Clubroot: Don’t let this yield robbing disease move into your field

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Canola Council of Canada
Clubroot World-Wide Distribution
Annual growth index for projected clubroot development based on long-term climate normals (1961–1990)
Growth Index Values

• Describe suitability of locations for species survival and reproduction

• Growth Index (GI) values
  – 0 - 10 = little or no occurrence, not economic
  – 10 - 20 = limited to low occurrence, generally not economic (limited impact)
  – 20 - 30 = routinely occurs, economic impact
  – >30 = very favourable, chronic economic impact
  – Year to year weather fluctuations will impact EI’s and potential for development and impact
    • E.g. Below versus above average rainfall in June and July
Results and learning from 2018

• Visible symptoms of clubroot have been confirmed in 43 commercial canola fields (2017 and 2018).

• The clubroot pathogen was detected at low levels in 3 fields without visible clubroot symptoms.
Clubroot biology: remains the same (but still complex)
How is clubroot spreading?

Clubroot travels where soil goes......
Water/wind dispersal of *P. brassicae* resting spores

Compiled by BD Gossen
Samples analyzed for dust/spores

- Spore concentrations ranged from 0 to $2.2 \times 10^5$ (220,000) resting spores/g soil

- Likely contributes to local spread
HOW MANY SPORES COULD THERE BE ON MY MACHINE?

100 lbs

45,359,200,000 spores

7200 acres
HOW MANY SPORES COULD THERE BE ON MY MACHINE?

600 lbs

271,500,000,000 spores

42,000 acres
YES! The dirt on your machine is a significant risk.
Clubroot ID
Clubroot Scouting
Entances and Exits…

90% chance of finding disease

23% approach

300m

15%

23% approach

300m

Road
Farm Yard Entrance
Near Grain Bins
Near Power Lines, Oil and Gas Activity
Low Areas
Clubroot Control
Clubroot Control

1. Prevent Spore Buildup
2. Reduce Spore movement
3. Scout!
### Clubroot severity at different concentrations of resting spores

<table>
<thead>
<tr>
<th>Spores Concentration</th>
<th>Description</th>
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<tbody>
<tr>
<td>&lt; 1,000</td>
<td>Mild</td>
</tr>
<tr>
<td>1,000</td>
<td>Moderate</td>
</tr>
<tr>
<td>10,000</td>
<td>Severe</td>
</tr>
<tr>
<td>100,000</td>
<td>Very severe</td>
</tr>
<tr>
<td>1,000,000</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

This will vary with soil conditions.

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Slide courtesy of Mary Ruth McDonald UoGuelph
- As galls mature, begin to decay
- Decaying galls become soft/mushy, brownish in color

Root galls can release up to $800 \times 10^6$ spores/g gall x 20 g/gall in a mature plant
(up to 16 billion spores per plant)

S.F. Hwang
Prevent Spore Build Up
Crop rotation with clubroot on yield

Yield (% of 3 year break)

- No rotation
- 1 year break
- 2 year break
- 3 year break
- 4 year break

Peng, AAFC, 2015
Clubroot Resistance
Clubroot Resistant Varieties in 2019

Proven (Nutrien)
- PV 581GC
- PV 591GCS
- PV 585GC **

BrettYoung
- 6076 CR**
- 6090 RR
- 4187 RR

Pioneer/Brevant (Corteva)
- 45H29
- 45H33
- 45CM36 **
- 45H37
- 45CM39 **
- 45CS40
- D3155C
- 1024 RR
- 1026 RR
- 1028 RR
- 2028 CL

Invigor (BASF)
- L135C
- L241C
- L234PC**
- L255PC
- L258HPC

Victory (Cargill)
- V 14-1
- V 12-3

Dekalb (Bayer)
- 75-42 CR
- DKTF 94 CR

Canterra
- CS2000
- CS2600 CR-T

** = contains a new clubroot resistance trait
Clubroot Resistance Erosion

Increase in fields with resistance not working

Fields in which new strains are confirmed

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Fields</th>
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<tr>
<td>2013</td>
<td>2</td>
</tr>
<tr>
<td>2014</td>
<td>18</td>
</tr>
<tr>
<td>2015</td>
<td>42</td>
</tr>
<tr>
<td>2016</td>
<td>64</td>
</tr>
<tr>
<td>2017</td>
<td>104</td>
</tr>
<tr>
<td>2018</td>
<td>&gt;150</td>
</tr>
</tbody>
</table>

Samples tested from SK & MB do not appear to overcome resistance

Strelkov et al. unpublished
Implications

- Emergence of new strains able to overcome resistance highlights continued vulnerability
- Loss of resistance would represent loss of most effective clubroot management tool
- Resistance stewardship is very important
  - Need longer rotations out of canola, especially where clubroot is an issue!
## Canadian Clubroot Differential (CCD) Pathotype Classifications

<table>
<thead>
<tr>
<th>Differential Host</th>
<th>Reaction</th>
</tr>
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<tbody>
<tr>
<td>ECD 02</td>
<td>- - - - - - - - - - - - - - - - - - - -</td>
</tr>
<tr>
<td>ECD 05</td>
<td>+ + + + + + + + + + + + + + + + + + + +</td>
</tr>
<tr>
<td>ECD 06</td>
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<tr>
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<tr>
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<td>ECD 13 JQ</td>
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<tr>
<td>Brutor</td>
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<tr>
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<tr>
<td>Mendel</td>
<td>+ + - + - + - - - - - - - - - - - - - +</td>
</tr>
<tr>
<td>Westar</td>
<td>+ + + + + + + + + + + + + + + + + + + +</td>
</tr>
<tr>
<td>45H29</td>
<td>+ + + + + - + - - - + + + + + + + + + +</td>
</tr>
</tbody>
</table>

### Pathotype designations

<table>
<thead>
<tr>
<th>CCD</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>X</th>
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<tbody>
<tr>
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<td>2</td>
<td>5</td>
<td>3</td>
<td>8</td>
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<td>5</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

Each unique virulence pattern on the hosts of the CCD Set assigned a different letter to designate each pathotype.
Resistance Management

- Pathogen populations can adapt in response to selection pressure

Continuous cropping of a resistance source

S.F. Hwang
Stinkweed

- Stinkweed and Shep. Purse
Prevent the movement of spores between & within fields and contain patch(es)
Minimum Tillage
Clean Inputs
Three steps in equipment sanitization:

1. Rough cleaning (90-95%)
2. Washing with pressurized water or cleaning with compressed air (95-99%)
3. Mist on disinfectant (bleach)  (99% to 99.9%)

This includes boots/tools/vehicles/other
‘Gospel’ Recipe for Clubroot Patches

• Identify and mark infested area
  – Symptomatic plants / spores in soil samples
  – Mark x2 affected area (at least!)

• Initial treatment
  – Fumigate and cover, or lime to ≥ pH 7.2
  – Seed to sod-forming grass (perennial rye)
  – Control weeds

• Evaluation and termination
  – Use soil sampling to monitor spore concentration
  – When no longer detectable, break sod
Manage Your Patch!

Field

Ditch

Road

Ditch
Manage Your Patch!

Field

Sanitation Zone

New Approach

Ditch

Approach

Road

Ditch

Grass-in

Clubroot
Soil Testing For Clubroot

- PCR – It’s either POSITIVE (+) or NEGATIVE (-)
  - What does that mean? How bad is it and where is it?
  - Labs have varying thresholds for reporting a (+)
  - A (+) result may not always cause plant symptoms
    - Environment, pH, # of spores present, etc

- qPCR – a quantitative test, which counts the number of spores per gram of soil
  - How do you interpret the results from such a difficult procedure (sample reliability, storage before analysis, lab extraction technique, lab DNA amplification technique, etc)
  - How was the sample taken
    - If a composite sample from many sites it isn’t really telling you much
    - Good for tracking the # of spores in a GPS’d location (e.g. when the # of spores is low enough to take the area out of grass or resume with canola production)
Take Home Message:

• Scout your fields
  – Find it early

• We have to start lengthening those crop rotation

• Start using clubroot resistant varieties

• ‘Don’t do nothing!’
WELCOME TO CANOLAWATCH

Canola can face many threats in the first few weeks after emergence, including flea beetles. Keep scouting!

LATEST ISSUE | JUNE 3, 2015 - ISSUE 12

JUNE 3 QUIZ — FLEA BEETLES
Four questions to test your flea beetle management...

LOTS OF RESEEDING
These canola plants are recovering 72 hours after a heavy frost. During the frost, the closest weather station to this field indicated -40°C at 4 a.m., and temperature did not get above 0°C until 9 a.m. Photo...

IN-CROP WEED MANAGEMENT AFTER A FROST
Wait for signs that canola plants have started regrowing before spraying after a frost. After a light frost, spraying could resume when the following conditions are met — A minimum of one night,..
Coming Event!

- 2019 Combine College
  - Where: Evraz Place, Regina
  - When: March 12, 2019
  - Learn about managing harvest losses, combine optimizing from major manufacturers, grading, harvest aids!

- Register at:
Thank You!

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