

Charcoal Rot in Sorghum

Conditions Conducive to Charcoal Rot Development

Hot temperatures with drought stress favor infection by the charcoal rot fungus (*Macrophomina phaseolina*). (Indeed, charcoal rot disease was first noticed in the United States during the Dust Bowl's consecutive years of drought.)¹ These tough conditions, especially when they occur after flowering, encourage charcoal rot infections to begin during the early milk to late-dough stages of sorghum growth.²

Additionally, the severity of charcoal rot is affected by several common stresses: a high plant population for the environment, the presence of foliar disease, insect feeding, and nutrient imbalance. *M. phaseolina* is an opportunistic pathogen that infects weakened stalks.³ Sorghum crops with shallow root systems are predisposed to drought stress and infection from this ever-present fungus.

Symptoms in Sorghum

Initial charcoal rot infection appears in roots and stalks as water-soaked lesions. These lesions soften while gradually turning brown to black in color (Figure 1). Lesions can be continuous or disjointed, but always spread vertically with plant growth. Susceptible sorghum products may have severe infections with lesions nearly reaching the grain head. Infected roots may be black and water-soaked in appearance.

Internally, infected stalks appear shredded at the soil line and above. The pith and cortical tissue deteriorate while tough vascular strands remain (Figure 2). Growers can distinguish charcoal rot from similar stalk rot symptoms by identifying black, dusty, pepper-like microsclerotia (fungal structures) present in the lower six to eight inches of the stalk.^{1,2}



Figure 1. Outer stalk and internodes show darkening from charcoal rot infection.



Figure 2. Microsclerotia and shredded pith tissues weaken stalks.

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Effects on Sorghum

Charcoal rot is a systemic infection affecting roots, stalks, phloem tissue, and xylem tissue. The weakened stalks do not allow water or nutrients to move vertically and prevent photosynthates from moving to the grain. Stalks break at the point of infection—often the crown or collar—leading to lodging late in the growing season. Additionally, stalks infected with charcoal rot can vertically split causing plants to quickly lose moisture.³ Sorghum growers using the stover as a forage or fodder find affected sorghum stalks are drier and less sweet after storage.

Yield potential diminishes as infected plants cannot properly fill grain. Fewer seeds per panicle and lighter seed weights develop in charcoal rot infected plants. Grain yield losses of 70% have been approximated, along with completely lodged fields.¹

Disease Defense

- Avoid moisture stress: encourage deep root growth or sustain soil moisture levels with irrigation
- Choose plant populations to match the available moisture: high plant populations can strain moisture levels and predispose sorghum to lodging
- Balance nitrogen and potassium fertility: a nutrient imbalance of high nitrogen and low potassium levels should be corrected with a fertility program^{2,4}
- Scout: sorghum fields should be scouted toward the end of the growing season for signs of charcoal rot
- Make infected fields a harvest priority: lodging can be severe in infected fields, and harvestability could be compromised by small panicles

Sorghum Product Selection

Though crop rotation is typically a best practice for disease management, *M. phaseolina* can infect 500 host species.¹ A broad host range combined with infectious microsclerotia that can survive in the soil for 15 years means crop rotation is not a reliable management strategy for *M. phaseolina*. Sorghum products with tolerance to abiotic (environmental, weather, physical, or chemical) and biotic stresses (pathogens, insects, feeding injury) are essential for dryland production. Key sorghum product characteristics to consider include:

Roots. Deep-rooted sorghum products help retrieve moisture. Roots play an important role in charcoal rot infection because microsclerotia germinate at 86 to 95 °F temperatures while in the presence of sorghum root exudates.¹

Staygreen and Stalk Strength. Delayed senescence after flowering, or staygreen, has historically been attributed to delayed onset of charcoal rot and less severe infections. This is because *M. phaseolina* can rapidly colonize and spread in dying tissues, so delayed senescence can delay disease onset. Additionally, selecting the correct seeding rates and row widths can help increase sorghum stalk strength and its ability to withstand infection.

Earliness. Choose products with early flowering and maturity. Where unavailable, an earlier planting date helps avoid extreme mid-growing season heat stress. Escaping abiotic stresses has been an effective disease management practice for sorghum growers in other countries.³

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Figure 3. Sorghum field with severe charcoal rot and premature senescence.

Conclusion

Charcoal rot is one of the main yield-robbing diseases in dryland sorghum production. Avoiding this soil-prevalent fungus through crop rotation is not a reasonable option. Because *M. phaseolina* spreads quickly in senescing tissues, managing this disease requires limiting or escaping stresses leading to premature senescence.

Sources

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Performance may vary, from location to location and from year to year, as local growing, soil and environmental conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on their growing environment.

The recommendations in this material are based upon trial observations and feedback received from a limited number of growers and growing environments. These recommendations should be considered as one reference point and should not be substituted for the professional opinion of agronomists, entomologists or other relevant experts evaluating specific conditions.

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