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BALING QUALITY HAY USING PRESERVATIVES

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All types of hay need to reach 18% or under in real moisture content before mold growth and heating is not at risk. The standing crop is 70% to 80% moisture. The harvest interval, or time between cutting and baling reduces the crop harvested in three key ways:

1. RESPIRATION LOSSES
2. WEATHER DAMAGE
3. REDUCTION IN SEASONAL GROWING DAYS

A grower, taking ten days between cutting and baling, is taking a significant reduction in harvested crop compared to a grower who gets the job done in three days.

Getting all of the hay in the field under 18% moisture is a challenge that separates the true hay producer from the novice. In working with hay producers across the country, I have seen two key management skills that the producers who are successful have developed (in order of importance):

1. WINDROW PREPARATION
2. MOISTURE MANAGEMENT

Windrow Preparation
Producing a good windrow is a high priority for any hay production operation. Consistent moisture content in the windrow means consistent moisture content in the bale. Moisture will migrate in the bale between the dry portions and the wetter ones. This migration will help keep the hay from spoiling. Migration is slower in the large square bale and large round bale than in the conventional bale. Using an electronic moisture meter in stored hay, we tested three kinds of bales with the following results in Table 1.

The large bale takes longer to cure down to ambient moisture and thus, the higher moisture spots in the bale are a place where mold growth and heating can be established.

The second reason preparing a windrow for the large baler is more of a challenge than for a conventional baler has to do with the capacity of the baler. Large balers are being fed with hay from between 18 feet and 36 feet of cutting, creating heavy windrows. Some balers will cover up to 40 acres per hour. This

has created significant windrow preparation problems for producers of large bales.

Pay closer attention to the type of crop you are mowing. Heavy to light spots in the field cause moisture variations all the way through the drying process. The most important design feature in a mower is its ability to lay down an even windrow or swath. Keep the conditioning mechanism, the reel and any in-process augers timed properly. Eliminating density differences in the windrow at time of cutting will minimize moisture differences at time of baling. In certain mowing conditions, you may be forced into tedding out the windrow problem early in the drying curve (run the next day at 50-60% moisture). In alfalfa production, leaf-shatter is a consideration any time the hay is mechanically operated on, so keep tedding to a minimum.

Raking is the most important part of windrow preparation.
When the raking operations are pulling two windrows together management is even more critical. Not only is there an opportunity to leave wet spots in the row, there is an opportunity to create more wet spots. I often suggest to hay producers to "get down on your hands and knees" after you rake and look the windrow over carefully. Your objective in raking should be to create the most uniform moisture condition that you can. A well-made windrow can have moisture variations under 5 points. Poorly made windrows often have moisture variations of 20 points or more and that really makes baling a tough proposition.

Tandem wheel rakes are commonly in use all over the country in production of large square bales. Their limitation: the hay has to be dry (under 30% average moisture) to create an even moisture windrow. Above 30% this tool will do a good job of building a row of piles as opposed to a real windrow. The advantage to a wheel rake is that it has the least amount of leaf shatter on drier alfalfa. But when the hay reaches 22% moisture and under, it will shatter. With the limited window of operation (30% down to 22% moisture), I recommend 2 tandem wheel rakes for every large square baler.

Tandem bar rakes were the common tool in use in the Western states when the large balers first came in. They can do a good job raking between 35% and 25% moisture. Again, they have a limited window of operation (a little higher than the wheel rake), but a good unit with multiple adjustments can run a higher speed than the wheel. Except on days when the hay is drying really fast, one good operator with one good bar rake will keep up with at least a 3 by 3 baler.

My number one preference in rakes is the rotary rake, available with alfalfa tines and in tandem from three manufacturers. I have two reasons I like this rake. First, raking at 45% moisture is possible only with this piece of equipment. If there was a mowing problem or some other uneven drying going on, this rake will take it out early. It too, can run down to 25% moisture in alfalfa, giving it the widest window of operation of the three styles of rakes.

The second reason I like the rotary is that it builds a high, fluffy windrow which is good for drying. In certain areas of the western U.S. and Canada, this rake is taking over in the production of quality hay. The downside of the rotary is the problems hay producers in windy areas have with the higher rows blowing around.

Have good raking equipment available, put a good operator on it. Match your raking speed to at least double your baling speed. Don't run on the row with the raking tractor. Try to relocate the row onto dry ground. Don't rake too wet or too dry. Doing a good job building the windrow will be the most important part of getting a good bale.

MOISTURE MANAGEMENT

Perfect drying conditions happen very infrequently in most hay growing regions of the U.S. The standing crop is between 70% and 80% moisture, and safe baling is under 18% moisture. Drying down the hay is slower in the last 10 percentage points of curing, and it sometimes takes several days to lose those last ten points. If a hay producer is willing to bale in the 18% to 28% moisture range, the number of hours the baler is in the field can be increased significantly. Many hay producers have decided to operate in the 18% to 28% area, utilizing hay preservatives, moisture testing equipment and management skills they have learned to put up hay in this moisture range.

An important tool is a good moisture tester. Because hay can lose or gain 3 to 5 points of moisture in an hour, and because there is easily 5 points of variation in the windrow when the hay is in the 18% to 28% range, fast and multiple testing is essential. The most accurate testing comes from the heat drying process where a sample is weighed, dried in an oven or microwave, and then re-weighed to calculate moisture. The process is too slow (10 to 20 minutes per sample) to be a viable part of good field moisture management.

Electronic testers are the tool of choice for most hay producers. They give instantaneous readouts and can be used to test a windrow, a bale or mounted in the chamber of the large square baler to provide a fairly accurate reading of what the hay is. Electronic moisture testers are subject to error. Consider what they do. They measure the resistance or capacitance of the hay sample using 12 volts of DC power to pass through the sample with the theory that wetter hay allows more electricity to pass through it than drier hay. Most are calibrated for alfalfa hay in a conventional bale with a normal mix of stem moisture and outside plant moisture. The most accurate and common electronic testers use resistance to measure hay moisture and generally, their readings can be corrected for abnormal field conditions as follows in Table 2.

The reading on the in-chamber tester may not be as accurate. However, I consider it to be a much more meaningful tool because of the number of samples it takes. The most recent models take 3 samples per second and display an

average of the 15 readings every three seconds. Although the individual readings may not be as accurate as the hand-held tester readings, the average reading sees so much more hay than a hand-held tester ever does, and therefore is a more accurate indication of the moisture of the hay. In-chamber testers, however, are subject to more mechanical problems than the hand-held models. A sensor pad is located inside the bale chute, two to eight flakes back of the plunger face on large square balers. It is subject to wear and must be inspected often. If the baler is doing any silage bales, the sensor will pick up a wet residue from the wet hay, making any reading after this high. Some tractor-baler combinations have a field interference with the moisture testers electronics. Check the specifications of any in-chamber tester installed to make sure it is okay for both the baler and the tractor. And finally, the current level that is interpreted as moisture is fairly low. Any problem in the wiring between the sensor and the tractor cab will throw the readings off.

Hay preservatives are an important part of many baler operator's management. Preservatives have been around for a long time, but in the large square baler application, things get pretty serious when a baler is in the field at 18% to 28% moisture. First, the baler is putting up a lot of hay fast and second, the moisture that is going into that bale is going to be there longer.

There are three basic types of preservatives being used on large square balers. First are bacterial silage inoculants. Yes, I said SILAGE inoculants. Under some conditions (air limiting storage, low field mold counts, uniform moisture), I have seen cases where a good silage inoculant has forced a low-moisture fermentation at 25% to 35% moisture, and without wrapping. But it is risky business in that it doesn't take too much to go wrong to spoil the hay.

The second type of product is a dry hay inoculant. They are usually labeled up to 20% moisture content for large square bales. In a normal season, there are a few times when the windrow will all be between 18% and 20% moisture, primarily in hay that has totally cured out and with the dew coming back on. In these limited conditions, dry hay inoculant provides a viable management tool for producers of large square bales.

The most popular type of product that producers of large square bales use, is a buffered PROPIONIC ACID product. The buffered products are essentially non-corrosive, but do the same thing that propionic acid does, limits mold growth and prevents heating by direct acidification. The more moisture in the hay, the more acid it takes to stop the mold growth. Therefore, it is important to take a look at the level of propionic acid in the product. No other acid is anywhere near as effective in preventing mold growth. The level of application is related to the strength of the product. Since moisture will stay with the large square bale longer, the product should be applied at a stronger rate on large squares compared to conventional bales. If there is only one rate for both types of bales

on the label, it may be that the application recommendations are high for the conventional bales, or low for the large square bales.

Bales treated with buffered propionic acid at 18% to 28% moisture will eventually cure down to moistures below 16%. After curing they will not necessarily appear any different than bales made dry. With alfalfa, depending on harvest conditions, they may retain more leaves, simply because they were put up at a higher moisture and leaf-shatter at the pick-up head will be reduced. Bales treated with buffered propionic acid are safe for all livestock. There is no waiting period for feeding them. Propionic acid does have a tendency to brown the hay (the stronger the product, the more browning potential). If appearance is important to a buyer of your hay, consider one of several products that have color retaining ingredients in them.

Be aware of the moisture condition of the hay being put up as large square bales. Stop baling over 18% moisture without preservatives. Stop baling over 28% moisture with preservatives. If you question the moisture content of something that you have baled, don't take chances. Try to feed it right away.

CONCLUSIONS

The ability to operate baling equipment at higher moistures is a definite management advantage. The use of preservatives will give hay producers that advantage, but it opens up additional challenges.

Table 1. Moisture content of several bale types at various times after harvest.

		Moisture Content After Harvest			
Bale Type		48	96	1	3
Conventional Square Bale	18-28%	16-24%	15-20%	14-18%	12-15%
Large Round Bale	18-28%	17-25%	15-18%	14-17%	12-14%
Large Square Bale	18-28%	18-28%	17-27%	17-25%	14-22%

Table 2. Suggested modifications to moisture content of hay with different conditions after cutting.

Conditions	Hand-held tester	In-chamber tester on large square baler
alfalfa hay, average weather, no dew	add 2 points	no correction
alfalfa hay, dew moisture only	subtract 2 points	subtract 4 points
grass hay, good drying day	add 6 points	add 2 points
grass hay, dew moisture only	subtract 2 points	subtract 4 points