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# Phytophthora Root and Stem Rot (PRR) of Soybean

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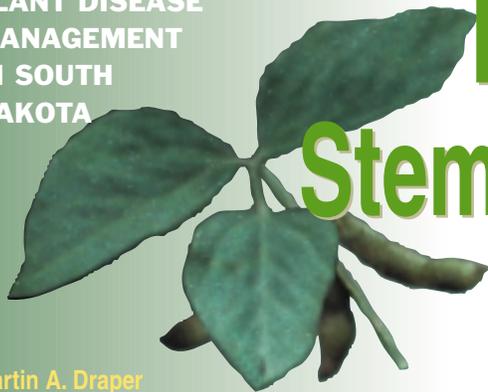
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# Phytophthora Root and Stem Rot (PRR) of Soybean

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## History and impact

Phytophthora root and stem rot (PRR) is currently the most damaging disease of soybeans in South Dakota. Statewide losses from Phytophthora root and stem rot are around 4–6% each year. The impact of the disease is affected by the rainfall patterns in a given year. Sites that receive heavy rains or irrigation may suffer substantial plant mortality and yield losses up to 100% in portions of affected fields.

The pathogen was first reported from Indiana and Ohio around 1950 and has since become widespread and common in the northern states. Crop damage may occur in the first year of planting soybeans at a location.

## Biology of the pathogen

Phytophthora root and stem rot is caused by the fungus *Phytophthora sojae*. This fungus is a water mold, or Oomycete. Two types of spores characterize this unusual group of fungi. One spore, called an oospore (Fig. 1) acts as the survival mechanism of the fungus. The thick-walled oospores may persist in soybean residue and soil for many years in the field. Zoospores (Fig. 2) are produced from infected tissue during the growing season. They also are produced when oospores germinate in the presence of a soybean crop. Oospores may remain dormant for many years. Factors that stimulate the oospore to break dormancy and germinate are not well understood. The zoospores are attracted to soybean roots by chemical signals. They swim through films of water to the roots where they infect, and the fungus subsequently grows into and among the root cells of the plant.

Infection is favored in compacted soils and in poorly drained, fine textured, clay soils where temporary flooding may occur and drainage is poor. Typically, soil temperatures must be above 60F for the fungus to germinate and infect.

Successive years of cropping soybeans on the same fields may increase the potential for damage. Studies in Iowa have shown that reduced tillage practices, especially no-till, can increase the potential for damage by maintaining a high concentration of the resting spores of the fungus in the soil layers where the root systems of the new soybean crop will grow. The disease risk is further increased because no-till soils dry out more slowly. High levels of residual nitrogen that may be present where swine manure has been injected into fields will increase the severity of PRR when soil moisture favors infection. This effect may be related to lush plant growth or stress from higher salt content in the soil.



Figure 1. These spherical structures are called oospores, the resting stage of the Phytophthora fungus.

Figure 2. Zoospores are liberated from mature oospores. They swim to soybean roots, diagonal in background of photo, where they encyst and infect.  
(Photo provided courtesy of Anne Dorrance, Ohio State University)



**SOUTH DAKOTA STATE UNIVERSITY**

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When the race of the fungus in a field is known, select a cultivar based on which specific resistance genes the variety possesses. Table 1 describes the race specific resistance that is conveyed by each resistance gene. An indication of the predominant race of *Phytophthora sojae* in a field can be deduced by the performance of resistant varieties in a field. For example, fields planted to a cultivar with the *Rps-1c* gene that still experience significant PRR suggests that race 4 is present and growers should select cultivars in the future with the *Rps-1k* gene. In the absence of testing, growers should employ the *Rps-1k* gene in a background of good to high tolerance or field resistance for the best performance. A resistant soybean cultivar such as "Dassel," will typically yield much higher than a susceptible soybean cultivar in a *Phytophthora*-infested field (Fig. 9).

### FUNGICIDE TREATMENT

Fungicides also can be used to reduce losses by PRR, but not all fungicides are active against PRR. Only metalaxyl and related fungicides such as mefenoxam and oxadixyl are highly effective against *Phytophthora* and related water-mold fungi.

Fungicides most often are delivered as seed treatments. When applied to the crop as seed treatments, lower, more affordable rates can be used. Typically a higher seed treatment rate is needed to be effective against *Phytophthora* than would be used to control *Pythium damping-off*. Seed treatment products include metalaxyl (Allegiance), oxadixyl (Anchor), and mefenoxam (Apron XL).

Fungicides also can be applied to the soil as a band application over the row. This treatment is rarely used in narrow-row planted beans, because the treatment essentially becomes a broadcast treatment and less affordable. Ridomil Gold is the product used for this treatment. When soybeans are planted in wide rows, band applications of metalaxyl have been shown to be highly effective against PRR. This effect is particularly apparent on compacted soils (Fig. 10).

Photos 1, 3-7 by M. A. Draper

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Figure 9. Effect of PRR on susceptible and resistant soybean cultivars grown on compacted and non-compacted soils.

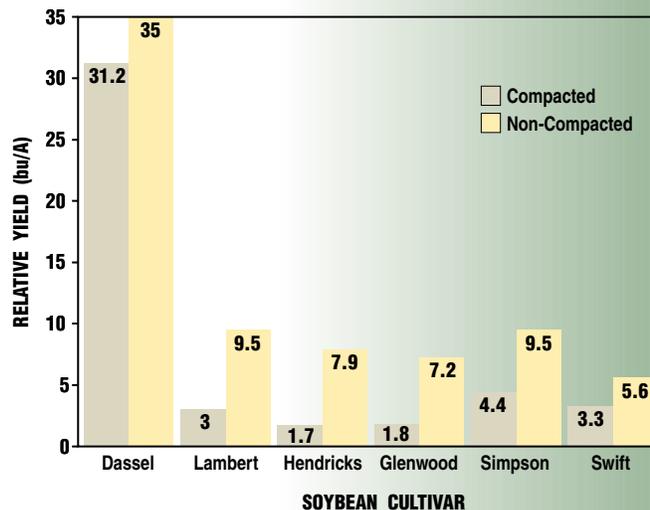


Figure 10. The effect of soil applied metalaxyl in compacted and non-compacted soil in resistant (R), tolerant (T), and susceptible (S) cultivars.

