
Forage News
Mississippi State University Extension Service

Monitoring Mold When Feeding Hay

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Mississippi forage producers harvest about 1.7 million tons of hay annually valued at 124 million dollars, but large losses in quality and quantity occur. This past summer and fall's wet weather conditions have resulted in poor hay quality for winter feeding. In many cases, heavy and continuous rain delayed hay harvest, damaged already-cut hay the field, and/or forced some producers to harvest hay at improper moisture levels (>18% moisture). Also, producers have left hay exposed in the field causing greater deterioration due to inappropriate storage conditions. If you harvested or bought rain-damaged hay this year, the question to answer now is how bad is the damage and what is the nutritive value of the resulting hay?

One of the most frustrating factors that results in downgraded hay is mold. Grey or black hay is an indication of mold and should be avoided at all costs. Take a bale apart to check the inside; black sections of mold inside the hay indicate bad baling or storing procedures. Mold makes hay less palatable, resulting in lower intake or in greater animal hay refusal. Many other problems from mold occur because of mycotoxins produced by certain types of mold fungi. Be cautious as you prepare to feed, but if you see mold in your hay, keep in mind that not all mold produces mycotoxins, and the amount produced by the different types of fungi is unpredictable.

How Sensitive is Livestock to Mold? – Feeding moldy hay to livestock is a tough decision. The effect of mold on livestock health can vary depending on the type of livestock. Horses might be most sensitive to mold and mold spores might cause respiratory conditions (COPD) like heaves and digestive problems like colic. Cattle can generally tolerate and eat a little mold without problems, but keep in mind that some types of mold may cause mitotic abortion or aspergillosis. People handling moldy hay should avoid breathing in many of the spores since they can grow in the lung's tissue causing a condition called farmer's lung. To avoid livestock issues, it is best to minimize feeding hay to more sensitive livestock such as horses and pregnant cows. Although others recommend mixing moldy hay with other feeds to dilute the problem, producers should take very careful consideration since they can make the livestock sick by forcing them into eating bad hay that they will normally refuse.

Mold Growth in Hay – In hay, mold growth is comprised of two components: mycelium and spores. Mycelium is the stringy growth structure of fungi, and spores are the reproductive or seed like structures. The main concern for cattle is the total amount of mycelium and spores combined or the total fungal biomass. In hay, the white mold in the bale is the mycelium and dustiness is from the tiny spores. The potential for hay molding starts even with the standing hay crop where bacteria protects the plant from fungal and yeast infections. As the hay crop is cut and the moisture content of the plant rapidly decreases, the predominant and beneficial bacteria and yeast are no longer competitive at low moisture levels, allowing for a new group of microbes (especially fungi) to multiply. Most of the new fungi feed off sugars and organic acid exudates produced during the respiration and drying processes. Hay harvested and stored under ideal conditions often contains 1 to 2% total fungal biomass while severely molded hay

may contain up to 10 to 12% total fungal biomass. Although this may not seem to be a great percentage, livestock do not like eating mold, and there could be a greater loss of nutrients during the molding process. You have probably had moldy hay in the past that your livestock consumed with no problem or other moldy hay that they avoided. Some studies have shown inconclusive data related to hay intake under different percentages of total fungal biomass.

Types of Mold in Hay Production – Each type of fungi have their own ideal temperature and moisture level where they grow best, but none grow well at low moisture levels (<15%). There are over 10 main types of fungi that can be found in hay production. Molds commonly found in hay include *Alternaria*, *Aspergillus*, *Cladosporum, Fusarium*, *Mucor*, *Penicillium*, and *Rhizopus*. These molds can produce spores that cause respiratory problems (especially in horses) and under some conditions, will produce mycotoxins. Although mycotoxins can be produced by certain fungi during hay storage, they are much more common problems in forages stored under higher moisture conditions (haylage and silage) or in grain fed to livestock. Spore count in moldy hay (**Table 1**) can usually provide an estimate of the mold infection and the level or risk when feeding this type of hay. Estimating spore counts could be a very tedious process and while most molds do not produce mycotoxins, the presence of molds could indicate the presence of mycotoxin. Livestock being fed moldy hay should be watched carefully for mycotoxin symptoms. Some of the symptoms include:

- Feed refusal or reduced intake
- Reduced nutrient absorption and impaired metabolism
  - ✓ Altered digestion and microbial growth
  - ✓ Diarrhea and intestinal irritation
  - ✓ Reduced reproduction, lower fertility, abortions
  - ✓ Lethargy and increased morbidity
- Alterations in the endocrine and exocrine systems
- Suppression of the immune system
  - ✓ Livestock predisposition to many diseases
  - ✓ Increase milk somatic cell count
  - ✓ Lack of response to medications and failure of vaccine programs
- Cellular death causing organ damage

Table 1. Feeding recommendations at various mold spore counts present in hay for horses.

Mold Spore (count per gram in millions)[1]	Feeding Recommendations and Risk[2]
<0.5	Relatively low risk
0.5 to 1	Relatively safe
1 to 2	Feed with caution
2 to 3	Closely monitor livestock and performance
3 to 5	Medium risk, dilute in mix ration with other feeds
>5	Very high risk, stop feeding

[1]Based on a 90% dry matter or air-dried basis.
[2]Risk refers to the effect of mold without taking into consideration possible mycotoxin presence.
Source: Richard et al., 1993.

Effect of Mold on Hay Quality – Mold and hay quality is a very difficult issue because the presence of mold does not necessarily mean that the feed quality is lower until the total fungal biomass is assessed and forage quality is chemically analyzed. Hay baled at moisture levels of 22% or above will usually develop mold and/or undergo excessive heating (over 200 ºF). This

excessive heating will damage the protein content and reduce the overall digestibility and palatability. Wet hay usually increases microbial activity of anaerobic bacteria and thus spoilage. As mentioned previously, under these conditions, mold will reduce forage quality and some types of fungi can produce toxic compounds. We cannot overstate the importance of analyzing the nutrient quality of hay, especially when considering purchasing or incorporating rain-damaged hay into your winter feeding rations. Testing nutrient quality will allow you to determine if animals should or should not be fed with this type of hay. Testing will also allow balancing the least cost of rations for animals of various groups and ages based on their cycle of production. Most producers do not usually get their hay tested. In the absence of any forage analysis, it is best to assume that the quality of the hay is poor and should be fed only to mature dry cows. Avoid feeding this low quality hay to weaned calves, lactating cows, or cows during late pregnancy. Even with these precautions, a nutritional supplement might be needed when feeding rain-damaged or over-mature hay. Remember, not all feed ingredients are equal in nutrient value or price. If supplementation is needed, forage analysis will help determine the least cost for supplements, which may reduce cost and increase performance and profitability.

Some studies at University of Tennessee suggest that the effect of moldy hay could be reduced by feeding high quality hay and grain along with it or using a commercial supplement. Findings suggest that when feeding severely molded hay to cattle, the hay should be diluted to no more than 30% of the ration to reduce the risk of mycotoxins and poor animal performance. On the other hand, hay with mold and limited heat damage could be diluted to 40-60% of the total ration. An important management approach is not to force the cattle to consume moldy hay without other forage or supplement being available.

Can Mold Development Be Prevented or Treated? – It is important to keep in mind that mold can never be completely eliminated in hay production. Hay desiccants such as potassium or sodium carbonate offer chemical alternatives for a faster dry down, but the effectiveness varies with climatic conditions. Another mold prevention strategy is to use a hay preservative (organic acids, yeast cultures, enzymes, etc). Propionic and acetic acid and their derivatives such as sodium diacetate are the most common organic acids used in hay production. These acids will inhibit mold growth which causes dusty hay. One disadvantage is that these acids need to be applied in the field when hay is not yet dry enough to be baled safely and rain poses a threat to getting the crop harvested. Some popular articles indicate that there acids that can affect horses, but in reality these acids (propionic and acetic) are naturally produced in the cecum and colum of horses as the result of the microbial digestion of fibrous feeds. It is important to add these preservatives at recommended rates. Buffered propionic acid (with a pH of 5.5 to 6.0) will restrict the growth of aerobic molds at hay moisture levels greater than 20%. Its effectiveness is primarily determined by its level of addition to the forage. Approximately 20 lb/ton of hay (1%) is recommended. The more concentrated these preservatives are applied, the better because it means less water added on to the hay.

Ammonia or urea can also be used to prevent mold growth and heating when injected into the hay bales after harvest. As moisture content increases, more ammonia is needed and since ammonia volatilizes, its effectiveness is increased if the bales are wrapped or covered. Anhydrous ammonia is only recommended for lower protein grass hay, because adding it to high protein hay could cause severe health problems.

Microbial inoculants are also used on hay. Bacterial inoculants provide another method to potentially reduce mold growth. The principal idea behind bacterial inoculants is to dose the plant with adequate amounts of these beneficial bacteria, so that they inhibit the mold causing fungi and out-compete the bacteria that contribute most to heating. Lactic acid bacteria cannot grow at moisture contents less than 35% and under the aerobic conditions of hay storage. For this reason, silage inoculants are not recommended for use on hay. Microbial inoculants are not very consistent on providing good prevention; in some studies they have shown good results but in others, they have not significantly reduced mold formation.

Summary – Good hay should contain maximum digestible energy and protein to meet the needs of high producing livestock. Baling hay at the correct moisture, 15% to 18%, is not always possible when dealing with the types of weather conditions we have experienced in Mississippi this year. Over one-half of baled hay produced is damaged by not reaching proper moisture levels when baling. This damage is due to baling hay that is too wet or too dry. Hay harvested at 18% and above actual moisture will heat, mold, and loose feed value and palatability. Hay harvested below 14% moisture will be brittle, have leaf shatter and high dry matter loss. The window for optimum baling is indeed very narrow and hard to hit when the climatic conditions are so variable. It may never be possible to completely eliminate molding in hay, but there may one day be alternatives to preservatives for safely baling higher moisture hay. Mold is not always a negative, but it is never a positive and direct negative effects of moldy hay are difficult to document.

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