Identification and management of root rot of pulses

Research on root rot diseases of pulse crops is summarized to provide a brief description of the important pathogens and their management. In addition to existing tools such as seed treatment, crop rotation, and early, shallow seeding to manage root rot risk in the short term, the development of new tools, such as partially resistant cultivars and pathogen avoidance based on risk assessment of individual fields, will be important.

The root rot disease complex of pulse crops on the Prairies consists of Fusarium spp., Pythium spp., Rhizoctonia solani, and Aphanomyces euteiches. This complex causes damping-off, seedling blight, and root rot, which reduces stand establishment, nitrogen fixation, root distribution, and root vigor.

**Fusarium spp.**

Fusarium spp. are the predominant root rot pathogens on pulse crops on the Prairies. On dry bean, *F. solani f. sp. phaseoli* is highly destructive. On field pea, *F. avenaceum* is the species most frequently isolated in western Canada. On chickpea, *F. solani* and *F. redolens* are most common, and *F. avenaceum* is predominant on lentil.

Symptoms include reddish-brown to blackish brown lesions on roots, and a red discoloration of the root vascular system. The taproot may remain discolored but intact, but fine roots can be
completely destroyed, resulting in fewer nodules. Yield losses can be up to 60% in field pea and 84% in dry bean, but are normally much lower.

Root rot symptoms on field pea caused by Fusarium spp.

Seed treatments with synthetic fungicides are an effective management option for Fusarium seedling blight of pulse, but generally have little effect on root rot. Biocontrol seed treatments with activity against Fusarium root rot have been identified, and several have shown some promise, but none have been widely adopted.

On lentil, seeding in mid-May generally improved seedling establishment compared with early or late May planting dates in trials inoculated with F. avenaceum, even though the most severe root rot symptoms occurred at temperatures between 20 and 27.5°C under controlled conditions. Seeding date did not affect emergence or yield of field pea inoculated with F. avenaceum.

On field pea, research found that fields with an extended rotation interval (1 in 4 to 5 years) experienced severe root rot injury associated with F. solani f. sp. pisi and F. avenaceum, which indicated that rotation was not effective in reducing Fusarium root rot on pulses. Current research is looking into the effect of partial resistance (the best available) on Fusarium root rot.
**Pythium spp.**

Pythium spp. are important root pathogens of pulse crops, with estimates of losses as high as 50%. Pythium spp. infect seeds or seedlings before emergence, causing pre-emergence damping-off. The pathogens can also infect the seedling root and hypocotyl, causing post-emergence damping-off. Seedlings may survive root infection after emergence, but typically exhibit reduced vigor and growth. As a result, moderate to severe disease pressure often results in a patchy plant stand

Root rot symptoms caused by Pythium spp, on seed, germinating seed and young field pea seedlings (healthy plant on left).

Pythium spp. are most damaging when soils are waterlogged. Even one day of waterlogging can substantially enhance root infection, damping off, and subsequent root rot development. Acidic soil pH can reduce the formation of oospores and sporangia, so populations of Pythium spp. tend to be higher at pH ≥7.0.

Research has found that the optimum temperature for infection of field pea was 15 to 22.5°C for *P. ultimum* and 17.5 to 27.5°C for *P. irregulare*. Research found that emergence was 10 to 15% lower and seed yield was 20 to 50% lower when the crop was seeded into warm soil in late May to early June. This indicated that, on the Prairies, the crop should be seeded early to maximize yield, even where soils are infested with Pythium spp.
Seed treatment with fungicides can reduce seedling blights for 2 to 3 weeks after sowing.

**Rhizoctonia solani**

Losses in yield in inoculated trials have been as high as 79% in field pea, 88% in dry bean, 70% in chickpea, 69% in lentil, and 19% in faba bean, but losses in commercial fields are normally much lower.

Seedling infection often results in seed rot, damping-off, and seedling blight. Infection of older plants results in sunken, reddish-brown, penetrating lesions on tap roots, hypocotyls, epicotyls, and stem bases; soft rot of stems and roots in pea and faba bean; and stunting, wilting, and girdling of the stem in pea.

Late seeding into warm soil resulted in the greatest reduction in seedling establishment and the lowest yield in pea, lentil and chickpea. Deep seeding (2" versus 1" depth) also resulted in reduced seedling emergence of field pea and chickpea. Poor soil conditions, such as low fertility, compaction, and poor drainage increase the risk of pulses to Rhizoctonia seedling blight and root rot.

Treatment with systemic fungicides generally improves seedling establishment and yield in inoculated trials more than contact fungicides. In research trials, seed treatments that contained combinations of active ingredients were found to be highly effective.

Rotation with nonhost crops for at least 3 years reduced inoculum density. However, because other susceptible crops include canola, mustard, soybean, sunflower, and potato, cereals are the only nonhost crops alternative, making management with crop rotation difficult.

**Aphanomyces euteiches**

Until recently, *A. euteiches* was not recognized as a pathogen of concern on pulses on most parts of the Prairies, but it is now considered to be widespread across the region. Dry bean, field pea, lentil, and various forage legumes are susceptible, while soybean is a non-host crop, faba bean has good partial resistance, and chickpea are considered moderately resistant.

Infected pea root tissues exhibit a water-soaked, honey-brown discoloration that eventually extends throughout the root system and into the epicotyl. Infected tissues often turn black. In advanced stages, the entire root mass can be decayed. Shoot symptoms (chlorosis, wilting, and eventually death) only become obvious when root symptoms are advanced.
Root rot symptoms (healthy plant on left) of field pea caused by *Aphanomyces euteiches* (A) and oospores (B) in infested roots.

The pathogen is favored by high soil moisture, and is associated with poor drainage, heavy clay soils, and soil compaction.

In research, short-cropping rotations with susceptible pulses rapidly increased the inoculum potential in a field. Severity increased in the presence of other root rot pathogens. Current research is trying to identify crop rotation intervals that will help minimizes *Aphanomyces* root rot.

Ethaboxam (Intego Solo) seed treatment is registered for suppression of *Aphanomyces* root rot on chickpea, dry bean, lentil and field pea, but only protects seedlings.
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