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Cob Rots of Maize: A Threat to Food Safety

S. Ameer Basha* and V. Ramya

Dept. of Plant Pathology, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana State, India

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Corresponding Author

S. Ameer Basha

e-mail: ameerplantpath@gmail.com

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Abstract

Cob rot of maize is caused by many pathogens, some of the common stalk rot pathogens are also frequently encountered as cob rots. These diseases have a worldwide distribution and are present in all climates where corn is grown. The major cob rots were caused by *Diplodia* (Stenocarpella), *Fusarium*, and *Gibberella* are the pathogens while, *Penicillium* and *Aspergillus* cause little damage, but may be confused with more significant pathogens like *Trichoderma* and *Cladosporium* are also included in the cob rot group. The corn ear rots particularly troublesome because multiple yearly cropping cycles allow the pathogens to develop large populations. In addition, the above listed fungi produce mycotoxins that are harmful to humans and livestock when consumed. This creates a need for public awareness for both economic and health reasons.

Introduction

Maize cob rots are widespread and occur worldwide wherever maize is grown. Cob rot, caused by *Fusarium* spp., is probably the most serious disease of maize, not only because it reduces maize yield, but also reduces the nutritional value of infected grains and may induce the development of mycotoxins, threatening human and livestock health. In addition to the physical damage caused by cob rots, some cob rot fungi produce mycotoxins that reduce the quality and value of the grain (Wagacha and Muthomi, 2008). *Gibberella* and *Fusarium* species are known toxin producers under field conditions. Mycotoxins are toxic compounds which are produced by cob rot pathogens of maize and decrease the quality of grain and silage. At harvest, grain drying is critical to stop fungal growth and further mycotoxin contamination; however, since mycotoxins are highly stable, drying will not reduce the already existing mycotoxin levels in grain. Maize grain mostly contaminated with fumonisins produced by *F. verticillioides* and *F. proliferatum*, and/or by deoxynivalenol and other trichothecenes along with zearalenone produced by *F. graminearum*, which affect the health of human and animals. Ear rot caused by *F. verticillioides* favored warm and dry conditions, however, warm and wet conditions following silking have been reported to be conducive for disease development (Munkvold, 2003). Weather conditions during flowering are critical for primary infection, as well as for toxin accumulation during flowering and then before harvesting (Maiorano *et al*., 2009; Cao *et al*., 2014). Low rainfall and a high number of days with maximum temperatures around 30-35 °C during flowering favor disease development. Additionally, precipitation stimulates mycotoxin accumulation before the maturity stage because of the extended harvest period.

Major Types of Cob Rots in Maize

Aspergillus Cob Rot

Olive-green or gray-green mold at ear tips and between rows of kernels. This mold often has a velvety or dusty appearance (Figure 1a). Usually occurs during hot, dry weather. Often associated with damage to ear tips from insects or other causes. *Aspergillus* produces the mycotoxin, aflatoxin. *Aspergillus* will grow in storage.

Penicillium Cob Rot

Caused by several *Penicillium* species. Signs include a green-blue powdery mold between kernels near the tip of the ear (Figure 1b). Different *Penicillium* species affecting different maize can produce mycotoxins; however, these are considered to be a greater problem in silage.

Diplodia Cob Rot

Diplodia cob rot symptoms associated with infections during early ear development are the yellowing and drying of husk leaves, while stalks and leaves remain green. Infection generally begins at the ear base and ramifies upwards. The entire ear becomes overgrown with a white mycelial growth (Figure 1c). A cross section of an infected ear shows black spore-producing bodies at the kernel bases.

Fusarium Cob Rot

Caused by many different *Fusarium* species. Signs include a brown discoloration or a white mold on scattered kernels (Figure 1d). Affected kernels may also show a starburst pattern (white streaks radiating from the point where the silk was attached). Fusarium ear rot may lead to contamination with mycotoxins called fumonisins, that are highly toxic for horses and swine.

Gibberella Cob Rot

Caused by *Fusarium graminearum* and favored by cool and humid weather conditions. Symptoms include a reddish discoloration that begins at the tip of the ear, where a red to bright pink mold develops toward the base of the ear (Figure 1e). The fungus may contaminate corn with the mycotoxins deoxynivalenol (also known as DON or Vomitoxin) and Zearalenone, which causes feed refusal and reproductive problems in farm animals, respectively.

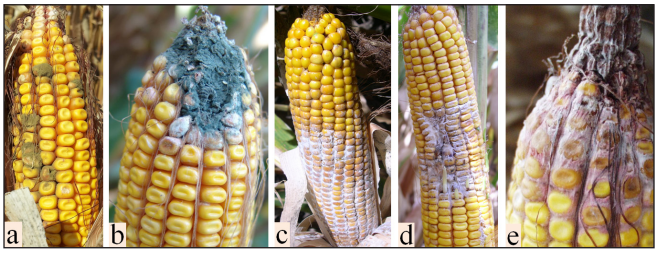

Figure 1: Major cob rots of maize [a) *Aspergillus* cob rot, b) *Penicillium* cob rot, c) *Diplodia* cob rot, d) *Fusarium* cob rot, e) *Gibberella* cob rot]

Risk Factors for Cob Rots

- If a hybrid is susceptible to one or more cob rots, it may be at risk.
- If weather conditions were (are) cool and wet (due to high humidity, dew, and rainfall) extended (7-14 days) after pollination and grain development, it may be a high risk.
- However, the greatest risk for cob rots and the toxins they produce if all three of the above conditions are satisfied: hybrid is susceptible, weather after pollination was cool and wet, and you are planting no-till corn-after-corn.

Major Strategies Followed for Control of Cob Rots of Maize

Crop Rotation

The main inoculum sources for ear rots of maize are crop residues of previous diseased crops. The best documented example is the high risk of ear rot when maize is grown in monoculture or after wheat.

Crop Residue Management

Physical removal or the use of specially designed biological crop residue treatments. Microbial decomposition of crop residues is a natural process which can be supported by adding stimulating nutrients or selected micro-organisms. Using a cultivator it is possible to mix mulched maize residues into the ground to accelerate decomposition. Mechanical cutting of plant residues before ploughing is recommended to minimize infection and to promote rotting.

Varietal Choice

To control cob rots is to use resistant hybrids. Hybrids that hold their ears vertically and have poor ear cover are more susceptible to cob rots. Hybrids with tight husks appear to be more vulnerable to red ear rot.

Seed Quality

Seeds have a small effect on ear rots; they should be of the best quality and free of diseases and pests to guarantee the highest production potential.

Sowing Time

Early plantings usually escape serious injury.

Crop Structure

High plant density affects the development of disease and, indeed, increases the risk of disease through increased humidity in the canopy. Infection and disease development are favoured by warm conditions and moist periods.

Harvest Time and Storage

Late harvest is a major risk factor. It is therefore important to grow varieties belonging to a precocity group adapted to the local climatic conditions. After harvest, the disease continues its development if ears are stored in conditions of

high humidity and insufficient aeration. This means harvested grain should be dried to 15% moisture content or in storage. Good storage conditions such as an appropriate temperature and moisture content, aeration, insect control and clean bins will lower significantly the risk of grain infection.

Chemical Control

In the case of systemic infections of maize plants, application of fungicide early in the season can limit cob infection. Cob rot diseases develop late in the season, the use of fungicides is not appropriate. If the *Fusarium* spp. has already attacked maize plants, harvesting should be completed as soon as possible.

Weed Control

Weeds also affect the development of the disease. If they offer more favourable conditions for the development of cob rot pathogens, for example, higher humidity in the crop.

Conclusion

In an attempt to maintain quality, farmers sort their maize by removing infected ears or grain. Advise farmers to grow varieties which are not susceptible. Researchers need to incorporate breeding for ear rot resistance in their programmes to enable them identify sources of resistance to improve materials already on market and those local authorities to sensitize the public on how to maintain grain quality through proper post- in the pipeline. Joint efforts are required among health workers, extension staff and harvest handling.

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