Potato Cyst Nematode (PCN)
The Hidden Threat

Shane Kennedy,
Teagasc Potato and Tillage Advisor
Presentation Outline

• What is PCN?
• “A Pest That Requires Your Undivided Attention”
• PCN Testing
• The Current State of Play
• Avoid and Control Strategies⚠️
What is PCN?

- A parasite that invades root tissues of potato crops
- Commonly known as eelworm
- Eggs can hatch and multiply rapidly in the presence of a suitable host
- Can result in severe yield loss
- A shovel full of soil can contain 1,000,000 nematode species
Two PCN Species

Globodera rostochiensis
(yellow cyst nematode)

Globodera pallida
(white cyst nematode)

Images from AHDB Encyclopaedia of pests and natural enemies in field crops; copyright of SASA
PCN in the Field

Images from Netherlands Food and Consumer Product and Safety Authority; Department of Agriculture, Food and the Marine; AHDB; Nematology Lab, Ontario Plant Laboratories, CFIA
“A Pest That Requires Your Undivided Attention”

Dr. Matthew Back, Harper Adams University

- 9% of annual global yield loss
- Not just quality loss – complete loss
- High cost of chemical control
- Legacy effect
- Eggs can lay dormant in soil for up to 25 years
Current Legislation

• If land found positive for PCN landowner is issued with a ‘Potato Cyst Nematode Prevention Notice’
• Prohibited from growing potatoes or other listed host crops.
• Must wait a minimum of 6 years before retesting
• Includes ware potatoes ⚠
PCN Testing

- EU PCN Directive 2007/33/EC

  PCN test all **seed** potato land annually

  PCN test approx. 1% of **ware** potato land annually

The Irish Agriculture and Food Development Authority
## Ware Land Sampling 2013-2016

<table>
<thead>
<tr>
<th></th>
<th>Ware Area Sampled (ha)</th>
<th>PCN Infested Area (ha)</th>
<th>G. p (ha)</th>
<th>G. r (ha)</th>
<th>G. p &amp; G. r (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>71.54</td>
<td>7.33</td>
<td>3.21</td>
<td>4.12</td>
<td>0.00</td>
</tr>
<tr>
<td>2014</td>
<td>77.25</td>
<td>15.70</td>
<td>10.73</td>
<td>0.00</td>
<td>4.97</td>
</tr>
<tr>
<td>2015</td>
<td>85.61</td>
<td>19.67</td>
<td>19.67</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>2016</td>
<td>64.86</td>
<td>17.82</td>
<td>0.00</td>
<td>15.34</td>
<td>2.48</td>
</tr>
<tr>
<td>4 Year Avg</td>
<td>74.82</td>
<td>15.13</td>
<td>8.40</td>
<td>4.87</td>
<td>1.86</td>
</tr>
</tbody>
</table>

- Approx. 20% of tested land infested
- Historically, *G. rostochiensis* has been the dominant species in Ireland, are things changing?
The Current State of Play

Have *G. rostochiensis* levels plateaued and are *G. pallida* levels are rising?

- Bad news, because with *G. pallida*.....
  - Hatching period is longer
  - Can survive at lower temperatures
  - Less resistant varieties available
  - Slower rate of decline
  - Nematicicides are less effective
Avoid and Control Strategies

• Variety selection
• Rotation
• Chemical
• Trap Crops
• Biofumigants
• Hygiene
Resistant Varieties

• Resistance to *G. rostochiensis* is conferred by one gene
• Resistance to *G. pallida* is more complex
• Resistant varieties encourage PCN eggs to hatch but arrest PCN lifecycle and reduce PCN populations
• Planting resistant varieties can ‘clean-up’ field
What are the Resistant Varieties?

AHDB POTATO VARIETY DATABASE

http://varieties.ahdb.org.uk/varieties/index/A

THE EUROPEAN CULTIVATED POTATO DATABASE

http://www.europotato.org/varieties

The Irish Agriculture and Food Development Authority
Tolerant Varieties

- Tolerant varieties have the ability to produce high yields despite the presence of PCN
- Usually achieved through increased root mass production
- But can leave behind a greater no. of PCN cysts
- Lacking info on varietal tolerance
Rotation - modelling

• Crop rotation is important but not a cure

Chart produced by Dr. Brian Rigney using data extrapolated from British Potato Council
### Nematicicides

<table>
<thead>
<tr>
<th>Product Name</th>
<th>PCS No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eagle Green Care</td>
<td>92367</td>
<td>Nematicide</td>
</tr>
<tr>
<td>NEMGuard DE</td>
<td>05368</td>
<td>Nematicide</td>
</tr>
<tr>
<td>Nemguard Liquid</td>
<td>92307</td>
<td>Nematicide</td>
</tr>
<tr>
<td>Nemathorin 10G</td>
<td>02867</td>
<td>Nematicide</td>
</tr>
<tr>
<td>NEMguard Granules</td>
<td>92306</td>
<td>Nematicide</td>
</tr>
<tr>
<td>Vydate 10G</td>
<td>03698</td>
<td>Nematicide</td>
</tr>
<tr>
<td>Mocap 15G</td>
<td>04005</td>
<td>Nematicide</td>
</tr>
</tbody>
</table>

Correct Nematicicide Application

- If label says 15 cm and you incorporate to 30 cm then you have effectively halved the product dose
- Tuber planting depth is also important - the first roots that form should be in the treated soil
- Select a forward speed for adequate incorporation

Information and photo courtesy of Dr. Simon Woods, Harper Adams University
What is the Best Application Method?
Trap Crops

*Solanum Nigrum*
*(Black nightshade)*

Heal Farms, AHDB SPot Farm UK, August 2017

*Picture courtesy of Dr. Anne Stone, AHDB*
Trap Crops

- Members of *Solanum* family act as an alternative host for PCN but nematodes are unable to complete their lifecycle.
- ADAS/AHDB Report R468:
  - Black nightshade (*Solanum nigrum*) and garden huckleberry (*Solanum melanocerasum*) showed a 45-75% reduction in PCN numbers.
- Sticky nightshade (*Solanum sisymbriifolium*) has also been used (Foil-sis and DeCyst).
Trap Crops

- Longer growing season = greater PCN reduction
- Optimum sowing period of April to mid-July
- May require a ‘gap-year’ in cropping
Biofumigants

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

Images and information courtesy of Dr. Matthew Back, Harper Adams University

The Irish Agriculture and Food Development Authority
Biofumigants

- Indian mustard and oilseed radish have performed well in Harper Adams experiments
- Planting: ideally May-August
- >50 kg/ha N & 25-50 kg/ha S
- Destruct & incorporate at green bud/early flowering
- Flail, rotovate and roll in one pass preferably in moist soil at 10-12°C

Information source: Dr. Matthew Back, Harper Adams University
Hygiene

- PCN can spread via soil on machinery, commercial vehicles, seed potatoes, potato boxes
- Return tare soil to same field & segregate potatoes in storage by field
- Anecdotal evidence of spread via manures
- Use certified seed
- Minimise volunteers
Acknowledgements

- Various people from Teagasc, DAFM, AFBI-NI, SAC/SRUC, SASA, Harper Adams, AHDB
- Growers
National PCN Survey 2002

Globodera pallida

Mixed Species

Globodera rostochiensis

Source: Dr. Brian Rigney using data from Department of Agriculture, Food and the Marine

The Irish Agriculture and Food Development Authority
Northern Ireland PCN Survey 2002

Figure 5

PCN infested farms

- G. rostochiensis
- G. pallida
- G. rostoch/G. pallida in different fields
- G. rostoch/G. pallida in the same field

Source: Trevor Martin, AFBI
Ware Land Sampling 2013-2016

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PCN in Scotland: Recorded Infestations 2017

- 19,108 ha recorded as infested with PCN
- 150,000 ha of land used for potatoes?
- SG: 13% of Scottish potato land recorded as infested with PCN

Source: Dr. Jon Pickup, SASA, Scotland
PCN in Ware Land: 2010 - 2016

<table>
<thead>
<tr>
<th>County</th>
<th>Total area tested (Ha)</th>
<th>PCN incidence in ware land</th>
<th>PCN incidence in seed land</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANGUS</td>
<td>190.1</td>
<td>40%</td>
<td>10.2%</td>
</tr>
<tr>
<td>FIFE</td>
<td>110.2</td>
<td>36%</td>
<td>5.9%</td>
</tr>
<tr>
<td>PERTH</td>
<td>64</td>
<td>31%</td>
<td>4.6%</td>
</tr>
<tr>
<td>EAST LOTHIAN</td>
<td>48</td>
<td>58%</td>
<td>2.1%</td>
</tr>
<tr>
<td>ABERDEEN</td>
<td>42.9</td>
<td>28%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Others</td>
<td>108.5</td>
<td>15%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>563.7</td>
<td>34%</td>
<td>5.4%</td>
</tr>
</tbody>
</table>

EU 2007 Directive requirement to survey 0.5% of ware land p.a.

Source: Dr. Jon Pickup, SASA, Scotland
Avoid and Control Strategies

- Variety selection
- Rotation
- Chemical
- Trap Crops
- Biofumigants
- Hygiene
What are the Resistant Varieties?

http://varieties.ahdb.org.uk/varieties

http://www.europotato.org/varieties
# Some Variety Resistance Ratings

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<tr>
<th>Variety</th>
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<th>G. pallida</th>
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</thead>
<tbody>
<tr>
<td>Rooster</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Kerr’s Pink</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Queens</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Golden Wonder</td>
<td>low</td>
<td>-</td>
</tr>
<tr>
<td>Cultra</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Maritiema</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Maris Piper</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Markies</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Ramos</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Innovator</td>
<td>-</td>
<td>high</td>
</tr>
</tbody>
</table>
Ideally a Resistant + Tolerant Variety

Source AHDB 2018
What is the Best Application Method?