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Plant Pathology Fact Sheet

Charcoal Rot of Soybean

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Importance

Charcoal rot is a soil-borne fungal disease that is most evident in soybean plants as they approach maturity. While most fungal diseases of soybean are diminished when hot, dry weather prevails, charcoal rot is favored by these conditions. This disease is also worsened in plants weakened by such conditions as poor soil fertility, excessive seeding rates, soil compaction, and insect damage. Yield can be severely compromised by charcoal rot; however most producers tend to attribute low yields in dry years to the lack of soil moisture. Thus, growers may not realize that charcoal rot has also taken a significant toll.

Symptoms and Signs

After flowering, the surface tissues (epidermis) of the lower stems of affected plants usually exhibit a light gray or silvery discoloration and stems often have a shredded appearance (Figure 1). When the epidermis of lower stems and taproots is removed (by scraping with the thumbnail), extremely small, jet-black fungal structures called microsclerotia will be found embedded in the diseased tissue (Figure 2).

Figure 1. The shredded appearance of Charcoal Rot infected root/lower stems is common late in the season.

Figure 2. The tiny black specks embedded in the stem tissue are microsclerotia of the Charcoal Rot fungus.

Microsclerotia are usually so numerous that they resemble charcoal dust, hence the name of the disease. Splitting the taproot often reveals dark gray to blue-black streaks within (Figure 3).

The earliest symptoms of charcoal rot include smaller than normal leaves, leaf rolling, and wilting during the heat of the day.

FIGURE 3. INTERIOR STEM STREAKING IS OFTEN ASSOCIATED WITH CHARCOAL ROT.

Ultimately, premature death of affected plants is common. Symptoms tend to occur first in small groups of plants (FIGURE 4), often on ridge slopes/tops where soil is thin and along the edges of fields, especially where there is competition for soil moisture by bordering trees. In dry seasons, entire fields may show signs and symptoms of charcoal rot.

DISEASE DEVELOPMENT

The causal fungus, *Macrophominia phaseolina*, is present in all agricultural soils in Kentucky. Infection is favored by abundant soil moisture early in the season. Under these conditions, plants are infected during and shortly after seedling emergence. In fact, 80% to 100% of the plants in a field can be infected within 2 to 3 weeks of planting. These infections remain largely dormant and plants are symptomless unless high temperatures and low soil moisture coincide with plants in the reproductive stages.

The fungus survives between seasons as microsclerotia in plant debris or soil. Microsclerotia are very durable and cannot be eliminated from a field; however, their population in the soil can be lowered using certain cultural practices, as described below.

DISEASE MANAGEMENT

Because of the widespread distribution of *M. phaseolina* in Kentucky soils, and due to the near uniform susceptibility of soybean varieties, excellent control of charcoal rot is not possible when growing conditions favor infection and subsequent disease development. However, some success can be achieved when conditions are moderately favorable to the disease.

Crop rotation

Affected fields should be rotated out of soybeans for 1 to 3 years. Select non-hosts (such as cereals) or crops that support relatively reduced levels of microsclerotia in the soil (such as corn or grain sorghum). This practice may help diminish charcoal rot by lowering overall soil populations of the fungus.

FIGURE 4. AN AREA OF A SOYBEAN FIELD WITH STUNTED, DYING PLANTS RESULTING FROM CHARCOAL ROT.

Moisture management

Limiting drought stress is the best way to escape serious problems with charcoal rot. If irrigation is feasible, water fields when dry weather occurs during the soybean plants' reproductive stages. Planting soybean no-till can help conserve soil moisture and encourage slightly lower soil temperatures.

Seeding and fertility

Avoid excessive seeding rates and maintain adequate soil fertility to promote plant health and reduce the impact due to the disease.

Cultivar selection and maturity group

While all soybean cultivars are equally susceptible to charcoal rot, it may be possible to avoid this disease by planting early maturity groups early. In some years this may allow the crop to miss the most stressful growing conditions. According to University of Kentucky grain crops specialists, planting soybean cultivars belonging to maturity group 2 during late April, for example, provides the best chance of avoiding drought during the R1 to R7 reproductive stages. However, it must be noted that early cropping systems come with the additional risk of other problems, which is one reason why the combination is not widely adopted in Kentucky. Planting a late maturity soybean late may also work in some years, but the risk of an early freeze makes this option less desirable than the former one.

Scouting

When conditions are highly favorable for charcoal rot, there is often very little that could have been done to prevent serious yield loss. However, information gleaned from scouting will help in making future management decisions that might lower charcoal rot risk in subsequent crops. Growers are encouraged to walk some of their lower yielding fields after harvest and look for the tell-tale signs of charcoal rot in the remaining crop stubble. This is very easy to do since signs and symptoms of the disease (microsclerotia and streaking) are easily visible to the unaided eye.

Additional Resources

The following University of Kentucky publication is available at County Extension offices, as well as on the Internet.

- Kentucky Integrated Crop Management Manual for Field Crops: Soybeans, IPM-3 (2009)
http://www.uky.edu/Ag/IPM/manuals/ipm3soy.pdf

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Photos by Paul Bachi (Fig. 1, 2 & 3) and Don Hershman (Fig. 4), University of Kentucky