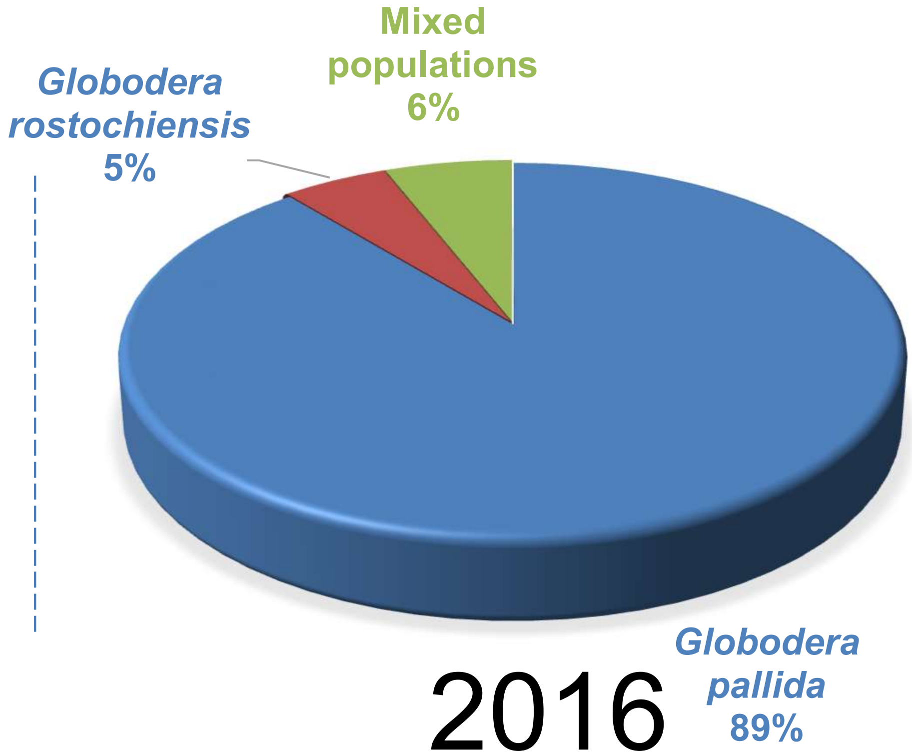
High cost of chemical control - c. £350 ha for granular nematicide

Potato cyst nematodes



2000

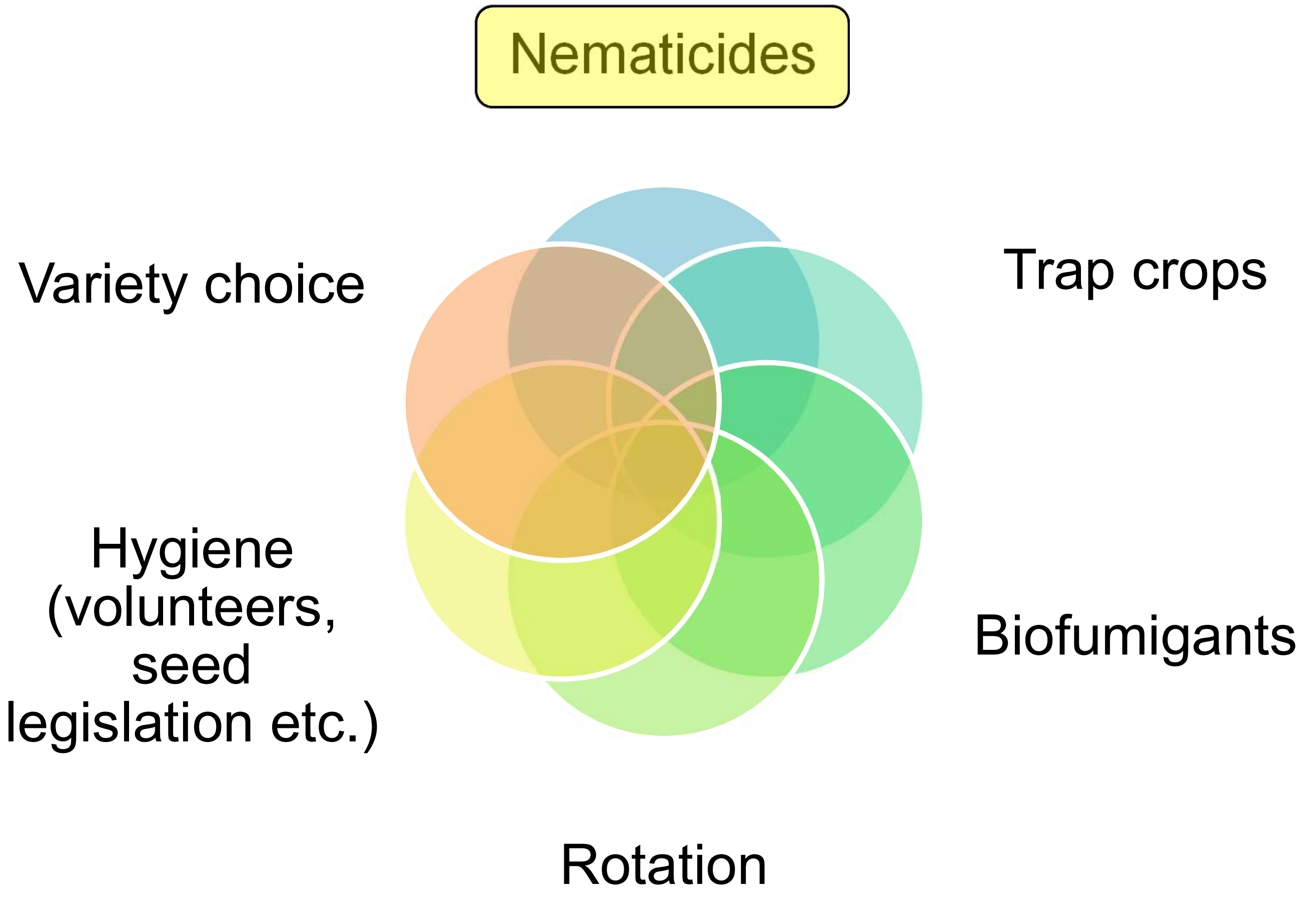
Source: Minnis *et al*., 2002



2016

Source: Dybal *et al*., Unpublished

PCN: Management



Important to know species ratio and population density

Nematicides

Limited options, but new products in the pipeline E.g. fluopyram

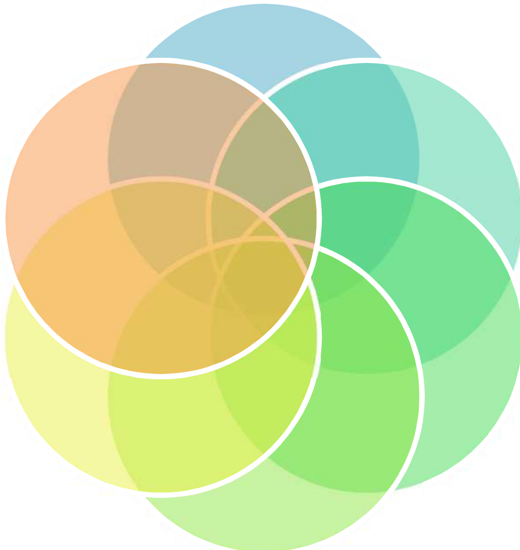
Great Britain is still under European pesticide legislation
– EC No. 1107/2009

Preservation of nematicides via Nematicide Stewardship Programme

Status of UK Nematicides

Product	a.i.	Nematode targets	Expiry date
Vydate 10G	Oxamyl (oxime carbamate)	PCN FLN (TRV vectors)	31/12/2018
Nemathorin 10G	Fosthiazate (organo – phosphate)	PCN FLN (TRV vectors)	30/04/2021
Mocap 15G	Ethoprophos (organo – phosphate)	PCN (useful reduction)	31/12/2018
Basamid	Dazomet	PCN	31/12/2021
Metam 510	Metam sodium	PCN	31/12/2021

PCN: Management



Trap cropping

UK: mainly *Solanum sisymbriifolium* (Foil-sis and DeCyst)

Main objectives

1. Maximise root length density
2. Maximise duration of cropping to encourage greater hatching of PCN

AHDB project on trap cropping completed by ADAS

1. *Solanum sisymbriifolium* less effective than seen previously
2. *Solanum nigrum* was the most effective species but agronomically challenging
3. *Solanum melanocerasum* appears to have potential

Trap crops

Solanum sisymbriifolium

Solanum melanocerasum

Solanum nigrum

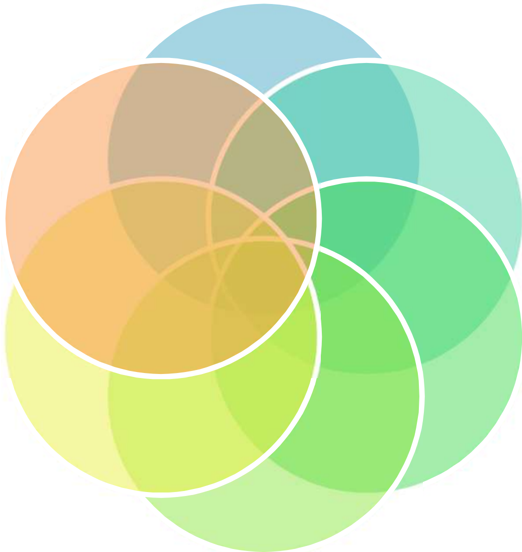
Trap crops – cont.

PCN: Management

Nematicides

Variety choice

Trap crops

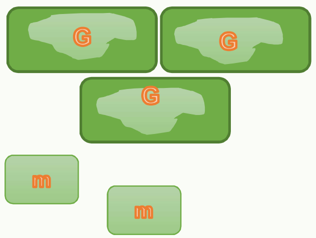


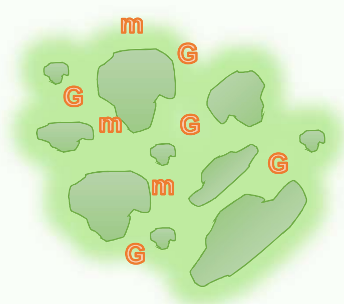
Hygiene (volunteers, seed legislation etc.)

Biofumigants

Rotation

Biofumigation





Isothiocyanates

Thiocyanates

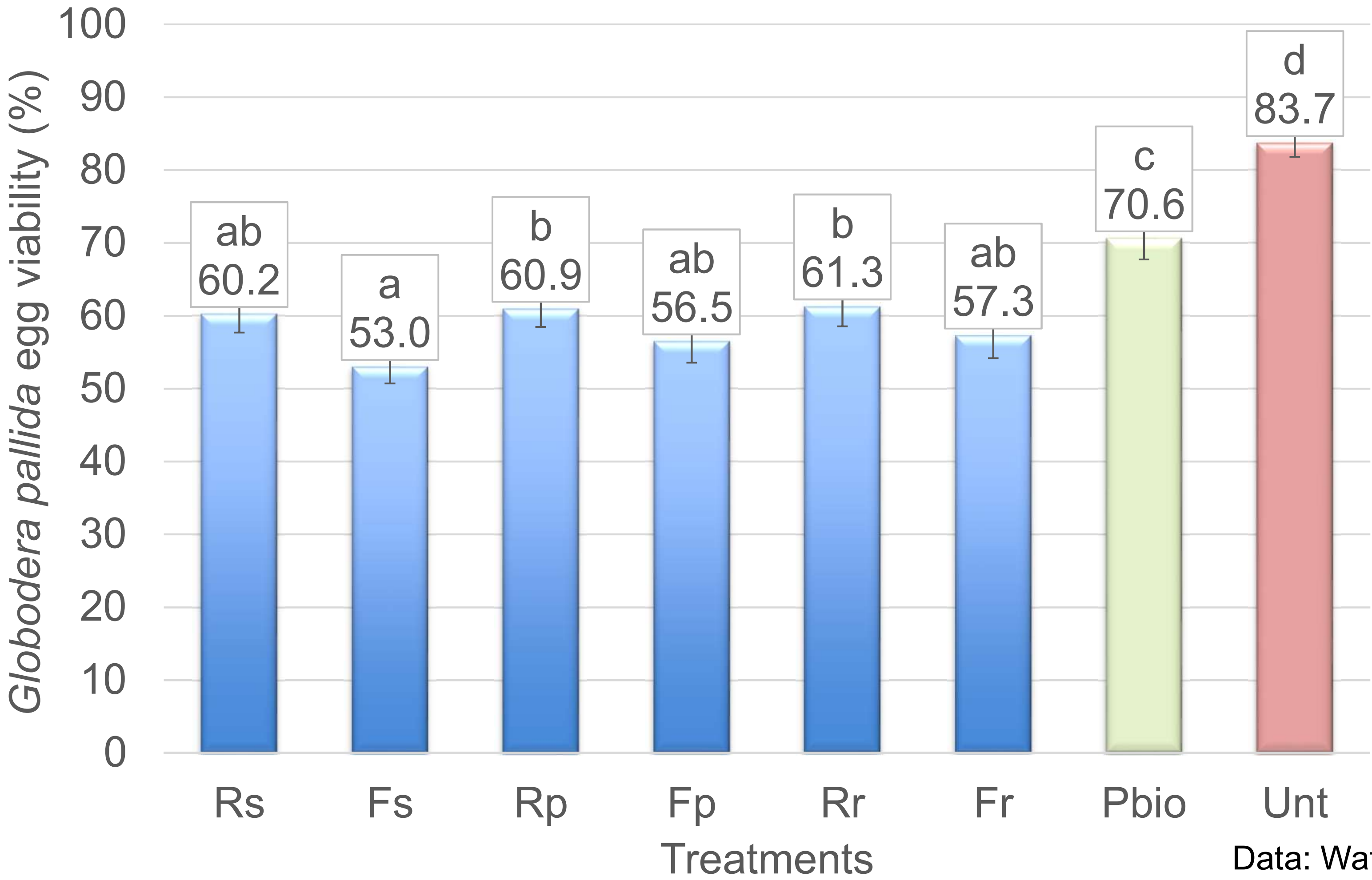
Nitriles

Intact brassica tissue:
Glucosinolates (G) and myrosinase (m) separated by plant cells

Damaged brassica tissue:
Glucosinolates and myrosinase interact in the presence of water

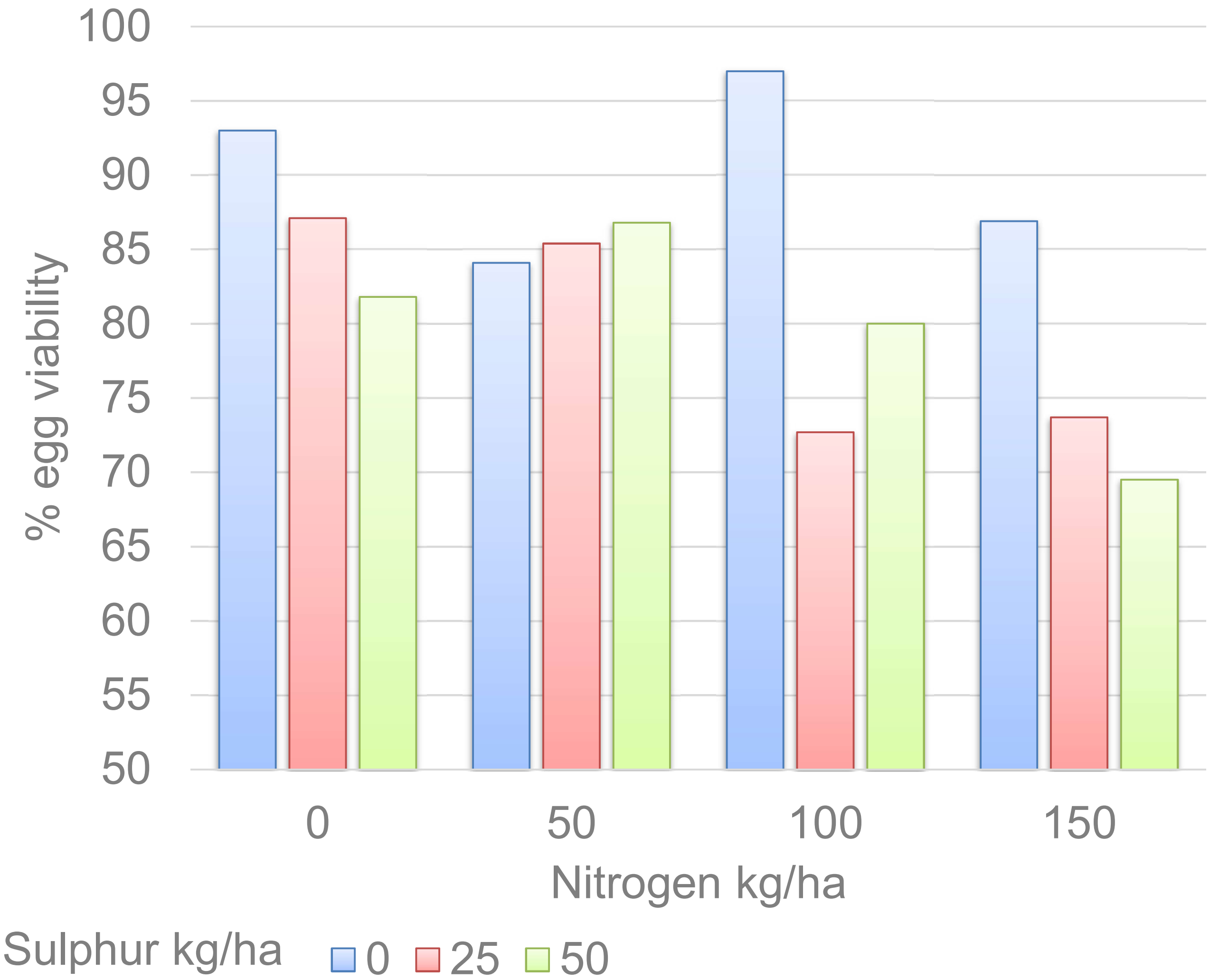
Products of hydrolysis:
Glucosinolates are hydrolysed to release an array of volatile, biocidal compounds

Biofumigation: maceration and incorporation



Data: Watts, unpublished

Biofumigation: N and S



Data transformed with Arcsin before analysis, 47d.f

Nitrogen:	P=0.011	SED = 2.333
Sulphur:	P<0.001	SED = 2.020
N*S:	P=0.004	SED = 4.041

%cv = 8.5

Data: AHDB project R476

Biofumigation: key points

Choice of variety/species: Indian mustard and oilseed radish have performed well in HAU experiments

Planting: Ideally May-August

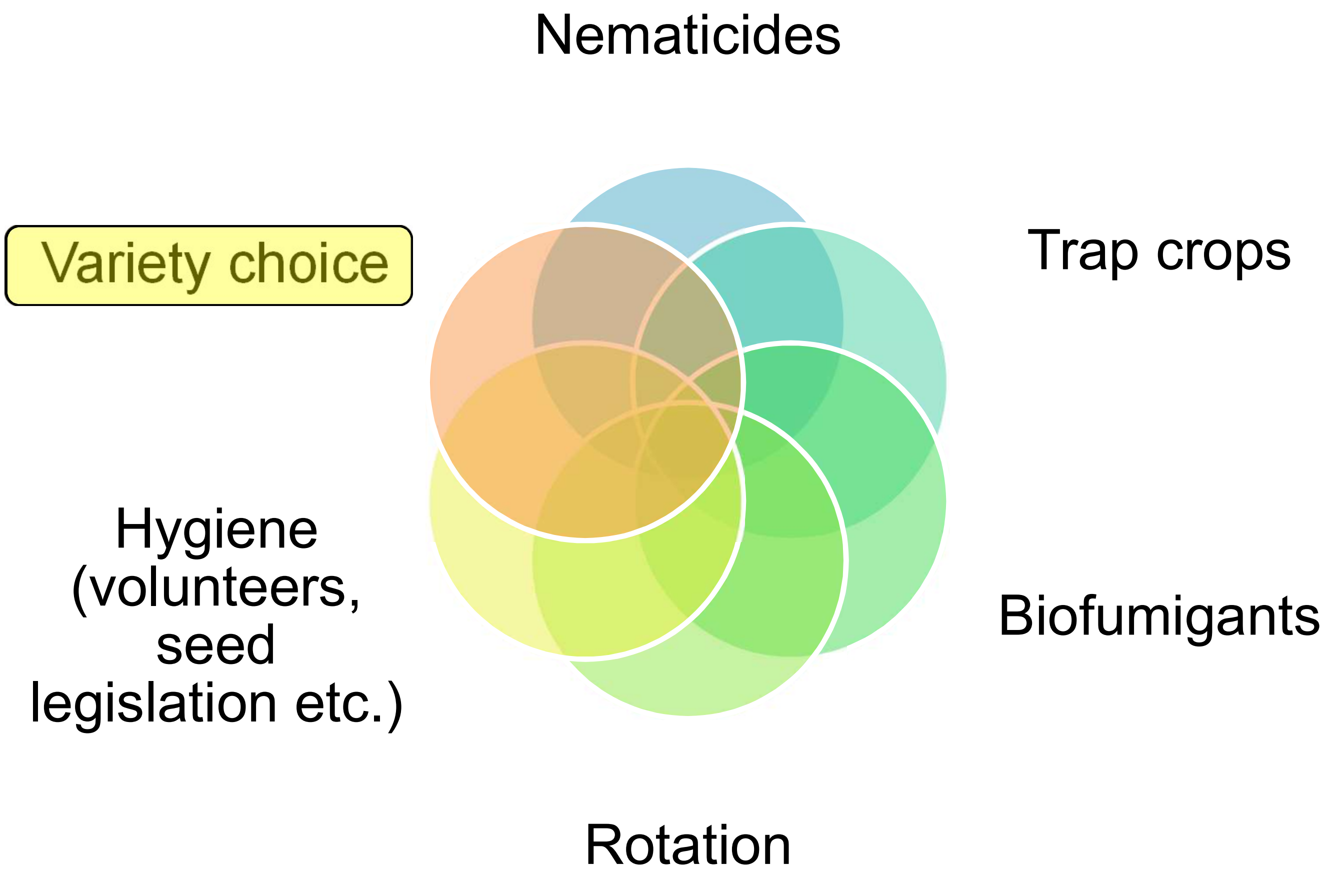
Nutrition: >50 kg/ha of N and 25-50 kg/ha S

Partial biofumigation: Observed with Indian mustard and oilseed radish

Biomass: Ideally between 6-10 t DM ha

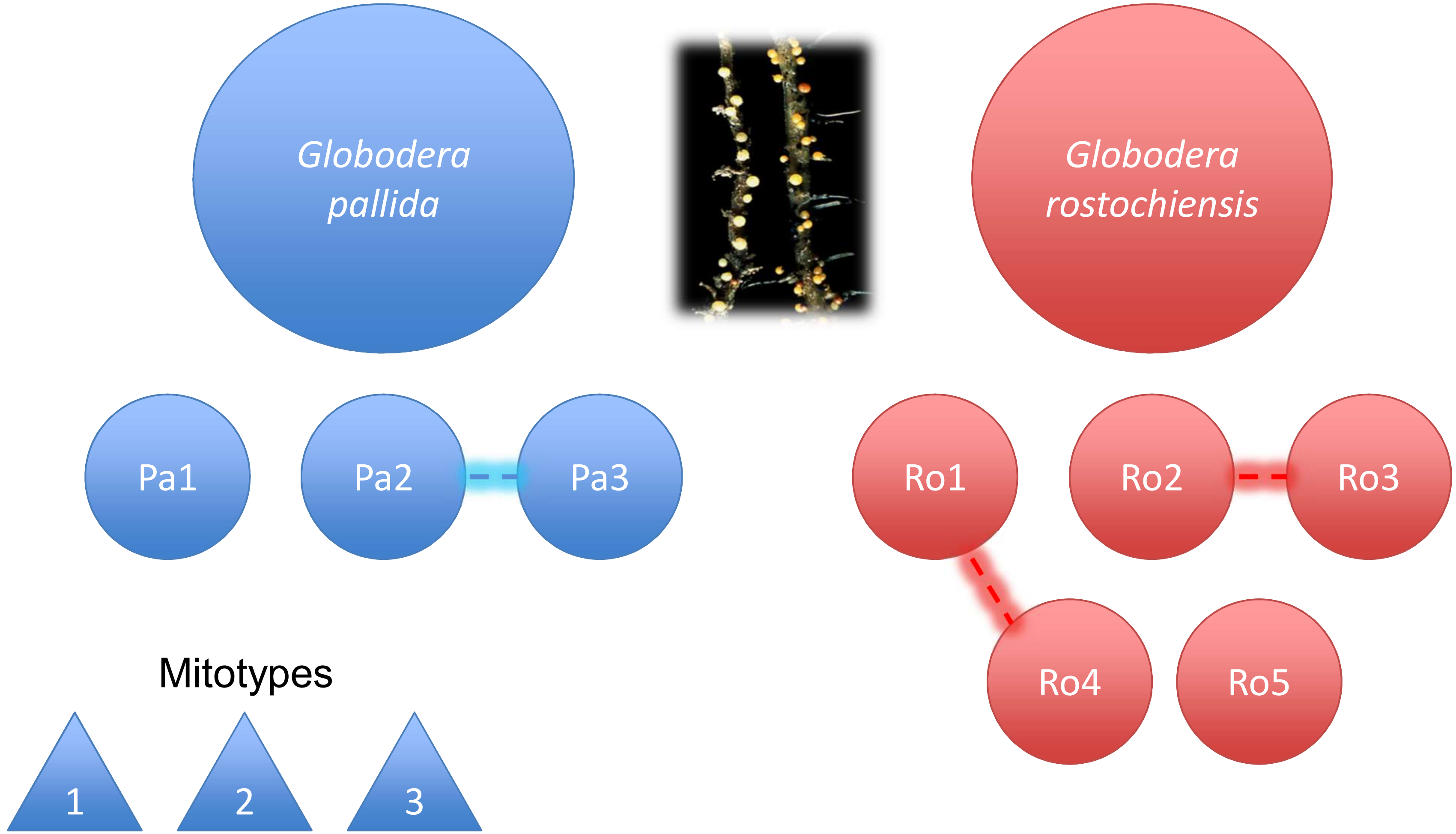
Crop destruction: At green bud/early flowering, flail/rotovate/roll to seal (one pass), in moist soil (c. 10-12°C)

PCN: Management



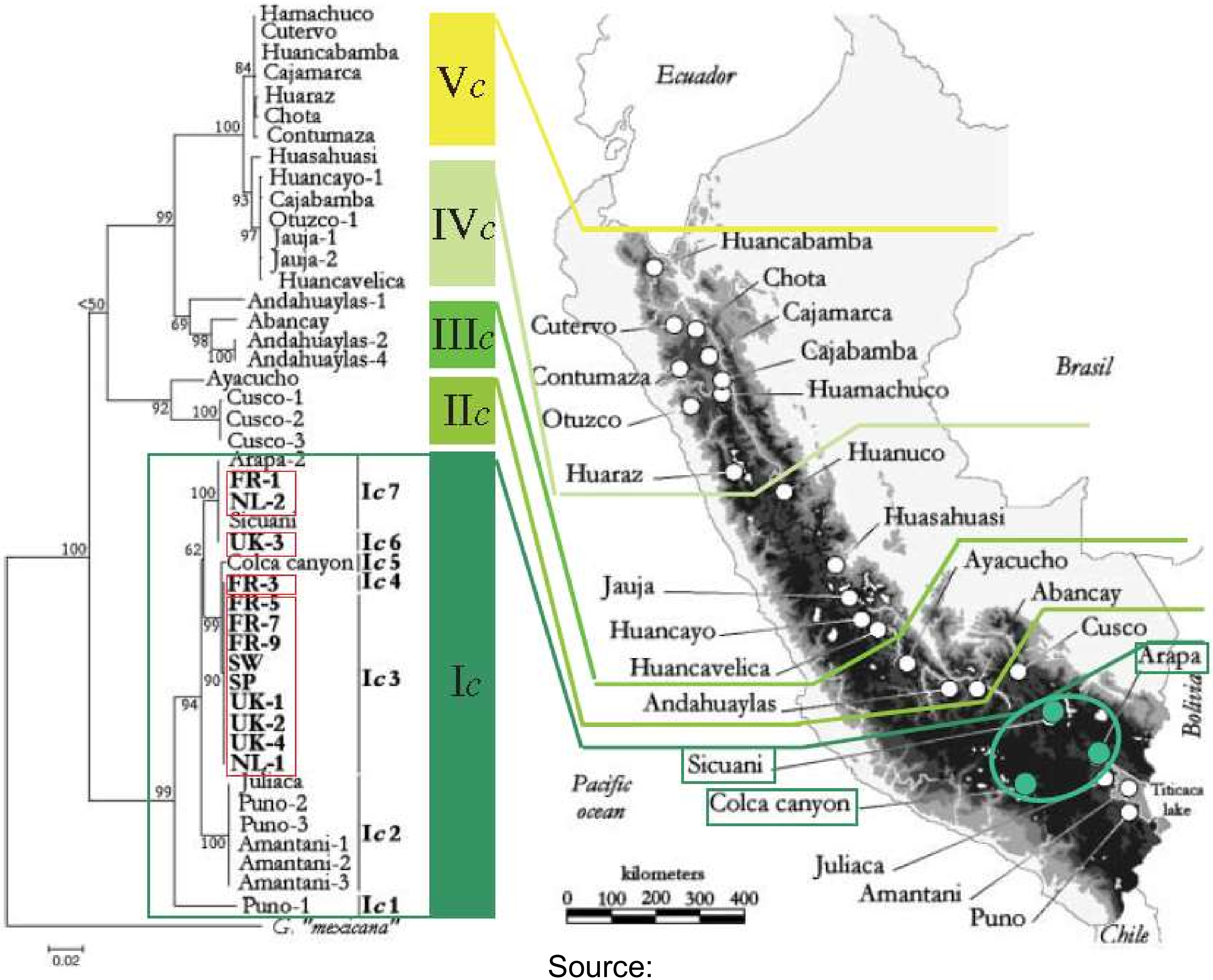
Variety choice

Image: Peter Blaylock, E. Park & Sons



Sources of resistance genes
Solanum vernei, S. spegazzinii
S. tuberosum ssp. *andigena*
Solanum multidissectum (*H2* gene)

Source of resistance genes
Solanum tuberosum ssp. *andigena*
(*H1* gene)



Source:
Plantard *et al*. (2008)

Potato Variety	Resistance status against *G. pallida* Pa2/3,1 (rating)	Resistance status against *G. rostochiensis* (Ro1)(rating)	Tolerance status	End market
Alcander	Resistant	Resistant	-	Fries/chips
Arieta	7	9	-	Fries/chips
Arsenal	8-9	8-9	Moderately intolerant	Fries/chips
Crisps4all	6	9	-	Crisping
Camel	9	9	Tolerant	Pre-pack
Eurostar	8-9	8-9	Moderately intolerant	Fries/chips
Harmony	4	4	-	Ware)
Innovator	8-9	(not resistant)	Intolerant	Fries/chips
Lady Anna	9	9	-	Fries/chips
Panther	8	2	Intolerant	Ware
Performa	8-9	4-6?	Tolerant	Fries/chips
Maritiema	5	8	-	Ware/fries
Ramos	4	8	-	Fries/chips
Royal	3	9	Tolerant	Fries/chips
Rock	9	9	-	Fries & table
Vales Everest	6	4	Tolerant	Processing (chips)

Based on data from the AHDB Potatoes - Potato Variety Database, AHDB report R264 and AHDB SPot East 2016

Summary

- Limited nematicide options but new a.i available in the future
- Trap crops also require careful management – **further research required to follow up on the work by ADAS**
- Biofumigants can be effective if used appropriately – **species, cultivar, crop management and incorporation**
- Varietal resistance improving but more options needed for the fresh market.
- The interaction between mitotypes and resistant genes needs to be understood
- SARIC project to improve the PCN calculator

Acknowledgements

Nematology team at HAU

Collaborators: Andy Barker (Barworth Agriculture), Andy Evans (SRUC)
Professor Urwin (University of Leeds)

Sponsorship: AHDB Potatoes, Frontier Agriculture, Agrovista, BBSRC/NERC

CERC: Rosie Homer, Grace Smith, Katarzyna Dybal

Local growers

Seed suppliers: Alec Roberts (Tozers seeds)

SPot West Results Day

Resistance and tolerance trial

Anne Stone AHDB

Topics in 2017

AHDB

- Tolerance and Resistance
- New Bayer nematicide
- Mycorrhizal inoculation
- Trap Crops

Tolerance and resistance
Site and trial design

- Designed for statistical analysis with 4 replicates
- PCN sampling 30 cores pre planting and post harvest using a 20cm hand corer
- PCN eggs/g and cysts – 1kg samples analysed by Fera
- 30 kg/ha Nemathorin 10G (fosthiazate 10%) - applied on bedformer/tiller as standard on this farm
- Plots hand planted at 30cm spacing
- All treatments as the field crop including drip irrigation

Plot Layout

AHDB

	untreated		fluopyram		Nemathorin + fluopyram		Vydate + fluopyram		8m
2m									
	S. sisymbriifolium		rye grass	*S. nigrum*	'Azo'		'KBL'		3m
2m									
	untreated		mycorrhizae		Nemathorin		mycorrhizal + nemathorin		5m
2m									
4.8m	Performa	Performa	Innovator	Innovator	Alacander	Alacander	Royal	Royal	
2m									
4.8m	Piper	Piper	Eurostar	Eurostar	Peer	Peer	Arsenal	Arsenal	
2m									
4.8m	Alacander	Alacander	Peer	Peer	Arsenal	Arsenal	Royal	Royal	
2m									
4.8m	Innovator	Innovator	Piper	Piper	Performa	Performa	Eurostar	Eurostar	
2m									
4.8m	Peer	Peer	Arsenal	Arsenal	Alacander	Alacander	Piper	Piper	
2m									
4.8m	Performa	Performa	Royal	Royal	Eurostar	Eurostar	Innovator	Innovator	
2m									
4.8m	Piper	Piper	Arsenal	Arsenal	Peer	Peer	Royal	Royal	
2m									
4.8m	Performa	Performa	Innovator	Innovator	Alacander	Alacander	Eurostar	Eurostar	

PCN egg counts at planting

79	63	65	73
99	*113*	69	87
88	83	91	84

144	114	114	114	107	76	52	78
123	99	73	97	120	71	58	62
88	97	95	139	93	111	114	97
131	98	104	103	104	79	143	92
129	116	66	117	145	123	109	104
140	124	91	113	122	138	128	125
143	91	124	129	120	102	147	79
129	110	128	125	89	135	119	98

Initial cultivation

AHDB

Nematicide application on bed tiller

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Destoning, after incorporation

AHDB

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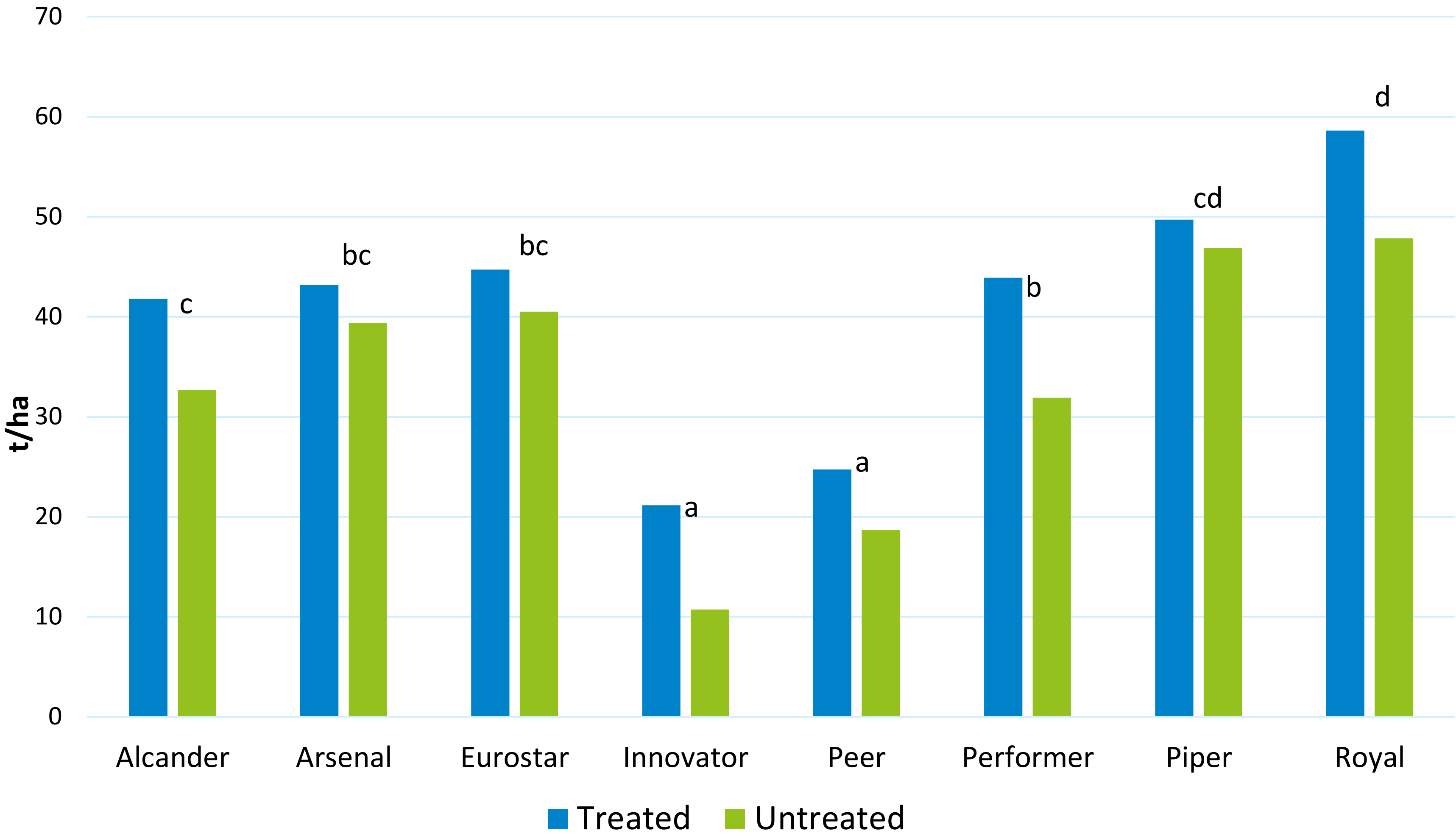
Hand planting of trial

Weeding volunteers

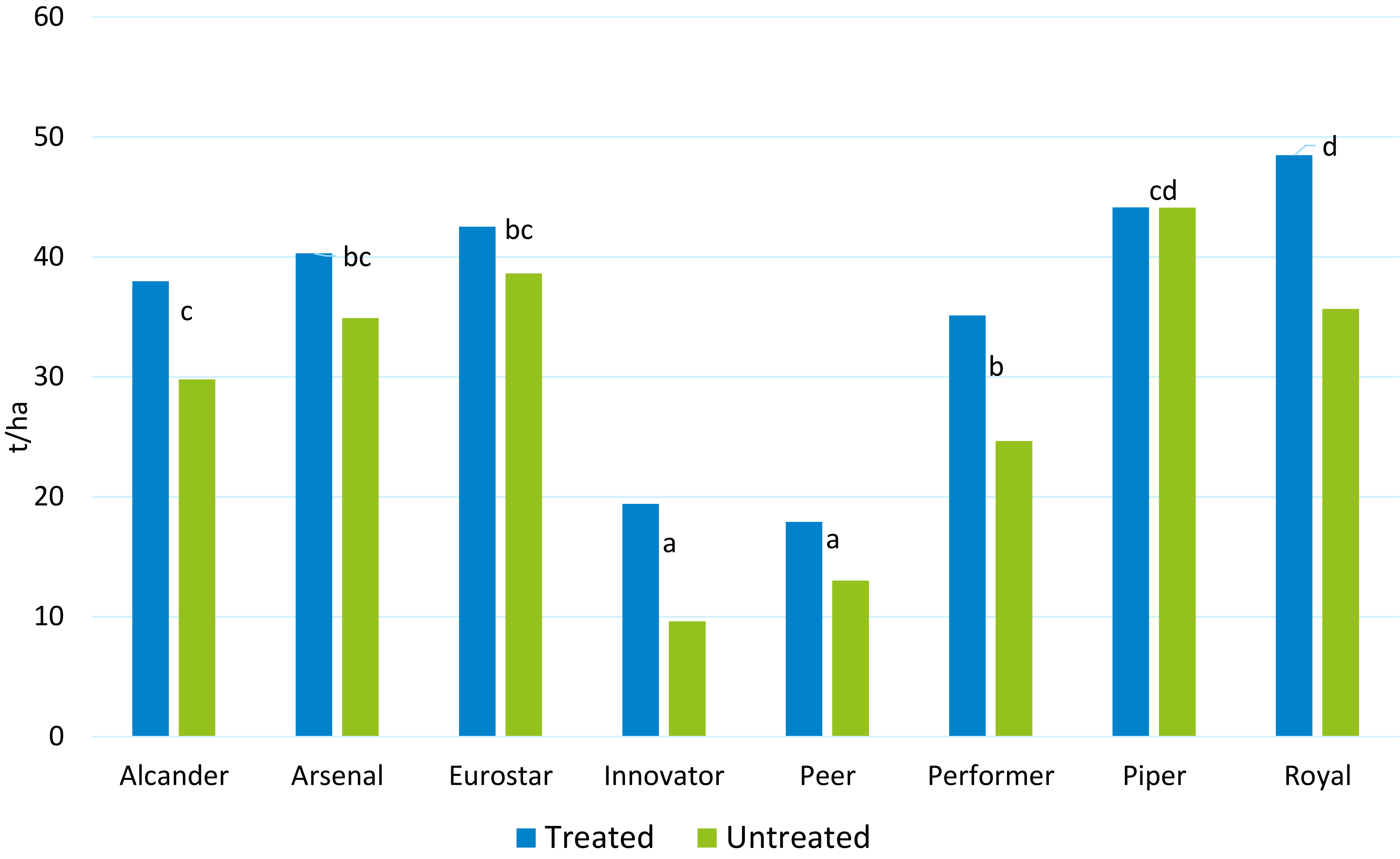
Tolerance varied between varieties

Innovator on left
Royal on right
No nematicide

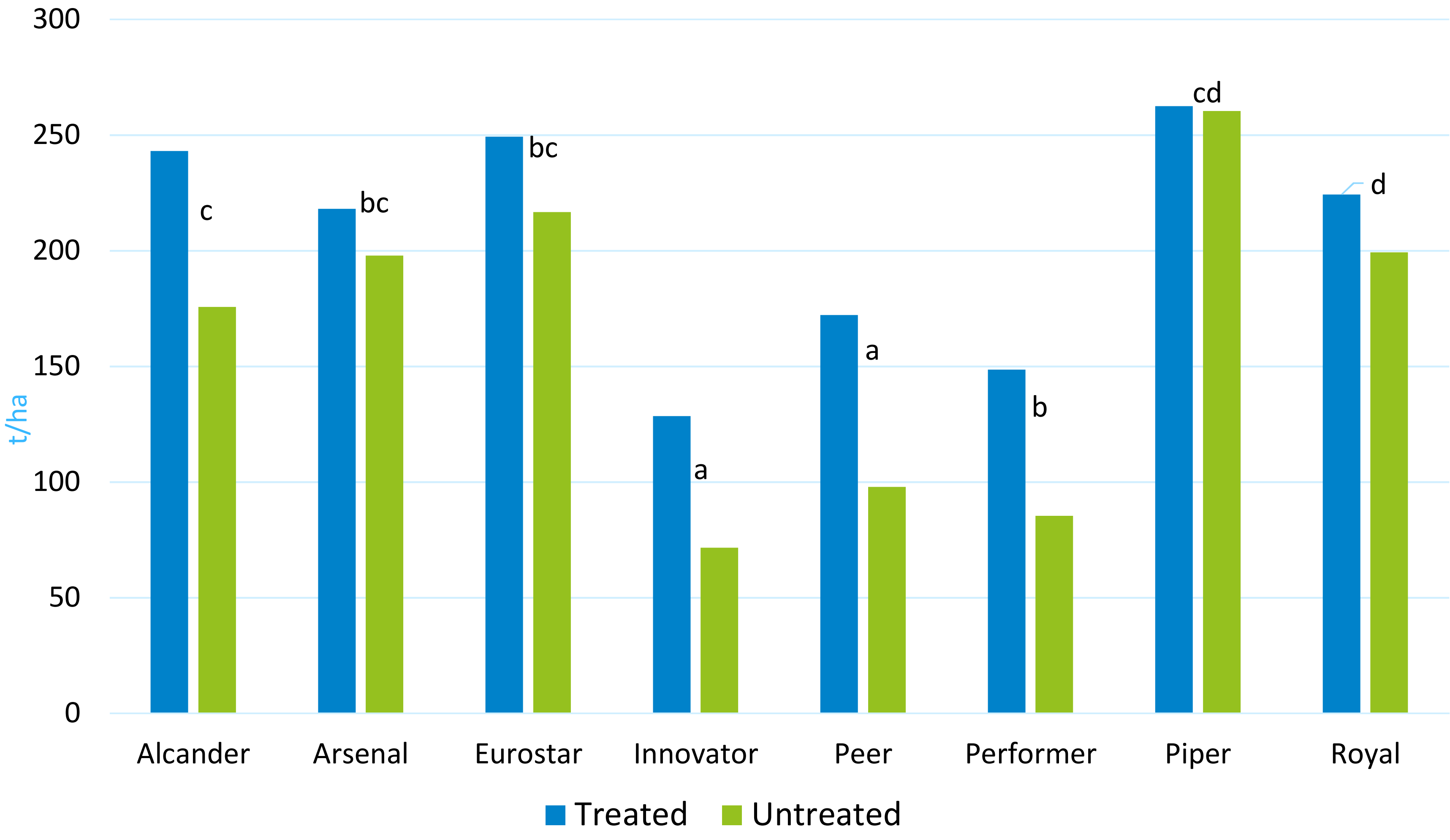
Effect on total yield of nematicide and variety



Effect on yield 45-85mm of nematicide and variety



Effect on tuber number 45-85mm of nematicide and variety



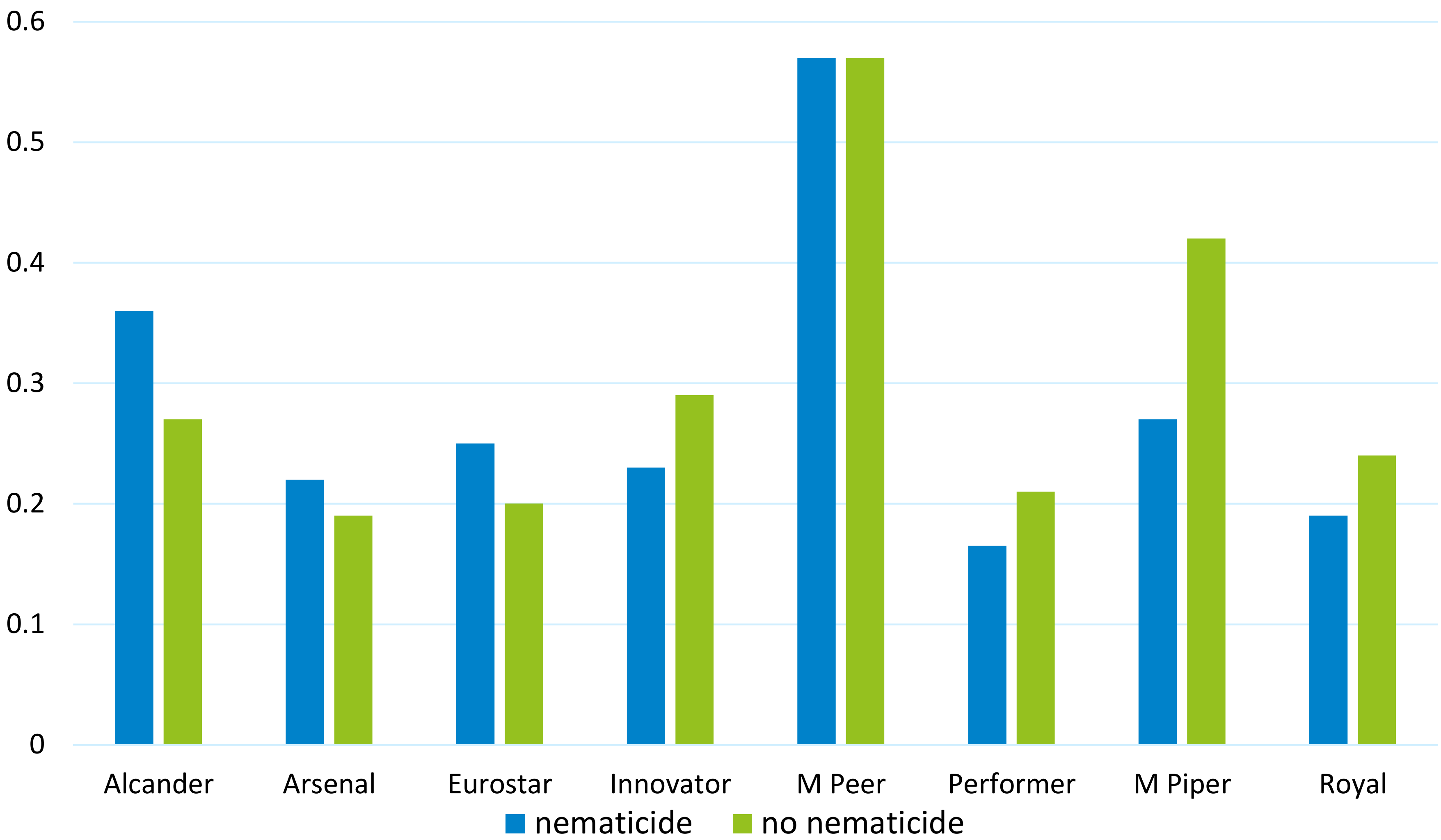
Tolerance scoring

Variety	Yield% decrease without nematicide	Untreated Yield (t/ha)	Mean Score 4 is intolerant 1 is tolerant
Alcander	22	33	**3.5**
Arsenal	9	39	**2**
Eurostar	9	41	**2**
Innovator	49	11	**4**
M. Peer	25	19	**4**
Performer	27	32	**4**
M. Piper	6	47	**1.5**
Royal	18	48	**2.5**

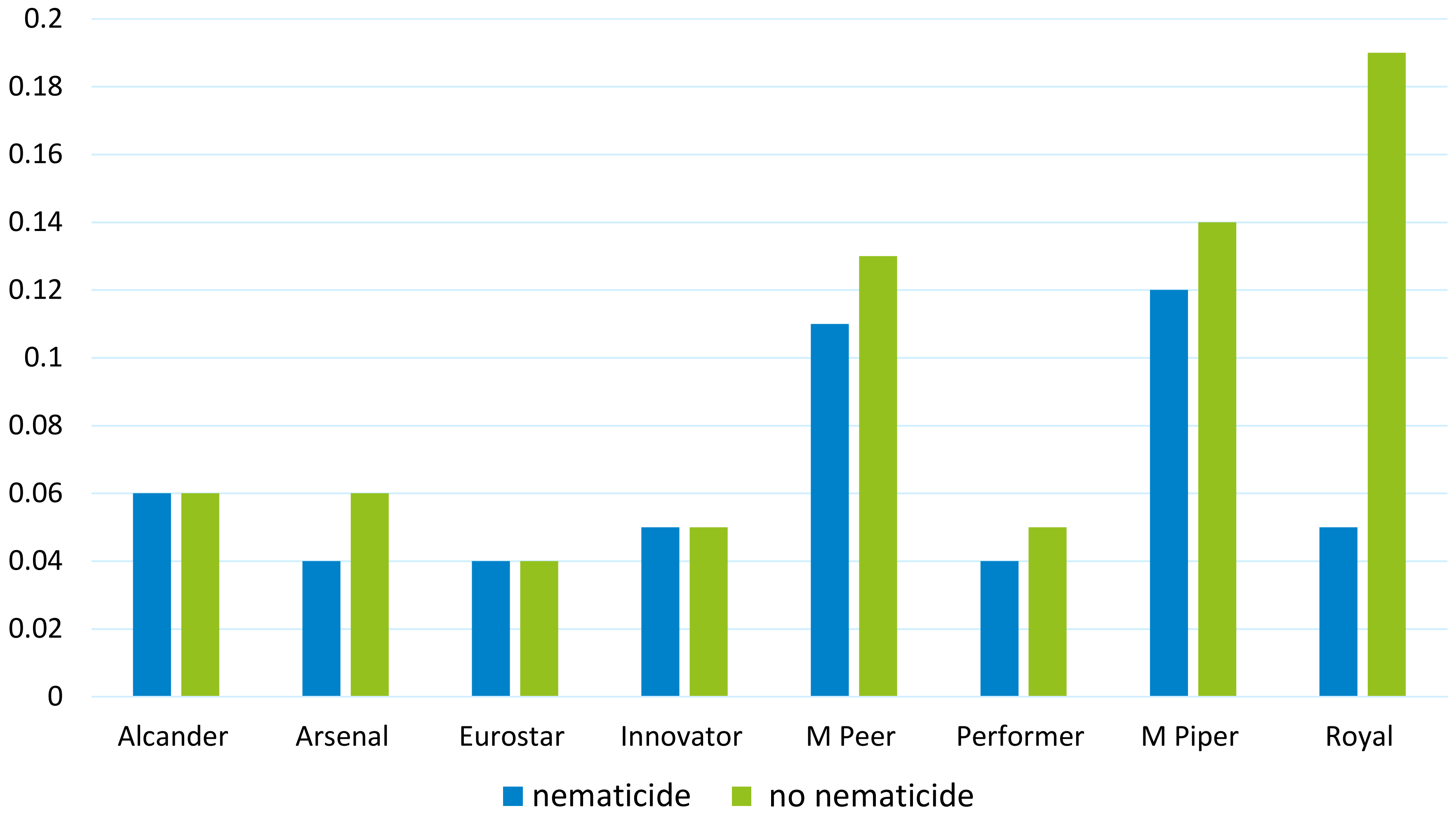
Tolerance is variable

Variety	Tolerance rating Elveden 2016	Tolerance rating Heal 2017
Arsenal	moderately intolerant	moderately tolerant
Eurostar	moderately tolerant	moderately tolerant
Innovator	intolerant	intolerant
M.Peer	moderately intolerant	intolerant
Performer	tolerant	intolerant
M. Piper	tolerant	tolerant
Royal	tolerant	moderately intolerant

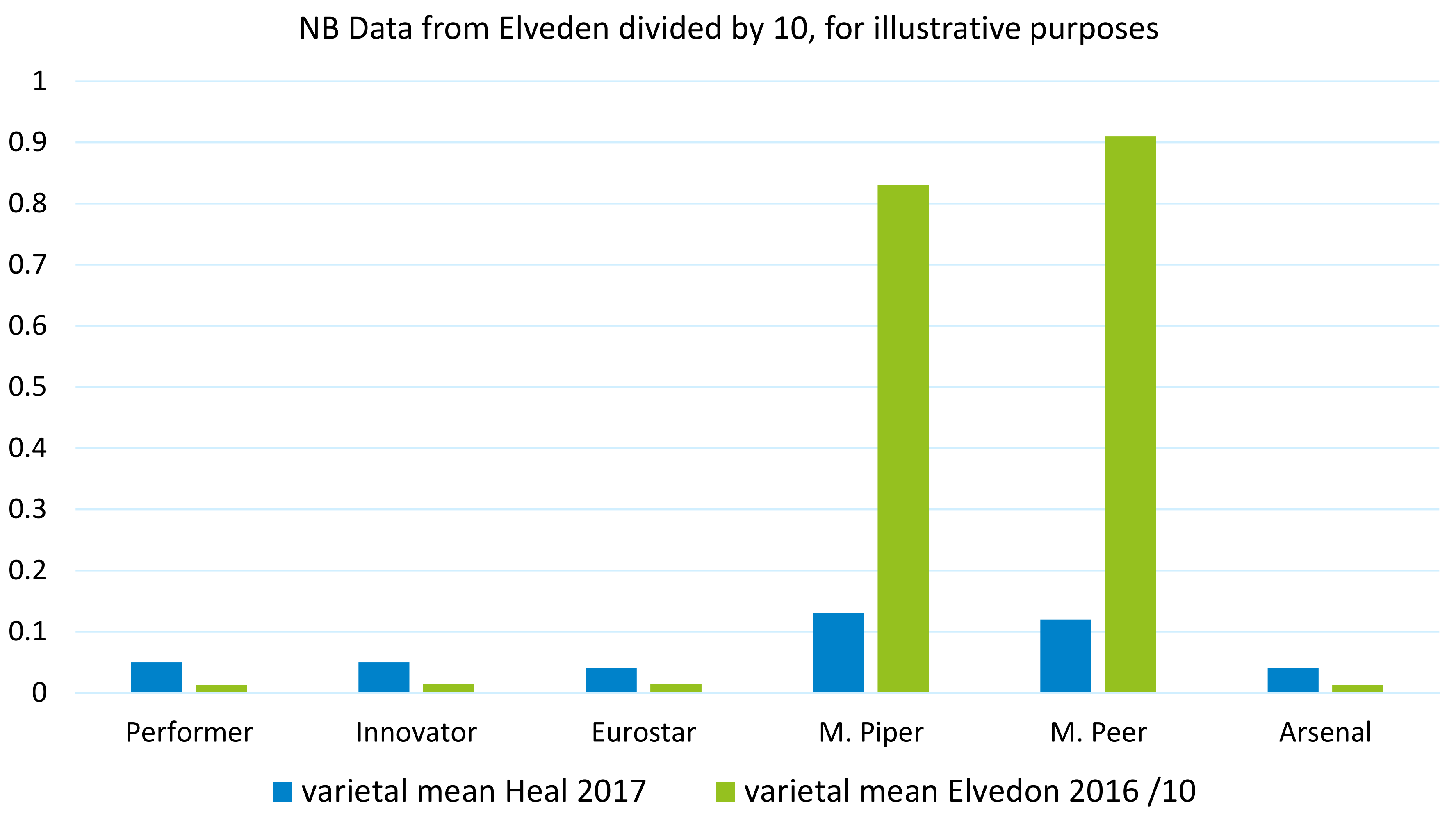
Pf/Pi cysts, effect of variety and nematicide



Pf/Pi eggs, effect of variety and nematicide



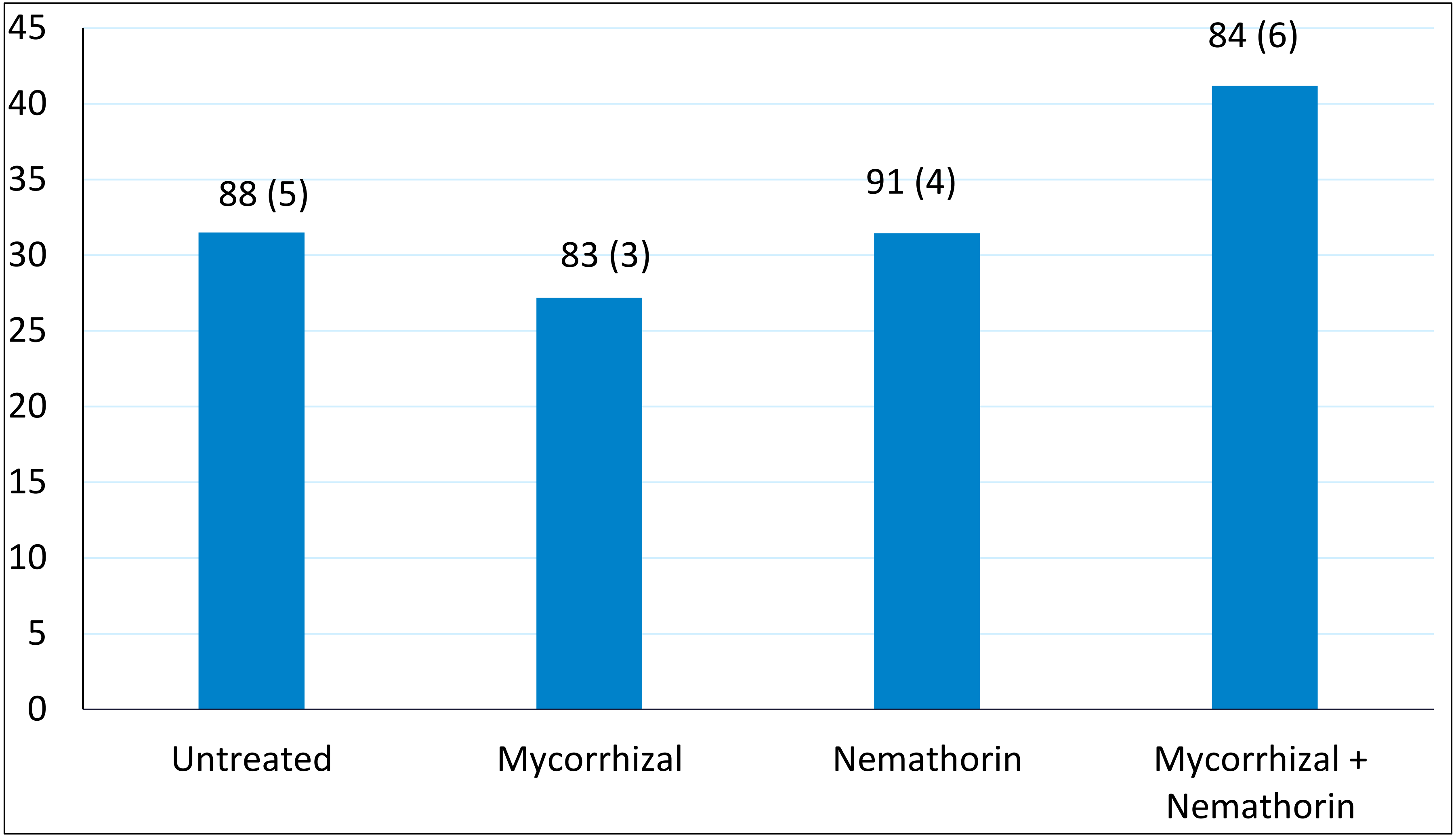
PfPi showed huge difference between Heal and Elveden



Possible reasons for low final egg counts

- Depth of cysts greater at Heal due to drip irrigation versus overhead, so the same sample sampling method cause many to be missed at Heal?
- Biological control of cysts and eggs e.g. by *Pochonia chlamydospria*, *Paecilomyces lilacinus*?

Yield of mycorrhizal demonstration



Trap crop ‘KBL’

Pi 87eggs/g
Pf 1eggs/g

Trap crop
Solanum nigrum

Pi 113 eggs/g
Pf 5 eggs/g

Trap crop Azo

Pi 69 eggs/g
Pf 2 eggs/g

SPot West - Control of *G. pallida*

AHDB

Conclusions

- Nematicide gave a significant yield increase
- Nematicide had no significant effect on PCN multiplication
- Tolerance
- Tolerance of Performer and Royal relatively low at this site
- Tolerance of Eurostar maintained in challenging environment
- Trap crops grew vigorously
- Mycorrhizal inoculation may improve nematicidal effect

SPot demonstrations of *G. pallida* control

2018

- Method/depth of nematicide incorporation at SPot West
- Maximising benefit from Bayer's new nematicide at SPot West and SPot East
- Trap cropping at SPot East
- Newer varieties to be tested for tolerance and resistance at SPot East


‘Inspiring our farmers, growers
and industry to succeed in a
rapidly changing world’

The new Bayer nematicide

Gareth Budd / Bayer Crop Science

- Slides not available for public use – please contact Bayer for details

Lunch

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SPot farm results day 2018

Benchmarking: giving you a competitive edge

Carol Davis

AHDB Farm Economics

Content

Why benchmark?

What can you do?

How?

Why benchmark?

“Ask yourself if what you are doing today is getting you closer to where you want to be tomorrow.”

Walt Disney

(1901 - 1966)


Challenges for potato growers
Weather
Soil and crop health
Overheads
Succession
Potato prices
Marketing/risk management
Input prices
Land and rent prices
Labour availability

Help with marketing decisions

Help with business decisions such as land rental

Identify strengths and weaknesses

Helping to survive volatility

How successful?

£/tonne	Grower 1
Net margin	8

What can you do?

Work out costs of production

Enabling producers to…

- Make informed decisions
- Compare performance year-on-year
- Compare with other data
- Compare with industry targets

Important to ensure that the comparison is like for like

Grower meeting option

- share experiences & best practice
- have peer review
- accept possible need to change

How?

FARMBENCH

Farmbench.ahdb.org.uk

Motivation for Farmbench

- Measure & record performance
- Compare performance

Multi-enterprise benchmarking

Suckler cows and beef cattle

Sheep

Combinable crops

Potatoes

Forage enterprises

Dairy – later in 2018

Business | Enterprise | Land Allocation & Basic Detail | Output | Variable Cost | Fixed Cost | Depreciation

Estimated Arable Output

Enterprise	Ha	Budgeted yield t/ha	Budgeted tonnes produced	Budgeted £/T	Total budgeted crop sales	By-products total £ (e.g. straw)	Total budgeted output
Wheat (Milling Wheat)	25	9	225.00	£ 150	£33,750.00	£ 5000	£38,750.00
Wheat (Feed)	25	8	200.00	£ 110	£22,000.00	£	£22,000.00
Oilseed Rape (Oilseed Rape)	50	4	200.00	£ 220	£44,000.00	£	£44,000.00
Potatoes (packing)	30	45	4,500.00	£ 130	£585,000.00	£	£585,000.00
Potatoes (salad)	30	40	1,200.00	£	£0.00	£	£0.00
Potatoes (ware)	40	45	1,800.00	£	£0.00	£	£0.00

Previous | Save and Next

Notes

Add Note

Crop Protection

	Ha		Herbicides	Fungicides	Insecticides	Nematicides	Molluscicides	PGRs	Other	Total
Total	272									
Wheat (Wheat)	56	Total £	1364.72	6567.12			103.6	1188.88	632.8	9857.12
		£ / Ha	24.37	117.27			1.85	21.23	11.3	176.02
Barley (spring barley)	95	Total £	2261	4899.15						7160.15
		£ / Ha	23.8	51.57						75.37
Barley (winter barley)	18	Total £	471.06	1304.28	36			280.98		2092.32
		£ / Ha	26.17	72.46	2			15.61		116.24
Oats (Oats)	28	Total £	803.32	1398.32	55.44			197.96		2455.04
		£ / Ha	28.69	49.94	1.98			7.07		87.68
Oilseed Rape (Oilseed Rape)	13	Total £	372.06	1391.13	201.24		216.71		312	2493.14
		£ / Ha	28.62	107.01	15.48		16.67		24	191.78
Potatoes (Potatoes)	62	Total £	4387.12	16820.6	11878.58		2790	172.36		36048.66
		£ / Ha	70.76	271.3	191.59		45	2.78		581.43

Business | Enterprise | Land Allocation & Basic Detail | Output | Variable Cost | Fixed Cost | Depreciation

Potato Specific Variable Costs

			Seed certification and inspection	Seed treatment	Fleece	Sprout suppression	Store cleaning	Potato levy
	Ha	**Total Cost (£)**						
Potatoes (packing)	30	Total Cost (£)						
		£/ha						
Potatoes (salad)	30	Total Cost (£)						
		£/ha						
Potatoes (ware)	40	Total Cost (£)						
		£/ha						
		Non-benchmarked enterprises(£)						

Previous | Save and Next

Business | Enterprise | Land Allocation & Basic Detail | Output | Variable Cost | Fixed Cost | Depreciation

Overheads

Overhead Allocation

	Office, telephone and subscriptions	Miscellaneous business costs	Professional fees	Insurance
Total cost (£)	3000.00	1503.00	1150.00	2400.00
Benchmarked Combinable Enterprises(%)	45.00	45.00	45.00	55.00
Benchmarked Potatoes Enterprises(%)	55.00	55.00	55.00	45.00
Non-benchmarked enterprises(%)	0.00	0.00	0.00	0.00

Previous | Save and Next

Equipment Depreciation

Equipment valuation

Equipment type	No. of items	Name	Total second hand value at start of year (£)	Purchases this year (£)	Sales this year (£)	Net Value of Equipment
Telehandler	1	andler	50000	55000	20000	85000
Other self-propelle	1	forklift	15000	0	0	15000
Tractor	1	T6 175 Tract	40000	0	0	40000
Tractor	1	T6 175	50000	0	0	50000
Tractor	1	T6 165	30000	0	0	30000
Tractor	1	T7 185	40000	0	0	40000
Ridger/Bed former	1	ridger	3000	0	0	3000
Ridger/Bed former	1	bed tiller	2700	0	0	2700
Planting equipmen	1	planter	5000	0	0	5000
Other specialist pot	1	destoner	20000	0	0	20000
Potato harvester	1	Potato harve	80000	0	0	80000
Other specialist pot	1	topper	2500	0	0	2500

Add Equipment

Equipment allocation

Previous | Skip | Save and Next

Benefits of Farmbench

- Free to use
- Web-based
  - Always using latest version online
  - Can use on any internet enabled device
  - Data always kept confidential, secure and backed up
- Standardised methodology for consistent comparison with others
- Only view the relevant data input pages
- Easier allocation of costs
- A variety of reports and comparisons available

AHDB expertise, the energy and the passion

Regional Officer team

- 7 RBOs located around GB
- Available to help you start benchmarking
- Point of Farmbench contact for growers
- Work across sectors
- Work with grower and farmer groups

Dedicated telephone helpline

Benefits to advisors

- Free to register and use themselves (e.g. virtual farm)
- Use with individuals or groups of clients
- Farmer gives advisor access via website
- No limit to number of growers
- Support from AHDB
- Ultimately, successful clients!


FARMBENCH


‘Inspiring our farmers, growers and industry to succeed in a rapidly changing world’

SARIC • SUSTAINABLE AGRICULTURE RESEARCH & INNOVATION CLUB

Harper Adams University

UNIVERSITY OF LEEDS

AHDB AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

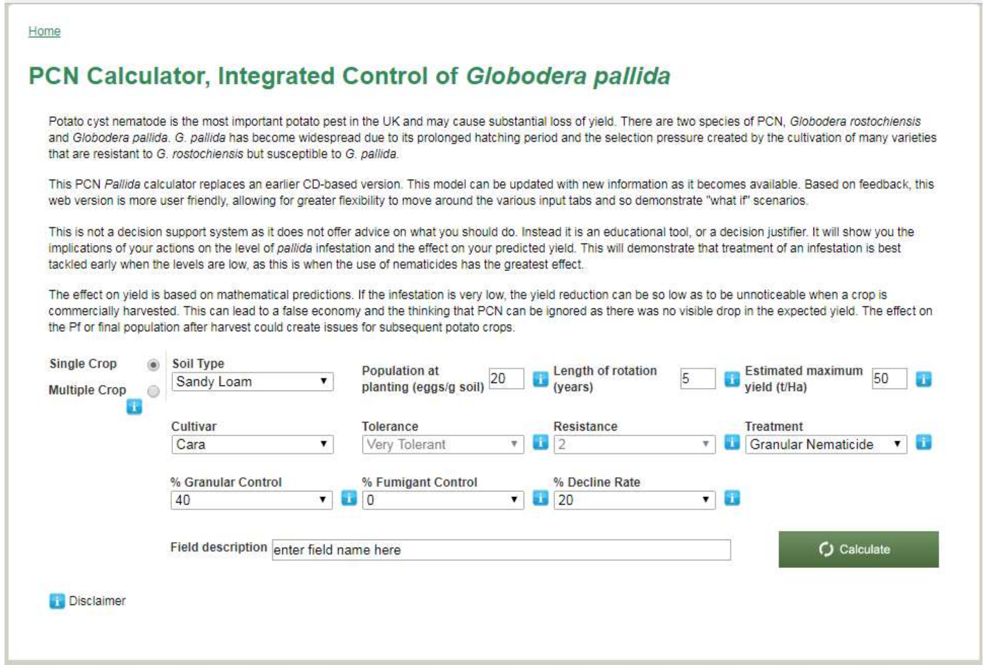
Updating the AHDB PCN calculator

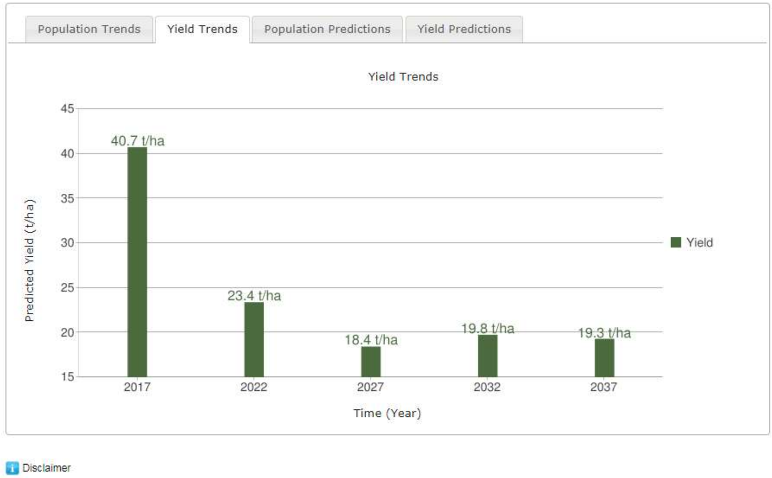
William Watts, Harper Adams University

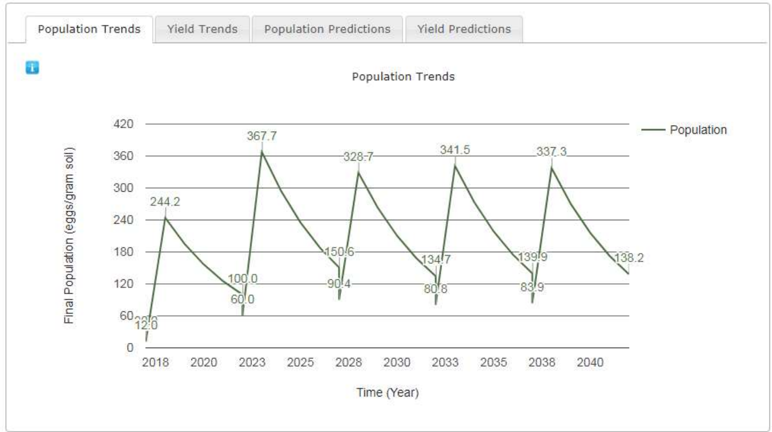
Funding for this project is being provided by the Natural Environment Research Council (NERC) and the Biotechnology and Biological Sciences Research Council (BBRSC).

The Calculator

A useful yield and PCN population prediction tool in need of new data sets







- 5 of the top 10 varieties in the UK missing from the variety list.
- New management practices such as trap cropping and biofumigation not yet built in.
- Does not currently incorporate summer temperatures into decline rates over time.

Project aim & objectives

Project aim

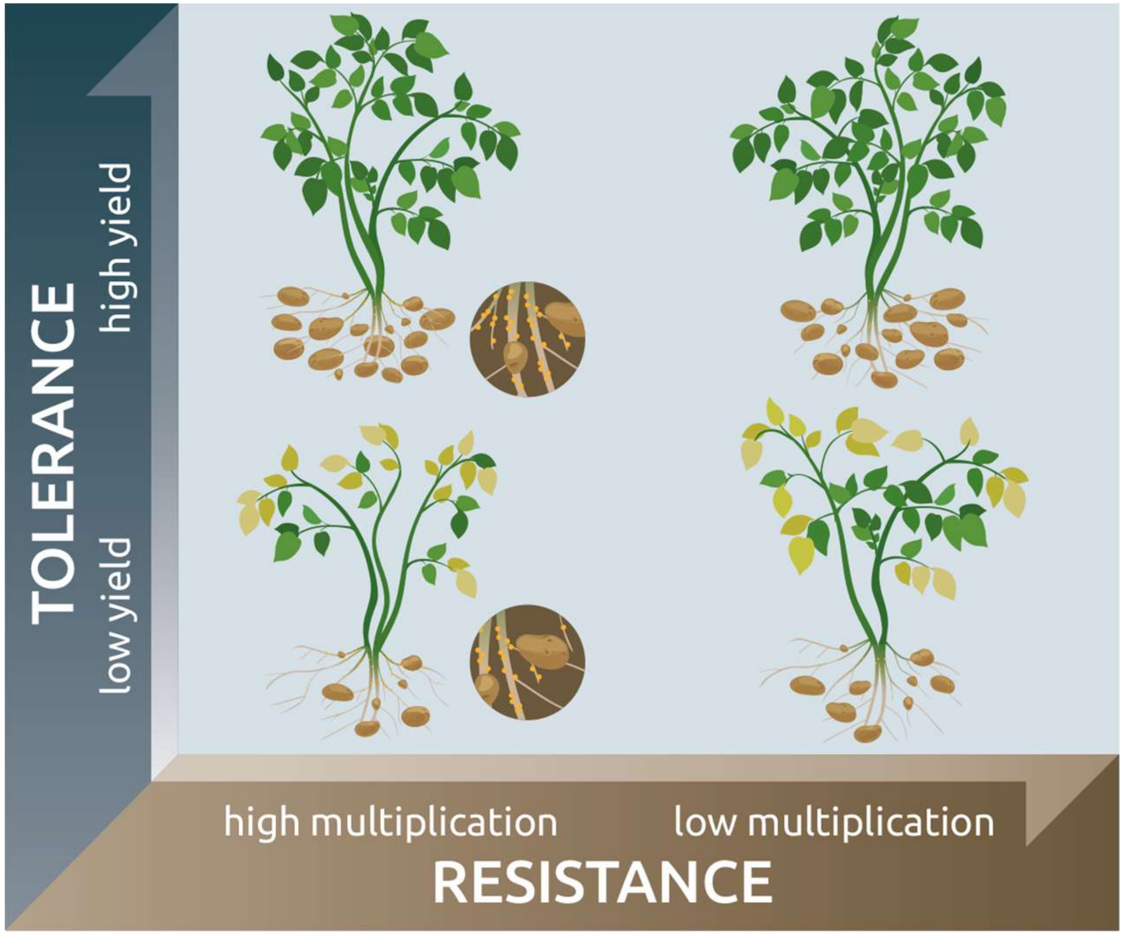
- To improve the accuracy of the PCN calculator relating to tuber yield and PCN population dynamics following potato cropping

Project objectives

- Determine and model field-specific PCN decline rates associated with soil type and amend the calculator accordingly
- Incorporate the effect of summer temperatures on reproductive performance of PCN into the calculator
- Improve the calculator to include the impact on PCN decline rate of having a Brassica in the rotation
- **Revise the calculator in relation to cultivar tolerance and resistance**
- Update the consequence of imposing a pre-planting mortality: nematicides, biofumigation and trap-cropping
- Determine if there is a correlation between *Globodera* mitotypes and decline rates

Tolerance and resistance

What is resistance and what is tolerance?



Source: AHDB (2018)

Tolerance and resistance measurements and indicators

Tolerance (plant)

- Plant emergence velocity and success
- Ground cover
- Nutrient deficiencies
- **Tuber yield**

Resistance (nematode)

- Population dynamics (P_i/P_f)
- Nematode juvenile development in roots

AHDB
AGRICULTURE & HORTICULTURE DEVELOPMENT BOARD

Revising the calculator in relation to cultivar tolerance (and resistance)

POTATOES

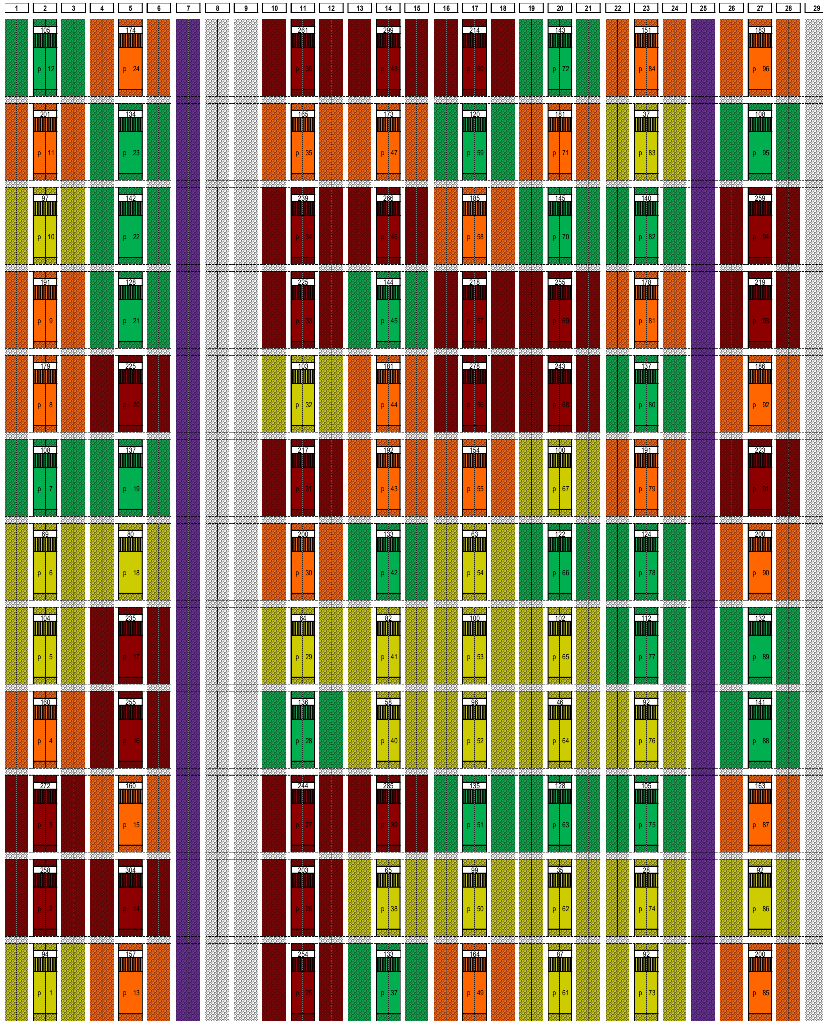
Experiment 1 (2017 season)

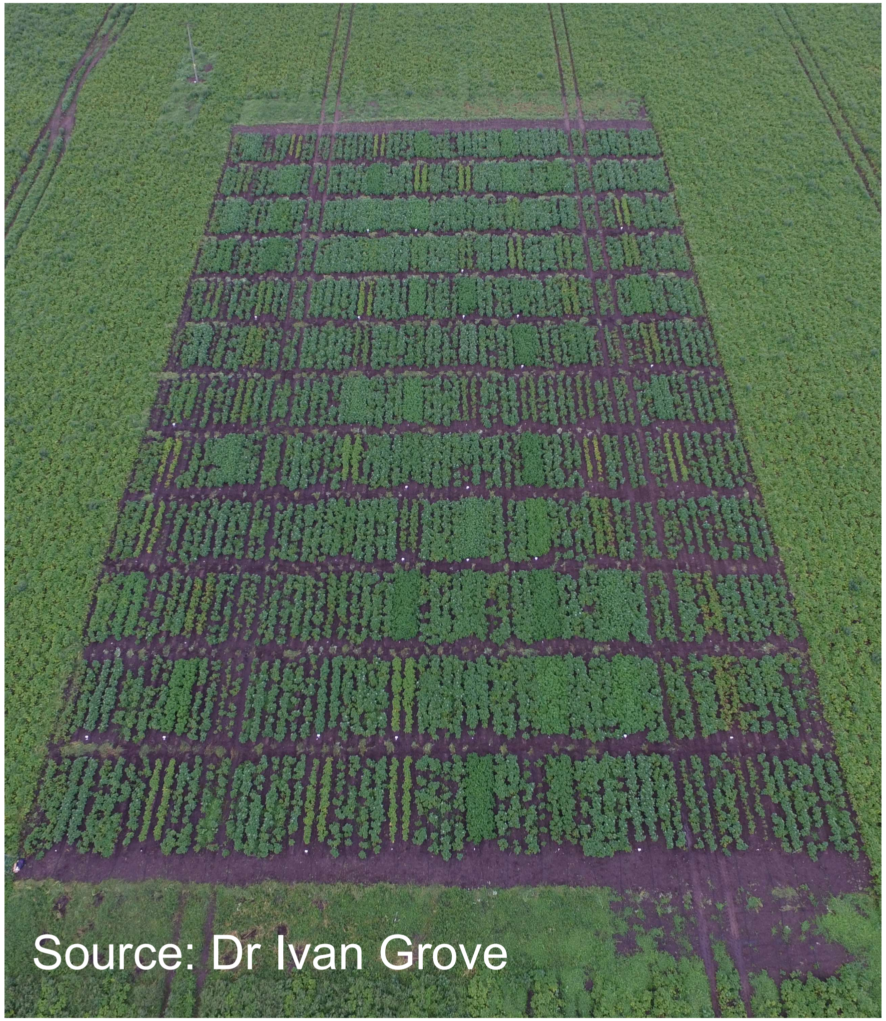
- **12 varieties (UK top 10 plus tolerant controls)**
- **Granular nematicide treated plots (+/-)**
- **Stratified randomized block design based on PCN density (4 blocks)**

- **Varieties:** Cara (tolerant control), Desiree (guards), Estima, Lady Rosetta, Marfona, Maris Peer (intolerant control), Maris Piper, Markies, Melody, Nectar, Pentland Dell, Royal, Taurus
- **Seed size:** 25>65mm (av. 35-55mm)
- **Nematicide:** Oxamyl applied using a bed-tiller
- **PCN egg density on-site:** 28-304 eggs g^{-1} soil (previously commercial testing of 2 ha zones suggested 18-109)
- **Planting date:** 2^{nd} week in May
- **Harvest date:** 2^{nd} week September
- **Assessments:** PCN in soil and roots, emergence, ground cover and tuber yield

- **NB/** fertilizer (17: 17: 17) was applied by hand at recommended rates of nitrogen for varieties. A pre-em and two post-em herbicide applications were made. Blight spraying was performed as the field crop (Arsenal), as was irrigation which was by trickle tape.

Experiment 1 (2017 season)

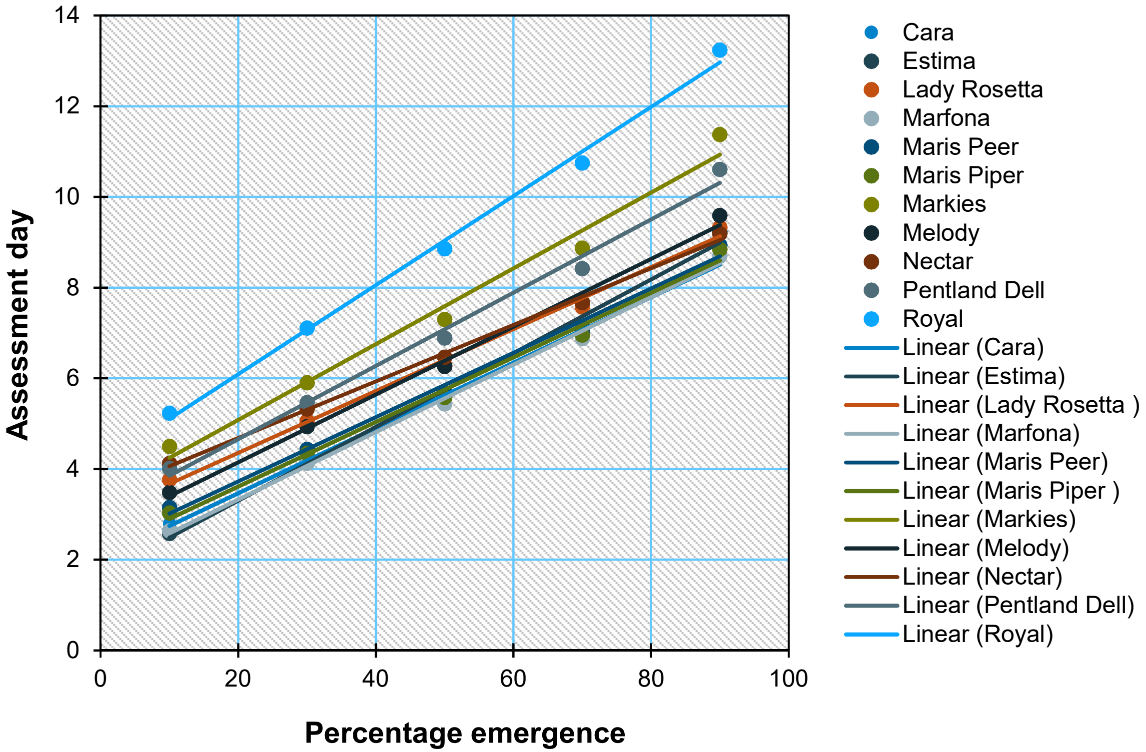




4 blocks: 28-104, 105-145, 151-201, 203-304 eggs g^{-1} soil (viability 75%)

Emergence

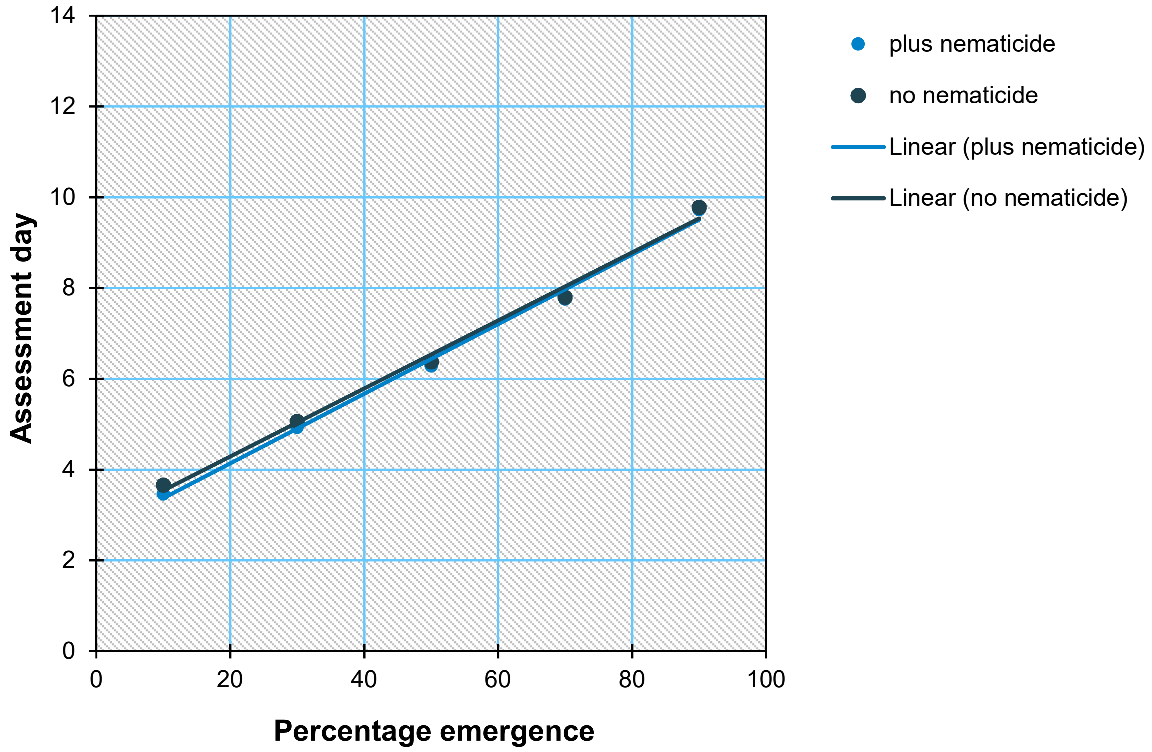
- Grand regression P<0.001
- Percentage variance accounted for 84.0



- Compared to Cara reference

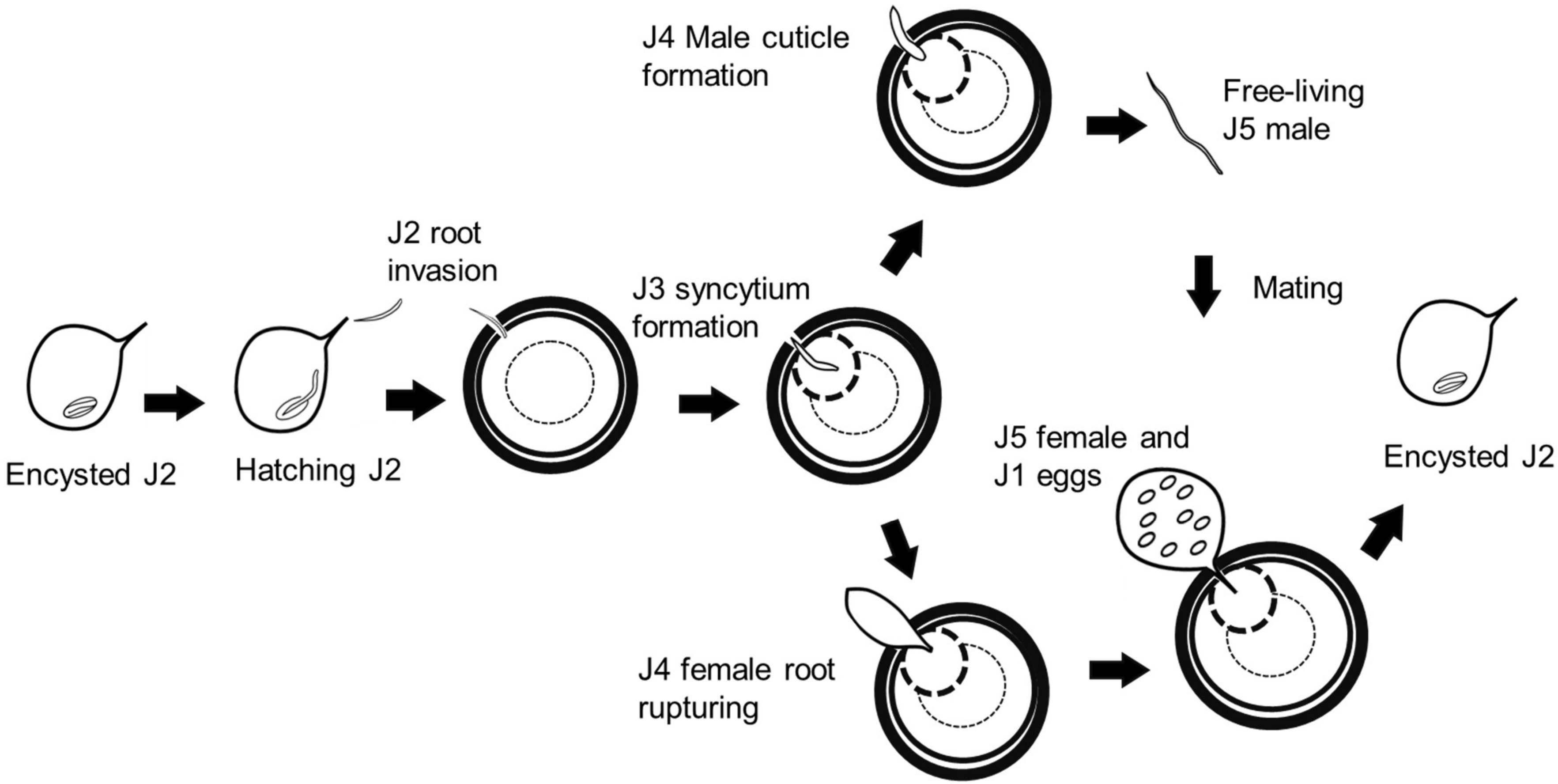
Estima: *P* = 0.450, **Lady Rosetta: *P* = 0.039 (half a day-day behind),** Marfona: *P* = 0.684, Maris Peer: *P* = 0.545, Maris Piper: *P* = 0.725, **Markies: *P* = 0.003 (1 – 2 days behind),** Melody: *P* = 0.18, **Nectar: *P* = 0.003 (1 day behind), Pentland Dell: *P* = 0.030 (1-2 days behind), Royal: *P* <0.001 (2-4 days behind).**

Emergence



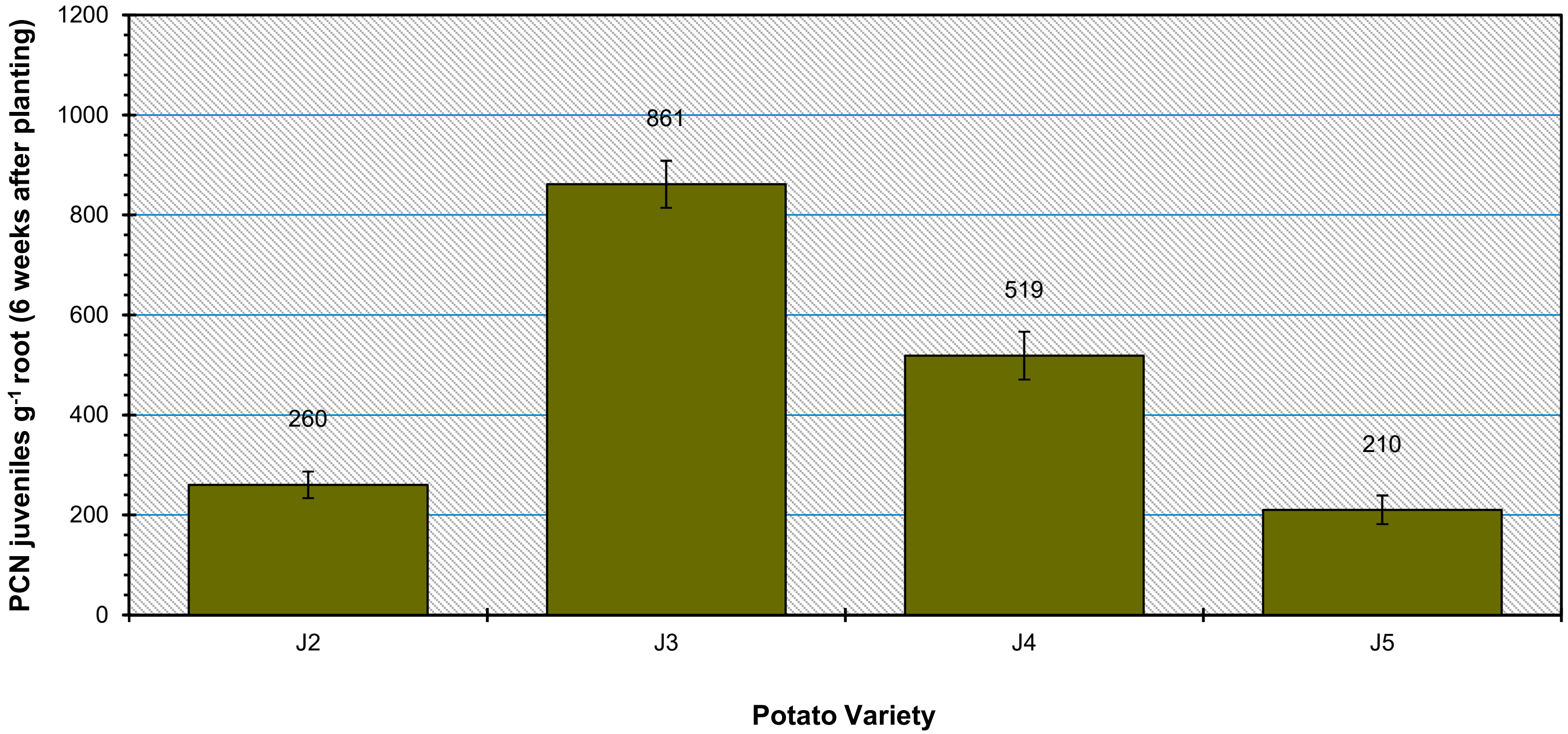
- Grand regression $P < 0.001$
- Percentage variance accounted for 69.6
- Nematicide $P = 0.455$

Nematode juvenile development in roots: lifecycle

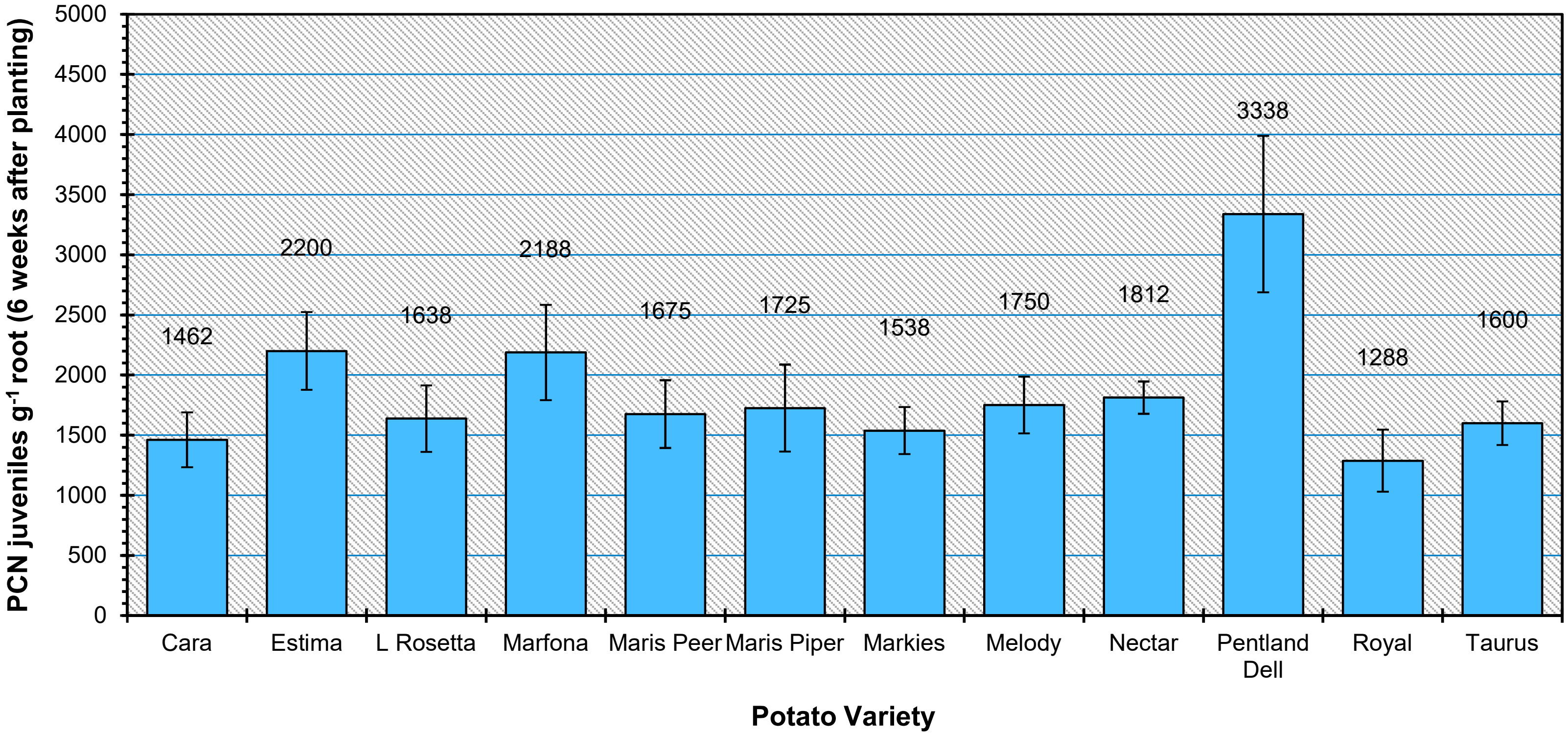


Source: William Watts, Harper Adams University

Preliminary root invasion results

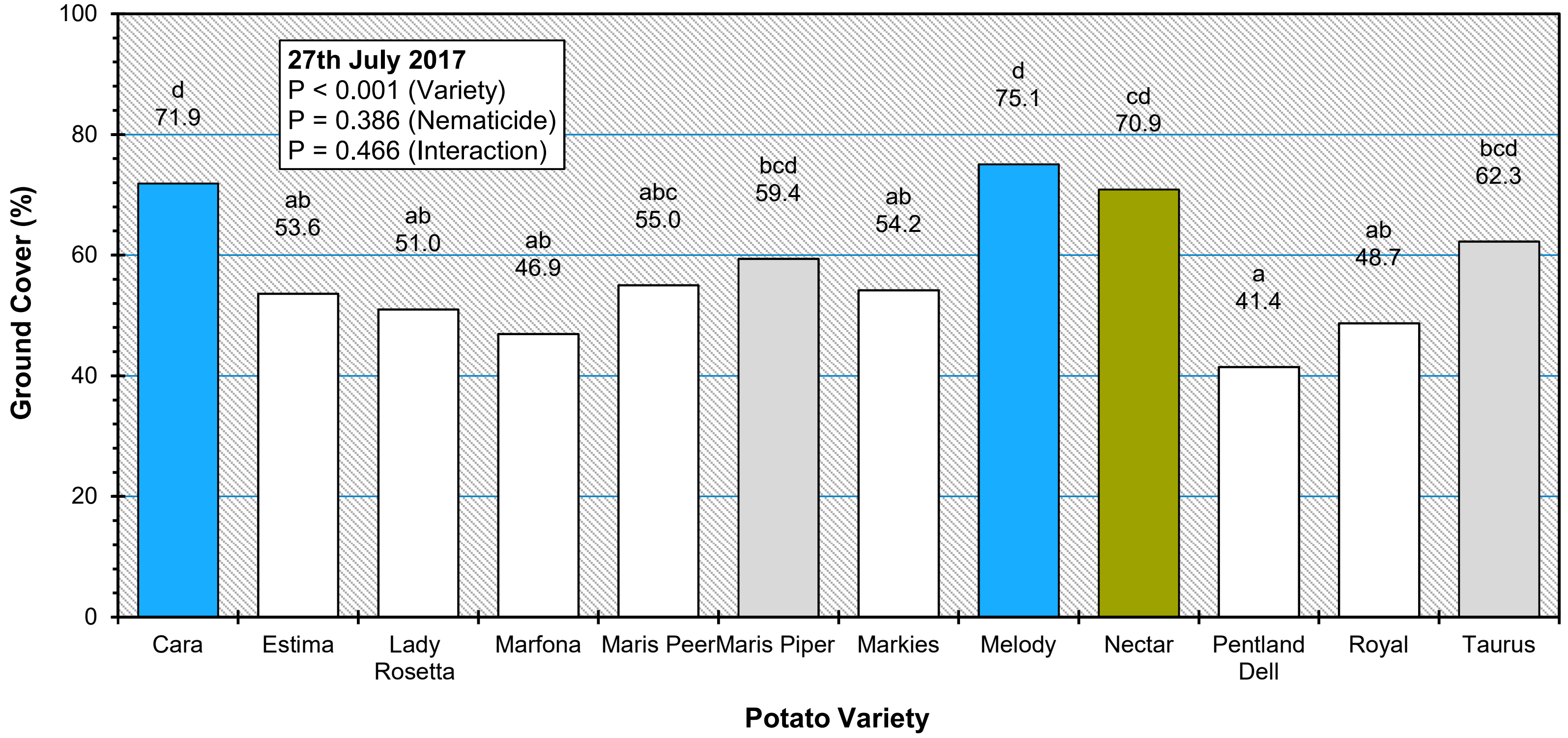


Preliminary root invasion results



Ground cover

- 27th July (*c.* 70 days after planting)

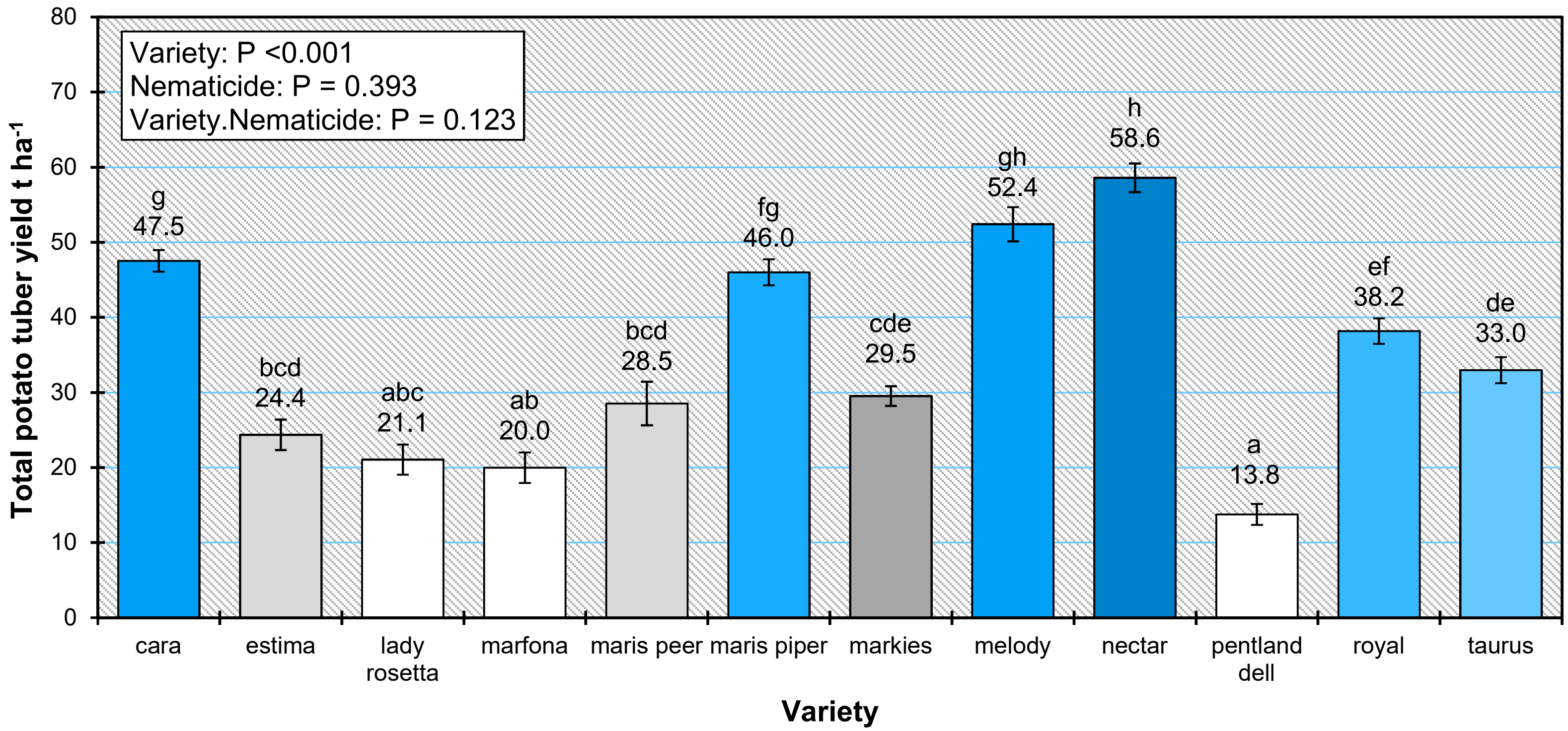


Nutrient deficiencies

- **Phosphorus deficiency in Taurus**

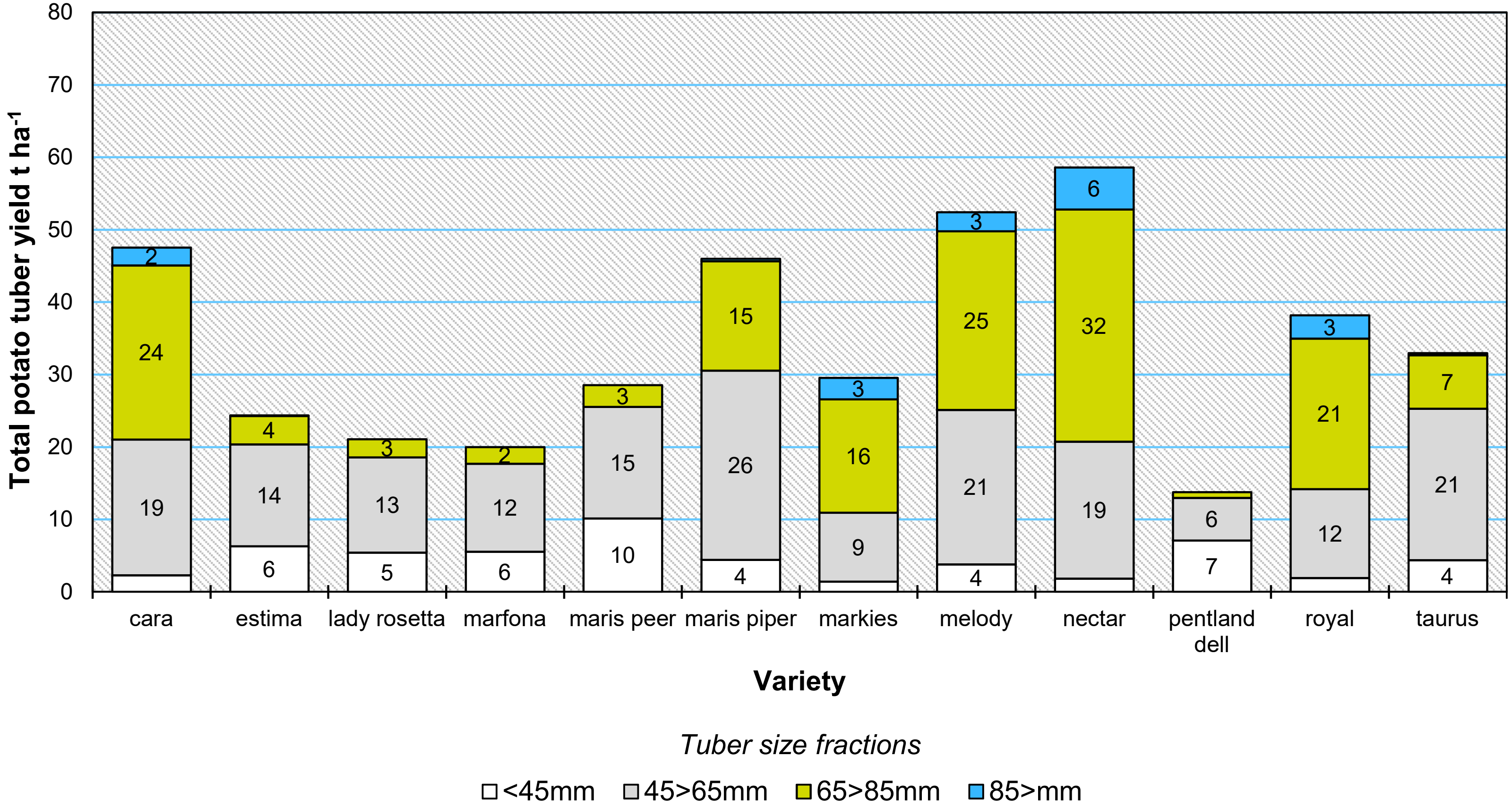
Tuber yield

- Total tuber yield is shown below in t ha^{-1}. Shading of bars indicates distinct yield groups.



Tuber yield

- Individual fractions of tuber yield are shown below in t ha^{-1} (sizes <45, 45-65, 65-85 and >85 mm).



Population dynamics (P_i/P_f)

Population final PCN soil samples are still being processed

A repeat to be set-up in April 2018.

Project team

Leeds University

Prof. P Urwin (Principal Investigator)

Dr C Lilley (Post-Doc Researcher)

Prof. P Urwin (Co-Investigator)

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Harper Adams University

Dr M Back (Co-Investigator)

Dr Ivan Grove (Co-Investigator)

W Watts (Senior Research Assistant)

S Cochrane (Research Technician)

Email: mback@harper-adams.ac.uk

Twitter: @CropResearcher

SARIC members

Root lesion nematodes:

Pratylenchus

Valaria Orlando / HAU

Spot Results Day

PhD project : "Assessing the impact of root lesion nematode (*Pratylenchus* spp.) infestations on the production of potatoes"

PhD student: Valeria Orlando HAU

Supervisors: Dr. Matthew Back, Dr. Ivan G. Grove, Prof. Simon Edwards, Tom Prior (FERA), Dr. Roy Neilson (JHI)

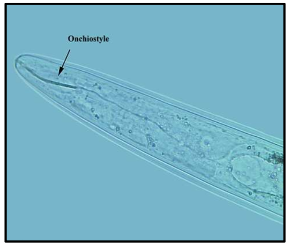
Outline:

- Free living nematodes of potatoes
- Root lesion nematodes: infection on potatoes
- Root lesion nematodes on potatoes: symptoms and management
- Root lesion nematodes: potato damage thresholds
- PhD project: material and methods, preliminary results

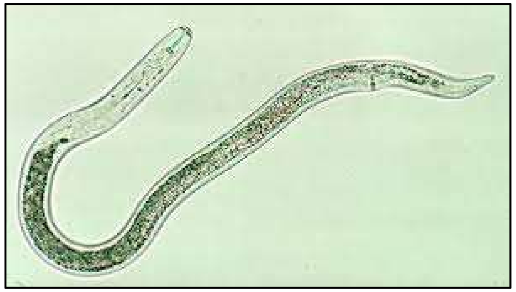
Free living nematodes of potatoes

- Free living nematodes (FLN) – all <u>plant parasitic</u> nematodes present in the soil causing damage to crops

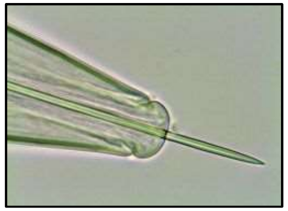
Stubby Root Nematodes
Trichodurus spp. and
Paratrichodorus spp.
– vectors of tobacco rattle virus



Root lesion nematodes
Pratylenchus spp.



Needle Nematodes
Longidorus spp.
– vector of tomato black ring virus



POTATOES

Root lesion nematode – *Pratylenchus ssp.*

Infection on potatoes

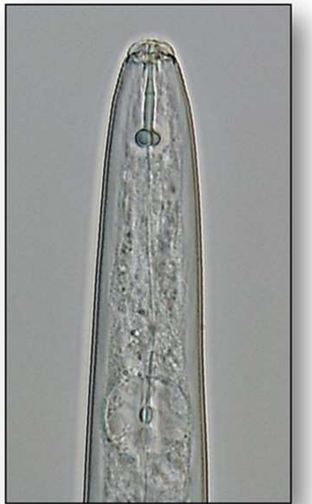
- ***Pratylenchus penetrans, P. crenatus, P. neglectus, P. alleni, P. thornei*** and ***P. scribneri*** are the most common species associated with potatoes

SYMPTOMS

ROOTS:
- Dark-coloured necrotic lesions
- Poor growth

HAULM:
- Poor growth
- Plants stunted with leaf chlorosis

TUBERS:
When high populations are present in the soil
- Wart-like protuberances
- Scabby appearance



POTATOES

Root lesion nematode – *Pratylenchus ssp.*

Potato damage thresholds

- Damage can be related to population densities
- Few studies on the thresholds of RLN for potato damage:

RLN species	Damage thresholds (nematodes kg^{-1} soil)	Authors
P. penetrans	1000 – 2000	Olthof & Potter, 1973
P. penetrans	400	Holgado *et al.*, 2009
P. scribneri	1000 – 2000	Riedel *et al.*, 1985
P. neglectus	600	Olthof, 1990

- Damage thresholds can vary according to:
  - cultivars
  - soil texture
  - temperature
  - moisture

Bernard & Laughlin (1976) - *P. penetrans* :

Potato Cultivars	Damage thresholds (nematodes kg^{-1} soil)
Katahdin	1500 – 2000
Kennebec	810
Superior	380
Russet Burbank	-

AHDB

POTATOES

PhD Research project

"Assessing the impact of root lesion nematode (*Pratylenchus* spp.) infestations on the production of potatoes"

Objectives:

1. To undertake a **survey** to determine the distribution and prevalence of *Pratylenchus* spp. in potato growing land in England and Scotland
2. To determine **potato damage thresholds** for *Pratylenchus* species in different soil types with a range of cultivars under controlled conditions

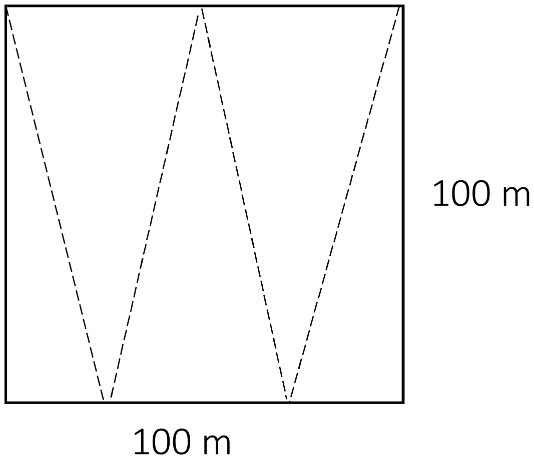
- Survey -

Material and Methods

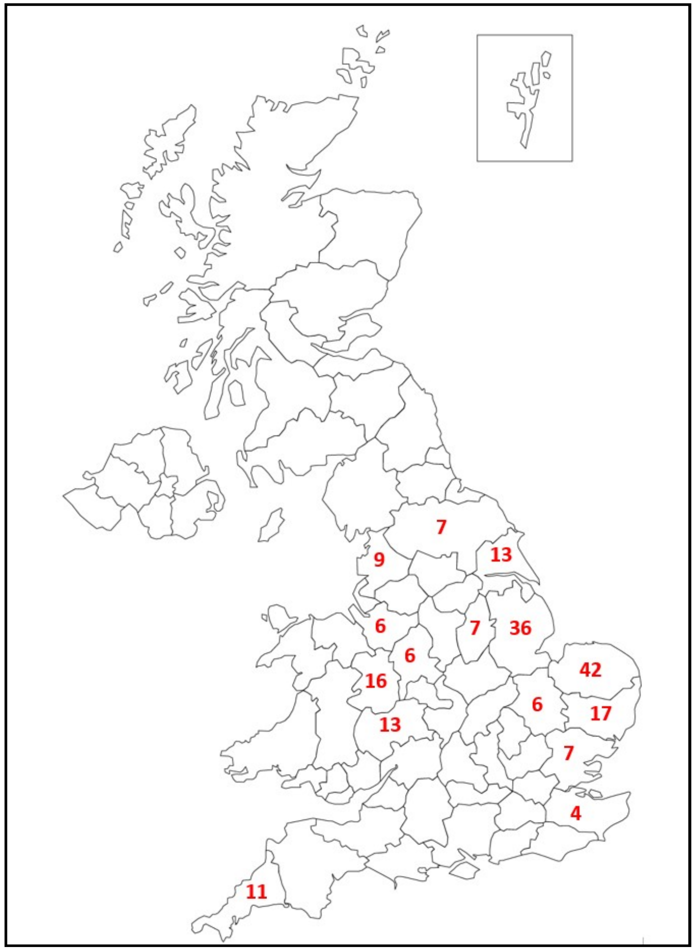
1. To undertake a **survey** to determine the distribution and prevalence of *Pratylenchus* spp. in potato growing land in England and Scotland

200 fields from England

- Time of sampling: September-November
- W pattern grid (1 ha): 60 cores - 1 kg soil
- At 20 cm depth with auger
- At the gate entrance



+ 600 samples from Scotland



- Survey -
Results

- 100 fields have been sampled between September and November 2017, from 7 counties (Shropshire, Staffordshire, Essex, Kent, Cambridgeshire, Norfolk and Suffolk)
- Species: ***P. crenatus, P. thornei*** and ***P. neglectus***
- Soil extraction and identification is still in progress!

Further work:

Sampling - Next September 2018:

Lincolnshire	Cornwall
Yorkshire	Nottinghamshire
Herefordshire	Cheshire
Lancashire	

POTATOES

- Pathogenicity assay -

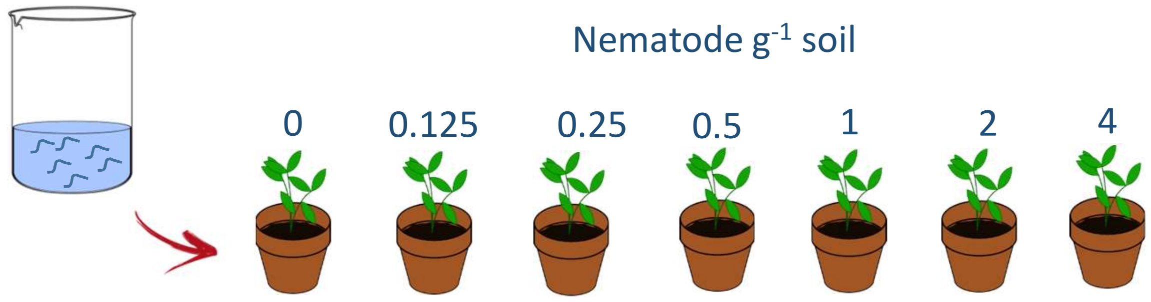
Material and Methods

2. To determine **potato damage thresholds** for *Pratylenchus* species in different soil types with a range of cultivars under controlled conditions

P. penetrans

INFECTION

Nematode g^{-1} soil



SOIL:

ST1: 10% compost, 90 % coarse sand
ST2: 20% compost, 80% coarse sand
ST3: 40 % compost, 60% coarse sand

CULTIVAR:

- Maris Peer

- Day of emergence
- After 6 weeks: Plant height, weight of plants and roots, number and weight of tubers
- Nematode counting from soil and roots

- Pathogenicity assay -

Results

Day of emergence

- Plants growing with higher nematode densities (2-4 nematode g^{-1} soil) emerged later than the others at lower densities – nematode might slow down the emergence of plants

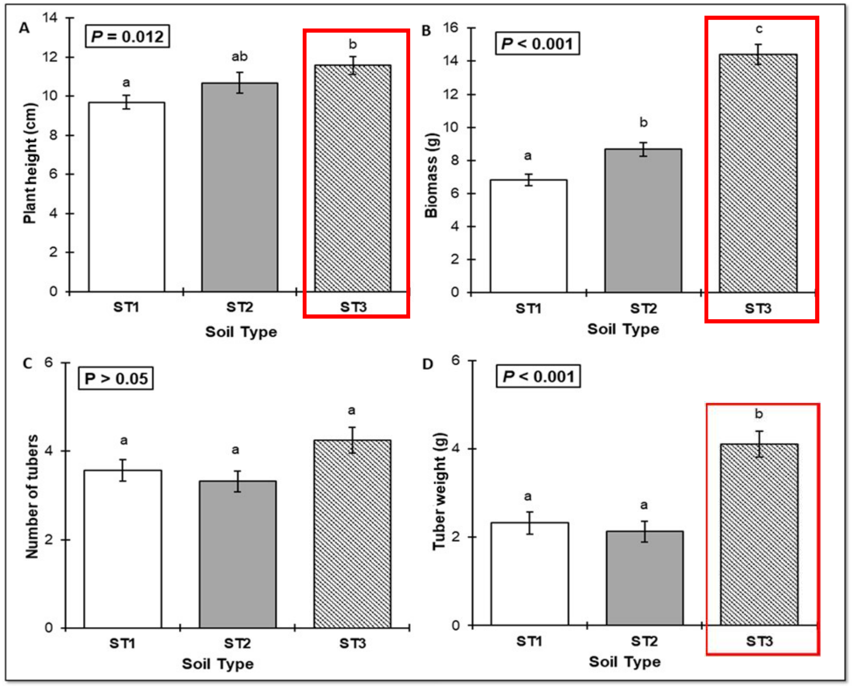
- Soil type influenced the emergence of the plant, and plants emerged faster when growing in ST3 (with higher proportion of compost) than the other two soil types

- Pathogenicity assay -

Results

Plant growth and yield of potatoes

- Nematodes did not affect the development of plants and tubers in each soil type



- However, plant growth and potato yield were affected by **soil type**:

  Yield of potatoes were higher in **ST3** (with higher proportion of compost) than ST1 and ST2

- Pathogenicity assay -

Results

Nematode reproduction

Root lesion nematodes inside potato roots

CONCLUSION

- Plants growing in **ST1** had weaker roots compare to ST2 and ST3
- Root lesion nematode infected Maris Peer cultivar; however, nematode densities did not affect the yield of potatoes - not possible to determine potato damage thresholds
- Nematodes reproduced more on the soil type **ST1** than the other two soil types

AHDB POTATOES

AHDB

Further work:

Further studies are necessary to determine the damage thresholds and fully understand the pathogenicity of root lesion nematode and the effect of different soil types on Maris Peer.

Other cultivars such as Maris Piper, Pentland Dell, Marfona and Nectar will be tested.

POTATOES

Thanks to…

Dr. Matthew Back (Director of studies)
Dr. Ivan G. Grove (Supervisor)
Dr. Simon Edwards (Supervisor)
Dr. Roy Nielson (Supervisor) - JHI
Tom Prior (Advisor) – FERA
Nancy de Sutter – ILVO (Belgium)
Dr. Fabio Veronesi – HAU
Matyn Cox – Agronomist

Nematology group at HAU:
- William Watts
- Ahmed Moammed
- Katarzyna Dybal
- Victoria Taylor
- Musa Nasamu
- Ana Morais Natalio
- Alex McCormack

And all the farmers for helping me on my survey of potato fields across the country!

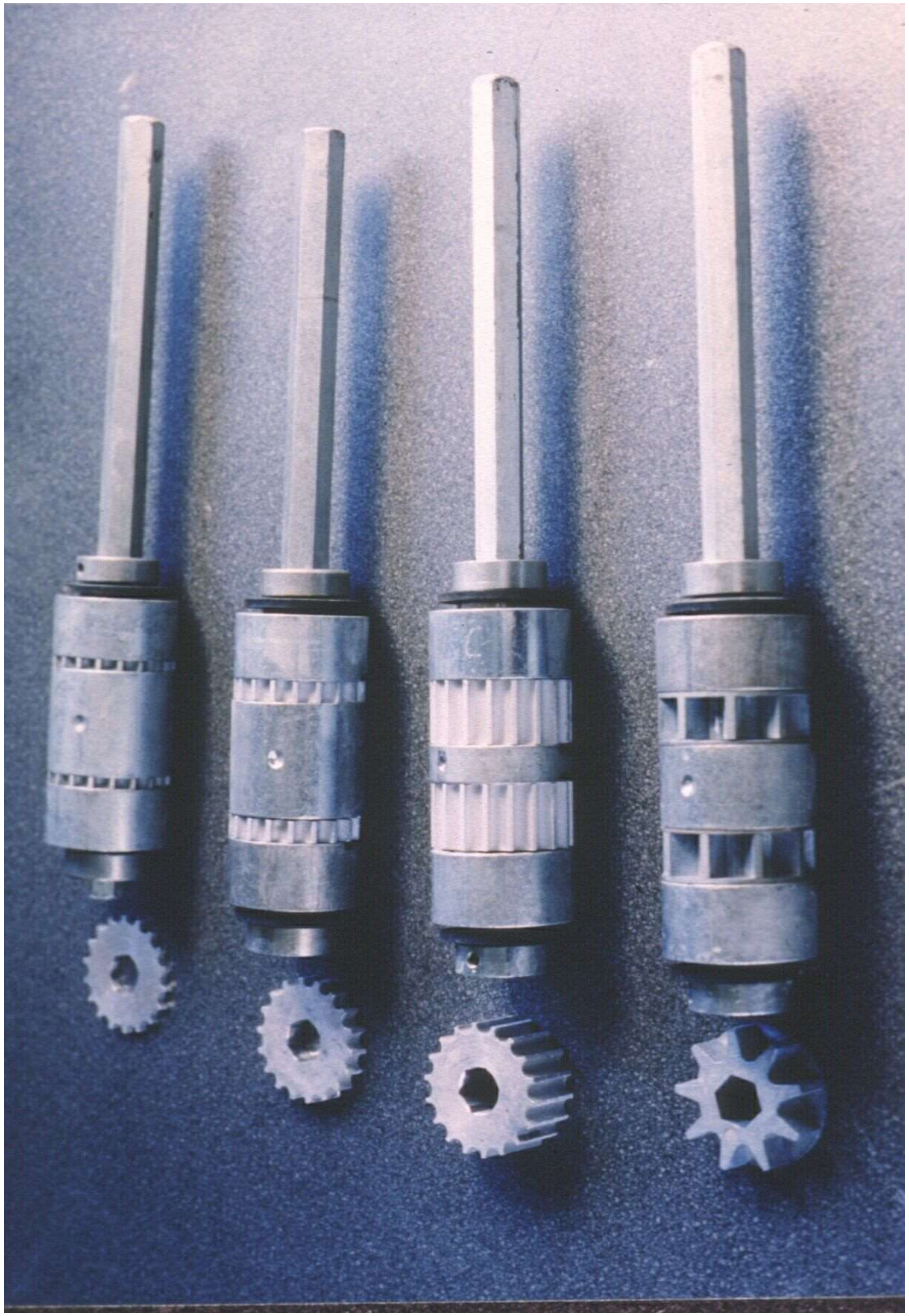
Nematicde Application

Simon Woods / HAU

POTATOES

Application and Incorporation of nematicides 25 years ago

- Incorporate granules to 10-15cm depth
- Use rotary cultivator
- Use harrows making two passes at right angles
- Stone and clod separators generally not endorsed
- Metering predominantly by land wheel driven positive displacement units often hand built by the operator
- Product supplied in cardboard boxes

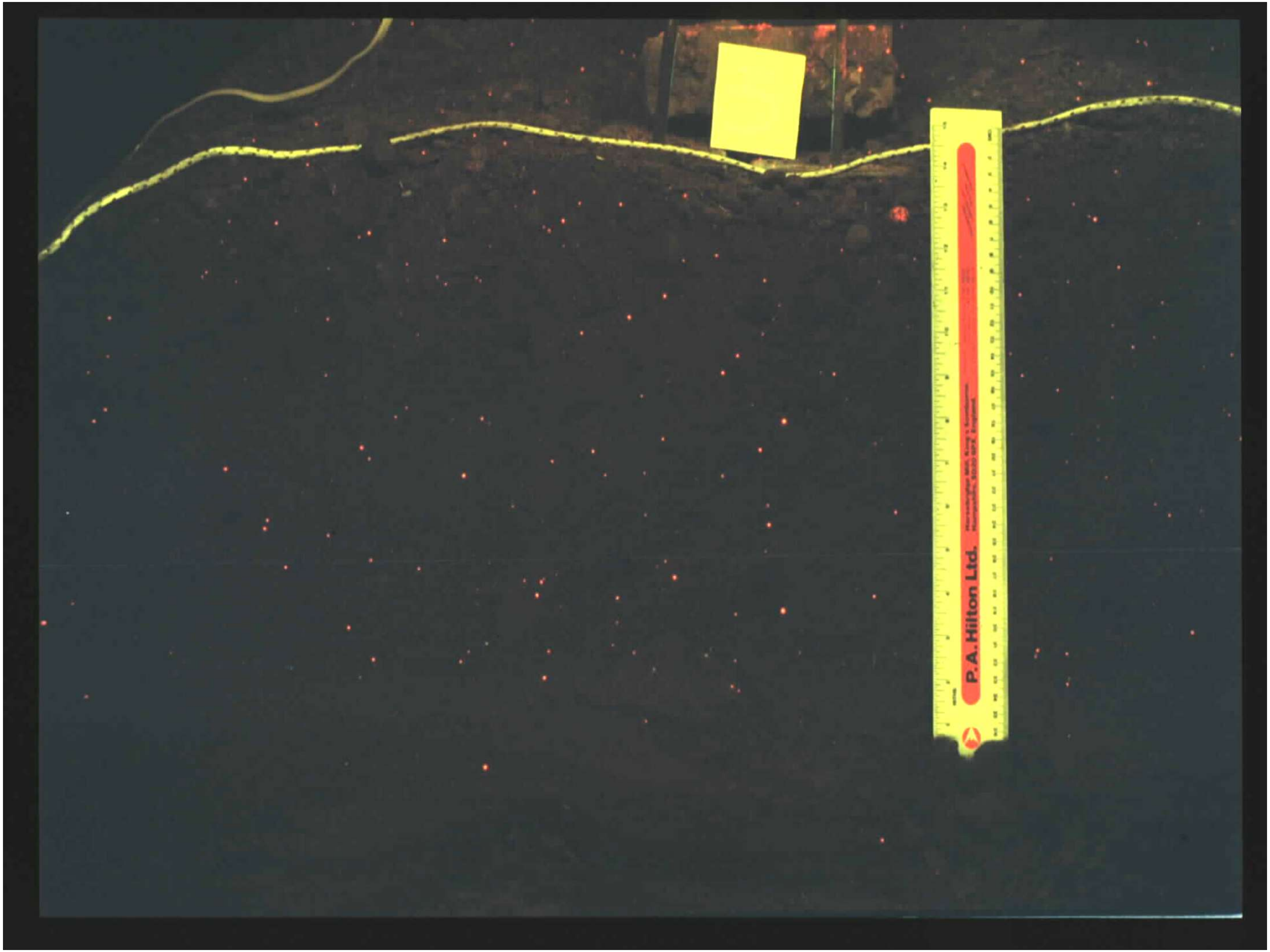


Current Situation

- Over the past 25 years work at Harper involving many of the nematicide manufacturers and machinery stakeholders has provided better guidance on incorporation
- Application and incorporation to 15cm by rotavation on flat ground is the most reliable method for PCN control

Tracer studies at Harper Adams

- Range of incorporation machinery tested
- Found that incorporation technique can be classed as:
- Too shallow; granules left on soil surface
- Too deep; granules incorporated to depths greater than 20cm
- OK; granules 15cm deep and **no** deeper than 20cm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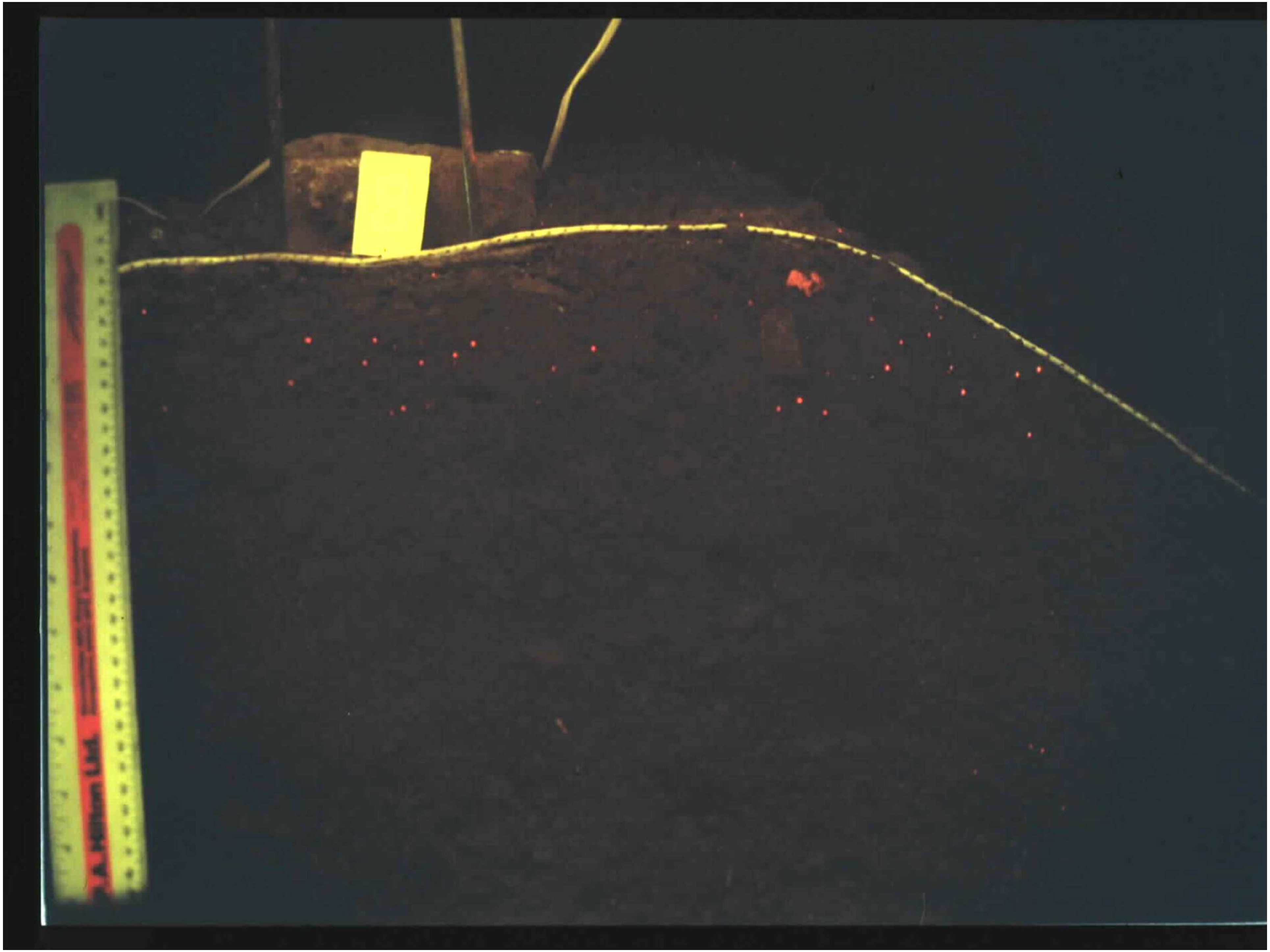
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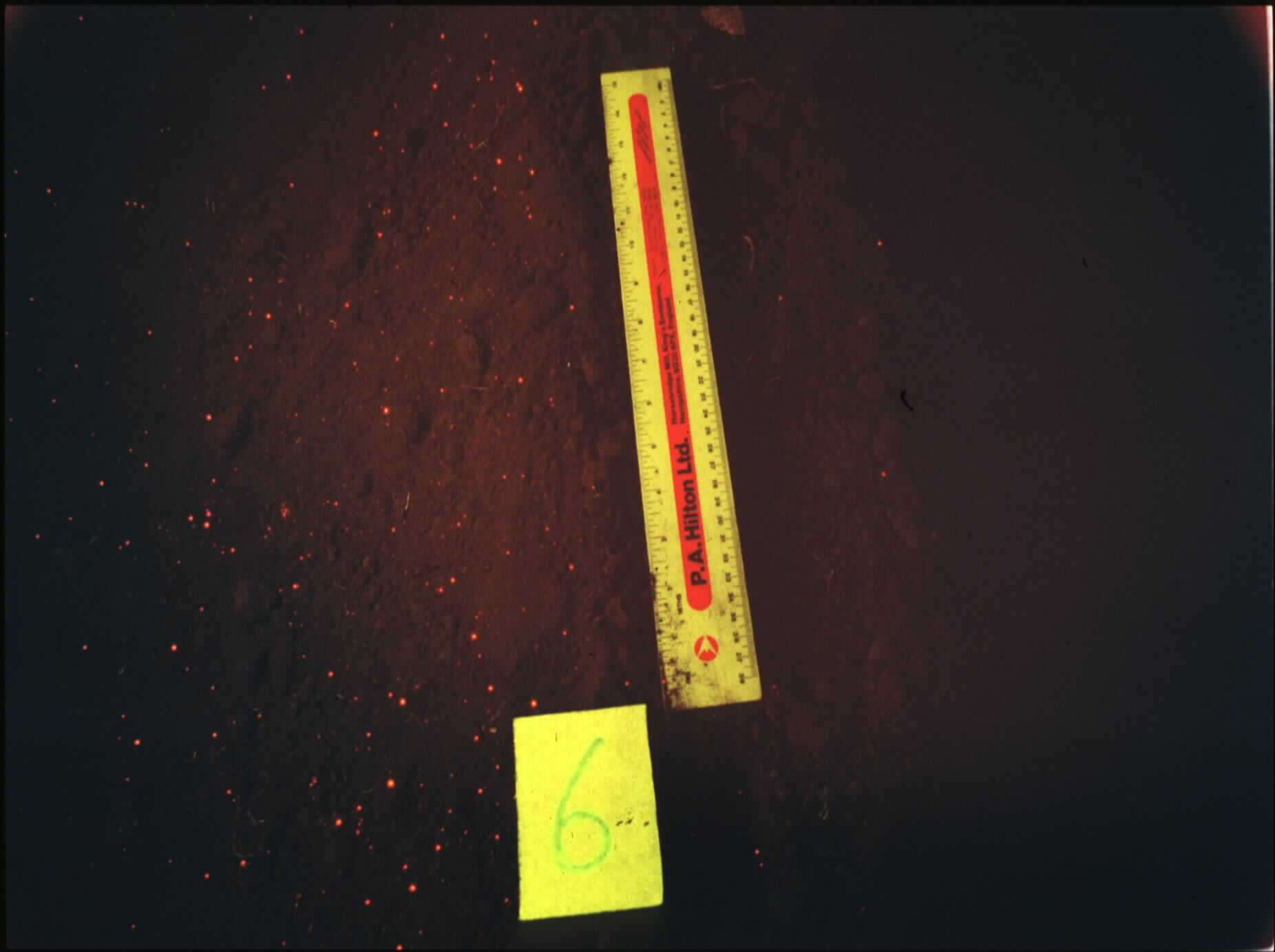
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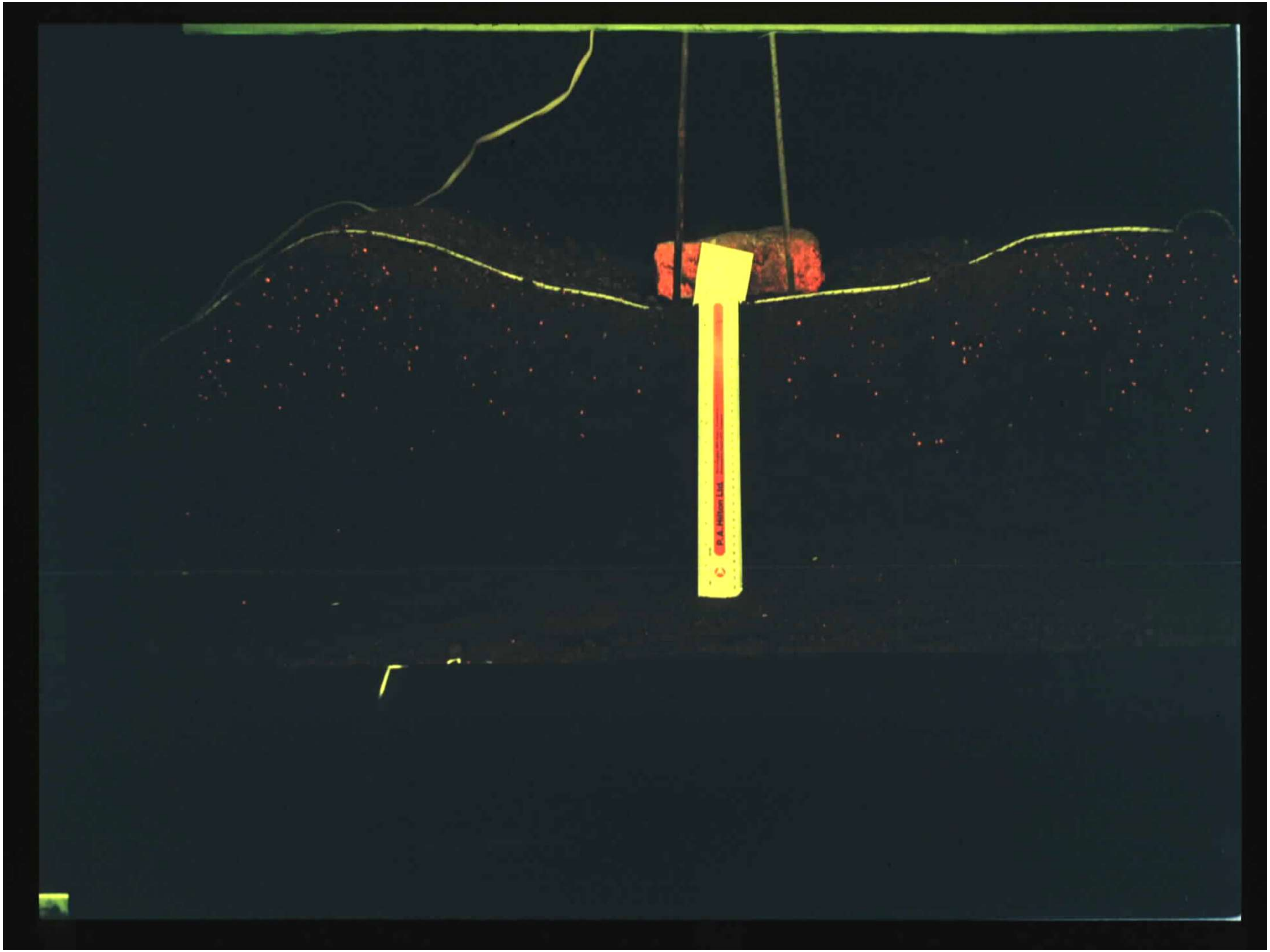


P.A. Hilton Ltd.

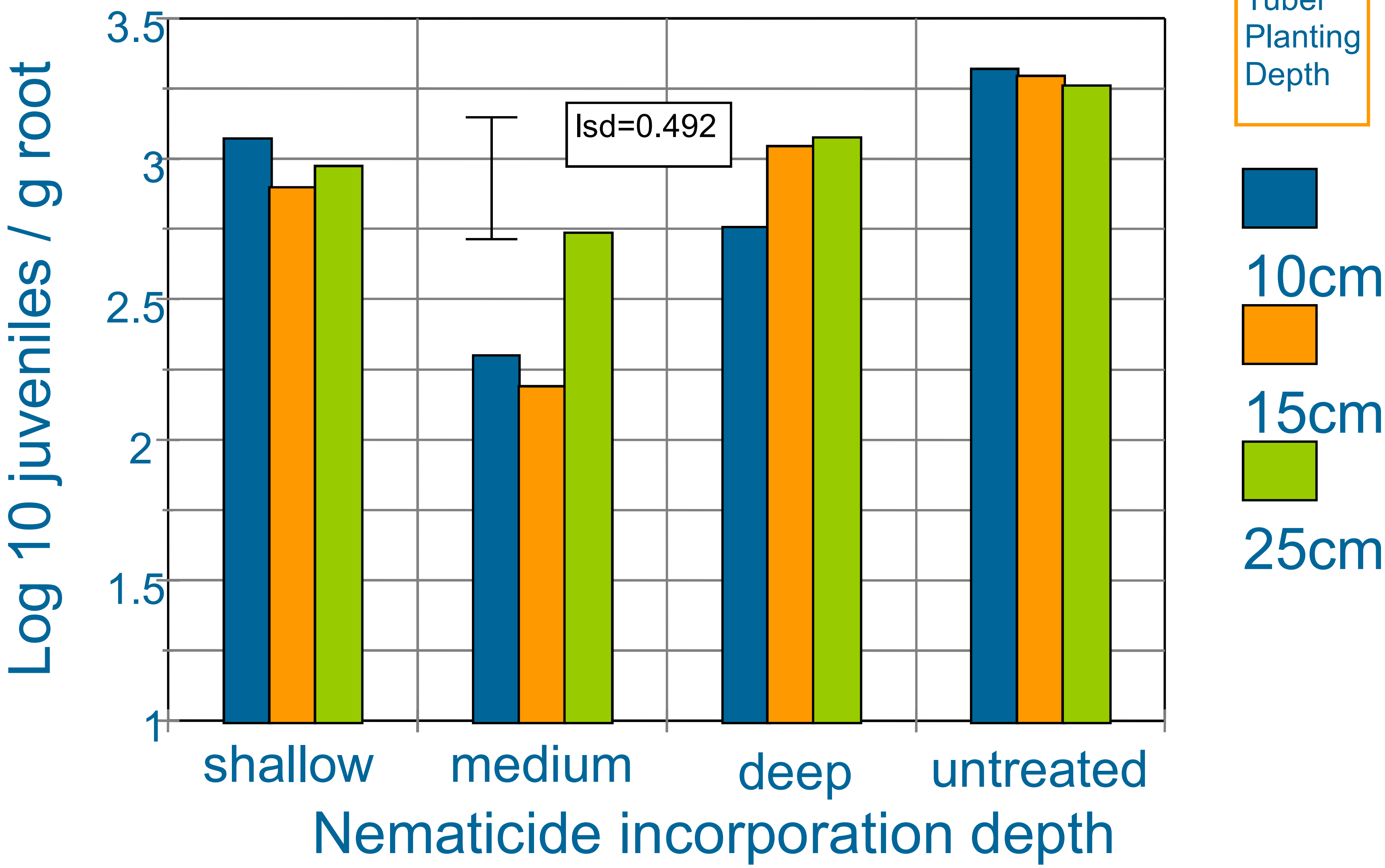
Field experiments

- Field experiments using shallow (>5cm), medium (15-20cm) and deep (35cm) depth of nematicide incorporation
- Three planting depths; Shallow (10cm), medium (15cm) and deep (25cm)

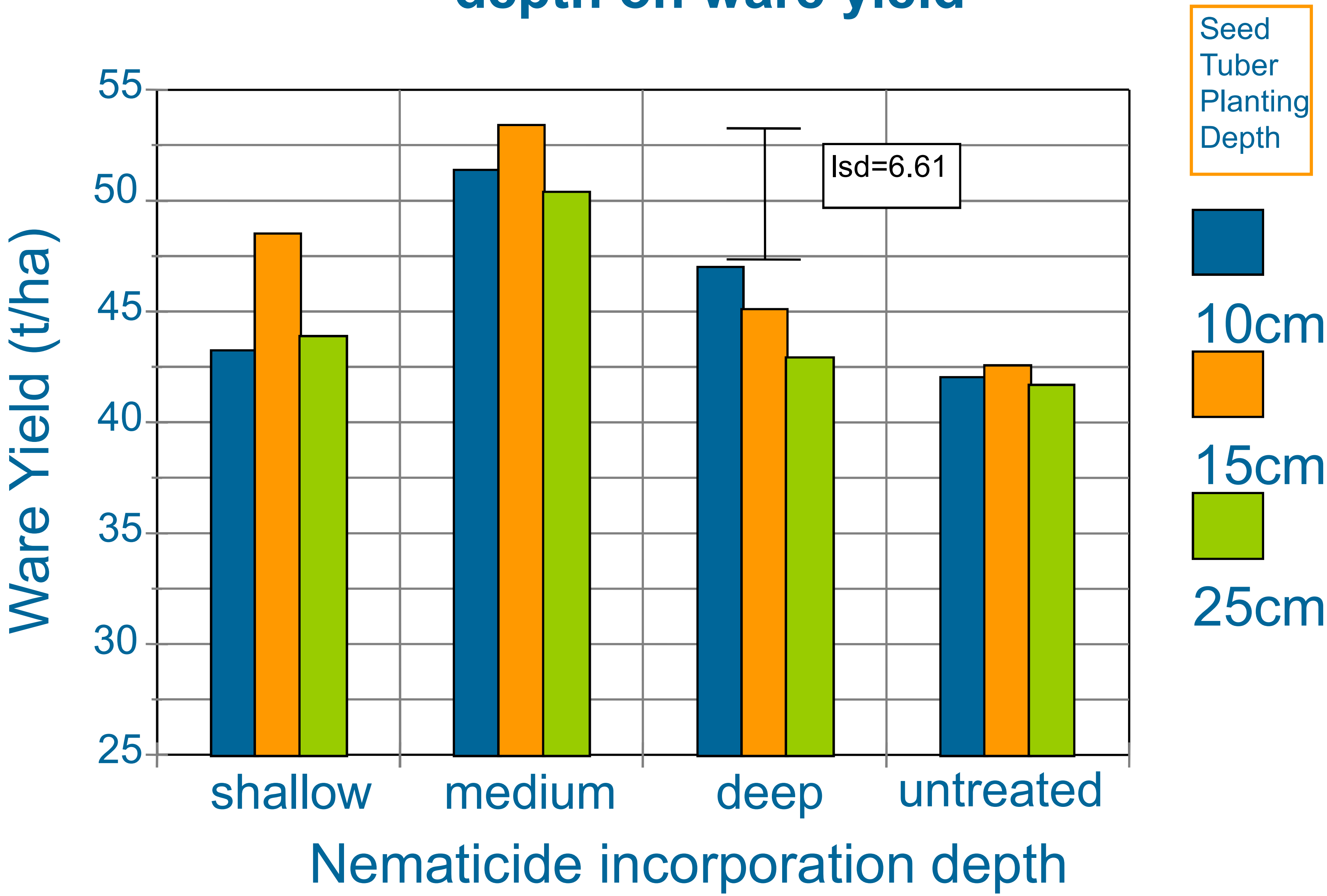
Findings

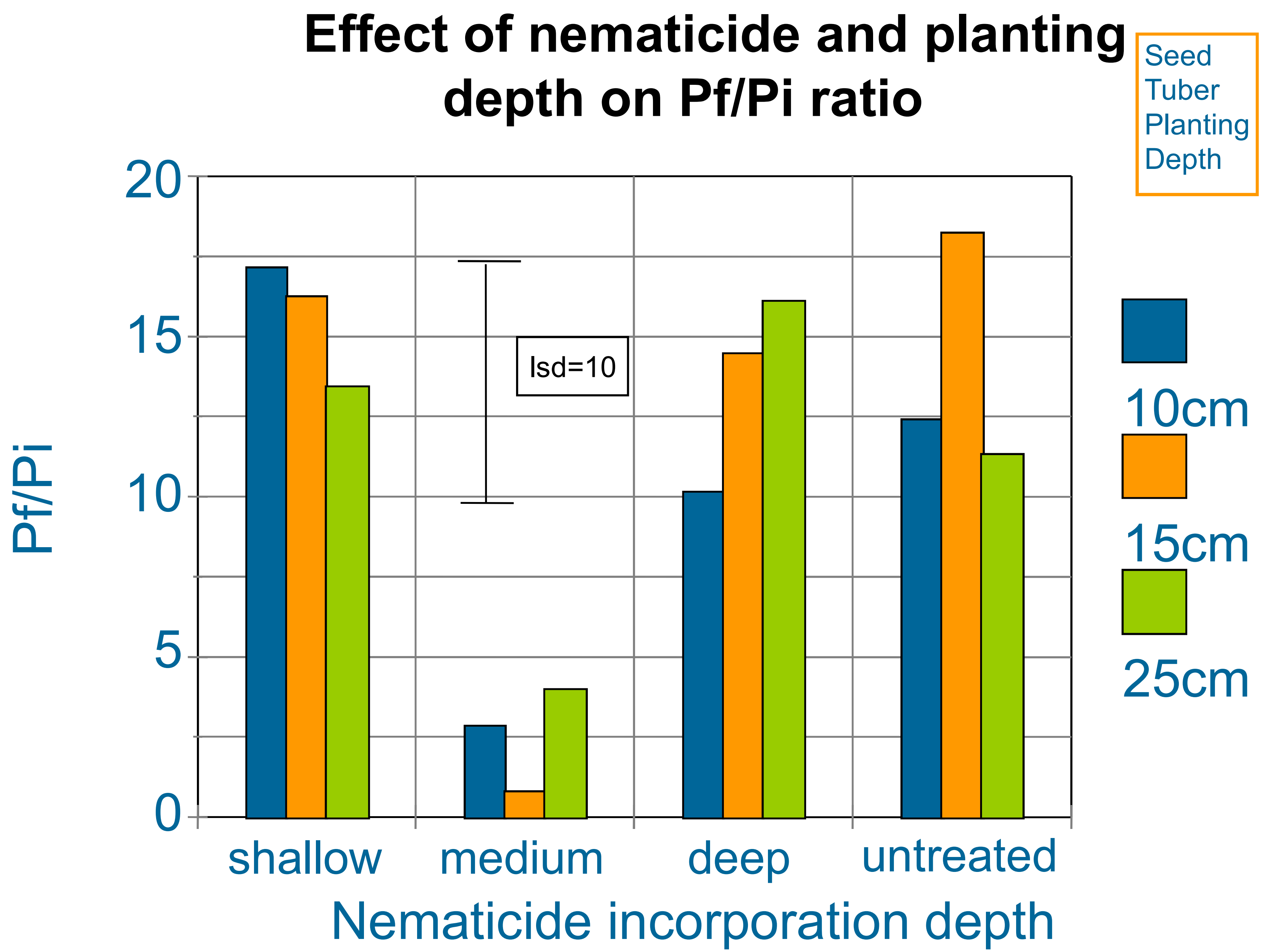
- Found medium incorporation depth gave the best yields and nematode control
- Also medium planting depth in medium nematicide incorporated plots reduced root invasion by nematodes

Effect of nematicide and planting depth on root invasion



Effect of nematicide and planting depth on ware yield

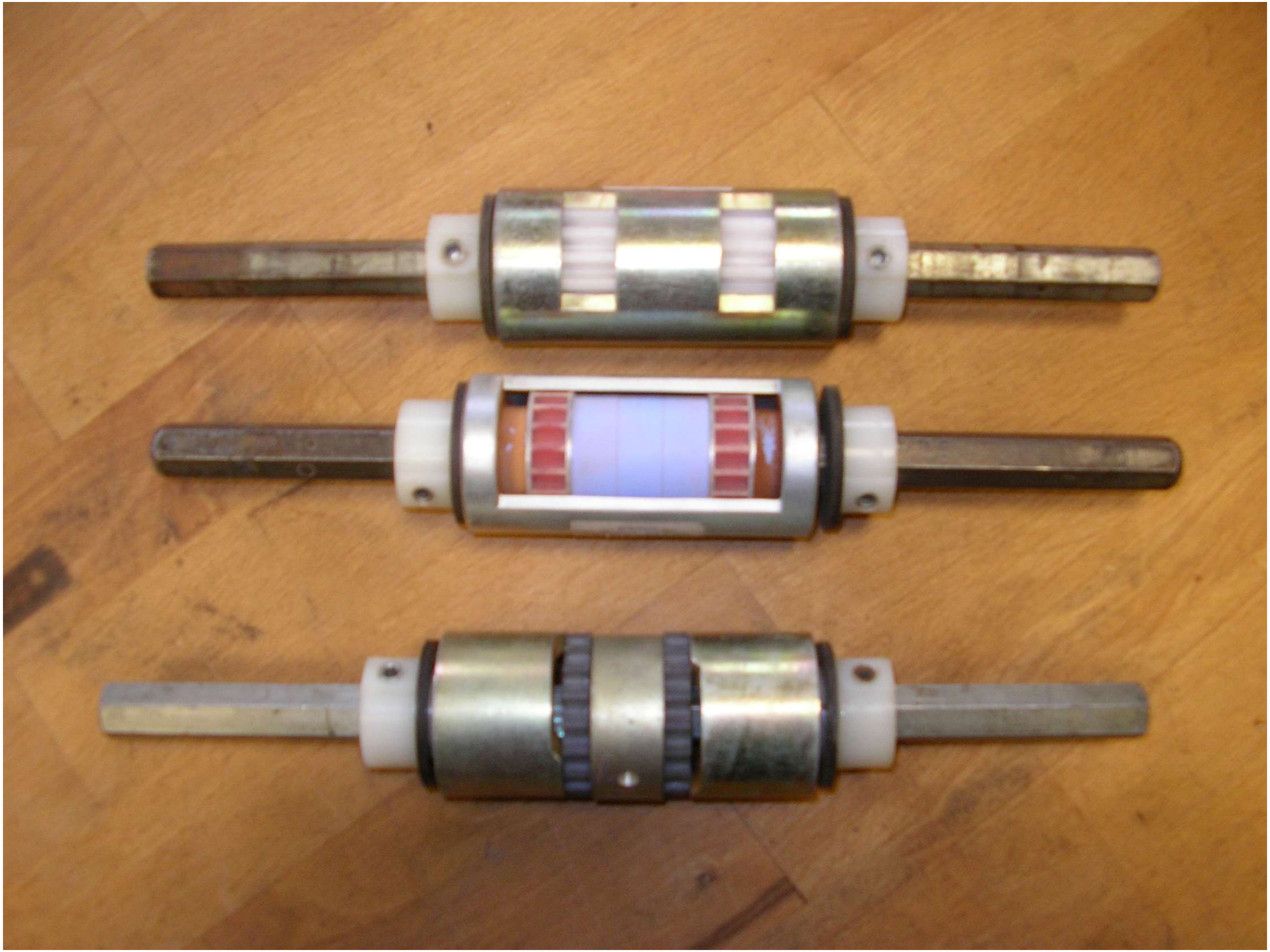




Effect of nematicide and planting depth on Pf/Pi ratio
Seed Tuber Planting Depth
20
15
10
5
0
Pf/Pi
lsd=10
10cm
15cm
25cm
shallow
medium
deep
untreated
Nematicide incorporation depth

http://youtu.be/B9zzDH9CBlg

- Application and incorporation during bed tilling followed by stone and clod separation using a star based separator is OK
- Application during stone and clod separation using a webbed based separator will give good results provided that application occurs towards the front of the machine
- Purpose built product specific cartridges available
- Closed transfer systems now used
- Move towards GPS (precision farming) control of metering unit rather than land wheel drive (NOT VARIABLE RATE)




HORSTINE FARMERY LTD

Nematicide Stewardship is class leading

BUT……………..

We've got to get on!

How much soil!

- 1 ha of soil to a depth of 15cm could contain

As much as 1,500,000 kg of soil.

This is worth bearing in mind when we attempt to mix anywhere between 30 and 60kg of nematicide granules into it!

Forward Speeds

- 5km/hr = 1.38m/s
- 10km/hr = 2.7m/s
- 15km/hr! = 4.16m/s

Calculation of rotor speed for the Jones Veggie Tiller

PTO : Rotor gearbox ratio	= 4:1
Rotor Diameter	= 0.45m
PTO input speed	= 1000rpm
Rotor Speed	= 1000 / 4
	= 250rpm
Distance travelled by rotor tip in one revolution	= πD
	= 3.142 x 0.45
	= 1.41m
Rotor speed	= 1.41 x 250
	= 325.5 m min^{-1}
	= 5.88 m s^{-1}
Rotor speed at 540rpm	= 3.17 m s^{-1}

Calculation of rotor speed for the Jones Veggie Tiller

PTO: Rotor gearbox ratio	= 4.1
Rotor diameter	= 0.45m
PTO input speed	= 1,000rpm
Rotor speed	= 1,000/4
	= 250rpm
Distance travelled	= ∏D
by rotor tip in one revolution	= 3.142 x 0.45
	= 1.41
Rotor speed	= 1.41 x 250
	= 325.5m min^{-1}
	= 5.88ms^{-1}
Rotor speed at 540rpm	= 3.17 ms^{-1}

What happens if the rotor wears down?

- A rotor diameter of 0.3m on the veggie tiller would result in a tip velocity of 3.9m/s at 1000pto

- Its feasible for the rotor to be travelling at the same speed as the tractor!
- Therefore no mixing

Can more be done?

- Rotavation needs a thorough investigation
- Forward speeds
- Rotor speeds
- Work rates and costs involved
- Energy required

Precise nematicide incorporation – A farmer's view

Andrew Webster / AW and MA Webster

POTATOES

Andrew Webster

Applying Nematicide in the right place and at the right dilution....

A farmers perspective

How many tonnes of soil is the tiller moving per Ha working at the following depth?

A: 20cm

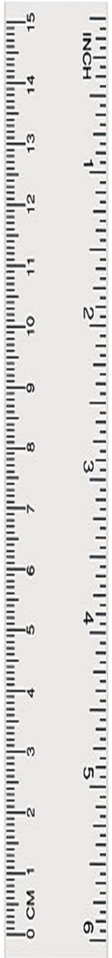
B: 30cm

How many tonnes of soil is the tiller moving per Ha working at the following depth?

A: 20cm - ***3000 Tonnes***

B: 30cm - ***4500 Tonnes***

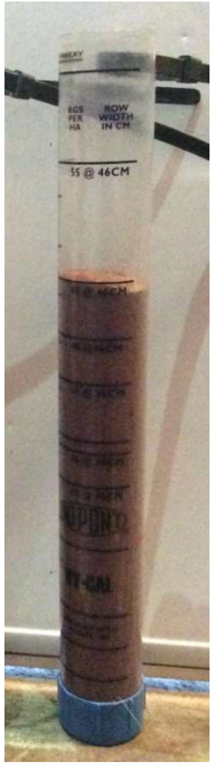
The Incorporation Challenge



20CM

30CM

:



1KG
Nematicide

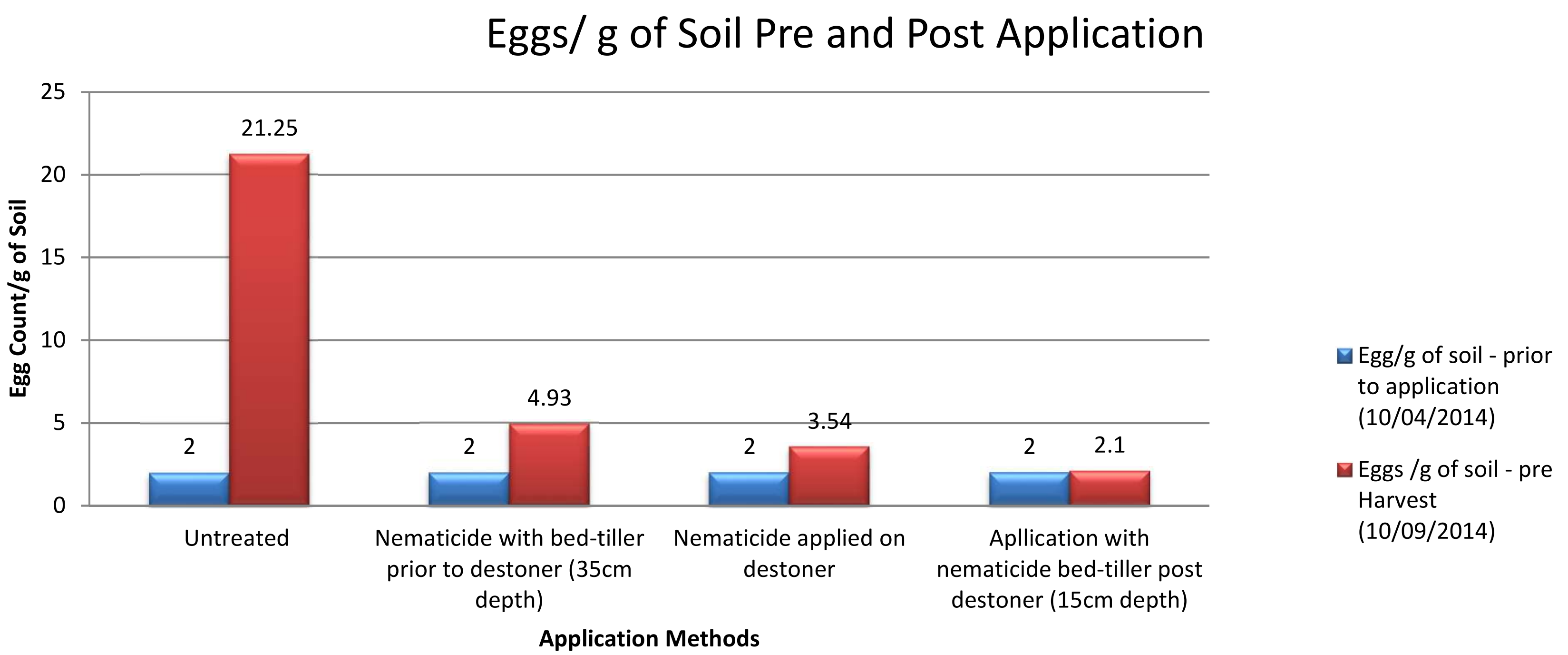
Potato Council: North West Potato Day

11th September 2014

•Asked to host NW Potato event in Lancashire to improve Knowledge Transfer within the industry/ region.

•Trails for the event partly focused on identifying best practice methods for Nematicide application, we believed we could improve application and wanted to trial this on our farm.

•The research formed part of a wider dissertation conducted by Myerscough College student, Tom Smith and the research has helped us to apply Nematicide more effectively.

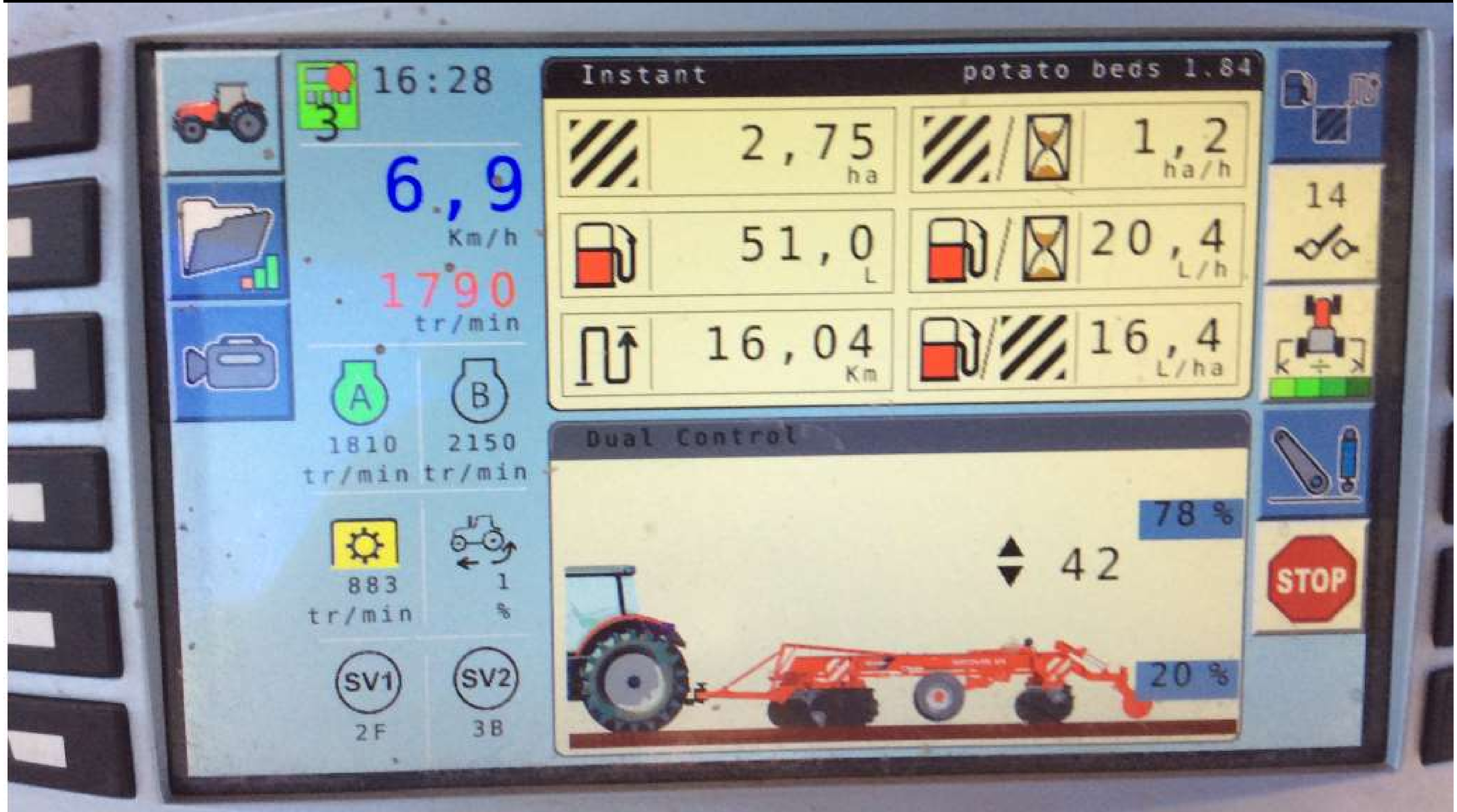



HICKEYS


STANDEN
PEARSON


MASSEY FERGUSON
GRIMME
GL 32T

2017



16:28
3
6,9
Km/h
1790
tr/min
A
B
1810
tr/min
2150
tr/min
883
tr/min
1
%
SV1
2F
SV2
3B
Instant
potato beds 1.84
2,75
ha
1,2
ha/h
51,0
L
20,4
L/h
16,04
Km
16,4
L/ha
Dual Control
78 %
42
20 %
14
STOP


09:14
0,0
Km/h
740
tr/min
950
tr/min
2150
tr/min
0
tr/min
0
%
SV1
53.0
SV2
53.0
Dual mode
Front Dual Control
STOP
100 %
40
0 %
92 %
73
10 %
In
40 %
In lenght
3,0 m
Out lenght
3,0 m
Esc

[redacted]

Andrew Webster

Thank You

Review of the day

Mike Storey / AHDB


‘Inspiring our farmers, growers and industry to succeed in a rapidly changing world’