**CAUSAL ORGANISM**
Fungus: *Macrophomina phaseolina*

**COMMON NAMES**
Charcoal rot; dry weather wilt; summer wilt

**HOST RANGE**
This fungus has an extremely broad host range which includes *Glycine max* (soybean), *Helianthus annuus* (sunflower), *Phaseolus vulgaris* (common bean), *Sorghum bicolor* (sorghum), *Zea mays* (maize), *Gossypium* (cotton), *Nicotiana tabacum* (tobacco) and a range of vegetable crops.

**IMPORTANCE**
This disease is economically important throughout the world, particularly in arid maize growing regions where extensive yield losses occur when the crop is infected early. Yield losses as high as 70% have been documented in Africa. The disease is particularly prevalent in drought years and in arid regions where maize is regularly cultivated in rotation with other host crops. The disease is heat and stress (drought) driven and is therefore rare in cooler climates and irrigated fields. Increased losses may be experienced where maize is mechanically harvested due to lodging.

Charcoal rot is not new to South Africa but a high incidence of this disease was observed on maize in the Free State and drier North West Province areas during the 2007/08 season. This has serious implications on the selection of follow-up crops since crops like sunflower and soybeans are also seriously affected by the disease. Crop rotation with susceptible crops could thus lead to more problems should a dry spell occur in the latter part of the season.

**DISEASE INFORMATION**
The severity of disease caused by *M. phaseolina* in various hosts is associated with high soil temperatures (30-42°C) and low moisture or when unfavourable environmental conditions stress the plant. Maximum infection occurs in plants subjected to moisture stress during the post-flowering period. Post-flowering stresses due to high plant population or drought coupled with heavy applications of nitrogen fertiliser, hail or insect damage promote disease development. The disease is especially widespread during extremely hot and dry seasons.

Charcoal rot overwinters or survives as resting structures (microsclerotia) on lower stem residues that remained in the field after harvesting. The main risk of dispersal is by the movement of soil, contaminated with microsclerotia, on tractors, ploughs and other farm machinery and packing material.

The alternate hosts are also a major source of inoculum causing infection in the following seasons. The incidence of seedborne infection is generally low, with no strong evidence to suggest transmission by seeds.

**SYMPTOMS**
In maize, early symptoms of this disease are similar to those caused by Fusarium (Gibberella) or Diplodia stem and root rot. After flowering, initial symptoms are the abnormal drying of upper leaf tissue, stem lodging and premature death.

When plants approach maturity, the lower stem internodes (usually limited to the first 5 nodes) show a typical charcoal, grey-black discolouration which often gives the whole land a black appearance (Fig.2). When the stem is cut open numerous minute black specks (microsclerotia) are visible on the shredded vascular bundles and on the inside of the stem (Fig. 1), giving the interior parts of the stem a charred appearance. These survival bodies or microsclerotia can best be seen through a dissecting microscope, however, even a magnifying glass or hand lens will reveal these structures (Fig. 3). Brown, water-soaked lesions, which later turn black, are present on the roots. The fungus may also infect kernels, blackening them completely.

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Compiled by Rikus Kloppers and Stephanie Tweer. Comments/feedback can be sent to stephanie.tweer@annar.co.za.
Disclaimer: This document serves as a guideline and is given in good faith.
Charcoal rot

**Figure 2.** Black appearance of susceptible hybrid (left).

**Figure 3.** Black specks (microsclerotia) on the vascular bundles.

**CONTROL**

**Cultural control:**
- Use of resistant hybrids is the most common and easiest method – hybrids with good resistance or tolerance to Fusarium and Diplodia stem rots normally have good resistance to Charcoal rot. Certain hybrids offer some resistance, possibly through drought tolerance.
- The population of *M. phaseolina* in soil will increase when susceptible hosts are cropped in successive years. Maize, sorghum and cotton are hosts for the pathogen, but they support lower populations of microsclerotia in soil than soybean. Rotation with maize for three years may help reduce populations, but not eliminate the pathogen from the soil. Rotation with a poor host such as cotton or non-host plants such as small grains, including wheat or barley, may only require one or two years to reduce inoculum levels in soil.
- Debris serves as inoculum for leaf, stem and root diseases. In the absence of leaf disease, use of a no-till cropping system conserves soil moisture, reducing water stress and limiting disease progress.
- Avoid high plant populations. High plant populations can contribute to increased plant stress and competition for water, especially during a dry season, increasing charcoal rot potential.
- Stressed plants are more susceptible; avoidance of stress factors (drought, unbalanced nutrition) may help reduce damage. Higher nitrogen levels increase disease incidence. Adequate levels of available P and K reduces nutrient stress and encourages plant health. Good water management to avoid stressing plants is important in managing this disease, particularly as the crop approaches the flowering stage.
- A range of organic amendments such as farmyard manure have been used to control *Macrophomina* diseases.
- Avoiding early senescing of stems will reduce the disease severity. Leaf diseases such as Grey leaf spot, Northern corn leaf blight and Common rust predispose plants to stem rots. Under high leaf disease pressure, photosynthetic leaf area available for grain filling is lost and sugars are diverted from the stalks for grain filling. Stems are weakened, senesce prematurely and susceptibility and subsequent colonisation by opportunistic stem rot organisms is increased. Thus, selecting hybrids with good leaf disease resistance and good leaf disease control will also reduce stress and therefore stem infections.