Root Rot in Pea and Lentil in Western Canada
Root Rot of pea and lentil is a disease that affects the below ground portion of the developing plant, leading to poor performing pulse crops. The organisms that cause the disease are soil borne and can infect the plant at any stage. Unfortunately once root rot has set in, there is nothing that can be done. Understanding the disease, identifying the risks for root rot infection, and thorough planning for prevention are the only options.

Various fungal and fungus-like organisms make up the complex that cause/contribute to root rot. Other conditions can also contribute to root rot, including abiotic factors such as flooding and soil oxygen depletion. Abiotic factors can result in root cell death and symptoms that are similar to root rot, as well as facilitate infection by root rot pathogens.

**Fusarium Root Rot**

Fusarium species isolated from pulses in Saskatchewan include *F. avenaceum*, *F. solani*, *F. redolens*, *F. oxysporum*, *F. graminearum*, *F. equiseti*, *F. culmorum*, and *F. poae*. These are non-specialized pathogens that can also infect cereals, causing root rot and head blight. A distinguishing feature of fusarium root rot is a red discolouration of the vascular tissue below the soil line.

**Root Rot Symptoms**

- Poor emergence, stunting, yellowing of leaf tissue, a reduced root system, decay, and brown discolouration of roots.
- Nodules are often reduced, pale in colour, or have not developed.
- Typically occur in patches and may expand if conditions are favourable for the pathogens over several growing seasons. Symptoms are often associated with areas of flooding or waterlogging.
- Difficult to identify root rot pathogen(s) once plants are heavily damaged or dead, due to the presence of other organisms that feed on decaying tissue.
- Pathogens associated with root rot often appear in the form of a complex, where more than one pathogen is present, making identification of the primary causal agent difficult.
Aphanomyces and Pythium Root Rots

Pythium spp. and Aphanomyces euteiches are organisms that belong to a group of fungal-like root pathogens commonly referred to as “water moulds”. As the name indicates, they are particularly adapted to wet, waterlogged soils. Pythium spp. can be controlled with certain seed treatments, however there is no effective seed treatment available against A. euteiches. Because of the lack of seed treatment and the longevity of its spores in the soil, A. euteiches is the most difficult and therefore most serious pathogen among the root rot pathogens.

Water moulds produce round oospores in crop roots.

SOURCE: CROP DEVELOPMENT CENTRE

A distinguishing feature of aphanomyces root rot is the development of caramel coloured roots (below). Later, roots darken and the cortex is sloughed off.

Caramel coloured roots are a key symptom of aphanomyces root rot.
Left: Diseased plants, Right: Healthy plants.
SOURCE: CROP DEVELOPMENT CENTRE

Other Forms of Root Rot

Rhizoctonia solani is also a root rot fungus that may be present in soil. Botrytis and Sclerotinia are other pathogens that may be present on seed and able to cause seedling diseases as well.
Risk Factors for Root Rot

Stress factors that delay germination and slow emergence and growth of plants contribute to an increased risk of root rot infection.

<table>
<thead>
<tr>
<th>Stress Factors</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Conditions</td>
<td>Wet feet stresses plants and reduces rhizobial activity. Root rot fungi need water to germinate and infect roots</td>
</tr>
<tr>
<td>Cool Temperatures Early in the Season</td>
<td>Slow plant growth and slow nitrogen availability from organic matter</td>
</tr>
<tr>
<td>Shortened Rotations</td>
<td>Increase level of pathogens in soil</td>
</tr>
<tr>
<td>Heavy Textured Soils</td>
<td>More prone to waterlogging and compaction</td>
</tr>
<tr>
<td>Soil Compaction</td>
<td>Root growth impeded and less aeration</td>
</tr>
<tr>
<td>Nutrient Deficiency</td>
<td>Slows seedling growth and weakens plant</td>
</tr>
</tbody>
</table>

- Cool conditions slow seedling metabolism and root growth. This also slows mineralization of nitrogen from organic matter.
- Under cloudy skies, plants turn pale green and yellow due to reduced photosynthetic activity.
- Seed with low vigour and stressed plants are more susceptible to seedling diseases.
- Seed treatments are ineffective past the seedling stage and foliar fungicides will not work on root diseases.
- Root rots are most severe under waterlogged conditions. However, crops can be diseased even under ideal moisture conditions, and crops can also suffer due to wet feet regardless of pathogen pressure.

Key Facts:
- Plant roots and nitrogen fixing bacteria need oxygen. When the soil is saturated, roots function poorly, and *Rhizobia* activity is slow, resulting in yellow growth.

Heavy Disease Pressure
When a pathogen is able to build up in the soil due to conditions conducive for its development in consecutive seasons (such as waterlogging and tight rotations), it may continue to cause issues even when conditions return to what would be considered normal or ideal for crop production.

More than One Susceptible Crop
Depending on the pathogen, root rot can infect various crops in the rotation, or survive as a saprophyte (feeding on dead plant material) until the next susceptible crop is grown, and/or conditions are favourable for disease.
The purpose of diagnosing root rot is not to implement an immediate fix as there are no effective treatment options. However, proper diagnosis will aid in future crop management decisions and may reveal trends among varieties, crop rotations, management practices that affect the soil, or other inputs and stresses. This information also supports researchers in breeding efforts.

Send Samples to a Lab:
Diagnostic laboratories may be able to examine freshly infected roots for spores, plate samples for fungal identification, or confirm disease using DNA testing. The following labs offer analysis for root rot disease:

BDS Laboratories - Qu’Appelle, SK
306-699-2679
www.bdslabs.com

BioVision Seed Labs - Sherwood Park, AB
1-800-952-5407
www.biovision.ca

Discovery Seed Labs Ltd. - Saskatoon SK
306-249-4484
www.seedtesting.com

20/20 Seed Labs Inc – Nisku and Lethbridge, AB; Winnipeg, MB
1-877-420-2099
www.2020seedlabs.ca

Individual labs may differ in testing methods and sample requirements. Please check with the lab prior to sending samples.

<table>
<thead>
<tr>
<th>Information to Gather for Diagnosis and Discussions</th>
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</thead>
<tbody>
<tr>
<td><strong>Field History</strong></td>
</tr>
<tr>
<td><strong>Herbicide History</strong></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
</tr>
<tr>
<td><strong>Soil Information</strong></td>
</tr>
<tr>
<td><strong>Seeding Information</strong></td>
</tr>
<tr>
<td><strong>Field Information and Maps</strong></td>
</tr>
<tr>
<td><strong>Patterns in Field</strong></td>
</tr>
<tr>
<td><strong>Photos and Samples</strong></td>
</tr>
</tbody>
</table>
Phosphorus (P) is important for good root development and to support the nitrogen fixation process. Good P levels are important for early growth, especially under cool conditions associated with early seeding. Maximum safe rates of seed placed P are 20-25 lbs/acre for lentils and 15-20 lbs/acre for peas based on narrow opener (15 per cent seedbed utilization), and good moisture conditions. If higher P rates are required, banding is the best strategy.

**Seed Treatments**

Root rot pathogens can be controlled to a certain degree using seed treatments. However, fungicidal effects will only last two to three weeks against early season disease pressure.

<table>
<thead>
<tr>
<th>Pathogen (Disease)</th>
<th>Seed Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pythium spp. (Seed rot and damping off)</td>
<td>Allegiance FL® (metalaxyl S)</td>
</tr>
<tr>
<td></td>
<td>Belmont 2.7 FS® (metalaxyl S)</td>
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<tr>
<td></td>
<td>Agro FL® (captan)</td>
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<tr>
<td></td>
<td>Apron Advance® (fludioxonil C metalaxyl-M S and thiabendazole)</td>
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<tr>
<td></td>
<td>Apron Maxx RTA/RFC® (fludioxonil C, metalaxyl-M S)</td>
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<tr>
<td></td>
<td>Cruiser Maxx Pulses® (thiamethoxam insecticide, fludioxonil C and metalaxyl-M S fungicides)</td>
</tr>
<tr>
<td></td>
<td>Evergol Energy® (penflufen, prothioconazole and metalaxyl)</td>
</tr>
<tr>
<td></td>
<td>Thiram (thiram)</td>
</tr>
<tr>
<td></td>
<td>Trilex AL® (trifloxystrobinC and metalaxylIS)</td>
</tr>
<tr>
<td>Botrytis, Sclerotinia, and Fusarium (Seed rot and seedling blight)</td>
<td>Evergol Maxx RTA/RFC® (fludioxonil, metalaxyl-M and sedaxane)</td>
</tr>
<tr>
<td></td>
<td>Vitaflo® products (carbathiin and thiram)</td>
</tr>
<tr>
<td></td>
<td>Crown® (carbathiin S, thiabendazole S,C)</td>
</tr>
<tr>
<td>Rhizoctonia solani</td>
<td>Cruiser Maxx Pulses® (thiamethoxam insecticide, fludioxonil C and metalaxyl-M S fungicides)</td>
</tr>
<tr>
<td></td>
<td>Evergol Energy® (penflufen, metalaxyl, and prothioconazole)</td>
</tr>
<tr>
<td>Aphanomyces euteiches</td>
<td>Vitaflo products® (carbathiin and thiram)</td>
</tr>
<tr>
<td></td>
<td>None registered</td>
</tr>
</tbody>
</table>

1 Crown is registered for lentil but not registered for pea
2 Thiram is registered for pea but not registered for lentil
3 Includes Vitaflx 280, Vitaflx Fungicide, and Vitaflx SP

Refer to product labels and the most recent Guide to Crop Protection for more information on seed treatments.

Making informed decisions before root rot symptoms appear is the best option. Once the seed is in the ground it is important to monitor plant health by checking above and below ground portions of the plant throughout the season.
Provincial pulse organizations Alberta Pulse Growers, Manitoba Pulse Growers Association, and Saskatchewan Pulse Growers are currently funding ongoing research to determine the extent of root rot issues in the prairies, assess the impact of various factors on root rot development, develop management options, and develop new varieties with improved root rot resistance.

Get in touch with your local pulse organization to learn more.

**For More Information on Root Rot**

**Saskatchewan**

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The Crop Development Centre (CDC) is a field crop research organization within the Department of Plant Sciences at the University of Saskatchewan. CDC scientists integrate basic research with genetic improvement of spring wheat, durum, canaryseed, barley, oat, flax, field pea, lentil, chickpea, fababean, and dry bean.

To learn more about the CDC at the University of Saskatchewan, visit: www.agbio.usask.ca/research/centres-facilities/crop-development-centre.php

The Ministry of Agriculture fosters a commercially viable, self-sufficient, and sustainable agriculture and food sector. The Ministry encourages farmers, ranchers, and communities to develop higher value-added production and processing and promotes sustainable economic development in rural Saskatchewan through better risk management.

To learn more about the Ministry of Agriculture, visit www.agriculture.gov.sk.ca/

Manitoba Pulse Growers Association (MPGA) is a not-for-profit organization that represents 3,000 farmers in Manitoba who grow edible beans, peas, lentils, chickpeas, fababees, and soybeans. MPGAs mission is to provide Manitoba pulse grower members with production knowledge and market development support, through focused research, advocacy, and linkages with industry partners.

To learn more about MPG, visit www.manitobapulse.ca

Saskatchewan Pulse Growers (SPG) is a not-for-profit organization working on behalf of 17,000 pulse crop growers in Saskatchewan. SPG invests a one per cent check-off (levy) in areas such as Research and Development (R&D), Variety Commercialization, Market Promotion, and Communications to benefit the Saskatchewan pulse industry.

To learn more about SPG, visit www.saskpulse.com

Alberta Pulse Growers Commission (APG) is a non-profit organization that supports over 5,000 Alberta farmers who grow pulses, including field peas, dry beans, chickpeas, lentils, fababees, and soybeans. Through a levy based on one per cent of pulses sold in the province, Alberta Pulse Growers conducts research, administrative, marketing, and extension activities on behalf of our members.

We promote the benefits of including pulses in a sustainable crop rotation and in a healthy diet through research and marketing initiatives, all in an effort to increase the sustainability and profitability of pulse production in Alberta.

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