

Haymaking conditions this spring have been poor. Much hay has been rained on or left lying in the field for prolonged time periods due to cool and humid conditions which reduced drying rates. The long drying periods with high humidity allowed field growth of mold on the hay.

Poor drying weather has also meant that some hay was put up wetter than usual and mold growth occurred in storage. With wet weather and high humidity, normal drying in storage may not occur and hay can retain elevated levels of moisture allowing mold growth. Mold will grow on hay without preservative at moisture levels above 14% to 15%. The mold growth produces heat and can result in large amounts of dry matter and TDN (total digestible nutrient) loss – a loss of carbohydrates and binding of proteins. In some cases, heating can be great enough to cause spontaneous combustion and hay fires. Drying of stored hay (moisture loss) is enhanced by ventilation, creation of air spaces between bales, allowing ample head space above a stack of bales in a barn for moisture to evaporate since moisture tends to move up and out the top of a stack of bales, avoidance of other wet products in the same area (if enclosed storage), reduced size of stacks, alternated direction of stacking, and not placing tarp directly over a stack in the field because that traps.

Molds commonly found in hay include *Alternaria*, *Aspergillus*, *Cladosporium*, *Fusarium*, *Mucor*, *Penicillium*, and *Rhizopus*. These molds **can produce spores that cause respiratory problems**, especially in horses or other animals fed in poorly ventilated areas and, **under some conditions, will produce mycotoxins**. There is much confusion about mycotoxins in forages because several mycotoxins may be present, diagnostic methods are not consistent, and treatment and control recommendations lack needed research. While most molds do not produce mycotoxins, the presence of mold indicates the possibility of mycotoxin presence and animals being fed moldy hay should be watched carefully for mycotoxin symptoms.

### Mycotoxins effects on animals:

- 1) intake reduction or feed refusal;
- 2) reduced nutrient absorption and impaired metabolism, including altered rumen fermentation and microbial growth, diarrhea, intestinal irritation, reduced production, lower fertility, lethargy, and increased morbidity;
- 3) alterations in the endocrine and exocrine systems;
- 4) suppression of the immune system which predisposes livestock to many diseases and may increase milk somatic cell count. A suppressed immune system may also cause lack of response to medications and failure of vaccine programs;
- 5) cellular death causing organ damage.



Mycotoxins may cause acute (immediate) health or production problems which are most common in horses and other non-ruminants. In cattle, mycotoxins more likely will contribute to chronic problems including a higher incidence of disease, poor reproductive performance, or suboptimal milk production. Ruminants are somewhat protected from acute toxicity because the rumen destroys a large portion of most

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mycotoxins. However, rumen degradation of mycotoxins may hide the acute symptoms resulting in undetected chronic problems including reduced feed consumption, altered rumen fermentation, reduced production, lower fertility, lethargy, and increased morbidity.

The mycotoxins of greatest concern are those produced by *Aspergillus* (aflatoxin, gliotoxin, fumitremorgens, fumigaclavines), *Fusarium* (deoxynivalenol, zearalenone, T-2 toxin), and *Penicillium* (PR toxin, mycophenolic acid, roquefortine C, patulin), but other mycotoxins can be present. There are about 400 different known mycotoxins.

Increased attention to field and storage management may help reduce the incidence and concentration of mycotoxins in forage. Heavily contaminated forage may need to be discarded. Lightly contaminated feed can be diluted and used for animals under less stress. Dry cows and transition cows should receive clean feed because they are exposed to or are soon to be exposed to greater stress.

A therapy that has been effective is the use of mycotoxin adsorbents that bind with mycotoxins in the feed and reduce their absorption by the animal. This effectively reduces, but does not eliminate, mycotoxin exposure to the animal. In cattle, a robust rumen fermentation can help maximize mycotoxin detoxification. Therefore, the use of sufficient effective fiber, buffers and microbial products to stimulate rumen function can be helpful. Because many nutrients interact with mycotoxins to modify their toxicity, optimal levels of nutrients can be helpful to reduce mycotoxin effects. In particular, antioxidants (selenium, vitamin E, synthetic antioxidants, etc.) can help protect the animal against increased oxidative stress caused by mycotoxin exposure.

If you have mold in hay, watch for the symptoms mentioned above. If hay is dusty (from mold spores) take care in feeding to sensitive animals and those in areas with poor ventilation. If mycotoxin symptoms are observed, check with a nutritionist to make sure the ration is properly balanced and possibly with a veterinarian to eliminate other disease/health problems. Quick test kits (ELISA kits) are available (listing at <http://www.ces.ncsu.edu/gaston/Agriculture/mycotoxins/mycotest.html>) to determine presence of a limited number mycotoxins but they can give false positives. Some forage testing laboratories will provide other mycotoxin tests. Often, the best strategy is to remove a suspected mycotoxin-contaminated feedstuff from the diet and see if symptoms disappear. If mycotoxins are present, the feedstuff can often be fed at a diluted rate and/or with approved feed additives.

#### **In summary:**

- ◆ Most molds are harmless - not producing known mycotoxins.
- ◆ Many of the commonly diagnosed mycotoxins are produced in the field prior to harvest.
- ◆ While vomitoxin (DON, deoxynivalenol) is a toxic mycotoxin, its presence has been used as a “marker” for the potential presence of other more toxic mycotoxins. Therefore the observed responses to vomitoxin are highly variable.
- ◆ Positive ELISA tests should be retested by laboratory analysis (e.g. HPLC or GC tests) since current ELISA tests can give false positives.
- ◆ If a mycotoxin problem is suspected, a comprehensive review of herd nutrition and health is essential - e.g. herd problems blamed on mycotoxins may be other disorders or nutritional issues. Diagnosing a mycotoxin problem is difficult and often involves the elimination of other possible factors.
- ◆ Certain feed additives have proved to be helpful in treatment.
- ◆ The physical dust problem associated with moldy forage can be reduced by ensiling, mixing with a high moisture feed or wetting the hay, but these will not reduce mycotoxins if present.

## Moldy Hay for Horses<sup>1</sup>

Haymaking conditions this spring have been poor. Much hay has been rained on or left lying in the field for prolonged time periods due to cool and humid conditions

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Molds commonly found in hay include *Alternaria*, *Aspergillus*, *Cladosporium*, *Fusarium*, *Mucor*, *Penicillium*, and *Rhizopus*. These molds **can produce spores that cause respiratory problems**, especially in horses and, **under some conditions, will produce mycotoxins**.

Horses are particularly sensitive to dust from mold spores and can get a respiratory disease similar to asthma in humans called Recurrent Airway Obstruction (RAO), commonly referred to as heaves. A horse with RAO will have a normal temperature and a good appetite, but will often have decreased exercise tolerance, excessive tearing of the eyes, coughing and nasal discharge. The horse will appear winded. Some horses are highly allergic to certain mold spores while others seem to be unaffected. Even among horses with symptoms, there seems to be a variation to their sensitivity level. To decrease exposure, have the horse spend more time outside at pasture than inside and feed the horse outside if possible. Some other ways to reduce dust exposure are as follows:

- Use dust-free bedding such as shredded paper or rubber mats.
- Don't feed dusty and moldy hay and grains.
- Keep your horse out of the stable when you are cleaning to reduce exposure to dust.
- Feed hay outside to minimize dust problems.
- Soak dusty hay for 30 minutes before feeding so that the horse can eat it while it's wet.
- Store hay away from your horse as much as possible and ensure any hay in the vicinity is kept dry to reduce mold.
- If the horse is housed indoors, ensure that there is good, draught-free ventilation through the stable.

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Sometimes mold spores are counted on moldy feeds to obtain an indication of the extent of molding and relative risks in feeding them. **Table 1** contains classification of risks at various mold spore counts.

While most molds do not produce mycotoxins, the presence of mold indicates the possibility of mycotoxin presence and animals being fed moldy hay should be watched carefully for mycotoxin symptoms.

<b>Table 1. Feeding Risks<sup>a</sup> at Various Mold Spore Counts</b>	
Mold Spore count per gram	Feeding Risk and Cautions
Under 500,000	Relatively low Risk
½ to 1 million	Relatively Safe
1 to 2 million	Feed with Caution
2 to 3 million	Closely observe animals and performance
3 to 5 million	Dilute with other feeds
Over 5 million	Discontinue feeding
<sup>a</sup> Risks refer primarily to effect of mold per se without regard to possible mycotoxin content.  Data from Richard S. Adams, Kenneth B. Kephart, Virginia A. Ishler, Lawrence J. Hutchinson, and Gregory W. Roth. 1993. Mold and mycotoxin problems in livestock feeding. The Pennsylvania State University.	

**Mycotoxins effects on animals:**

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- 3) alterations in the endocrine and exocrine systems;
- 4) suppression of the immune system which predisposes livestock to many diseases and may increase milk somatic cell count. A suppressed immune system may also cause lack of response to medications and failure of vaccine programs;
- 5) cellular death causing organ damage.

If you have mold in hay, watch for the symptoms mentioned above. If hay is dusty (from mold spores) take care in feeding to sensitive animals and those in areas with poor ventilation. If mycotoxin symptoms are observed, check with a nutritionist to make sure the ration is properly balanced and possibly with a veterinarian to eliminate other disease/health problems. Quick test kits (ELISA kits) are available (listing at <http://www.ces.ncsu.edu/gaston/Agriculture/mycotoxins/mycotest.html>) to determine presence of a limited number mycotoxins but they can give false positives. Some forage testing laboratories will provide other mycotoxin tests. Often, the best strategy is to remove a suspected mycotoxin-contaminated feedstuff from the diet and see if symptoms disappear. If mycotoxins are present, the feedstuff can often be fed at a diluted rate and/or with approved feed additives.

**In summary:**

- ◆ Most molds are harmless producing spores and dust but not producing known mycotoxins.
- ◆ Many of the commonly diagnosed mycotoxins<sup>a</sup> are produced in the field prior to harvest.
- ◆ If a mycotoxin problem is suspected, a comprehensive review of herd nutrition and health is essential - e.g. herd problems blamed on mycotoxins may be other disorders or nutritional issues. Diagnosing a mycotoxin problem is difficult and often involves the elimination of other possible factors.
- ◆ The physical dust problem associated with moldy forage can be reduced by feeding in a well ventilated area, mixing with a high moisture feed or wetting the hay, but these will not reduce mycotoxins if present.

Weather conditions prior to, during first cutting, and while making hay have been very moist. Many areas have 2 or more inches of above normal precipitation. Much hay has been rained on or left lying in the field for prolonged time periods due to cool and humid conditions which reduced drying rates. The long drying periods with high humidity allowed field growth of mold on the hay. We will try to state some facts and offer some recommendations for hay producers and livestock producers.

### What is the “black dust” that covers my mower or swather?

- The black dust is most likely spores produced by fungal organisms. Spores are how the fungi reproduce and are always present but usually at lower concentration. The black dust on a mower or swather indicates that fungal growth was present prior to cutting.

### What is the “black dust” on the hay in the windrow, and coming out of my baler or forage harvester?

- The dust is partially fungal spores which have been produced at any point prior to harvest; but most likely, spores were produced after mowing in the windrow, under high moisture levels.
- Another source of the dust is pulverized and decomposed plant material after drying.

### What can I do to prevent fungal growth in the crop prior to mowing?

- There are few options to prevent fungal growth in uncut forage. There are no current registered fungicides for alfalfa forage use, other than Apron™ for seed treatment at planting. Furthermore, it is probably not economic to treat even if you could forecast long term weather problems. For periods with high precipitations, adjust your watering schedule, prevent over irrigation, and allow plants to dry up faster.

### You can prevent further mold growth in harvested hay and silage!

- To improve drying and solar radiation on forage: 1) make a wide windrow, 2) mow in sunny weather, 3) rake or invert the windrow at about 40% moisture.
- Hay preservatives such as propionic acid products and other mold inhibitors can reduce or stop further mold growth in hay and silage, at least temporarily, when applied at baling or chopping. These products will not reduce the damage done before harvest, they merely stop new growth.

### What effects do molds have on animals?

- The spores can produce undesirable physical responses from humans and livestock from the physical dust and an allergic response of animals. Horses and other non-ruminants are generally more susceptible to this problem than cattle.
- Feed intake is reduced.
- The spores indicate a possibility of mycotoxin producing organisms.

For more information on mycotoxins and molds, see the fact sheet “Moldy Hay” by



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Undersander et al. 2009.

A mycotoxin is a toxic secondary metabolite produced by an organism of the fungus kingdom, including mushrooms, molds, and yeasts.

We have cultured fungal spores from *Phoma* (alfalfa spring black stem and leaf spot) and *Colletotrichum* from alfalfa in the Kimberly area. These genera are not known to produce mycotoxins, however, there other toxin producing fungi may be present.

Molds commonly found in hay include *Alternaria*, *Aspergillus*, *Cladosporium*, *Fusarium*, *Mucor*, *Penicillium*, and *Rhizopus*. These molds **can produce spores that cause respiratory problems**, especially in horses or other animals fed in poorly ventilated areas and, **under some conditions, will produce mycotoxins**. There is much confusion about mycotoxins in forages because several mycotoxins may be present, diagnostic methods are not consistent, and treatment and control recommendations lack needed research. While most molds do not produce mycotoxins, the presence of mold indicates the possibility of mycotoxin presence and animals being fed moldy hay should be watched carefully for mycotoxin symptoms.

If you suspect the hay has mycotoxins consult your veterinarian or nutritionist.

#### **Strategies for the utilization of moldy hay:**

- If hay is dusty (from mold spores) avoid feeding it to sensitive animals and those in areas with poor ventilation. If mycotoxin symptoms are observed, check with a nutritionist to make sure the ration is properly balanced and possibly with a veterinarian to eliminate other disease/health problems. Quick test kits (ELISA kits) are available (listing at <http://www.ces.ncsu.edu/gaston/Agriculture/mycotoxins/mycotest.html>) to determine presence of a limited number mycotoxins but they can give false positives. Some forage testing laboratories will provide other mycotoxin tests.
- Often, the best strategy is to remove a suspected mycotoxin-contaminated feedstuff from the diet and see if symptoms disappear. If mycotoxins are present, the feedstuff can often be fed at a diluted rate and/or with approved feed additives.
- Dilute the suspected feed by starting with a small amount, gradually increase the proportion, and observe animal behavior and health closely.
- Allow animals to sort through the hay and reject molded forage, and then remove the rejected forage.

#### **In summary:**

- ◆ Most molds are harmless - not producing known mycotoxins.
- ◆ Many of the commonly diagnosed mycotoxins are produced in the field prior to harvest.
- ◆ The physical dust problem associated with moldy forage can be reduced by ensiling, mixing with a high moisture feed or wetting the hay, but these actions will not reduce mycotoxins if present.