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KEY POINTS:

- Charcoal rot thrives in the hottest, driest part of the growing season when soybean plants are under stress.
- Scraping the outer stem tissues reveals black, dusty microsclerotia - a diagnostic symptom of charcoal rot.
- Charcoal rot may cause moderate to significant yield loss, depending on disease severity and environmental conditions. Producers may attribute low yields to drought and not realize the significant effect of the disease.

DISEASE FACTS

- Caused by the soil fungus *Macrophomina phaseolina*; infects the roots and lower stems of soybeans.
- Has a wide host range of over 500 plants, including soybeans, corn, sorghum, alfalfa and sunflower.
- Is also called “summer wilt” or “dry-weather wilt.”
- Commonly found throughout the U.S. where hot, dry conditions occur.
- Prefers soil temperatures as high as 80 to 95 °F (27 to 35 °C).
- Can even occur when irrigation is limited after R1.
- Is most evident as soybean plants reach maturity, though it may also appear on young plants.

Disease Development

- Fungus overwinters in dry soil or residue of host plants and can be spread in contaminated seed.
- Infection of soybean plants typically occurs early in the spring when soil moisture is high.
- Disease can manifest early if weather is hot and dry, but symptoms usually occur later in the summer during reproductive growth stages.
- Disease thrives in the hottest, driest part of the growing season when plants are under stress.
- Microsclerotia (hardened fungal survival bodies) are formed in infected tissue of soybeans and other hosts.
- The fungus can survive on available nutrients in plant debris or in the soil, or by infecting alternate hosts.



Early symptoms of charcoal rot

SYMPTOMS

- Symptoms usually begin during the reproductive stages of soybean development and are first evident in the driest areas of the field.
- Earliest symptoms include smaller than normal leaves, reduced vigor, premature yellowing of top leaves and plants wilting during the midday heat.
- A light gray discoloration develops on the surface tissues of the roots and lower stem.



Outer stem symptoms of charcoal rot

- Scraping the outer tissues reveals black, dusty micro-sclerotia - a diagnostic symptom of charcoal rot.
 - A hand lens is useful in detecting microsclerotia.
- As drought persists and charcoal rot progresses, plants reach the permanent wilt point and die prematurely.



Plants dying due to charcoal rot infection

IMPACT ON CROP

May cause moderate to significant yield loss, depending on disease severity and environmental conditions.

- Under severe infection and hot, dry conditions:
 - Seedlings to early reproductive plants may die or be severely stunted (see image at right).
 - Entire fields may show disease symptoms.
- Under more moderate infection and conditions:
 - Root mass is reduced, decreasing drought tolerance.
 - Plants have smaller leaflets and reduced vigor.
 - Wilting of plants is common; pre-mature death may occur.
 - Pods abort and seeds are fewer and lighter, reducing yield.
- Seed quality may be reduced; seed may crack and shrivel and microsclerotia may form in fissures.
- Producers may attribute low yields to drought and not realize the significant effect of the disease.



Infected soybean plant at harvest, showing stem symptoms and reduced yield (low number of pods and seeds).

- **Variety Selection** – No highly effective sources of resistance are currently available in commercial soybean varieties.
- However, soybean varieties differ in tolerance to charcoal rot drought complex.
 - Variety scores range from 3 to 7 on the Corteva Agriscience 1 to 9 scale (1 = susceptible, 9 = resistant).
 - Scores are based on Corteva Agriscience research observations of the comparative ability to tolerate drought and limit losses from charcoal rot infection among various soybean varieties.
 - In fields with a history of infection, avoid using the most susceptible varieties with scores of 3 or 4.
- Corteva Agriscience soybean breeders are using new genetic sources and implementing new screening methods to improve future charcoal rot tolerance in commercial varieties.
- **Irrigation**, where available, helps reduce drought stress, (especially important during reproductive stages R1 to R7).
- **Scouting** – Scout to determine tolerance of varieties to charcoal rot and note for next year's variety decisions.
- **Seeding and Fertility** – Avoid excessive seeding rates and maintain adequate soil fertility levels (especially potassium) to reduce disease incidence and severity.
- **Chemical / Biological** control measures are currently not available to help manage charcoal rot.
- **Reduced Tillage** systems may help conserve moisture but also increase disease inoculum in crop residue.
- **Weed Management** – Controlling weeds reduces alternate hosts and competition for available soil moisture.

MANAGEMENT

- An integrated management approach is required to reduce microsclerotia levels in the soil and stresses to the crop.
- **Rotation** can help ease but not eliminate problem.
 - Rotating to corn or wheat can reduce inoculum levels.
 - Two years away from soybeans suggested in severe cases.

CREDITS

Images and review by Larry Osborne and Jim Boersma, Field Agronomist and Product Agronomist, respectively.

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