Making Hay When the Sun Doesn't Cooperate

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Rain on the windrow removes soluble nutrients from hay and increases the relative fiber content of forage. When fiber content is increased, dry matter intake and digestibility are reduced. While some luck with the weather is always crucial, producers can control those losses by using a multiple organic acid-based hay preservative to bale hay at higher moisture content.

Organic acid hay preservatives inhibit microbial growth that can occur during storage of higher-moisture hays. By baling hay at higher moisture, there are more leaves present in the hay, and therefore, a higher level of nutrients.

Why are Multiple Organic Acid Preservatives Better?

Work in the early 1970s by Pelhate* clearly demonstrated various spoilage organisms have different susceptibilities to different organic acids. This led to the conclusion that wide spectrum mold inhibitors should have a variety of acids formulated into them.

Kemin Industries, Inc., tested the ability of an organic acid blend to increase the efficacy of propionic acid which has long been recognized as one of the most efficacious mold inhibitor ingredients. A typical mash feed was used in order to simplify the experiment, however the results can be applied to other substrates such as hay.

Two specific products were formulated. The first was a generic product containing 65% propionic acid buffered with ammonium hydroxide to a pH of 5.5. The second was an experimental product containing the same amount of buffered propionic acid, but it also contained 2% sorbic, 2% benzoic and 2% acetic acids. Both were applied to 15% and 22% moisture feed. Total microbial respiration was used to monitor the efficacy of the products by measuring the ability of a particular formulation to repress carbon dioxide formation within a sealed container because that measurement will not differentiate between mold and bacterial growth. In the case of the higher moisture feed, after two and a half days the untreated material began to show significant levels of carbon dioxide accumulation. After four days, the amount of difference increased and, after five days, the difference was even more pronounced — a clear and statistical advantage for the product containing the additional acids.

Similar Results Can Be Achieved in Making Hay

In a Kemin field trial, third cutting orchardgrass hay measured 22% moisture in the windrow and 22.5% moisture in the bale. Multiple organic acid hay preservative was applied at six pounds per ton of hay to one-half of the field. The hay tested 16.5% moisture in the windrow and 17.5% in the bale. The remaining hay was not treated with the hay preservative. Hay samples were collected from 25 random bales from each treatment with a hay probe at baling and after 12 weeks of storage, composited at each time point, and analyzed for nutritional composition. Twenty-five bales from each treatment were randomly chosen and weighed as a group at baling and after 12 weeks of storage.

The results of the nutritional analyses are shown in Table 1. By design, the moisture content of the hay treated with the hay preservative was higher than untreated hay at time of baling. The crude protein level of the untreated hay was 7.9% lower than hay treated with the preservative at baling time and 4.8% lower 12 weeks after baling. This is most likely due to soluble proteins being leached out of the untreated hay. As a result of this loss, acid digestible fiber (ADF) and non-digestible fiber (NDF) levels were higher for the untreated hay. In addition to lower protein levels, the untreated hay had lower total digestible nutrients (TDN) and lower energy levels. Due to higher fiber content, the untreated hay had an 18.9% lower relative feed value (RFV) at time of baling and an 11.6% lower RFV after twelve weeks of storage. The relative forage quality (RFQ) of the treated hay was 30.7% higher at time of baling and 20.5% higher after 12 weeks of storage. Bale weight of the treated hay was 10.2 pounds heavier at baling and 8.3 pounds heavier after 12 weeks of storage.

	Non-Treated		Treated	
	Baling	**12 Weeks**	**Baling**	**12 Weeks**
Moisture, percent	17.78	14.65	19.22	15.43
CP, percent	17.98	17.48	19.52	18.37
ADF, percent	36.54	35.14	30.77	31.62
NDF, percent	50.72	49.84	44.16	45.93
TDN, percent	52.15	53.05	59.17	57.91
NFC, percent	19.46	20.93	23.64	23.26
RFV	111.04	114.95	136.91	130.03
RFQ	120.69	131.95	157.76	159.04
NE_l Mcal/kg	1.04	1.18	1.33	1.30
NE_g Mcal/kg	.49	.52	.71	.67
NE_m Mcal/kg	1.04	1.07	1.28	1.24
Avg. Bale weight, kg	23.30	21.90	27.90	25.70
Mold presence, cfu/g		45,000		13,500
Yeast presence, cfu/g		$9.0x10^6$		$1.0x10^6$

Table 1. *Nutritional analysis of non-treated alfalfa-orchardgrass hay and hay treated with a multiple organic acid hay preservative. Values expressed on a dry matter basis.*

Producers who utilize a hay preservative are able to remove the hay from the field sooner, and are able to have more cuttings in a season. Therefore, not only are the bales heavier and contain more nutrients, a producer can harvest more bales per acre due to an additional cutting.

Conclusions

The results of this demonstration trial clearly show the advantages of using a multiple organic acid hay preservative as a management tool in hay production. Through the use of the hay preservative, a larger quantity of higher quality hay was harvested. The treated hay had higher levels of protein and energy, with lower levels of fiber, which should result in higher animal performance. The increased levels of nutrients and the larger tonnage of hay harvested from the field more than offsets the increased cost of hay production with the preservative. However, even if the enhanced nutritional value were completely offset by the treatment cost, the increase in bale weight due to treatment with the hay preservative would result in an additional increased return in price per bale and a significant increase in tonnage per acre.

Total acid content in hay preservatives is important. Just as important is the number of specific different acids included in them that can control different organisms. Producers should compare the list of all ingredients in various EPA-registered hay products, both "active" and "inert," before buying. Clearly understand the reasons why each is included in a formulation. All ingredients are listed in descending order by percentage of content on the label. Be sure the hay preservative purchased carries an EPA registration number — most major brands do. However, some products in the marketplace are not registered, and using them violates the law.

Also remember that using a hay preservative is not a substitute for good management practices. Harvest all hay at the proper moisture and stage of maturity. Do not store untreated hay near high moisture treated hay. Store hay off the ground under a roof. Newly baled hay will sweat until its moisture has evaporated. For that reason, be certain to provide good ventilation and allow adequate head clearance between the top bale and the roof.

References

Pitts, R. E. 1990. Silage and Hay Preservation. NRAES-5. Natural Resource, Agriculture, and Engineering Service. Ithaca, New York. Pelhate, J. (1973) Ann. Technol. Agric. 22: 647-661.