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Best Management Practices for Corn Production in South Dakota: Corn Diseases in South Dakota

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CHAPTER 9
Corn Diseases in South Dakota

Corn diseases can be separated into 1) seed and seedling diseases, 2) root-infecting nematodes, 3) leaf diseases, 4) rusts, 5) stalk rots, and 6) ear and grain molds. Yield losses can result from diseases directly reducing yields or from harvestability, spoilage, or marketing and/or use issues associated with mycotoxin contamination. See Table 9.1 for corn disease management information.

Attention to optimal seed quality, hybrid selection, seed treatments, weed and insect control, crop rotation, soil fertility, irrigation, and prompt harvest can reduce disease impacts. This chapter discusses aspects of recognizing and managing South Dakota corn diseases.

Seed and Seedling Diseases

The major seed and seedling diseases of corn in South Dakota are seed rot, damping-off, and seedling blights. Fungi that are found naturally in soil cause these diseases. Losses from seed and seedling diseases can be severe, especially in years when soils remain cool and wet after planting. Poorly drained

Table 9.2. Managing seed and seedling diseases

➤ **Fungicide seed treatments**
- Captan (not effective against *Pythium*)
- Fludioxonil (not effective against *Pythium*)
- Metalaxyl
- Mefanoxam

➤ **Cultural practices**
- Avoid planting when soil temp <50°F.
- Place seed at appropriate depth.
- Use quality seed treated with fungicide.
- Manage crop residue.
- Avoid conditions that compact soil.
- Consider drainage, if feasible.

Table 9.1. Corn disease management

Preplant considerations
- Know the disease history of fields and select hybrids resistant to the most common diseases.
- Always choose high-quality seed that has been treated with fungicide.
- Use seed treatment fungicides that address known disease risks.
- Avoid planting when soil is cold and wet.
- Avoid situations that favor soil compaction.
- Manage crop residue to avoid clumps or areas of heavy mulch.
- Plant seed at populations recommended for the selected hybrid.
- Regularly rotate to crops other than corn.
- Avoid nutrient deficiencies. Potassium nutrition is most critical.

In-season considerations
- Periodically scout for diseases to identify problems for future management decisions.
- Control grassy weeds in and around fields to destroy sites where pathogens and pathogen carriers can survive.
- Control insects that may act to transmit diseases from plant to plant.
- Apply an effective fungicide to susceptible hybrids when conditions favor disease and scouting indicates a threat.

Grain storage and use
- If grain is to be stored for more than 6 months, maintain grain moisture content at or below 13%.
- To reduce spoilage potential, sanitize bins before filling.
- If ear or kernel diseases are observed, test grain for mycotoxins before feeding.

soils or areas with heavy residue cover often have more disease problems than do well-drained soils.

Poor, sparse, or irregular stands and wilting and damping-off of young seedlings are typical symptoms of seed and seedling diseases. Poor-quality seed (low test weight) can lead to poor vigor and increased disease problems. Control for seedling diseases includes broad-spectrum seed treatments and various cultural practices that reduce seedling stress (Table 9.2).

Table 9.3. Nematodes parasitic to corn

- *Pratylenchus* (lesion)
- *Xiphinema* (dagger)
- *Hoplolaimus* (lance)
- *Longidorus* (needle)
- *Trichodorus* and *Paratrichodorus* (stubby-root)
- *Tylenchorhynchus* (stunt)

Nematodes

Nematodes are microscopic roundworms commonly found in soil. Some species are beneficial, while others are detrimental to crops. Nematodes that feed on corn roots reduce the root mass and allow entry of fungi that cause root diseases. Corn yield losses can result from *Pratylenchus* infestations in South Dakota. To date, other nematode species have been inconsequential in South Dakota corn production. It is not economically feasible to use nematicides for the control of corn nematodes, unless a soil analysis reveals exceptionally high populations. See Table 9.3 for a list of nematodes that are parasitic to corn.

➤ Symptoms of corn nematodes:
- Stunted plants and uneven plant height along rows.
- Uneven population.
- Yellow (chlorotic) plants.
- Poor ear fill.

➤ Managing corn nematodes:
- Soil analysis to determine population of a detrimental nematode.
- Contact your local Extension educator or the SDSU Nematode Testing Service for assistance.

Fungal Leaf Diseases

Substantial yield losses can result from leaf diseases. Leaf diseases increase the susceptibility of the plant to stalk rots that can lead to ear rots, lodging, and poor grain quality. Yield reductions are related to hybrid susceptibility, the presence of inoculum, weather conditions, and the timing of the infection. In addition, excessive crop residue on the soil surface can increase leaf diseases. Gray leaf spot and anthracnose were mere curiosities until the wide-scale adoption of no-till systems.

Residue-borne diseases can be managed by selecting resistant hybrids, by burying surface residue with tillage, and by crop rotation. Any disease can be managed more effectively by recognizing incidence and practices that favor disease development (Table 9.4).

Table 9.4. Common South Dakota leaf diseases and symptoms

Northern Corn Leaf Blight
(Exserohilum turcicum, aka *Helmithosporium turcicum)*
Symptoms: Long, narrow, cigar-shaped, tan lesions (fig. 9.5).

Gray Leaf Spot
(Cercospora zeae-maydis)
Symptoms: Small, boxy, elongated, water-soaked lesions (fig. 9.6).

Eyespot
(Aureobasidium zeae, aka *Kabatiella zeae).*
Symptoms: Small, light-colored, circular lesions (1/8") (fig. 9.7).

Anthracnose
(Colletotrichum graminicola)
Symptoms: Large (~½" long), oval/elliptical, brown lesions (fig. 9.8).

Favorable conditions
- Warm, wet conditions; high humidity.
- Extended rainy periods.
- Heavy morning dew.
- Plants stressed by weather or poor fertility.
- Anthracnose is associated with potassium deficiency.

Management/control measures
- Tillage to reduce residue.
- Crop rotation.
- Resistant hybrids.
- Fungicides when conditions favor disease.

Northern corn leaf blight (NCLB)

Many modern hybrids have low resistance to northern corn leaf blight. This pathogen survives the winter on corn residue. Viable spores infect the leaves of the following corn crop, producing cigar-shaped lesions that can become quite large (fig. 9.1).

Gray leaf spot (GLS)

Gray leaf spot (GLS) survives on corn residue and is a serious problem in reduced-till and no-till irrigated fields. Symptoms of GLS are elongated, angular lesions that may grow together to form large dead areas on leaves (fig. 9.2). Significant yield reductions can result from heavy infestations.

Eyespot

Eyespot is a problem in continuous corn and reduced-tillage systems because the pathogen survives on corn residue. In rare cases, yield loss may be significant due to barren ears and reduced plant vigor. Symptoms of eyespot are small, light-colored, circular lesions (fig. 9.3). Light to moderate infections typically result in little to no yield loss, but symptoms can be striking. Eyespot may increase susceptibility to stalk, ear, and grain rots. Resistant hybrids are the best defense against this disease.

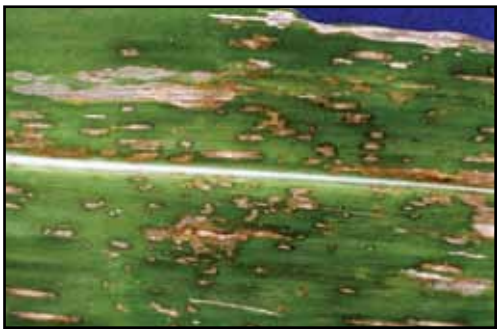
Anthracnose

Anthracnose is a leaf spot or blight that may develop into a stalk rot. Symptoms are large (~½" long) oval/elliptical brown lesions (fig. 9.4). The pathogen that causes anthracnose survives on corn residue. Potassium deficiency and continuous corn systems elevate the risk for this disease. Residue management and selecting resistant hybrids are the best options for control.

Figure 9.1. Northern corn leaf blight

(Photo courtesy of Martin Draper, USDA-CSREES)

Figure 9.2. Gray leaf spot in corn



(Photo courtesy of Martin Draper, USDA-CSREES)

Figure 9.3. Eyespot in corn

(Photo courtesy of University of Nebraska)

Figure 9.4. Anthracnose in corn

(Photo courtesy of Martin Draper, USDA-CSREES)

Fungal Leaf Diseases – Rusts

Spores of rust-causing fungi typically blow in on southerly winds. The rust that frequently occurs in South Dakota, common corn rust, is less of a yield threat than is southern corn rust. Selecting resistant hybrids is the best strategy for control.

- ➤ Disease organism
  - • Common corn rust (*Puccinia sorghi*) (fig. 9.5a)
  - • Southern corn rust (*Puccinia polysora*) (fig. 9.5b)
- ➤ Symptoms
  - • Erupting pustules of reddish-brown spores that crack the epidermis and easily rub off.
  - • Common rust sporulates on the both upper and lower leaf surfaces.
  - • Southern rust sporulation is heavier on the upper leaf surface.
- ➤ Favorable conditions
  - • Cool nights.
  - • Dews or light rains.
- ➤ Management/control measures
  - • Resistant hybrids.
  - • Fungicides are only recommended to protect susceptible inbred lines.

Figure 9.5. Corn rusts

a. Common corn rust

b. Southern corn rust

(Photos courtesy of Karen Rane and Gail Ruhl, University of Maryland)

Bacterial Diseases

Bacterial diseases can be destructive if infections are severe and widespread. The selection of resistant hybrids and the use of other integrated pest management strategies is the best approach for controlling bacterial diseases. Anti-bacterial pesticides are not available for sale.

Stewart's disease

This disease (fig. 9.6) is occasionally seen in southeast South Dakota. It is spread by corn flea beetles feeding on plant leaves. Incidence and the severity of the disease is related to the winter survival of flea beetles.

Figure 9.6. Symptoms of Stewart's bacterial disease

(Photo courtesy of Martin Draper, USDA-CSREES)

Table 9.5. Organisms and symptoms of common bacterial diseases in South Dakota

Stewart's disease (*Pantoea [Erwinia] stewartii*)
Symptoms: Water-soaked margins (fig. 9.11) and flea beetle feeding.
Holcus spot (*Pseudomonas syringae*)
Symptoms: Circular tan and papery lesions 3/8 inch in diameter (fig. 9.12).
Goss's wilt (*Clavibacter michiganense*)
Symptoms: Small green to black lesions that may grow together, progressing to discolored vascular tissue with a slimy stalk rot leading to wilting (fig. 9.13).

Favorable conditions

- Warm winters may elevate populations of flea beetles that carry the disease organism (Stewart's disease).
- Heavy rainfall, especially when accompanied by high winds.

Management/control measures

- Tillage to bury crop residue.
- Crop rotations.
- Selection of resistant hybrids where appropriate.

Flea beetles are likely to overwinter if the *sum* of the average monthly temperatures for December, January, and February in degrees Fahrenheit (°F) is greater than 90. The wilt phase of this disease has not been observed in South Dakota from 1997 to 2007.

Holcus leaf spot

Leaf spot is sporadically observed in South Dakota but is not known to reduce yield or grain quality. Symptoms are tan, papery, circular lesions (3/8" diameter) (fig. 9.7) and can be mistaken for paraquat injury. The bacterium survives on corn residue, spreading by rain splash. Typically, infections follow heavy thunderstorms or irrigation. Crop rotation and residue management are recommended in situations of severe outbreak.

Goss's wilt

Goss's wilt is rare in South Dakota. It was first recognized in south-central Nebraska. The pathogen can be seed borne but is also associated with residue, making it a potential problem in continuous corn or reduced tillage systems. Most problems are observed on susceptible hybrids and inbred lines.

Goss's wilt is generally restricted to the leaf-spotting phase of the disease, sometimes called "freckles." Spots may coalesce, forming large dead areas on the leaf. In some cases the disease becomes vascular, causing the wilt phase of the disease (fig. 9.8).

Viral Diseases

While many viruses are known to infect and cause corn diseases, only wheat streak mosaic virus (WSMV) and maize dwarf mosaic virus (MDMV) are observed to varying degrees in South Dakota. Wheat streak mosaic can be severe on wheat but rarely causes measureable yield loss in corn. Nonetheless, corn may serve as a reservoir for WSMV, infecting newly planted winter wheat in the fall.

The wheat curl mite (*Aceria tosichella Keifer*) transmits WSMV and can survive on both wheat and corn. Corn serves as a host for the mite after wheat harvest, until a new crop of wheat emerges. Winter wheat adjacent to corn may be at risk from WSMV. In corn, wheat curl mites feeding in developing ears cause a kernel red streak (fig. 9.9); the streak is a response to a toxin in the saliva of the mite. Red streak is often seen during drought periods that favor wheat curl mite populations.

MDMV is transmitted by several species of aphids, especially the corn leaf aphid. Aphids overwinter in

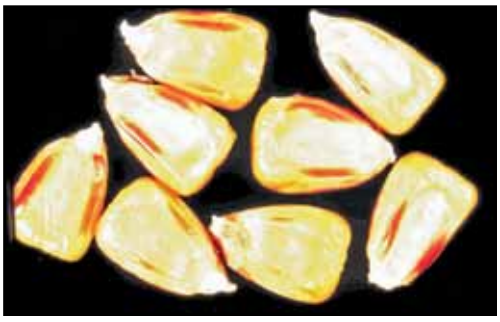
Figure 9.7. Symptoms of Holcus leaf spot

(Photo courtesy of Martin Draper, USDA-CSREES)

Figure 9.8. Symptoms of Goss's wilt

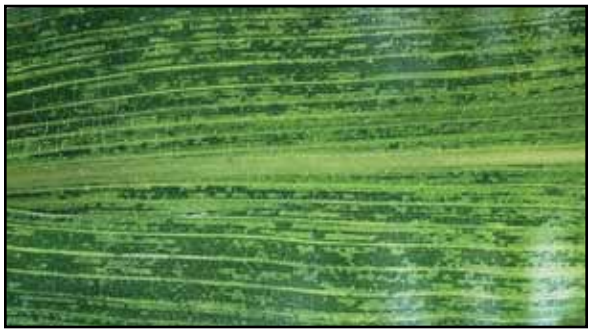
(Photo courtesy of University of Nebraska-Lincoln)

Figure 9.9. Kernel red streak (response to toxin in saliva of wheat curl mite [*Aceria tosichella Keifer*])



(Photo courtesy of Martin Draper, USDA-CSREES)

Figure 9.10. Maize dwarf mosaic



(Photo courtesy of UC-Davis)

the southern United States and are brought to South Dakota by southerly winds and low-level jet streams.

Losses from MDMV are normally negligible in hybrid corn. MDMV can be problematic when planting is delayed or in susceptible inbred lines. Symptoms (fig. 9.10) will be more pronounced following periods with cool nighttime temperatures.

Resistant corn hybrids and wheat varieties are the best lines of defense against WSMV and MDMV, but a single hybrid cannot carry resistance genes for both diseases (Table 9.6).

Table 9.6. Organisms and symptoms of common viral diseases in South Dakota

Wheat Streak Mosaic Virus
Symptoms: Small chlorotic spots or rows of broken flecks that elongate parallel to the leaf veins.
Maize Dwarf Mosaic Virus.
Symptoms: Small chlorotic spots also oriented in rows parallel to the leaf veins (fig. 9.10).

Favorable Conditions

- Wheat Streak Mosaic – Dry weather and exposure to wheat curl mites.
- Maize Dwarf Mosaic – Cool nights, susceptible inbred lines, delayed planting, and aphid feeding.

Management/Control Measures

- Wheat Streak Mosaic – Avoid planting in wheat stubble and adjacent to wheat fields.
- Control grassy weeds and volunteer wheat.
- Resistant hybrids – No single hybrid can carry resistance for both WSM and MDM viruses.

Smuts

Smut is the most common and easily identified disease in corn. Common corn smut may occur on ears, tassels, or leaves (Table 9.7). This fungus can infect any rapidly growing tissue (fig. 9.11). Yield losses from common smut can be significant for susceptible hybrids.

Table 9.7. Characteristics of smuts found in South Dakota

Disease organism and symptoms
Common Smut (*Ustilago zeae*)
Symptoms: Silvery-white galls on ears and tassels (fig. 9.11); small to elongated pustules on leaf midrib.
Head Smut (*Sphacelotheca reiliana*)
Symptoms: Dark, "stringy" masses emerging from ear sheath or consuming tassel (rare).

Favorable conditions

- Plant injury from insects, hail, wind or field equipment.

Management/control measures

- Resistant hybrids.
- Reduce plant stress.
- Manage ear feeding insects.
- Balanced fertility.
- Fungicides are not proven to be efficacious.

Figure 9.11. Common corn smut (ear)

(Photo courtesy of Kurtis D. Reitsma, South Dakota State University)

Head smut is rare but has been reported in South Dakota. Head smut-infected ears are severely reduced in size, and the galls are not apparent. Most hybrids are tolerant to head smut.

Smut spores attached to soil particles can be blown long distances by the wind. Hot, dry conditions are favorable for transport of the spores. Wounds provide infection points for the fungus to enter the plant.

Management includes the adoption of techniques that reduce wounds (corn borers, injury to roots, stalks, and leaves), deep plowing of diseased stalks, and the use of resistant hybrids. Usually, smut-infected plants are destroyed. In Mexico, however, smut is called *nuit-lacoche*, which is considered a delicacy.

Stalk Rots

Stalk rots are among the most common and damaging of the corn diseases (Table 9.8; figs. 9.12, 9.13, and 9.14). Yield losses result from premature plant death and lodging.

The severity of stalk rot loss can be minimized by ensuring that optimal nitrogen (N) and potassium (K) levels are present. Excessive N that is out of balance with K can cause a rapid flush of growth that does not have sufficient structural composition to ward off colonization by fungal pathogens. Plants weakened by disease, drought, and other stressors may be predisposed to stalk rots. Increased severity of stalk rot is often observed in high plant populations.

Control measures for many stalk rot diseases include burying the residue by tillage or including non-host plants in the rotation. Adoption of conservation tillage may reduce stalk rot incidence by increasing water availability and reducing plant stress in a dry environment. However, in environments that favor stalk rot, non-host years are important.

Figure 9.12. Gibberella stalk rot

(Photo courtesy of Bradley E. Ruden, South Dakota State University)

Table 9.8. Organisms and symptoms of common stalk rot diseases in South Dakota

Fungi

Gibberella stalk rot (*Gibberella zeae* aka *Fusarium graminearum*) (fig. 9.12)

Fusarium stalk rot (*Fusarium* spp.) (fig. 9.13)

Charcoal rot (*Macrophomina phaseolina*) (fig. 9.14)

Bacteria

Erwinia stalk rot (*Erwinia carotovora* ssp. *carotovora*)

Symptoms

- Decay of pith in the center of stalk while the rind remains sound.
- Lodging.

Favorable conditions

- Nutrient deficiencies.
- Deficiency or imbalance of N and/or K.
- High plant populations under stress.
- Wet spring weather followed by hot, dry conditions in the late summer.
- Erwinia stalk rot is associated with overhead irrigation systems using surface water sources.

Management/control measures

- Resistant hybrids.
- Ensure sufficient levels of N and K are in soil.

Figure 9.13. Fusarium stalk rot

Cross section of a corn stalk infected with *fusarium* stalk rot. Note the stringy appearance of the tissue in the center of the stalk.

(Photo courtesy of Bradley E. Ruden, South Dakota State University)

Figure 9.14. Charcoal rot

(Photo courtesy of Bradley E. Ruden, South Dakota State University)

Ear and Kernel Rots – Mycotoxins

Ear and grain molds can severely reduce grain quality. Spoilage or mycotoxin concentration can limit end-use or reduce profits due to dockage or rejection at the point of sale. See Table 9.9 for additional information

The most common fungi that produce mycotoxins and attack grain are *Apergillus*, *Fusarium*, and *Penicillium*. However, not all ear rot diseases produce mycotoxins (e.g., Diplodia ear rot). Crop stress from drought; ear injury (e.g., hail); or cool, wet conditions following silking (R2) favor ear molds.

If infections occur in the field, look for the characteristic cottony growth of fungal mycelium. *Aspergillus* or *Penicillium* produce powdery yellow-green or blue-green mold, respectively, between the kernels, usually at the ear tip (figs. 9.15 and 9.16). *Fusarium* produces a whitish-pink to lavender mold on kernels and/or silks (fig. 9.17). *Gibberella* generally appears as a reddish or pinkish mold growing from the tip down the ear (fig. 9.18). Diplodia ear rot appears as a white or grayish mold between the kernels and is concentrated at the base of the ear (fig. 9.19). The husks appear bleached and may stick to the ear.

Stored grain with a moisture content of greater than 13% may be subject to mycotoxin problems. Stored grain with Penicillium ear molds may have a blue discoloration of the embryo ("blue-eye" mold) or a light cover of a yellow-green mold. *Aspergillus*-infected kernels may fluoresce green under UV light.

Figure 9.15. Aspergillus ear rot (*Aspergillus* spp.)

(Photo courtesy of Gary Munkvold, Iowa State University)

Table 9.9. Ear and kernel rot characteristics commonly found in South Dakota

Disease organisms (all fungi)

Aspergillus ear rot (*Aspergillus* spp.) (fig. 9.15)
Penicillium ear rot (*Penicillium oxalicum* [Currie and Thom]) (fig. 9.16)
Fusarium kernel or ear rot (*Fusarium* spp.) (fig. 9.17)
Gibberella ear rot (*Gibberella zeae* [Schwein.]) (fig. 9.18)
Diplodia ear rot (*Diplodia maydis* [Berk.] and *D. zeae* [Schwein.] Lev.) (fig. 9.19)

Management and control

- Timely planting, adequate fertility, good weed and insect control, supplemental irrigation, and suitable plant population and hybrid selection.
- Mycotoxin concentrations can be the highest in damaged kernels. Screening to remove smaller or cracked kernels can reduce concentrations.
- Properly harvesting, drying, and storing grain can reduce risk. Stored corn with a moisture content >13% can result in mold and mycotoxin production if not handled properly. Wet corn should be dried within 24 hours of harvest. Minimize the time that wet corn is stored in trucks, combines, or bins to no more than 4 to 6 hours. Reducing grain depth, stirring devices, or batch dryers also speed the grain drying process. As grain moisture content approaches 12%, mold fungi typically become dormant.
- Clean combines, carts, augers, and bins regularly to minimize cross contamination. A chlorine cleaning solution (¾ cup bleach/gallon of water) will suppress fungi and can kill fungal growth on handling facilities if contact is sufficient in length.
- If mycotoxin contamination in grain is suspected, a subsample should be tested prior to feeding to livestock.

Figure 9.16. Penicillium ear rot

(Photo courtesy of Bill Zettler, University of Florida)

Figure 9.17. Fusarium kernel or ear rot (*Fusarium* spp.)

(Photo courtesy of Gary Munkvold, Iowa State University)

Figure 9.18. Gibberella ear rot (*Gibberella zeae* [Schwein])

(Photo courtesy of Martin Draper, USDA-CSREES)

Figure 9.19. Diplodia ear rot (*Diplodia maydis* [Berk.] and *D. zeae* [Schwein.] Lev.)

(Photos courtesy of Gary Munkvold, Iowa State University)

Mycotoxins

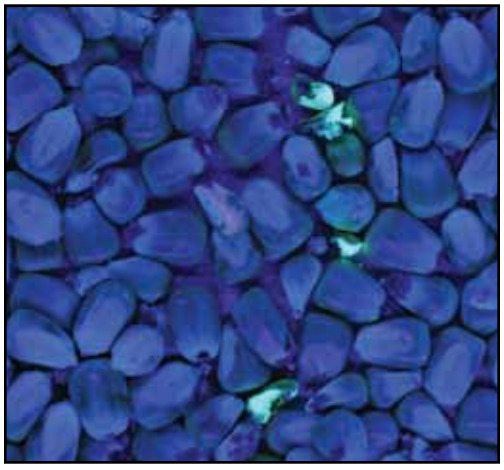
Fungi that infect cereals and grains often produce harmful metabolites that can reduce grain value. These metabolites are "mycotoxins," which means "fungus poison," and have serious effects if tainted grain is allowed to enter the food chain. During the Middle Ages, ergot-infected rye caused hallucinations. More recently, toxic concentrations of aflatoxin in corn used in pet food led to serious illness, death, and pet food recalls.

Grain is typically pre-screened for aflatoxin using a black light (UV) test (*Aspergillus*-infected grain generally glows bright green-yellow [fig. 9.20]). Although this test is quick and easy, it is not conclusive (because factors other than *Aspergillus* can cause grain to fluoresce). A definitive test in the laboratory is needed to confirm mycotoxin concentrations.

Corn suspected of containing aflatoxin or any other mycotoxin should be appropriately sampled and analyzed. The results of the analysis can provide the owner with options for disposition of the grain. Producers are advised to contact their local Extension educator or the SDSU Plant Diagnostic Clinic for more information regarding mycotoxin analysis.

Serious illness or death may occur in livestock if feeding guidelines developed by the United States Food and Drug Administration (FDA) are exceeded. FDA feeding guidelines and action levels are summarized in Table 9.10.

Figure 9.20. Black light (UV) test showing infected grain



(Photo courtesy of Bradley Ruden, South Dakota State University)

Table 9.10. Summary of U.S. Food and Drug Administration animal feeding guidelines

- ➤ Aflatoxin - produced by *Aspergillus* spp.
  - FDA animal feed guidelines – ***do not exceed:***
    - ♦ Dairy – 5 ppb.
    - ♦ Aflatoxin M1 can accumulate in lactating dairy cattle, leading to contaminated milk.
      - – FDA action level for milk – 0.5 ppb.
  - Mature breeding beef cattle, swine, and poultry – 100 ppb.
  - Finishing swine – 200 ppb.
  - Finishing beef – 300 ppb.
  - Human consumption.
    - ♦ FDA action level for all human food – 20 ppb.
- ➤ Fumonisins - produced by *Fusarium* spp.
  - FDA animal feed guidelines:
    - ♦ Horses – 5 ppm
    - ♦ Swine – 10 ppm
    - ♦ Cattle – 50 ppm
- ➤ Deoxynivalenol (DON) aka vomitoxin - produced by *Fusarium* spp.
  - FDA animal feed guidelines:
    - ♦ Cattle and chickens – 10 ppm not to exceed 50% of the diet.
  - Swine – 5 ppm not to exceed 20% of the diet.
  - All other animals – 5 ppm not to exceed 40% of the diet.
    - ♦ Can reduce weight gain and feed refusal at lower levels.
  - Human consumption.
    - ♦ FDA recommendation <1 ppm.
- ➤ Zearalenone - produced by *Fusarium* spp.
  - Zearalenone production is associated with excessive fall rainfall; highest accumulations are associated with fluctuating temperatures in the low to moderate range, particularly if high-moisture corn is harvested and stored.
  - FDA animal feed guidelines have not been developed.
    - ♦ Zearalenone has estrogenic properties and can affect livestock reproduction.
      - – Swine are the most sensitive livestock.
        - ♦ Concentrations of 1 to 5 ppm can adversely affect young gilts and breeding sows.
    - ♦ Can affect cattle and poultry.
      - – Poultry are the least sensitive.
- ➤ Ochratoxins - produced by *Penicillium* spp. ("Blue Eye")
  - Toxin is produced after harvest during improper storage. Storage of corn with moisture levels below 16% prevents accumulation of ochratoxin.
  - FDA animal feed guidelines have not been developed.
  - Major concern in swine but can also affect poultry.

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