AC-17-02

THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

Plant Pathology, 2021 Coffey Road, Columbus, OH 43210-1087

Phytophthora Damping Off and Root Rot of Soybean

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Phytophthora damping off and root rot have been the most destructive diseases of soybeans in Ohio for more than 40 years. When rainfall saturates fields soon after planting, severe seedling kill can result in yield losses greater than 50% in individual fields. Phytophthora seed rot and pre-emergence damping off are one of the major causes of replanting on heavy soils. Historically, statewide yield losses average 11% in years with wet springs and 8% in years with more normal planting seasons.

The disease is most severe in poorly drained soils with high clay content. Traditionally, the northwest section of the state has had severe problems with Phytophthora damping off and root rot. With the increased use of no-tillage and reduced tillage residue management systems, however, Phytophthora damping off and root rot has become a serious problem in other areas of Ohio as well. The soil-borne pathogen that causes this disease (*Phytophthora sojae*) can be found in most agricultural soils in the state.

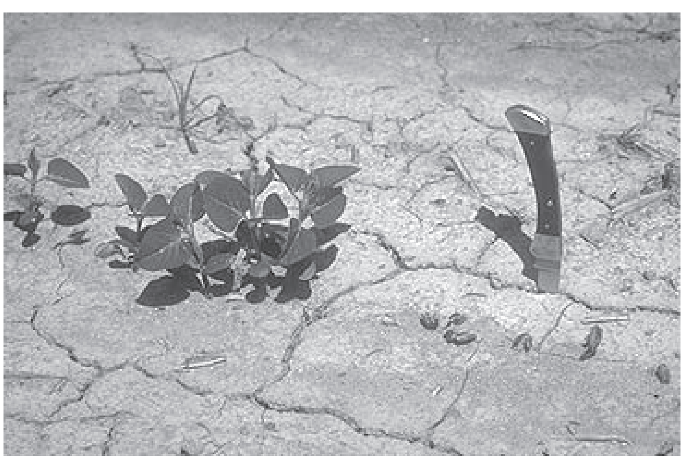


Figure 1. Phytophthora damping off in field.

Symptoms

Phytophthora can attack soybean plants at any stage of development. Symptoms in young plants include rapid yellowing and wilting accompanied by a soft rot and collapse of the root. More mature plants generally show reduced vigor and may be gradually killed as the growing season progresses. Foliar symptoms on older plants occur as general yellowing of the lower leaves that progresses upward on the plant, followed by wilting and death.

The root system is usually severely affected such that lateral and branch roots are almost completely discolored. Tap roots show a brown discoloration on the surface and, if split, the inner tissues show a tan to brown discoloration. Perhaps the best diagnostic symptom of the disease on susceptible varieties is a lower stem discoloration that may extend several nodes up the stem.

Figure 2. Phytophthora stem rot—adult plant showing stem discoloration.

Symptoms on varieties with partial resistance are not as evident as on highly susceptible varieties. When the soil becomes saturated soon after planting, varieties with partial resistance may be subject to damping off and root rot. However, when infections occur later in the season, the extent of the root damage will be restricted, and there will be no development of the girdling stem lesions as in susceptible varieties.

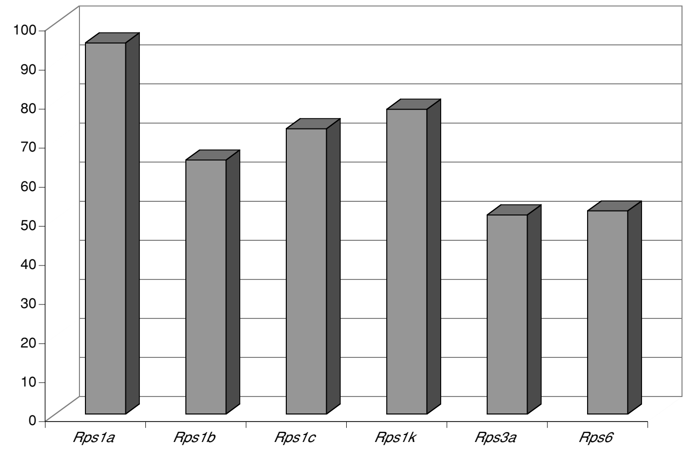
The Pathogen

The disease is caused by *Phytophthora sojae*. This pathogen survives as thick-walled resting spores, called oospores, which can persist for years in the soil. During periods of adequate soil moisture and temperature, oospores germinate to form structures called sporangia. When the soil becomes saturated, sporangia release small swimming spores called zoospores, that are attracted to the soybean roots, to which they attach and germinate. Phytophthora then invades the root and grows within the soybean root cells.

Conditions favorable for infection occur most often on heavy clay soils with poor drainage. Phytophthora can attack plants at soil temperatures above 50 degrees F, but severe disease generally occurs when soil temperatures are 60 degrees F or above.

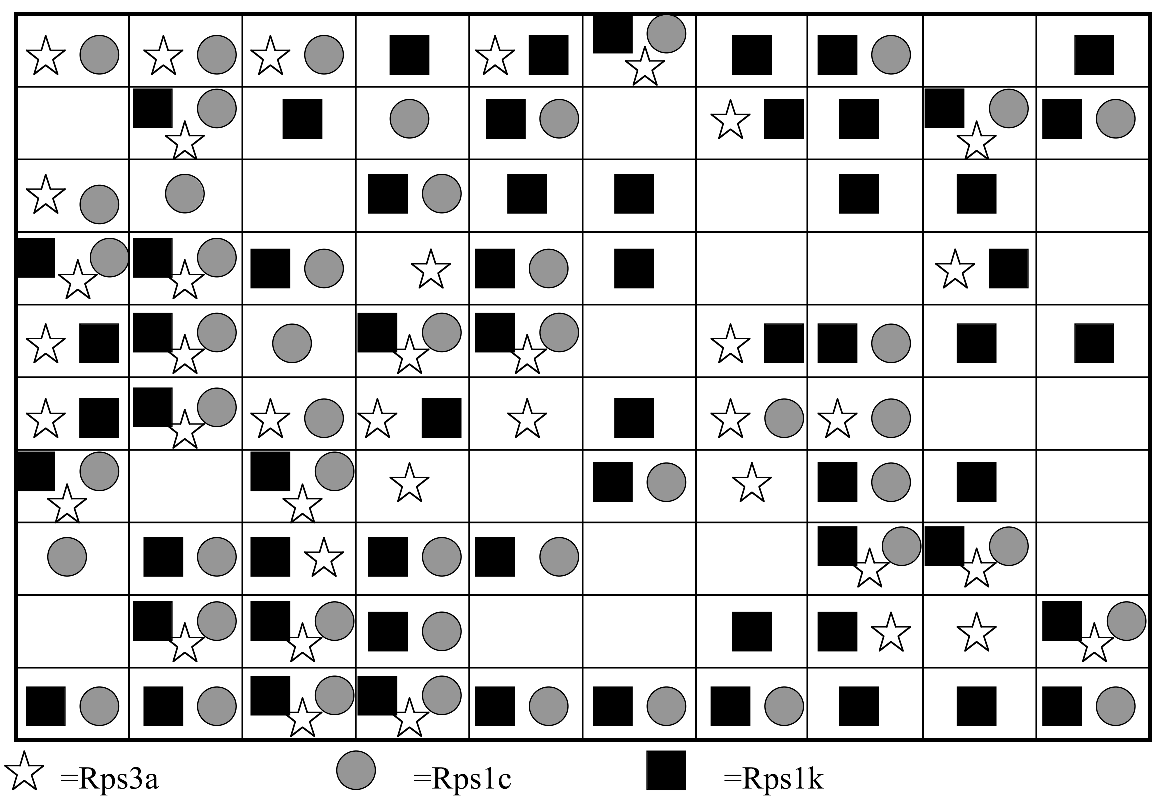
Phytophthora exists in soils as populations of different races. Over 70 different races of *P. sojae* have been detected in Ohio soils. *P. sojae* has been recovered from 82 of 86 fields taken from 20 Ohio counties. The tremendous variability in the *P. sojae* populations from these fields indicate that many *Rps* genes are no longer effective. The final outcome is that *P. sojae* populations in Ohio have adapted to many of the commercial *Rps* genes that are currently available in soybean cultivars.

Figure 3. Percent of locations where Phytophthora could kill plants with respective *Rps* gene.



Phytophthora sojae populations are in the midst of a race shift in Ohio. This means that not every individual can cause disease on a plant with an *Rps* gene. Figure 4 illustrates a *P. sojae* population in one field in Ohio

Figure 4



where 100 soil cores were collected, spaced 100 feet apart. *P. sojae* could be recovered from 82 of the 100 cores indicates a very high population. Next we analyzed this field for race type or pathotype. The squares indicate those locations where the *P. sojae* killed plants with the *Rps1k* gene; circles, *Rps1c*; and stars, *Rps3a*. From this field map we can see that any single gene would provide protection in 50% of the locations in the field, but not all.

Management

1) Choosing the right variety is extremely important when attempting to manage Phytophthora root rot. There are two different types of genetic resistance available in soybean varieties. Race-specific resistance is effective against certain races of the pathogen. The genes for resistance are designated as *Rps* genes. The second type is partial resistance. Partial resistance is effective against all races of *P. sojae*, but the level of resistance is not complete so some level of disease does occur. In problem fields it is best to choose varieties with race-specific resistance combined with partial resistance to achieve better levels of control. Plant resistant varieties that have race specific resistance and/or partial resistance in areas where Phytophthora has been a problem in the past. Varieties are available with resistance genes *Rps1*, *Rps1c*, *Rps 1k*, *Rps 3*, or *Rps 1b+ 3*. Only the *Rps 1k Rps 1c, Rps 3a* or gene combinations of *Rps 1k+3a* or *Rps 1c+ 3a* will be effective against the majority of populations that exist in Ohio. There are an increasing number of fields in Ohio in which single *Rps* genes of *Rps 1k* or *Rps 1c* will not be effective due to the adaptation of the pathogen to these *Rps* genes. In those fields where Phytophthora is a severe problem, combinations of *Rps* genes with partial resistance are essential.

Table 1 illustrates the information in the Ohio Soybean Performance Trial report available at all Ohio State University Extension offices or on the Ohio State University web site Ohioline (**http://ohioline.osu.edu**). For every variety listed, the *Rps* gene it has is listed in the resistance gene column. Choose the *Rps* genes that have provided control for your fields. If you had replant problems or if there are areas where stem rot has developed late in the season, then select a variety with a gene combination. If *Rps* genes do not provide adequate control or you are unsure, select varieties with highest levels of partial resistance. These would be scores of 3.5 to 4.5 (these scores are the highest and point to the best levels of partial resistance).

2) An essential step to control Phytophthora root rot is to improve soil drainage so that flooding is eliminated or minimized. Use cultural practices that reduce soil compaction and improve drainage. Improving drainage is particularly important in no-till soils that retain moisture and require less precipitation to saturate the soil. Phytophthora zoospores are produced only in saturated soil; if soils are not saturated early in the season, varieties with partial resistance will escape disease and remain disease-free throughout the season.

3) In areas where Phytophthora root rot is a consistent problem, fungicide seed treatments can be used to reduce the early season damping off. To achieve the maximum performance out of soybean varieties with partial resistance, it is important to treat the seeds of these varieties with Allegiance or Apron XL prior to planting. These

Table 1. Sample Soybean Performance Chart *(for illustration only)*

				Phytophthora		
Variety	Relative Maturity	Plant Height	1000 seeds/lb	**Resistance Gene (*Rps*)**	**Partial Resistance***	Yield Bu/acre
46K92	2.3	33	2.5	1k	6.0	55.4
FGA36	2.7	33	2.2	1k + 3a	4.0	65.8
D299T	3.3	40	2.9	1c	4.0	65.5
32C01	3.1	30	2.8	3a	8.0	55.0
T2120	2.7	36	3.5	1c + 3a	7.0	63.0
Slade	2.8	33	3.0	1k	4.0	64.3

**3.0-3.9 = high partial resistance, 4.0-5.9 = moderate partial resistance, 6.0 and above = very susceptible*

Figure 5. Phytophthora seed treatment low rate.

Figure 6. Phytophthora seed treatment high rate.

fungicides are highly specific for control of Phytophthora damping off of seedlings. Any one of these seed treatments in combination with genetic resistance provides one of the best options for limiting losses from this disease. To control Phytophthora damping off, especially in poorly drained fields to be planted no-till, the higher rates of these fungicides should be applied.

4) Avoid applying high levels of potash, manure or municipal sludge immediately before planting. The chloride applied with potash, the nitrate applied with municipal sludge, or salt applied with manure will result in more severe root rot. Application should be made in the fall to allow for leaching of soluble salts. Avoid concentrating manure or municipal sludge in specific fields. Spread applications over all fields rather than concentrating on fields close to the source.

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