Pest e-alerts

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Fumonisins in corn

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As corn harvest progresses in Oklahoma, concerns about mycotoxin contamination of corn is increasing. Corn in the high plains is irrigated and rarely has aflatoxin problems unlike areas of the state where dryland corn is produced. However, beginning in west Texas south of the Oklahoma panhandle, fumonisin contamination of corn is being detected in corn this year. Corn in the high plains and perhaps nearby production areas will likely be tested this year and discounted if levels exceed Food and Drug Administration guidance levels. Initial levels in panhandle counties have been low, but rains last week could cause levels of increase as the fungi that produce fumonisin are favored by high moisture levels and warm temperatures and levels of fumonisin can increase in the field and in storage until the corn is dried.

Fumonisins are mycotoxins produced in corn grain by the fungi *Fusarium verticiliodes* and *Fusarium proliferatum.* These two fungi (formerly known as one species *F. moniliforme*) cause Fusarium ear rot. Ear rots generally appear during dent stages of corn maturity and are often more severe on ears with insect feeding damage. However, Fusarium ear rot can develop on sound kernels and ears. Fusarium ear rot occurs under a wide range of weather conditions, however drought stress during silking and rainy and humid weather before harvest favors Fusarium ear rot and fumonisin development. Fusarium ear rot appears as whitish to whitish pink fungal growth in patchey areas on kernels and silks (Figure 1). Infected kernels often turn brown and appear shriveled. When the fungus invades through the silks, kernels are infected internally and produce a “starburst symptom” (Figure 2). The disease often appears on ear tips damaged by insect feeding and the moldy growth may cover large areas of the ear, growing in between the ears.

Figure 1: Fusarium ear rot (right) compared to healthy ears (left).

Figure 2: Fusarium ear rot with "starburst" symptom.

Fumonisins are a recently discovered group of mycotoxins, toxins produced by fungi growing on and in grains and other agricultural products. The toxins were described in the late 1980s following horse deaths resulting from consumption of moldy corn. Aflatoxin, produced by the fungus *Aspergillus flavus* is a more well-known and toxic mycotoxin. Fumonisins occur as a group of over 12 related compounds produced by the *Fusarium* species with toxins B1, B2, and B3 being the most common. Mycotoxin tests that refer to "total fumonisins" evaluate B1, B2, and B3 fumonisin forms. Horses and swine are most sensitive to fumonisins. Fumonisins have been linked to neurological disease in horses, lung disease in swine, and elevated rates of esophageal cancer in South Africa. In feeding studies with laboratory animals, fumonisin resulted in liver cancer and the mycotoxin is classified as a possible human carcinogen. The US Food and Drug administration has set guidence levels for total fumonisins in corn (Table 1). Note that the levels are in parts per million compared to aflatoxin which is 20 parts per billion for human foods. The most sensitive species are horses and hogs while poultry and cattle are least sensitive.

Table 1. FDA guidance levels for total Fumonisins (B1+B2+B3)

human foods	2-4 ppm
horses and rabbits	5 ppm, ≤20% of diet
hogs and catfish	20 ppm, ≤50% of diet
breeding cattle, breeding poultry	30 ppm, ≤50% of diet
cattle for slaughter	60 ppm, ≤50% of diet
poultry for slaughter	100 ppm, ≤50% of diet
all other livestock and pets	10 ppm, ≤50% of diet

The conditions that favor fumonisin production are poorly understood. Not all isolates of the fungi that cause Fusarium ear rot produce fumonisin. Furthermore, levels of damaged grain in a sample do not always correlate with fumonisin levels. Silk cuts in corn kernels apparently allow entry of the fungus into kernels where fumonisins can be produced without the appearance of severe grain damage. Testing of corn is required accurately assess fumonisin levels before corn goes into storage. Crop insurance apparently covers fumonisin discounts, however it is important to prove that the contamination occurred in the field and not in storage. Corn growers should be in close communication with crop insurance representatives if fumonisin contamination is suspected.

The *Fusarium* species that cause fumonisins are virtually ubiquitous in corn fields where they used to be important causes of stalk rot before resistance to that was improved. Seed treatments are effective in controlling Fusarium diseases on seedlings, but not Fusarium ear rot. This is likely due to poor performance of fungicides in general against Fusarium diseases and the protection that corn husks provide once the fungus has penetrated ears. Control of fumonisins involves selecting hybrids with the best resistance to Fusarium ear rot. Hybrids are rated for Fusarium ear rot by major seed companies. Corn hybrids with the best BT traits to control insect damage to ears should also be planted. Fumonisin levels have been shown to be reduced where effective BT genes are deployed. Note that resistance has developed to some BT traits in ear feeding insects such as corn earworm, fall armyworm, and western bean cutworm. Finally, corn should be dried to below 18% moisture which inhibits fumonisin production. Grain dried to 15% moisture and below inhibits both aflatoxin and fumonisin development in storage.

Questions have been asked about sampling procedures and use of problem fields for grazing after harvest. Farmers are concerned that grain sampling probes at elevators may be contaminated with toxic grain from another farm thus triggering a positive test on their field. Fumonisin experts consider this risk to be minimal mainly because of the relatively high levels allowed in corn and the unlikely result that a few carryover kernals will trigger a positive test. This risk is greater for aflatoxin which has a thousand fold lower tolerance. Finally, fumonisin experts do not consider grazing corn stover after harvest to be a risk in cattle. The rationale is that fumonisin is not produced in stalks and leaves, and that cattle are not very sensitive to fumonisins. Visit http://www.cornmycotoxins.com for more information on fumonisins and other mycotoxins affecting corn.

Plant Disease and Insect Diagnostic Laboratory

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