Maize ear rots and mycotoxins

Fusarium and Aspergillus species

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Unidentified fungal mould on ear rot, a potential source of mycotoxins.

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Drying of cobs and rejection of damaged cobs both help to reduce mycotoxin contamination.

SUMMARY: Several fungi occur on maize and produce poisonous chemicals which contaminate food and feed. Known collectively as mycotoxins, these poisons have serious effects on human and animal health. *Aspergillus* is said to be the most important mycotoxin producer in Africa, though other fungi such as *Fusarium* are also involved. Both groups of fungi grow on dead and decaying plant material and cause rotting of maize ears in the field. They produce powdery masses of spores on cobs, pre- and post-harvest, but can also be present without any mould production. Ear rots caused by mycotoxin-producing fungi are more common when maize is stressed or growing poorly. The most effective control of these fungi combines timely harvesting of maize and drying of cobs before storing. Aflasafe™, a new biological control option against *Aspergillus*, is applied in the field before flowering of maize and shows considerable promise in reducing contamination of ears prior to harvest and later accumulation of mycotoxins in stored products.

KEY SIGNS

Aspergillus species typically produce a yellow-green mould on maize ears, although sometimes it is brown to black. The mould is similar in appearance to that found on decaying food. The powdery appearance is due to the production of millions of spores. *Aspergillus* causes little damage to living plants and often follows insect damage or other wounding. The fungus persists on dead and decaying material and in the soil and is an ever-present risk.

Fusarium species also persist on dead plant material and in the soil. They cause an ear rot with mouldy growth occurring between the ear and the husk (enclosing leaves). The symptoms usually start at the tip of the ear and advance downwards. Sometimes the whole ear becomes rotten. Infections can also follow physical damage, such as bird feeding. The mould is red to pink and more cottony or woolly when compared to *Aspergillus*.

There are other fungi which cause ear rots but do not produce mycotoxins. Both *Fusarium* and *Aspergillus* may be present on maize without producing moulds or other visible symptoms. The fungi are able to rapidly grow and produce mycotoxins when ears are harvested too early and become wet in storage.

MANAGEMENT

Prevention – what to do before signs are seen

Cultural approaches: Use clean seed for planting. If saving own seed, discard mouldy ears. Varieties of maize with a tighter husk will help to limit bird and insect feeding damage on ears, which allows *Aspergillus* and *Fusarium* to become established. Control of insects attacking ears will reduce fungal ear infections.

The general view is that, despite many years of trying to produce 'resistant' varieties, this approach has had little success and is unlikely to have a major impact on reducing mycotoxins. Maintaining good soil fertility and avoiding water stress will strengthen the ability of maize plants to limit infections of *Aspergillus* and *Fusarium*.

Attention is now focused on a new biocontrol option against *Aspergillus*, known as Aflasafe™, applied when maize is in the field. Aflasafe does not control *Fusarium*.

Aflasafe™ consists of sterile sorghum grains carrying a non-mycotoxin producing strain of *Aspergillus*. The grains are scattered throughout the maize field to encourage the displacement and therefore exclusion of mycotoxin-producing strains. Aflasafe™ is available in 5 kg and 10 kg plastic tubs from selected sources. Commercial production and distribution is being developed. Before applying Aflasafe™, weed and ridge the plot and apply fertilizer. It is important to avoid walking through a field after application since the sorghum grains need to rest on the soil. Broadcast Aflasafe™ two to three weeks before flowering to give the fungus enough time to grow and sporulate.

A tub of 10kg is sufficient for one hectare. Apply after rains, or when expected, or when the soil is wet. This will help the non-mycotoxin production, friendly fungus to grow quickly. Check the scattered grains about a week after applying to see if they are covered with a green powder.

Divide the Aflasafe™ into equal portions to enable even application to the maize field. A half kg portion is enough for an area 10 metres by 50 metres (500 m^2). Chickens, birds and wildlife may pick up the sorghum grains but will not be affected. Ants may carry the grains below ground but later the grains will be returned to the soil surface.

There is a high risk of contamination with *Aspergillus* and/or *Fusarium* on harvested cobs in all maize growing areas. Mouldy ears should be discarded after harvest. Remove plant debris and practice crop rotation in order to reduce fungal inoculum in the field.

When harvesting maize, avoid damaging the grains, to prevent invasion by fungi. Do not harvest and store rotten maize cobs. Reject those with a mouldy appearance. This may be difficult to accept for small-scale, poor farmers who need to maximize harvests. A partial solution is to remove at least the mouldy part of the ear before storage.

Maize grain should be dried on raised platforms or over a plastic sheet or tarpaulin. Do not dry directly on the ground. Store the grain in cool and dry conditions. Promoting these practices amongst farmers will help reduce contamination with mycotoxins and make food and feed safer to eat.

Although this fact sheet focuses on maize and ear rots, mycotoxins are associated with other important crops, such as cassava. Choice of planting material, reducing stress on crops, timely harvesting and reducing the wetness of stored products to control fungal growth apply equally to other crops affected by mycotoxins.

CAUSE

There are two important *Aspergillus* mycotoxin producing species: *Aspergillus flavus* (a yellow-green, powdery mould) and *Aspergillus parasiticus* (a dark green, powdery mould). *Aspergillus niger* has a black powdery mould and is a common ear fungus on maize in fields but it is not a mycotoxin producer. *Fusarium moniliforme* (pink, cottony) is said to be the most common pathogen of maize ears around the world and also an important mycotoxin producer. *Fusarium* is generally more of a problem in temperate maize-growing areas.

Mycotoxin is a generic term. Specific types are associated with different fungi, such as aflatoxins and *Aspergillus*, and fumonisins from *Fusarium*. Species of both fungi also produce other mycotoxins, such as ochratoxins.

IMPACT

The damage caused by *Aspergillus* and *Fusarium* to standing crops is small compared to the adverse health effects on humans and animals due to ingestion of mycotoxins. The effects on young children and during pregnancy are especially harmful. Chickens are highly susceptible to mycotoxins.

Mycotoxins cannot be seen or tasted. They have no smell, taste or colour and they can only be detected by chemical analysis. Their presence is often only revealed by wide-ranging symptoms shown by people and animals that have eaten contaminated maize products, particularly over a long period of time. Long term (chronic) exposure to mycotoxins leads to reduced immunity to disease, kidney and liver damage, and stunting of children.

Reliable estimates suggest that 25% of the world's food is contaminated with mycotoxins and that 2.5 billion people are regularly exposed to them. A high proportion of soils (40-80%) contain aflatoxin-producing strains of *Aspergillus*. Financial losses are substantial. A reduction in groundnut exports from Africa (to meet EU mycotoxin testing requirements) meant an annual loss of US$670 million to exporting countries.

DISTRIBUTION

Aspergillus species producing mycotoxins occur in all areas in Africa where maize is grown.

FURTHER READING AND OTHER RESOURCES

Crop Protection Compendium (www.cabi.org/cpc) and Plantwise (www.plantwise.org).

Mycotoxin fact sheets: http://bit.ly/1O3OVWh 'Tackling killer aflatoxins in African food crops' and other information about Aflasafe™: www.aflasafe.com

Material prepared by Eric Boa, December 2014