Managing small areas of clubroot infestation

Bruce D. Gossen and M. R. McDonald
AAFC, Saskatoon and University of Guelph

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No single approach effective on its own!

- Spore conc. in soil is important.
- Spore conc. is difficult to change - even fumigants do not eliminate the pathogen.
- Most strategies for reducing spore conc. are expensive - generally too costly to be applied to entire fields.
- Producers need an effective way to minimize movement of soil out of infested patches and to reduce spore conc.
Clusters of Fields with New Strains

- New types found in clusters
- Spreading to nearby fields?

(Strelkov & Hwang)
Spore Conc. after Susceptible Canola

Spores g⁻¹ soil (log)

Break following susceptible canola (years)
Resting spore conc. and pH

Incidence (%) vs. Spores g⁻¹ soil

- 5.5
- 6.0
- 6.5
- 7.0
- 7.5

Spores g⁻¹ soil:
- $1 \times 10^3$
- $1 \times 10^5$
- $1 \times 10^7$
Does moderate pH reduce clubroot?

Field with clubroot in Alberta: pH above 7.5 reduces clubroot, but otherwise the relationship is quite weak.
The graph shows the relationship between spore concentration (log) and years for both control and treatment groups. The control group is represented by black diamonds, while the treatment group is represented by green squares. The x-axis represents years, ranging from 0 to 3, and the y-axis represents spore concentration (log). The percentage of infection is marked as 100% at the bottom of the graph, with blue triangles indicating the points where the infection rate reaches 100%.
<table>
<thead>
<tr>
<th>Severity (DSI), Fumigation trial, 2015</th>
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<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>3.3</td>
</tr>
<tr>
<td>21.1</td>
</tr>
<tr>
<td>3.3</td>
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<tr>
<td>15.6</td>
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<tr>
<td>36.7</td>
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Bait crops
- Some (most?) non-host crops stimulate spore germination.
- Examined before, but in fields with high spore conc.
- Quantification has improved.

Perennial grasses
- Lots of roots, good coverage.
- Limits movement of soil.
- Area is out of production.

Cereal crops
- Lots of roots.
- Maintain cash flow.
Resting spores at 8 weeks after seeding

![Bar chart showing spores per gram of soil (x1000) for pre-plant, soil only, Norlea, Signal, and Radisson. The y-axis represents spores per gram of soil (x1000), and the x-axis represents different treatments. The chart indicates that pre-plant has the highest spore count, followed by soil only, Norlea, Signal, and Radisson with the lowest count.]

- **PCR**
- **PMA**

- **Pre-plant**: 300 spores
- **Soil only**: 100 spores
- **Norlea**: 150 spores
- **Signal**: 20 spores
- **Radisson**: 5 spores
Gossen’s Recipe for Eradicating Clubroot

• Identify and mark infested area
  – Symptomatic plants.
  – Mark x2 affected area (at least!) in every direction.
  – Exclude traffic.

• Initial treatment
  – Incorporate lime to pH 7.5 (fumigate / solarize?).
  – Seed sod-forming grass.
  – When established, traffic allowed.
  – Synergy / antagonism between pH & grass?

• Evaluate and terminate
  – Use soil sampling to monitor spore conc.
  – When levels fall enough, break sod.
  – Use only clubroot-resistant cultivars.
CCC - Manage your patch!

Field

Sanitation zone

New exit

Ditch

Grass

Club-root

Entrance

Road
Patch Management

Bruce GOSsen

Curtis RemPEL (CCC)

GOSPEL Recipe

From: Dan Orchard
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Research Activities

1) Resistance to 5X (+Y, Z, A, B, C…)
   - On-going (almost everyone doing research on clubroot)

2) Identification of pathotypes in Canada
   - Molecular approaches (Strelkov)
   - Interim differential set (Strelkov/Hwang, Gossen/McDonald)
   - Near-isogenic differentials (Yu, Peng, Gossen/McDonald).

3) Pathogen biology and physiology
   - Differentiation of molecular mechanisms of CR genes
     - RNA/Micro-RNA sequencing, proteomics, metabolomics
     - Synchrotron-based imaging (Peng/Yu, Strelkov/Hwang)
   - Split root (Gossen/McDonald)
   - 1° vs 2° zoospores (Strelkov/Hwang, Gossen/McDonald)

Questions / Comments?