Research on biology and control of sclerotinia diseases in Western Canada

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Contents:

Sclerotinia sclerotiorum

- Disease in Western Canada
  - Mainly on pulse, oilseed and vegetable crops
- Pathogen
  - Sclerotinia sclerotiorum (most important)
  - S. minor (no reports in commercial fields)
- Biology
  - New types of sclerotia (tan and abnormal)
  - Avirulent strains
  - Sclerotial germination
- Control
  - Biocontrol, soil amendment, and disease resistance

White mold of common bean in Alberta

<table>
<thead>
<tr>
<th>Year</th>
<th># fields surveyed</th>
<th>White mold</th>
<th>Gray mold</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>#</td>
<td>%</td>
</tr>
<tr>
<td>1983</td>
<td>17</td>
<td>13</td>
<td>77</td>
</tr>
<tr>
<td>1984</td>
<td>21</td>
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<td>1985</td>
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<td>31</td>
<td>100</td>
</tr>
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<td>1986</td>
<td>33</td>
<td>33</td>
<td>100</td>
</tr>
<tr>
<td>1987</td>
<td>25</td>
<td>24</td>
<td>96</td>
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<td>1993</td>
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<td>37</td>
<td>33</td>
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</tr>
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<td>1995</td>
<td>18</td>
<td>18</td>
<td>100</td>
</tr>
<tr>
<td>1998</td>
<td>21</td>
<td>20</td>
<td>95</td>
</tr>
<tr>
<td>1999</td>
<td>22</td>
<td>22</td>
<td>100</td>
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</tbody>
</table>

Sclerotia of S. sclerotiorum: two types of germination and two distinct diseases

Sclerotia from different hosts

Germination of sclerotia: two types
Diseases by myceliogenic germination of sclerotia

Diseases by carpogenic germination of sclerotia

Carpogenic germination of sclerotia: apothecia, asci and ascospores

Factors affecting myceliogenic germination:
1) sclerotial color
   • Role of melanized rind: tan sclerotia vs black sclerotia
   • Sclerotia from PDA cultures at 20°C for 3 weeks
Myceliogenic germination of sclerotia*:
2) sclerotial maturity

![Germination on moist sand - 1 day](image1)
![Germination on moist sand - 4 days](image2)

*Sclerotia collected from diseased sunflower plants

Myceliogenic germination:
3) sclerotial injury (physical injury, dry and wet, freezing)*

![Physical injury (moist 4 days)](image3)
![Physical injury (moist 4 days)](image4)
![Injury by wet and dry](image5)

*Sclerotia collected from diseased plant in the field

Effect of RH (%) and dry treatment on sclerotial germination and sunflower wilt*

![Germination of sclerotia (100% RH)](image6)
![Wilt of sunflower](image7)

*Sclerotia collected from PDA cultures at 20°C for 3 weeks

Carpogenic germination of sclerotia: temperature and strains

![Before cold conditioning](image8)
![After cold conditioning](image9)

Canadian strain (pea-87)
Taiwan strain (Tai)

Before cold conditioning

After cold conditioning
Both types of germination occur on the same sclerotium.

The sclerotium was from PDA culture at 10°C for 8 wks.

**Chemical components of medullar tissues**

- Amino acids (GC): 21 detected; no quantitative and qualitative differences, except tryptophan (low in abnormal sclerotia).
- 5-HT (5-Hydroxytryptamine) and 5-HIAA (5-Hydroxy indole-3-acetic acid) (HPLC).
- N scl. (high 5-HT).
- Ab scl. (high 5-HIAA).

**Abnormal sclerotia of Sclerotinia sclerotiorum**

- Medullar tissues: amber color (cell death).
- Formation: due to physiological changes.
- Reduced longevity (defective sclerotia).

**Formation of abnormal sclerotia: 5-HT (serotonin) and 5-HIAA in medullar tissues**

1986 field samples; HPLC.
Formation of abnormal sclerotia: Serotoninergic pathway

Cause of hypovirulence (HV) in tan-sclerotial strains
- dsRNA extracted: 1 = China (V), 2 = China (HV), 3 = S10 (V), 4-5 = S10 (MV), 6-9 = S10 (HV)
- Pathogenicity on canola

Biocontrol of Sclerotinia sclerotiorum by Coniothyrium minitans

Biocontrol of Sclerotinia sclerotiorum
Wilt of sunflower
White mold of bean
Pea pod rot

Field trial in Manitoba
Control of apothecia of *S. sclerotiorum* by *C. minitans* (Lethbridge, 1992)

Control of white mold of bean by *C. minitans* (foliar application) (Lethbridge, 1993)

Control of white mold of bean by *Coniothyrium minitans* (Lethbridge, 2004)

Effect of *Coniothyrium minitans* on yield and quality of bean (Lethbridge, 2004)
Protection of infection sites by *Bacillus cereus*, *C. mimitans* or *Epicoccum purpurascens*

Infection of canola pollen by *Sclerotinia sclerotiorum* (SEM)

Pollinators for control of blossom blight and pod rot (*Sclerotinia sclerotiorum*)?

• Alfalfa pollen is susceptible to mycoparasites e.g., *Coniothyrium mimitans* and *Gliocladium catenulatum*
• Use bees to enhance biocontrol of blossom rot?

Allelopathy, soil amendment and control of Sclerotinia

Manure (a resource?)

Feedlot in Alberta

Agriculture wastes: an environmental issue

Compost research, Lethbridge, AB
Water extracts of wheat and lentil straws on carpogenic germination of sclerotia

- Water
- 2% wheat extr.
- Water
- 2% lentil extr.

Soil amendment (lentil straws or CF-5*) on carpogenic germination of sclerotia

- Untreated
- 3% lentil straws
- Untreated
- CF-5*, 100 ppm

- CF-5 controlled apothecia of Sclerotinia and stimulated Trichoderma spp.

White mold resistance in bean (physiological and archetype resistance)

<table>
<thead>
<tr>
<th>Line (Class)</th>
<th>Phys. resist.*</th>
<th>Type</th>
<th>Disease incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Vauxhall 1998</td>
</tr>
<tr>
<td>AC Skipper (Navy)</td>
<td>A</td>
<td>Upright</td>
<td>20 d</td>
</tr>
<tr>
<td>L94D031 (Red)</td>
<td>C</td>
<td>Upright</td>
<td>16 d</td>
</tr>
<tr>
<td>L94F025 (Black)</td>
<td>C</td>
<td>Upright</td>
<td>-</td>
</tr>
<tr>
<td>US1140 (GN)</td>
<td>B</td>
<td>Viny</td>
<td>48 bc</td>
</tr>
<tr>
<td>NW63 (Red)</td>
<td>B</td>
<td>Viny</td>
<td>62 ab</td>
</tr>
<tr>
<td>Viva (Pink)</td>
<td>A</td>
<td>Viny</td>
<td>65 ab</td>
</tr>
<tr>
<td>L94C356 (Pink)</td>
<td>D</td>
<td>Upright</td>
<td>57 b</td>
</tr>
</tbody>
</table>

*D, least susceptible; E, most susceptible

White mold resistance of dry bean (Field, Sept 7, 1999)

- NW63 (Red) Viny, B (54%)
- UI906 (Black) Upright, A (8%)
Conclusions I.
- Sclerotinia is a versatile pathogen; understanding its biological behavior is the key to the control of this pathogen
- Biocontrol appears feasible under prairie conditions; it warrants further research efforts
- Cultural practice e.g. soil amendment is of merit
- There is a low level of physiological resistance in most hosts
- Disease avoidance by plant archetype is also useful

Conclusions II.
- Learn to treat Sclerotinia with respect
- Be humble; don't treat ourselves as Sclerotinia experts too soon!