Root Rot in Pulse Crops

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Sherrilyn Phelps, Saskatchewan Pulse Growers
Disease Triangle

Host(s)

Pathogen(s)

Environment
Root Rot Pathogens
Root Rot Pathogens

Fusarium
Pythium
Rhizoctonia
Aphanomyces

Root Rot Complex

- Can infect plant at anytime (not just at seedling stage)
- Later infections are not as visible in the field but result in lodging and harvest difficulties
Root rot pathogens

True fungi
- *Fusarium* spp.
- *Rhizoctonia solani*

Fungus-like organisms
- *Pythium* spp.
- *Aphanomyces euteiches*

• Saskatchewan samples analyzed to date always revealed *Fusarium* spp., in many cases *Aphanomyces euteiches*, and sometimes *Rhizoctonia* and *Pythium*
- *Fusarium* spp. common
- Same pathogen that causes FHB and others
Disease indicator for 2014 - Fusarium in wheat

PERCENT TOTAL FUSARIUM
ON CEREALS TESTED AT
SASKATCHEWAN SEED LABS - 2014

* indicates figure based on <10 samples.

PERCENT TOTAL FUSARIUM
ON CEREALS TESTED AT
SASKATCHEWAN SEED LABS - 2013

* indicates figure based on <10 samples.
**Aphanomyces euteiches**

- Reports on *Aphanomyces* spp. in Canada since 1938
- First confirmed report in SK in 2012
- 2014 widespread identification in soil and plant roots across SK
- Therefore, has been here but conditions weren’t favoring build of pathogen or infections until recently

Data from CDC, Discovery Seed & SK Agric. Crop Protection Labs
Aphanomyces euteiches

• Belongs to the ‘water moulds’ like Pythium (fungus-like)
• Survival of oospores in the soil without a host for up to 20 years
• Is mobile (zoospores) and can move with the water
• No chemical controls to date
Root Rot Pathogen Host Range

Species with a wider host range

– *Fusarium* spp. (e.g. *solani*, *avenaceum*, *acuminatum*, *graminearum*)
– *Rhizoctonia solani*
– *Pythium* spp.

Relatively host-specific species:

– *Fusarium oxysporum* f.sp. *pisi* or f. sp. *lentis*
– *Aphanomyces euteiches*
<table>
<thead>
<tr>
<th>Organism</th>
<th>Temperature optimums (°C)</th>
<th>Moisture favouring severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphanomyces</td>
<td>22 to 27</td>
<td>Excessive</td>
</tr>
<tr>
<td>Fusarium</td>
<td>25 to 30</td>
<td>Moderate</td>
</tr>
<tr>
<td>Pythium</td>
<td>17 to 23</td>
<td>Wet</td>
</tr>
<tr>
<td>Rhizoctonia</td>
<td>Can damage at 18 but most aggressive at 24 to 30</td>
<td>Wide range of conditions</td>
</tr>
</tbody>
</table>
Fusarium

Photo courtesy of F. Dokken-Bouchard, SMA

Photo courtesy of Dr. B. Gossen, AAFC Saskatoon
Aphanomyces infected vs healthy roots

Photo courtesy of C. Armstrong-Cho
Normal watering conditions
Fusarium vs Aphanomyces

Photo courtesy of Dr. S. Chatterton, AAFC Lethbridge
Aphanomyces Distribution in Soil

- Most concentrated at 10 to 40 cm depth in France (present in 0 to 60 cm)
- Initial study at U of S confirmed aphanomyces at 0 to 30 cm in SK (only went to 30 cm depth)
- Variable across fields and in soil profile

Dawson Detwiller: Dr. Sabine Banniza undergrad student fall 2014
Summary of root rot pathogens

• Root rot complex (Fusarium, Pythium, Rhizoctonia, Aphanomyces)

• Aphanomyces is a new issue to Sask
  – No chemical controls, very long lived, needs water
Environment
Weather patterns

2009 - last year of normal to dry conditions

2010 - 2013 – 2 years wet spring, 2 ave to wet
Forecast for 2015: Western Producer January 29

Spring planting conditions April-May 2015

Summer weather conditions June - August 2015

Source: Drew Lerner, World Weather | MICHELLE HOULDEN GRAPHIC
Symptoms... of disease or stress?

- Stunting
- Yellowing
- Poor root growth
- Little nodulation
- Browning of root area

Photo courtesy of S. Phelps, SPG
• Peas and lentil do not like wet feet
• A pea or lentil plant in wet soil is a stressed plant even without presence of pathogen

Peas grown in **sterile field soil**: left normal watering, right waterlogged conditions

Photo courtesy of Dr. Sabine Banniza, CDC
Waterlogged, sterilized vs. Waterlogged, unsterilized
Some fields – certain areas affected

Photo courtesy of Dr. S. Chatterton
Field edges – why?

Photo courtesy of S. Phelps, SPG
What are these paths from?

Photo courtesy of Dr. Sabine Banniza, CDC
Environment affects severity

**Increased severity**

- Wet condition or high moisture holding capacity
  - Heavier land
  - Compacted areas
  - Wetter areas of field (side hill seeps)

**Good Fields**

- Drier (better drainage)
  - Lighter land
  - Less compaction
Hosts
2010 - peas

2010 - canola

Photo courtesy of S. Phelps, SPG
Rotation

Photo courtesy of Dr. S. Chatterton

Peas >4 yrs ago

2010 - peas
Crop & Variety

• All pulse crops susceptible to root rot organisms (Fusarium, Pythium, Rhizoctonia)
• Soybean, fababean & chickpea have good resistance to aphanomyces compared pea and lentil
Varietal differences in resistance: Lentil

Disease severity (0-5)

- IG72815
- L01-827A
- CDC Dazil
- Eston
- CDC Greenland
- CDC Imax
- CDC Impact
- CDC Impower
- CDC Invincible
- CDC KR-1
- CDC Maxim
- CDC Redberry
- CDC Robin
- CDC Viceroy
- CDC Frontier
- CDC Meadow
Alternative pulse crops: Chickpea

- Good partial resistance to aphanomyces root rot
- Suitable for the brown and dark brown soil zone
- Ascochyta blight
  - Requires early fungicide application

www.saskpulse.com
www.agr.gov.sk.ca/chickpea-ascochyta
Alternative pulse crop: Faba bean

Dr. Sabine Banniza, CDC
Alternative pulse crops:
Faba bean

- Tolerant to wet soils and aphanomyces
- Foliar diseases:
  - Ascochyta blight
  - Chocolate spot (*Botrytis*)
  - Anthracnose

http://www.agriculture.gov.sk.ca/crops/Faba_Bean
Alternative pulse crops: Soybean

• Good tolerance to wet conditions
• Markets well developed
• Warm season crop

www.agriculture.gov.sk.ca
Resistance in pea to Aphanomyces root rot

• Extensive screening in France and USA
• USDA lines received by CDC (shown here)
• French lines currently not available until released to their farmers first
Resistance in lentil

• Preliminary testing of CDC interspecific lentil populations (*Lens ervoides*) showed some with moderate resistance (scored 3)
• Still to evaluate current varieties in SK

<table>
<thead>
<tr>
<th>Parents/Lines</th>
<th>Disease reactions</th>
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<th>Disease reactions</th>
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<tbody>
<tr>
<td>P-LR26-Eston</td>
<td>5</td>
<td>P-LR59-Eston</td>
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<tr>
<td>P-IG 72815</td>
<td>3</td>
<td>P-L01827 A</td>
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<td>LR26-12</td>
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<td>LR59-4</td>
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<td>LR26-19</td>
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<td>LR26-300</td>
<td>7</td>
<td>LR59-133</td>
<td>7</td>
</tr>
</tbody>
</table>

Dr. Sabine Banniza, CDC
Planning for 2015

Pathogen(s)

Environment

Host(s)
Prevention: Host Choice & Health

Rotation – pea/lentil once every 4 yrs (6+ if aphanomyces)

Test seed – Germ & quality, disease levels

Seed treatment
- Cool soils
- Proper method of application
- Only effective for 3-4 weeks

<table>
<thead>
<tr>
<th>Pathogen (Disease)</th>
<th>Seed Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pythium spp.</td>
<td>Allegiance FL® (metalaxyl S)</td>
</tr>
<tr>
<td>(Seed rot and damping off)</td>
<td>Belmont 2.7 FS® (metalaxyl S)</td>
</tr>
<tr>
<td>Use seed treatment if history of disease: seeding under cool/moist conditions</td>
<td>Agro FL® (capitan)</td>
</tr>
<tr>
<td></td>
<td>Apron Advance® (fluoxonil C metalaxyl-M S and thiabendazole)</td>
</tr>
<tr>
<td></td>
<td>Apron Maxx RTA/RFC® (fluoxonil C, metalaxyl-M S)</td>
</tr>
<tr>
<td>Botrytis, Sclerotinia, and Fusarium</td>
<td>Cruiser Maxx Pulses® (thiamethoxam insecticide, fluoxonil C and metalaxyl-M fungicides)</td>
</tr>
<tr>
<td>(Seed rot and seedling blight)</td>
<td>Evergo Energy® (penflufen, prothioconazole and metalaxyl)</td>
</tr>
<tr>
<td>Use seed treatment if pathogen detected over 10% on seed</td>
<td>Thiram (thiram²)</td>
</tr>
<tr>
<td></td>
<td>Trilox AL® (trifloxystrobinC and metalaxylS)</td>
</tr>
<tr>
<td></td>
<td>Vibrance Maxx RTA/RFC® (fluoxonil, metalaxyl-M and selenoxane)</td>
</tr>
<tr>
<td>Rhizoctonia solani</td>
<td>Vitaflor® products® (carbathiin and thiram)</td>
</tr>
<tr>
<td></td>
<td>Crown® (carbathiin S, thiabendazole S, C)¹</td>
</tr>
<tr>
<td></td>
<td>Cruiser Maxx Pulses® (thiamethoxam insecticide, fluoxonil C and metalaxyl-M S fungicides)</td>
</tr>
<tr>
<td>Aphanomyces euteiches</td>
<td>Evergo Energy® (penflufen, metalaxyl, and prothioconazole)</td>
</tr>
<tr>
<td></td>
<td>Vitaflor products® (carbathiin and thiram)</td>
</tr>
<tr>
<td></td>
<td>None registered</td>
</tr>
</tbody>
</table>

¹: Registered for S. cerevisiae
²: Registered for S. cerevisiae and S. pasteurianum
Prevention: Field Choice

Field selection – lighter land with good drainage

Avoid compacted areas or manage compaction

Fertility – know nutrient status & correct if needed
Prevention: Plant Health

• Healthy seedlings = better able to withstand infections or recover from stress
• Proper *inoculant* and good application methods
• Minimize damage to seed through air systems and in handling
• Roll under appropriate conditions (not wet)
• Monitor for signs of stress
• Follow herbicide labels

Photo courtesy of S. Phelps, SPG
## Prevention

1. Rotation
2. Field choice
3. Fertility
4. Seed testing/trtmnts
5. Maximize seedling vigor
6. Monitor

<table>
<thead>
<tr>
<th>Choices</th>
<th>Options for Reducing Risk of Root Rots</th>
</tr>
</thead>
</table>
| **Field Choice** | - Lighter textured soils (sandier) with good drainage  
|                  | - Out of peas/lentils for at least three years (four year rotation) and maybe up to six years if Aphanomyces positively identified |
|                  | - Manage or avoid compacted fields or areas |
| **Soil Testing and Fertility** | - Apply nutrients as needed  
|                  | - Starter nitrogen if soils <15 lbs/acre available nitrogen in top 12 inches  
|                  | - Phosphorous if seeding early into cool soils  
|                  | - Other nutrients only if deficient  
|                  | - Know the safe rates of nutrients that can be safely seed placed |
| **Seed Testing** | - Plant good quality seed |
| **Seeding Decisions** | - Apply seed treatments as warranted for seed borne disease or if planting early into cool soils (see next table) |
| **After Seeding** | - Use appropriate inoculant and good application methods  
|                  | - Choose more resistant crops - fababean, chickpea, and soybean (only for Aphanomyces root rot)  
|                  | - Minimize seed damage and watch airspeed of seeder  
|                  | - Seed into warm moist soil – the quicker the emergence the more vigorous the seedlings |
|                  | - Monitor crop for signs of stress  
|                  | - Follow herbicide labels - increased injury can occur when plants are stressed |
## Diagnosis

<table>
<thead>
<tr>
<th>Lab</th>
<th>Location</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery Seed Lab</td>
<td>Saskatoon</td>
<td><a href="http://www.seedtesting.com">www.seedtesting.com</a></td>
</tr>
<tr>
<td>BDS Labs</td>
<td>Qu’Appelle</td>
<td><a href="http://www.bdslabs.com">www.bdslabs.com</a></td>
</tr>
<tr>
<td>20/20 Seed Labs</td>
<td>Nisku</td>
<td><a href="http://www.2020seedlabs.ca">www.2020seedlabs.ca</a></td>
</tr>
<tr>
<td>Crop Protection Lab</td>
<td>Regina</td>
<td><a href="http://www.agriculture.gov.sk.ca/Crop_Protection_Lab">www.agriculture.gov.sk.ca/Crop_Protection_Lab</a></td>
</tr>
</tbody>
</table>

Individual labs may differ in testing methods and sample requirements. Please check with lab prior to sending samples.
More Root Rot Information

Root rot document: www.saskpulse.com

Contact:
Saskatchewan Ministry of Agriculture, U of S Crop Development Centre, or Saskatchewan Pulse Growers
A successful 2015!