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Charcoal Rot of Maize and Its Management

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Charcoal rot is a destructive disease of maize caused by the soil-borne fungus Charcoal rot, primarily associated with the pathogen *Macrophomina phaseolina*. It is widely distributed in tropical and subtropical regions and becomes especially severe under conditions of high temperature and drought stress. The disease can lead to significant yield losses, particularly when plants are weakened during the grain-filling stage.

Causal Organism

Charcoal rot is caused by *Macrophomina phaseolina*, a facultative parasite that survives in soil and crop residues through small, black survival structures called sclerotia. These sclerotia can persist in soil for several years, making the disease difficult to manage.

Symptoms

The disease is most noticeable after flowering and during the maturity stage. Key symptoms include:

- **Stalk discoloration:** Lower stem tissues turn gray to black.
- **Shredding of stalk tissues:** Internal tissues disintegrate, giving a shredded appearance.
- **Presence of black sclerotia:** These resemble charcoal dust, hence the name “charcoal rot.”
- **Premature drying:** Plants dry early and may lodge (fall over).
- **Poor grain filling:** Leads to reduced yield and grain quality.

Disease Cycle

The fungus survives in infected plant debris and soil. Infection occurs through roots, especially when plants are under stress (e.g., drought, nutrient deficiency). The pathogen colonizes vascular tissues, restricting water and nutrient movement, which accelerates plant senescence.

Favorable Conditions

Charcoal rot thrives under:

- High temperatures (30–35°C)
- Low soil moisture (drought conditions)
- Poor soil fertility
- High plant population density

Management Practices

Effective management of charcoal rot requires an integrated approach:

1. Cultural Practices

- **Crop rotation:** Rotate maize with non-host crops like pulses (except soybean) to reduce inoculum.
- **Timely sowing:** Early planting helps avoid peak drought stress during flowering.
- **Optimal plant spacing:** Avoid overcrowding to reduce stress on plants.

- **Field sanitation:** Remove and destroy infected crop residues.
- 2. Resistant Varieties**
 - Use drought-tolerant and disease-resistant maize hybrids where available. Resistance is partial but helpful in reducing severity.
- 3. Soil and Water Management**
 - Maintain adequate soil moisture through irrigation, especially during flowering and grain filling.
 - Improve soil fertility with balanced fertilization (especially potassium), which enhances plant resistance.
- 4. Biological Control**
 - Application of bio-agents such as *Trichoderma spp.* in soil can help suppress the pathogen.
- 5. Chemical Control**
 - Chemical control is generally less effective because the pathogen is soil-borne.
 - Seed treatment with fungicides (e.g., carbendazim) may provide some early protection.

Conclusion

Charcoal rot of maize is a stress-related disease that can severely impact crop productivity, particularly in arid and semi-arid regions. Since no single method provides complete control, integrating cultural, biological, and agronomic practices is essential for effective management. Emphasis should be placed on reducing plant stress through proper irrigation, nutrition, and field management.

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