Produced by:
Certified Alfalfa Seed Council, Inc.
P.O. Box 1017, Davis, CA 95617-1017

Making Quality Alfalfa Hay

In Less Time, With Fewer Risks

Making Quality Alfalfa Hay In Less Time, With Fewer Risks

The threat of rain is one of the greatest worries facing alfalfa hay producers in much of the United States. This threat causes lower hay quality and deters alfalfa production, particularly in the eastern half of the country.

It takes about 30 sunshine hours to field-cure non-conditioned hay in the Midwest, according to University of Wisconsin studies. In the spring, this requires about four days and decreases to about three days in the summer. Humidity, temperature and wind speed also influence curing time.

Even under good drying conditions, Michigan State University reports that 20 percent of the crop dry matter is lost by the time the crop is put into storage. The loss is 30 to 40 percent under poor drying conditions, with even greater losses under very poor drying conditions. Nutrient loss is as high or higher than dry matter losses.

The longer cut alfalfa remains in the field, the greater becomes the risk. This is true even in areas of the country where rains are not common during the hay harvest season. Besides rain damage, other risks or problems associated with slow hay removal from the field may include:

- Wheel traffic damage to alfalfa regrowth
- Bleached hay
- Excessive leaf loss
- Delayed irrigation
- Damage to regrowth from windrows shading plants

Because getting alfalfa off fields as soon as possible is so important, increased emphasis is being placed on two major areas:

1. Hastening drying time in the field with drying agents
2. Baling hay at higher moisture levels and safely storing it by using chemical preservatives or artificial drying.

This brochure describes these practices and provides management recommendations for methods that result in higher quality alfalfa hay.

Recently, the most attention has been given to hay drying agents, which also are called chemical conditioners. The term dessicants also has been used, but can be confusing and will not be included in this publication. The use of hay drying agents will receive the major emphasis of this brochure.

Photo: Hay & Forage Grower magazine

Photo: Domain, Inc.

Table 1. *An exampl… moisture content. Fr… and reported in WIS… magazine.*

Day 1	
7 a.m.	
Noon	
7 p.m.	
Day 2	
7 a.m.	
Noon	
7 p.m.	
Day 3	
7 a.m.	
Noon	
7 p.m.	

Table 2. *It is better … damage than wait f… allow the crop to furth… portant in improving … performance, as these … Wisconsin studies.*

State of quality	Compos… CP	A…
Pre-bloom	21.1	3…
First flower	18.9	3…
Mid-bloom	14.7	3…

* with 20% Concentra…
* with 54% Concentra…

CP = Crude Protein
ADF = Acid Detergent F…
NDF = Neutral Detergen…
DDM = Digestible Dry M…

Table 3. *Information presented by Jeff Roberts, President of Harvest Tec, Inc., H… HAY & FORAGE GROWER magazine. Drying times are achievable only when a… at their optimum effectiveness with good haying management.*

Hay-Drying Goals

Day…

Cutting Implement	Without Drying Agent
7-12′ Mower-Conditioner Leaving Wide Swaths	
1st cutting — wet conditions	5
1st cutting — dry conditions	3
2nd-3rd cutting — wet conditions	3
2nd-3rd cutting — dry conditions	2
4th cutting - dormant hay — wet conditions	7
4th cutting - dormant hay — dry conditions	5
12-16′ Windrower	
1st cutting — wet conditions	7
1st cutting — dry conditions	5
2nd-3rd cutting — wet conditions	5
2nd-3rd cutting — dry conditions	3
4th cutting - dormant hay — wet conditions	10
4th cutting - dormant hay — dry conditions	6

Artificial Drying

Artificial drying is becoming more important as a tool to speed up field removal of alfalfa hay. It is especially important in some of the northern states where seasons are short, rainfall is frequent, relative humidity is high or temperatures are relatively low in spring and fall. However, it also is being used in southern states to avoid rain-damaged hay.

Artificial drying adds to the cost and labor of hay making. However, it:

- Reduces dependence on weather
- Minimizes dry matter losses
- Results in better quality hay that often brings a higher price
- Reduces or eliminates the need for hay preservatives
- Properly cures hay that varied in moisture at baling

Artificial hay drying uses fans to force air through hay. The air often is unheated, but using air heated by solar collectors is gaining in popularity. Fans usually are used continuously on recently harvested hay, even when the air used is unheated and weather conditions are damp. This is necessary to keep hay cool and maintain high quality.

Hay drying time varies considerably, depending on volume of hay to be dried, moisture content of the hay, size of fans, outside air temperature and humidity. One cash hay producer reports that his 30 percent moisture baled hay can be dried to 15-16 percent moisture in two or three days with drying fans using unheated air in grain bins. This is when daytime temperatures reach 60-70 degrees. Drying time can extend to a week, however, when conditions are not as favorable.

A dairyman reports that he can dry his 35 percent moisture big round bales with solar-heated air in as few as 36 hours when days are sunny and humidity is low. His average drying time is 48-72 hours, but can take eight days during long rainy periods.

Many different kinds of structures can be used for artificially drying hay. Some are experimental; others are being used commercially. These include towers, conventional barns, pole barns and grain drying bins.

Artificial hay drying costs depend a great deal upon the type of structure built or adapted for the system and the electricity needed to run the fans. Labor is probably the greatest cost in operating an artificial hay drying system. Moving baled hay in and out of dryers is labor intensive. Costs may range from $10 to $20 per ton. Labor costs are less for loose or chopped hay, but the market for this type hay cannot compare to baled hay.

Dryers can handle hay as high as 50 percent moisture, but 35 percent is usually considered the highest moisture that can be dried economically. However, it may be economical to dry the higher moisture hay if it otherwise would be ruined by prolonged rainy weather.

One study has shown that 34 percent of the leaves are lost when alfalfa is baled at 35 percent moisture and 56 percent lost when baled at 20 percent moisture. This translates to a difference of up to 133 pounds of crude protein per ton of hay, worth about $30 when soybean meal sells for $200 per ton.

In Conclusion

Much time and considerable risk can be removed from making alfalfa hay and storing it safely. Hay drying agents, also known as chemical conditioners, can be used in combination with mechanical conditioners to reduce the time it takes to dry alfalfa in the field in preparation for storage as hay.

Practical steps, too, can be followed to speed up hay drying and improve hay quality. Both hay preservatives and artificial drying permit safe baling at higher moisture levels, further reducing curing time and weather risks and providing a higher quality hay product.

Other products and practices should be evaluated carefully in your own operations and under your growing conditions. Fully measure their practical applications, results and economic effects on reaching your goal of producing high quality alfalfa hay.

Drying Agents — What They Are and What They Do

Hay drying agents are chemicals that are applied to standing forage before or at cutting. They reduce field drying time by increasing the rate of water loss from cut alfalfa. These materials do not directly dry the hay. The chemicals break down the waxy layer called the cuticle on alfalfa stems, allowing moisture to evaporate faster. In comparison, mechanical conditioning physically breaks this waxy layer.

Two chemicals that traditionally have been used as drying agents on alfalfa are potassium carbonate and sodium carbonate. Both can be purchased generically or as commercial drying agent products. Potassium carbonate is considered the more effective of the two, but also is the more expensive. Sodium carbonate sometimes is mixed with potassium carbonate to reduce costs.

Other commercial drying agents are available in addition to potassium carbonate and sodium carbonate. One which has worked well in commercial operations uses alkaline n-silicates and alkaline carbonates in combination with wetting agents. Other compounds are being investigated and may be available in the future.

The use of hay drying agents promises to increase dramatically. It has been somewhat of a surprise that the use of these materials has not caught on faster than it has. A large number of university and industry tests, as well as on-farm trials and full-scale commercial operations, have shown that hay drying agents can speed the drying of alfalfa hay and reduce the risks of hay making.

Hay drying agents are most effective during good drying conditions — warm weather, low humidity, dry soil, light breezes, alfalfa with small stems and wide, thin windrows. They are less effective in the first alfalfa cutting when these good drying conditions are less likely to occur than in mid-summer. Compared to mowing with a standard mower-conditioner alone, chemical conditioning usually reduces curing time in northern states by 0-½ day at the first cutting, ½-1 day at second cutting, ½-2 days at third cutting and 0-1 day at fourth cutting.

Recommended application rates vary. Michigan State University recommends ⅛ pound each of potassium and sodium carbonate per gallon of water applied. Some other universities recommend application rates based on estimated alfalfa yield for the cutting, which improves the effectiveness of the material on heavier cuttings. Ohio State University suggests applying five pounds of sodium or potassium carbonate per ton of dry matter being harvested.

Sampling procedures are available to predict yield per acre. One easy procedure is to clip the crop at normal cutting height from a typical area of growth in a three foot by three foot area and weigh the sample to the nearest tenth of a pound. Repeat in several other areas and average the results. Calculate baled tons per acre by multiplying the average sample weight by 0.6. This method assumes standing alfalfa is at 75 percent moisture.

If computing on a dry matter basis, a microwave oven is a reliable drying tool. Contact your local cooperative extension service for full information on calculating dry matter and follow directions on the container of the commercial product you are using for more information on application rates.

Photo: Hay & Forage Grower magazine

As mentioned previously, drying agents most commonly are sprayed on standing alfalfa at the time of cutting. Sprayers usually are mounted on the mower-conditioner. It is very important that the spray material uniformly covers the whole plant stem. Use full-cone nozzles and a push bar mounted ahead of the spray boom to assure proper wetting and to minimize evaporation and overspray losses.

Application rates often call for as much as 30-50 gallons of water per acre with the drying agent. This requirement is considered a major reason why drying agents have not gained wider acceptance. To lesson the high water requirement, controlled droplet applicators are being tried.

Even though these application rates will cause frequent stops to fill application tanks, an Ohio State University publication points out that this amount of water is insignificant compared to the amount of water in the crop. For example, the fresh weight of one ton of dry alfalfa would be about 4½ tons and would contain about 870 gallons of water.

Economics of Using Drying Agents

Chemical hay conditioning may cost between $1.90 and $10.00 per ton of hay produced, according to Michigan State University figures. To equip a mower-conditioner or a tractor with a tank and spray equipment costs about $1,000 for parts and materials. Mixing and handling the spray material may increase mowing time 10 to 20 percent. Altogether, increased cost may amount to 75 cents per ton of hay for equipment, labor and added fuel — for a total cost of at least $2.65 per ton and as high as $10.75 per ton.

Is the added cost and effort worth it? Under long periods of good drying conditions, chemical hay conditioning gives little benefit. However, under poor drying conditions, it may save an entire crop. Michigan State University computer simulation studies over 25 years of hay making indicate that chemical conditioning can reduce dry matter losses by 75 pounds per acre and protein losses by 30 pounds per acre in second or third cutting alfalfa.

This extra hay yield and quality can cut a farmer's use of feed supplements and feed costs by $6 per ton of hay fed. When compared to the $2.65 treatment cost, chemical hay conditioning provides a gain in crop value that exceeds the cost. At a $10.75 cost, it does not.

Guidelines for Using Drying Agents

Effective and economical use of hay conditioning chemicals begins with good harvest management practices. Many of these procedures simply are the use of common sense, which apply whether a drying agent is used or not.

Topsoil moisture should be considered since it will influence the drying rate of alfalfa hay. If the ground is wetter than the cut hay, moisture evaporating from the soil will be absorbed by the hay above it. If drying agents are used, this absorbtion can happen even faster.

If possible, cut hay when the soil surface moisture is below 45 percent. If faced with frequent rains, cut when weather conditions are best and let hay lie on wet

Photo: Church & Dwight Co., Inc.

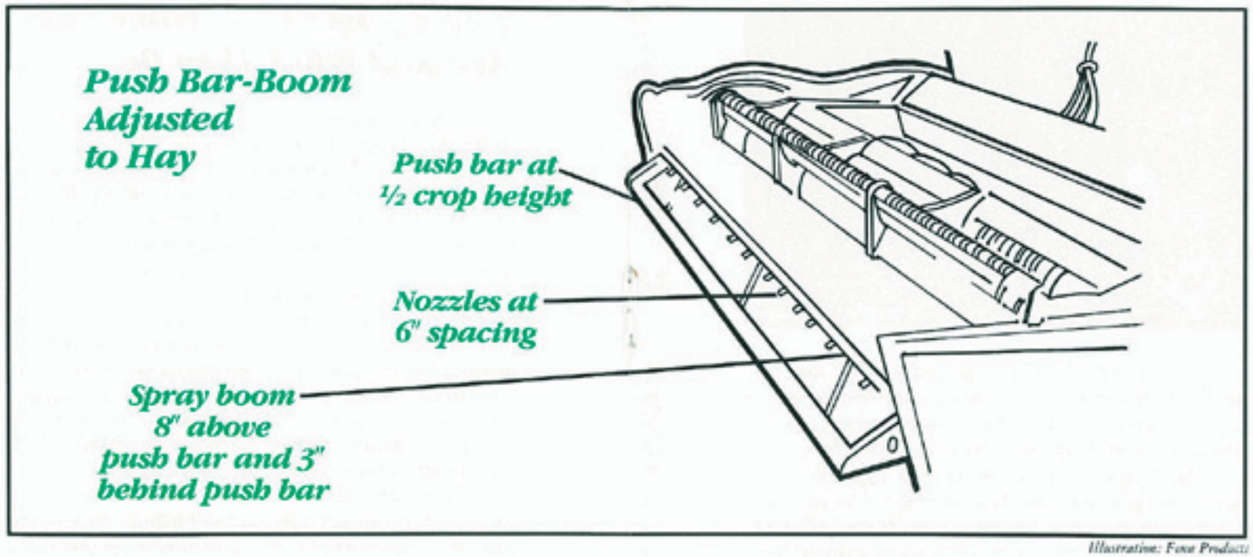

Illustration: Fox Products

ground until it reaches the moisture level of the ground. At that point the hay will dry no more until the ground under it dries, so producers should consider moving the hay so the ground can dry faster.

Move hay very carefully, however. Leaf shatter can be high on alfalfa containing less than 50 percent moisture. Rake into a windrow while hay is still tough in order to retain leaves. Windrows may need to be turned again if the soil below them is damp. Turn windrows during late evening, early morning or at night when high humidity and dew reduce leaf shatter.

When relative humidity is high, the evaporation rate is low and hay dries slowly. Gently rake or ted hay treated with a drying agent under these climatic conditions to expose hay to new air, rather than the saturated air that becomes trapped around swaths or windrows.

Here are a few other suggestions to speed drying:

- Have as much hay on the ground as possible by midday, when drying conditions are best.
- If fields have north and south facing slopes, consider baling the south-facing portion, which dries faster, and chopping for silage the part of the field that faces north.
- Adjust the conditioner so that hay is laid down in a wide swath pattern and with a high profile that air easily can move through.
- Taller stubble will aid drying the lower part of hay by keeping the hay off the ground and allowing better aeration.
- Avoid deep, dense windrows to allow faster drying of alfalfa hay. A narrow, thick windrow will not dry as fast as a wide, thin one that exposes more of the hay to sunlight and drying winds. Make windrows as wide and thin as your baler or chopper can handle.

Early Cutting Essential

Cut early to produce high quality, high value hay. Cut alfalfa in the bud stage for optimum feed value, animal performance and/or price. Alfalfa left growing beyond the bud stage declines in digestibility about 0.4 percentage unit per day, resulting in a loss of one pound of milk per day, based on University of Wisconsin studies.

Farmers often delay cutting in the hopes of "better weather." However, New York studies have shown that it is better to cut early and take a chance on rain damage than wait for more certain drying conditions and allow the crop to further mature and lose much of its quality. Cows fed early-cut, weathered hay produced four pounds more milk per day than cows fed late-cut, non-weathered hay. Drying agents can speed drying, reducing rain risk, for early-cut hay.

Baling at Higher Moisture

Baling at higher moisture levels and using chemical preservatives is another way to get hay out of the field earlier. Research with hay preservatives at many midwestern and eastern universities shows that:

- Higher moisture alfalfa hay (25 to 30 percent moisture) treated uniformly with an adequate amount of chemical preservative such as propionic acid and baled properly was comparable in quality to heat-dried hay. Preservatives must be applied uniformly and at the correct amount, based on yield and moisture content, or heating and mold can develop.
- There is no need to apply preservatives when hay moisture is below 20 percent.

- Harvested yields averaged 140 to 300 more pounds per acre when preservatives were used because there was less field loss due to leaf shatter and exposure to adverse weather.
- Treating and baling at 25 to 30 percent moisture permits baling earlier in the morning and later into the evening and at night. Baling with preservatives safely can begin as much as 12 to 24 hours earlier than baling without preservatives.
- Hay preservatives can be used in combination with hay conditioners in the same harvesting system and the benefits of each will be additive. At least one commercial product combines a preservative with a chemical conditioner which is applied at time of cutting.

There are some other factors that should be considered when using chemical hay preservatives:

- Propionic acid hay preservatives cost 45 to 75 cents per pound. At an application rate of 20 pounds per ton on hay containing 25 percent moisture, the preservative cost per ton will range from $9 to $15.
- While baling at higher moisture levels and using hay preservatives save leaves, this saving may not be economically justified under good drying conditions. Many producers find that preservatives are economical only when they allow baling to avoid rain damage.
- Some producers routinely use hay preservatives to bale hay. They like the insurance the preservatives provide against mis-judging hay moisture.
- When hay is baled at higher than normal moisture levels, leafier hay results, which often sells at a higher price. Hay often stays greener, is softer and smells cleaner.
- Producers marketing hay for horses cannot afford the risk of moldy hay and may find preservatives beneficial to their operation. However, some horse, cattle and dairy owners object to preservatives and will not buy hay treated with them.

Be careful in selecting hay preservatives. Propionic acid is one of the best and is available in commercial products and in generic form. If a product is based on propionic acid, do not use that product if it contains less than 50 percent propionic acid, because it may not be economical to use at applications rates needed to preserve hay.