Managing sclerotinia stem rot in canola
Canola Research Summit
Winnipeg, MB  April 12-13, 2011

Sclerotinia stem rot strategies

• Foliar fungicides are a very important strategy for sclerotinia stem rot control
• Decision support systems – often including climatic components
• Rotation
• Fertility/ Lodging
• Field scouting & record keeping
• **Tolerance/ resistance**
Average Per Cent Sclerotinia Incidence in Canola - 2010

Sclerotinia stem rot of canola
Melfort, 1998

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Sclerotinia Incidence (%)</th>
<th>Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsprayed</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>Ronilan</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Benlate</td>
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Melfort, 1999

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<td>Benlate</td>
</tr>
<tr>
<td>30</td>
<td>25</td>
</tr>
</tbody>
</table>

Legend:
- Yellow: Unsprayed
- Red: Ronilan
- Green: Benlate
Seeding rate

LSD = NS

Seeding Rate (Kg/ha)

% stem rot incidence

A98013
Effect of rotation on sclerotinia incidence

From Report on 1997 Western Canada Canola Disease Survey, R.A.A. Morrall et al.
Effect of rotation on sclerotinia incidence

From Report on 1997 Western Canada Canola Disease Survey, R.A.A. Morrall et al.

Disease Incidence (%)

Frequency of canola in rotation (yrs)

- Sclerotinia
- Blackleg
“It’s time we face reality, my friends... We’re not exactly rocket scientists.”
Effect of nitrogen fertilizer on sclerotinia incidence in western Canada

From Report on 1997 Western Canada Canola Disease Survey, R.A.A. Morrall et al.
Fertility rate and % sclerotinia stem rot incidence

Sig. linear increase

% stem rot incidence

Fertilizer Rate

A98013
Scouting

• **Pathogen identification:** what is out there and how will it be influenced by crop management, crop development and weather?

  Pre-spray scouting
  (to determine benefit of fungicide)

• **Past experience:** what diseases occur regularly and particularly last year

  Swathing time scouting
  (to collect information for future decisions)
Sclerotinia Stem Rot Checklist

When to complete the checklist:

Fill out the checklist and assess the crop shortly after first flower. First flower occurs when 75 per cent of the canola plants have three open flowers on the main stem. Usually this occurs during the last week of June or the first week of July.

How to complete the checklist:

Read each question and circle the point value assigned to the answer you choose. Count up the points for each question and enter the total for each section. Answer all the questions in this section.

Section one:

1. Have you had good looking crops at flowering and poor yields at harvest, even though growing conditions were favorable?  
   Yes - 20  No - 0

2. Have you seen sclerotinia stem rot in your crops in previous years?  
   Yes - 20  No - 10

3. Have you heard of sclerotinia problems in your area in the past two to three years?  
   Yes - 10  No - 5

4. Have you seen black sclerotia in your harvested seed in the past two to three years?  
   Yes - 20  No - 10

5. In previous years have your canola crops lodged?  
   Heavily - 20  Moderately - 10  Lightly - 0

6. Do you see large swaths at harvest but get low yield?  
   Yes - 10  No - 0

7. If you sprayed a sclerotinia fungicide in previous years, what were the results?  
   Better crop - 20  No difference - 0

Total points for section one =

If you scored 60 or more in this section you probably had sclerotinia stem rot in your canola crops. Proceed to section two with a 60 or more score.

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### Sclerotinia Stem Rot Checklist

(For each risk factor, circle the risk points that apply to your field.)

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>POSSIBLE ANSWERS</th>
<th>RISK POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER OF YEARS SINCE LAST CANOLA CROP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than six years</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Three to six years</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>One to two years</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>DISEASE INCIDENCE IN LAST HOST CROP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Low (1 to 10%)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Moderate (11 to 30%)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>High (31 to 100%)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>CROP DENSITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>RAIN IN THE LAST TWO WEEKS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10 mm (0.4&quot;)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10 to 30 mm (0.4 to 1.2&quot;)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>More than 30 mm (1.2&quot;)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>WEATHER FORECAST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High pressure</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Low pressure</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>REGIONAL RISK FOR APOTHECIA DEVELOPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None found</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Low numbers</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>High numbers</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL RISK POINTS FOR ALL RISK FACTORS =**
Bloom staging guides

20% bloom

10%  20%  30%  40%  50%  60%

Ronilan EG
Fungicides available for sclerotinia stem rot control in canola

**Group 2** – *risk of developing resistance: medium to high*
Rovral Flo iprodione

**Group 3** – *risk of developing resistance: medium*
Proline 480 SC prothioconazole

**Group 7** – *risk of developing resistance: medium*
Lance bosalid

**Group 11** – *risk of developing resistance: high*
Quadris azoxystrobin

**Groups 9 & 12** – *risk of developing resistance: medium & low - medium*
Astound Cyprodinil & fludioxonil

**Unclassified** – *bio-fungicide*
Contans WG Coniothyrium minitans
Serenade Max/ASO Bacillus subtilis
Improved assessment of canola petal infestation

- Graduate student (M.Sc. – U of A)
- Develop a qPCR detection method for *S. sclerotiorum* present on infested petals/flowers
- Determine the relationship between the quantity of *S. sclerotiorum* DNA, agar plate petal infestation assessments, and stem rot incidence/severity
- Correlate qPCR detection, agar plate assessments and weather-based forecasts with final disease incidence/severity
- Successful deployment of qPCR in private seed testing labs for commercial use
Sclerotinia of Canola Risk Forecast for Manitoba and Eastern Saskatchewan - July 6, 1998

Risk is based on canola in 20 - 30% bloom stage.
Weather Based Assessment of Sclerotinia Stem Rot Risk in Canola

- MSc student, Ms Reanne Pernerowski
  Drs. Paul Bullock and Dilantha Fernando
- Develop a means of predicting sclerotinia stem rot based on weather conditions, allowing more accurate fungicide application timing
- Use standard weather conditions to accurately model sclerotinia incidence/severity among varying crop densities through the use of a microclimate model
- Compare disease incidence under standard weather conditions vs. conditions of continual moisture supply (misting)
- Monitor the dispersal of spores within a canola field containing various crop densities and from a neighboring wheat field
**Bacterial antagonists against Sclerotinia sclerotiorum on canola**

- 10 bacterial strains suppress:
  - Mycelial growth, ascospore germination/viability & sclerotial formation
- Broad spectrum activity
  - (*Rhizoctonia solani, Phoma lingam, Alternaria brassicae, Phytophthora infestans*)

Incorporation of bacterial metabolites into agar
Dr. Fernando’s Biological Control Program

- Identification of key genes in biocontrol (mainly genes controlling antibiotic production) from *Pseudomonas chlororaphis* strain PA23 against Sclerotinia.
- Novel regulatory gene identified in biocontrol from strain PA23 (patented).
- In-vivo gene expression of bacterial biocontrol genes under different environmental conditions to enhance biocontrol activity of *Pseudomonas chlororaphis* strain PA23.
Research to utilize sclerotinia resistance in newly identified \textit{B. napus} germplasm for cultivar improvement

Lone Buchwaldt, Dwayne Hegedus and Isobel Parkin
AAFC, Saskatoon Research Centre

A break through in sclerotinia resistance screening has enabled identification of new resistant germplasm, development of molecular markers and identification of \textit{B. napus} defense genes

1. Screening resembles natural infection of stems
2. Agar plugs with mycelium are attached to the stem with Parafilm
3. Lesion growth is measured over three weeks
4. Example of a resistant and a susceptible line
New *B. napus* lines were identified with high level of sclerotinia resistance. Figure 1 shows lines sorted from resistant to susceptible in six geographical regions.

Zhongyou 821 from China was the first resistant *B. napus* we used for development of molecular markers linked to resistance (in collaboration with four canola breeding companies).

PAK54 and PAK93 from Pakistan are currently being utilized for marker development (SaskCanola - DIAP)

Additional funding is needed to exploit resistance sources from Japan and South Korea.
Molecular markers (A1a - C9b) linked to nine QTLs for sclerotinia resistance were identified (Fig. 2). Three QTLs contributed 30 - 40% to resistance and are suitable for marker-assisted-selection in canola breeding.

Defense genes up-regulated in during sclerotinia infection have been identified (Fig. 3). Lectin and O-methyl transferase were tentatively mapped to resistance QTLs (Fig. 2). Development of gene specific markers for O-methyl transferase and other genes is in progress. Selected defense genes have been cloned and *B. napus* transformation is in progress.

Results obtained with Zhongyou 821

A unique opportunity exists to make progress in the breeding of canola cultivars with sclerotinia resistance. Additional funding will be used for development of molecular markers linked to resistance in lines from Japan and South Korea, and for identification of specific defense genes as we are currently doing in Zhongyou 821.
Summary

• Sclerotinia stem rot of canola is extremely variable in occurrence and severity from year-to-year, region-to-region and field-to-field.

• Foliar fungicides remain the main control strategy. Tools that provide guidance to growers for fungicide application exist, and research to refine these tools continues.

• Resistant/ tolerant varieties are available and efforts continue to improve varietal resistance, in both the public and private sectors.