Rain causing issues in Montana hay

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After the large amounts of rain received throughout Montana in recent days, we have been receiving reports of heating and molding of hay bales stacked and stored outside. Rain can be detrimental at several points of the haying process, including after storage. It will increase the amount of wasted hay, due to molding and quality issues, as well as pose a safety hazard due to fire and health risks.

Problems following heating and water damage of hay include decreased quality, increased waste, and molding. Generally, the larger and more dense the bale of hay, the greater chance for heating and storage losses. Large round bales and large square bales are more susceptible than small square bales to losses and spontaneous combustion.

Rained on hay can cause increases in the internal temperature of the bale, which can then lead to spontaneous combustion. An Oregon report stated that the bottom bales of large stacks of hay stored outside had soaked up a large amount of moisture from the ground after a heavy rain, causing heating and internal combustion in the hay stack.

Spontaneous hay fires usually occur within six weeks of baling, however when external moisture such as heavy rain is added, issues can arise outside of that timeframe. Increases in bale moisture increase microbial activity, with heat as a by-product. It is typical to see temperatures peaking 3 to 7 days post-rainfall, but should return to normal by 60 days. This will depend on factors such as relative humidity, bale density, and amount of rainfall received. The longer it takes for the bale temperature to return to normal the more likely for a fire or significant damage will occur to the hay.

When available, a bale thermometer will be the most accurate estimate of internal bale temperature. Ensure that the thermometer can read up to 200^0 F and is long enough to reach the middle of the bale. If a thermometer is not available, an easy way to test the temperature of your bale is to stick a crowbar or a metal rod into the middle of the bale and keep it there for approximately 10 minutes. When the crowbar is removed, it should cool to the touch. If it is warm to the touch, then it is an indication of internal heating and should be taken care of immediately. If the crowbar is too hot to touch, this indicates that spontaneous combustion could be imminent. All stacked bales should be spread out, to allow for as much air movement through and around the bale as possible.

Temperature	**Suggestions**
< 130^0 F (cool to touch)	Generally safe
130-140^0 F (warm to touch)	Check every couple of hours
150^0- 175^0F (hot to touch)	Danger- move hay off by itself
175- 190^0F	Call Fire Department
>200^0F	Fire is present, even if it is not visible. Ensure Fire Department is there

Beyond possible spontaneous combustion, there are other quality losses associated with rained-on hay, especially hay that continues to sit in water. When hay begins to heat due to additional moisture, some of the proteins become unavailable for digestion due to binding with fiber, and is known as acid detergent insoluble nitrogen (ADIN). Unfortunately, this will still show up as crude protein on a standard lab test, and so may not exactly represent the amount of protein available to the animal.

You can ask for an analysis to include ADIN, which depending on the lab may also be referred to as acid detergent fiber nitrogen (ADF-N) or acid detergent fiber protein (ADF-P), usually at an additional charge. If the ADIN is <10%, then you do not need to adjust the crude protein (CP) levels. If the ADIN is >10%, then you should subtract 10% from the ADIN value to determine available CP. As an example, your analysis comes back with ADIN= 27% and CP=12%. To determine the available CP:

27 (% ADIN) – 10 = 17% ADIN
17 (calculated % ADIN from above) * 12% (CP) * 100 (conversion factor) = 2.
Subtract this from the total CP, so 12% (CP) – 2 (calculated above) = 10% CP available.

Hay left in field after an intense rainstorm in Phillips County. Photo courtesy of Marko Manoukian.

Perhaps a more well-known effect of rained-on hay is molding. In a standing crop of forage, the plant surfaces are covered with bacteria to help protect the plant against external assaults such as fungal infections, yeast, and potentially visible light. Once cut, the forage moisture begins to decrease, altering the bacterial populations and potentially increasing fungal and yeast populations. In normal moisture hay (<15% moisture), fungi will not grow well and there are usually limited mold issues. However, when the bale moisture is increased, this opens the opportunity for fungal and mold growth.

Cereal hays are especially prone to molding issues. At harvest, the stems of the plant are sufficiently dry, however the moisture in the grains is still above desirable levels. The grain loses moisture at lower rates than the rest of the plant, and so at baling are often above 15% moisture. Mold is commonly seen in these areas first, which then can spread to the rest of the bale.

Mold, and especially the mycotoxins that some molds produce, can be harmful to animals and humans alike. Horses are the most susceptible, with ingestion of moldy hay potentially resulting in respiratory and digestive issues. Ruminants aren’t as sensitive to moldy hay, but can have

experience negative effects such as abortions or aspergillosis. Additionally, there is a condition known as “farmer’s lung” that can occur in humans due to fungus growing in lung tissue after fungal spores have been inhaled.

Moldy hay can be fed to ruminants, however it does not come without risks. If the hay is dusty from mold spores, then do not feed it to sensitive animals, and ensure that where you are feeding it is properly ventilated. Make sure to dilute the moldy forage by feeding with “clean” hay, or hay that is not moldy. Mold does decrease the palatability of the forage, causing animals to avoid it, but if mixed in with other hay it will generally be accepted. However, ensure to remove any rejected forage that animals will not consume, and provide new hay at the next feeding.

If you are experiencing moldy hay, it is advised to have it tested. Laboratories such as Midwest Laboratories (Omaha, NE) and Dairyland Laboratories, Inc. (Arcadia, WI) have tests that can check for mold and mycotoxin levels in your hay.

If you have any further questions, please contact Emily Glunk, Forage Extension Specialist, at emily.glunk@montana.edu or 406-994-5688.