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Hay Preservatives

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Hay Preservatives

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As a rule, the practice of crushing or conditioning hay after it has been mowed reduces field curing time by as much as a day. Hay preservatives have the potential of cutting the curing time even further. This would facilitate the packaging of a better quality forage—one in which the leaves are less likely to be shattered and the nutrients are less likely to be leached by rains at harvest time.

The purpose of this publication is to provide information to the hay producer concerning various preservative materials. He can then determine whether he should use them routinely or only at special times.

TYPES OF HAY PRESERVATIVES

Following are some of the materials that have been used alone or in mixtures over the years to preserve forages. The degree of success achieved with these materials has varied from excellent to very poor. Some are no longer suggested for use, and others are still rather experimental.

Salt

Salt was one of the earliest preservatives used on hay. It was lightly spread by hand over each layer of bales in the storage facility before the next layer was stacked on top. The salt served to preserve hay in much the same way as it served to preserve home cured meat. It is still used by a few farmers today when wet bales must be placed in storage. However, its expense and influence on palatability have limited its use.

Anhydrous Ammonia

Anhydrous ammonia is potentially a more valuable preservative than organic acids, because it can actually improve the original product in some respects, namely crude protein percentage and fiber digestibility. However, more experimentation is needed before its use can be recommended.

Organic Acids

Organic acids are materials that function as a fungicide to prevent mold growth. At present, the ones being used most widely as preservatives are propionic acid, acetic acid and formic acid. The remainder of this publication deals with these materials—their recommended rates, application method, benefits and limitations.

APPLYING ORGANIC ACIDS

Rates of Application

Organic acids are used as the major preserving agent in several hay preservatives that have been sold in recent years in Indiana. Research workers at Purdue have found that the application rates shown in Table 1 are necessary to preserve hay effectively. It should be noted that these rates are in pounds of actual acid needed, not pounds of commercial product. Some commercial products contain as much as 80 percent water.

The organic acid content in commercial preservatives is shown on the product label and should be used to calculate proper rates of application. The number of gallons of a given commercial product that should be applied to each ton of hay to achieve the rates shown in the table may be calculated by using the following equation:

$$\text{Gals.} = \frac{\text{lbs. acid desired/ton hay}}{\text{wt. of 1 gal. of product} \times \text{pct. acid content of product}}$$

Table 1. Recommended Rates of Propionic Acid as a Hay Preservative.*

Moisture content of hay at baling time	Amount of actual acid per ton of hay
20-25 pct.	10 lbs.
25-30 pct.	20 lbs.
30-35 pct.	40 lbs.

*The rates shown apply to bales weighing approximately 50 lbs. Increase rates by 50 pct. for large hay packages.

Example. If the hay contains 32 percent moisture at baling time, and if the commercial preservative being used weighs 10 pounds per gallon and consists of 50 percent propionic acid + 50 percent flavoring materials and water, then the application rate would be 40 lbs. ÷ (10 lbs./gal. x 50%) = 8 gals. This 8 gallons of material would contain the 40 pounds of acid recommended in Table 1.

Methods of Application

One method for applying organic acids to hay has been to spray the windrow with the preservative before baling. Two major problems are encountered with this system, however. One is that windrow size varies over the field; the other is that organic acids vaporize from the windrow before baling occurs. Thus, the correct rate of preservative is not appropriate for each bale.

Application equipment is now available that mounts on the baler and applies the preservative to the hay near the bale chamber. This method is far superior to spraying the windrow.

BENEFITS OF ORGANIC ACID PRESERVATIVES

Field Curing Time Shortened

Generally, grass hay may be safely baled when its moisture content falls to 25 percent, and legume hay when it falls to 20 percent. In central Indiana, hay mowed in late May is likely to be rained on in 5 of 10 years if it must cure for 48 hours before reaching these safe moisture levels. The odds become 7 in 10 if curing time is extended to 72 hours.

If hay preservatives could be economically applied to the forage, the producer could safely bale hay at a higher moisture content (up to 35 percent) and thus reduce the time between mowing and baling. This would mean better quality hay and less chance of serious mechanical (leaf) losses associated with handling hay when it is dry.

Storage Losses Reduced

When hay is baled and stored at moisture contents above 20-25 percent, mold growth is encouraged which, in turn, generates heat. As the temperature of the hay increases, quality of the hay decreases; and if the process continues long enough, spontaneous combustion can occur to completely destroy both hay and storage facility.

Preservatives help to inhibit mold growth and thereby reduce the risk of loss in hay quality and the danger of spontaneous combustion. Figure 1 shows how Parker and others in Maryland, using propionic acid, were able to store moist hay without a heat problem occurring.

LIMITATIONS OF ORGANIC ACID PRESERVATIVES

Extra Costs

Before he can economically justify the use of preservatives on hay, the producer must at least recover the cost of the preserving material and the cost of applying it. If the extra quantity and quality of hay saved by the preservative are sufficient to cover the added expenses, then its use is probably justified.

The data in Table 2, generated by research at Purdue, should help the producer estimate roughly how much he could afford to pay for the use of a preservative. To determine its value, he should compare the value of the final product **per acre** obtained by the four alternative systems shown, taking into account both field and storage losses. The differences in final value are greater on a per-acre basis than on a per-ton basis. This is because the value-per-ton calculations do not take into account actual losses of dry matter, but only account for differences in quality.

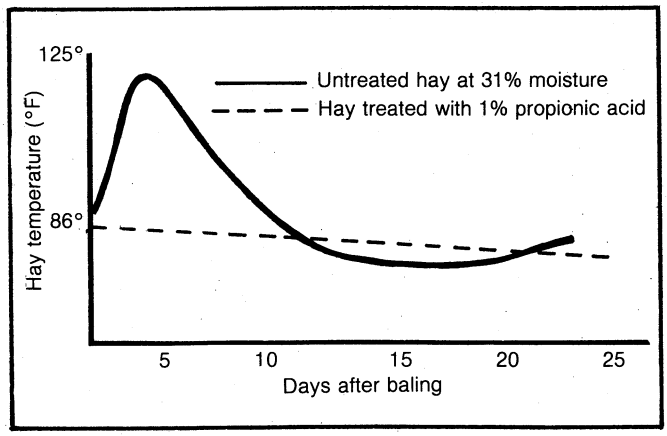

Figure 1. Storage temperatures of propionic acid-treated vs. untreated alfalfa-timothy hay baled at 31 percent moisture.

Table 2. A Comparison of Hay Crop Value for Four Systems of Harvesting (Holt and Lechtenberg, Purdue Agronomy Department).

Item	Unit	Col. 1 Baled dry -no rain	Col. 2 Baled dry -1" rain	Col. 3 Baled wet -treated	Col. 4 Baled wet -untreated
Original yield	lbs./ac.	2000	2000	2000	2000
Original digestibility	pct.	70	70	70	70
Original TDN	lbs.	1400	1400	1400	1400
Respiratory loss (field)	pct.	5	10	5	5
Mechanical loss	pct.	10	10	5	5
Total field loss	pct.	15	20	10	10
Harvested yield	lbs./ac.	1700	1600	1800	1800
Storage loss	pct.	5	5	10	18
Total dry matter loss	pct.	20	25	20	28
Final yield	lbs./ac.	1600	1500	1600	1440
Final digestibility	pct.	66	61	64	59
TDN remaining	lbs./ac.	1056	915	1024	850
Pct. original TDN lost	pct.	26	35	27	39
Value of each acre (Lb. TDN = $.05)	dol.	$52.80	$45.75	$51.20	$42.40
TDN per remaining ton	lbs./ac.	1320	1220	1280	1180
Value per remaining ton	dol.	$66.00	$61.00	$64.00	$59.00

Example. If the producer must choose between baling his hay at 25-30% moisture with a preservative (col. 3) or allowing the hay to be rain-damaged (col. 4), the table indicates that he could afford to pay about $5.00 per acre for the preservative treatment, if his potential yield was one ton per acre ($64.00 minus $59.00). The value of the preservative treatment, according to this analysis, is: $5.00 × tons of dry matter per acre at cutting time. The $5.00 value will vary depending on assumptions about the basic value of a pound of digestible dry matter (TDN), assumed in Table 2 to be 5 cents.

Potential Equipment Damage

One of the undesirable effects of using organic acids as a preservative is that they may encourage corrosion of equipment. Therefore, cleaning the machinery after use is advised. One way to do this is to run the last half dozen bales through the baler without applying the preservative. Another way is to hose down the machine with water.

SUMMARY AND CONCLUSIONS

Organic acids have a mold-inhibiting ability which aids in preserving wet hay. This can mean a significant reduction in both field and storage losses. Rates of application commonly vary from 1 to 3 percent of the wet forage weight.

At this point, use of preservatives is still somewhat experimental. More research is needed on application techniques, on the effects of various materials on animal health, and on the economic benefits of their use before preservatives can be endorsed without reservation.

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