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How Effective Are Hay Conditioners?

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Hay Conditioners?

Tests here at Iowa State and elsewhere show that, with proper management, hay conditioning can result in better-quality hay and decrease exposure risks. In good weather, conditioning can cut curing time almost in half.

by T. W. Casselman and Robert C. Fincham

Hay conditioners can result in better-quality hay and decrease the exposure risk for your crop—if used with certain common-sense management rules concerning your timing of mowing and conditioning. Tests at Iowa State show that, during good weather, conditioning can cut the curing time for hay almost in half.

It’s a common farm experience to cut high-quality alfalfa for hay and then, because of weather damage, end up gathering and storing low-quality hay—with only a portion of the original dry matter and nutrients. One of the main reasons is that the periods of good drying weather during the haying season in Iowa are often shorter than the time needed for field drying.

At the same time, the leaves of common legumes cut for hay dry faster than the stems. If you leave your hay in the field long enough for the moisture content of the stems to be low enough for baling, you find the leaves dried to the point where shattering losses are serious. This has frequently prompted the idea-wish to find some way to hasten the drying of the stems or to slow down the drying of the leaves.

Actually, the common practice of raking hay into windrows at a moisture content of 40-50 percent is an attempt to do just that. The mass of stems and leaves does tend to dry more uniformly than if left in the swath, but windrowing also lengthens the over-all drying time. Windrowing does reduce bleaching, a factor that can downgrade hay quality. But, basically, windrowing does nothing to shorten the total time necessary for field curing.

It wasn’t until hay conditioners came along that shortening of field-drying time became a practical possibility. These conditioners all perform the same basic operation. They crush, crimp or lacerate the stems so that more stem area is exposed to permit a more rapid release of moisture.

Types of Machines...

Many different makes have appeared on the market since hay conditioners were first introduced. But they can all be placed within three general classes: the corrugated roller, the smooth roller and the flail-type forage harvester as adapted for conditioning.

The corrugated roller machine (see photo 1), commonly called a crimper, consists of two cast-iron rolls with tapered flutes that mesh much like gear teeth. Hay in the swath is picked up by the lower roll, and the stems, on passing through the rolls, are cracked at uniform intervals.

The smooth roller machine operates in much the same fashion except that the stems are crushed along their entire length rather than at intervals. The rolls of some of these machines are smooth steel; others are rubber or rubber covered.

The flail-type harvester has a 5-foot rotating shaft parallel to the ground. A series of L-shaped swinging hammers or knives are attached to this shaft which rotates opposite to the direction of travel of the machine. When the machine is used as a hay conditioner rather than a harvester as such, its shear bar is removed to reduce the cutting action. The idea is to mutilate and shred stemmy material as much as possible without chopping it into short pieces.

If the material is cut too short, it won’t remain fluffy. For this reason, the forward speed of the machine is increased beyond that for conventional forage harvesting, but the rotor speed is reduced. A suggested rule of thumb is to adjust and increase forward speed and to decrease rotor speed until the machine is operating at a point just short of plugging. With rough field conditions, of course, high forward speeds can’t be used, so a compromise is necessary.

When used as a conditioner, a panel in back of the flail-type machine is opened allowing the green hay to fall back on the ground in a swath. A downspout attachment can be used to convey the...
conditioned hay back to the ground in a fluffy windrow (see photo 2). By swinging the downspout to the side on following rounds, as many as three 5-foot swathes can be put into the same windrow. One advantage of this method is that cutting and raking are performed as one operation. Off hand it might seem that hay conditioned and windrowed in this manner would call for a longer curing time than conventional methods. But this isn’t necessarily so.

**Our Tests . . .**

We conducted a series of hay-drying and conditioning experiments on first-, second- and third-cutting alfalfa in 1959. The purpose: to determine the relative merits of hay conditioning as compared with the conventional mow-rake-bale method of harvesting hay. We compared harvesting and conditioning with a crimper and flail-type machine with conventional harvesting. A smooth-roll crusher wasn’t included in our trials. Tests in other states, however, indicate that the drying rates of cramped and crushed hay are quite similar, with a slight advantage in favor of the smooth-roll machine.

Best results with crushing in the past were obtained when hay was conditioned immediately after mowing. We followed this practice in our tests. An efficient way to do this is to attach the crusher behind the mower so that hay in the previous swath is conditioned while the next swath is mowed. Doubling up like this saves an extra trip around the field with the crusher.

The flail-type machine used had a downspout for placing the conditioned hay in a windrow. We tried both two- and three-swatth windrows, but, as far as we could tell from these tests, one size didn’t cure any faster than the other. Alfalfa used in the experiments was about an average stand; with an extra-heavy growth, a two-swatth windrow might cure faster than a three-swatth windrow.

Both the conventional and crushed treatments were raked at about a 40-percent moisture content. The flail-conditioned material was given a half turn with a single-wheel rake at about a 55-percent moisture content as recommended by the manufacturer. This exposes the bottom side of the windrow and helps speed up the rate of drying. Careful use of a side-delivery rake would do the same job of turning as the single-wheel rake.

To follow the rate of drying, we took samples at intervals from the swaths and windrows of the variously treated hay, placed the samples on screen trays and weighed them. We took additional samples each time an operation such as raking or turning was performed to find the effect of each operation.

**Our Results . . .**

The graph shows the drying patterns for second-cutting alfalfa for each of the three treatments studied. Also shown is the variation in relative humidity during the period, which indicates that the period wasn’t ideal hay-drying weather. The results, nonetheless, furnish a comparison of the relative rates of drying for each of the three methods.

Notice that conventionally processed hay had the highest moisture content throughout the tests. This was also true for our tests with first and third cuttings. There wasn’t much difference between the cramped hay in the swath and the flail-conditioned material in the windrow until the flailed material was turned to expose the underside of the windrow. At this point the flailed material dried more rapidly and continued to do so until the time of baling.

In this test, the turned flail-conditioned hay could have been baled at about noon of the third day; the unturned flailed hay, about 5 hours later. The cramped hay, when raked, begins to fall behind the flailed hay in rate of drying because of slower curing in the windrow. The unturned flailed hay, even though in windrows, tended to dry more rapidly than the cramped hay because of the flail’s more severe bruising and the fluffier condition of the windrow.
Changes in Moisture Content of Hay for Three Treatments and Variation in Relative Humidity

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row which allowed some air movement.

Effects of rain: It did rain and remained overcast for one whole day and night during these tests. This, however, led to an interesting discovery concerning the three hay treatments.

When we reweighed samples after the rain, we found that the flailed hay hadn’t gained as much water as the crimped or conventionally treated hay. This might have been chance, so we simulated a rainfall on another batch of hay with the same treatments with the same kind of results. The flailed material absorbed less moisture per pound of dry matter than either of the other two treatments. Table 1 summarizes the results for both the natural and artificial rainfall. Statistical analysis confirmed that the differences weren’t due to chance or sampling variation.

We aren’t sure why the flailed material absorbed less moisture but it may be that the haphazard manner in which the flail-cut material is laid onto the windrow tends to shed rain more effectively than windrows of material treated by either of the other methods. Observation indicates that the flail-cut windrow may perhaps be likened to a thatched roof — where grasses are laid on the roof pointing down. If the grass stems are laid on the roof parallel to the ridge, however, the roof leaks. A similar situation exists in conventional hay windrows since the rake’s action tends to align the stems in the direction of the windrow, with a greater tendency for the “roof” to leak.

After the rain, all windrows were given half a turn as soon as the tops were dry. Once again, the flailed material dried more rapidly. This turning is important for any rained-on hay. But we found it especially important for the flailed material. Even a moderately heavy shower will compact the originally fluffy windrow formed by the flailed material and reduce the circulation of air. This results in a wet, soggy mass subject to rapid spoilage. But turning the windrow with a single-wheel rake or carefully with a side-delivery rake tends to refuff the hay and turns up the wet underside for drying.

Other tests: Our trials with first and third cuttings gave similar over-all results. The crimped and flailed material dried at about the same rate. Sometimes the crimped material dried more rapidly until the flailed material was turned.

In our tests with the third cutting, for example, we mowed and conditioned at 8 a.m. By 4 p.m. the crimped hay had a moisture content of 44 percent; the flail cut, 52 percent. The flailed material was turned at this time and dropped to a 43-percent moisture

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<table>
<thead>
<tr>
<th>Treatment</th>
<th>after natural rain</th>
<th>after artificial rain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flail-cut</td>
<td>0.85</td>
<td>0.62</td>
</tr>
<tr>
<td>Crimped</td>
<td>1.15</td>
<td>1.16</td>
</tr>
<tr>
<td>Conventional</td>
<td>1.68</td>
<td>1.08</td>
</tr>
</tbody>
</table>
content by 7:30 p.m.; the moisture content of the unturned flailed hay and the crimped was 46 and 40 percent, respectively, at this time. The following morning, the moisture percentages were 41 percent for the turned flailed material, 46 percent for the unturned flailed hay and 49 percent for the crimped — indicating that the turned flail-cut hay had dried some during the night.

The drying weather was good for the third-cutting tests. The flailed material was baled at 2 p.m. of the second day. The crimped material wasn't ready until 24 hours later. The conventionally treated hay wasn't ready for baling until about noon of the fourth day following cutting. The moisture variations over time for the three treatments for third-cutting alfalfa are summarized in table 2. The third cutting was light, and, in this case, turning the flailed material didn't have as great an effect on increasing the drying rate as expected.

**Reduces Risks . . .**

From these tests, we can conclude that hay conditioning, if the harvesting procedure is properly managed, can reduce harvesting risks by eliminating one or more nights of exposure. Previous testing with conditioners has shown that—if the crop is cut after the heavy dew is gone, if the windrows aren't too heavy and if drying weather is good—conditioned hay can be baled the evening of the same day, thus avoiding any night-time exposure. But cutting later than 10-11 a.m. doesn't allow enough time for even conditioned hay to dry enough to be baled by evening. Then the hay must be exposed during the night and baled the following day.

**Handling . . .**

Other states with similar weather patterns to Iowa's during the hay-drying season have reported getting the best cured hay when an operator cuts about as much green hay as he can safely handle in one day. Cutting the entire field at one time, on the other hand, increases the weather hazard.

The advantages of limited cuttings are obvious. (1) The operator has more control over the quality of his hay. The hay generally tends to be of more uniform quality since the time taken to cut each day's batch is short. In a large field cut all at once, the last hay baled often is much too dry, even though baling is started when the moisture content is just right. (2) If the mowed hay does get rained on, with limited cuttings, there's much less loss than if the entire field is mowed at one time.

A disadvantage is that the hay harvest can be extended beyond the time that the standing crop is at optimum maturity for highest-quality hay. Harvesting with limited cuttings, of course, isn't as efficient in terms of field operations as mowing the entire field at once. You must decide whether you want high-quality hay with some loss in operating efficiency or higher efficiency with a possible loss in hay quality.

One other point is important if you use a flail harvester as a hay conditioner. Especially if you place the hay directly into the windrow, take care that the tractor wheels don't run over any part of the windrow to cause packing. We found that, when this happens, only the uppermost layer of hay dries, while that below remains quite wet. Even turning the hay a half turn doesn't refuff the hay to its original state of looseness. When combining two or three swaths to make one windrow, it's necessary to straddle the windrow already made. To do this properly, we found that we had to spread the tractor wheels as far as possible.

**Highlights . . .**

Our tests here at Iowa State and results elsewhere show that hay conditioners can give you better quality hay and decrease exposure risks if you follow the suggestions outlined about the time of mowing and conditioning. During good weather, conditioning can cut curing time almost in half. We've had reports from farm users stating that they've successfully made "hay in a day" under good drying conditions. But to do this, it's necessary to cut the material early in the morning to take advantage of full drying benefits.

If you're considering "hay in a day" harvesting, we'd suggest cutting only as much hay at one time as you can mow, turn or rake, and haul away in 1 day. But if, despite your best plans, the hay does get rained on, you've only a portion of your hay ruined.

The people with whom we've talked in conjunction with our tests and who are using hay conditioners are convinced that they pay for themselves in quality hay. With proper management, a hay conditioner can be a profitable investment.

### TABLE 2. Variation of moisture content of hay for three treatments.

<table>
<thead>
<tr>
<th>Date and time</th>
<th>Treatment and moisture percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flail cut</td>
</tr>
<tr>
<td>Aug. 19</td>
<td></td>
</tr>
<tr>
<td>8:45</td>
<td>78%</td>
</tr>
<tr>
<td>12:45</td>
<td>62%</td>
</tr>
<tr>
<td>2:45</td>
<td>51%</td>
</tr>
<tr>
<td>4:45</td>
<td>42%</td>
</tr>
<tr>
<td>6:45</td>
<td>39%</td>
</tr>
<tr>
<td>Aug. 20</td>
<td></td>
</tr>
<tr>
<td>8:45</td>
<td>43%</td>
</tr>
<tr>
<td>10:45</td>
<td>34%</td>
</tr>
<tr>
<td>1:00</td>
<td>23%</td>
</tr>
<tr>
<td>5:00</td>
<td>Baled at 2 p.m.</td>
</tr>
<tr>
<td>Aug. 21</td>
<td></td>
</tr>
<tr>
<td>8:00</td>
<td>—</td>
</tr>
<tr>
<td>12:00</td>
<td>—</td>
</tr>
<tr>
<td>2:00</td>
<td>—</td>
</tr>
<tr>
<td>4:00</td>
<td>—</td>
</tr>
</tbody>
</table>