What's New in Forage Equipment?

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The forage equipment industry is changing in response to farmers' needs. These changes consist of innovations to increase capacity, to improve the usability of the machine, and to improve the quality of the product. Most changes are occurring with existing equipment, but some totally new product innovations are occurring.

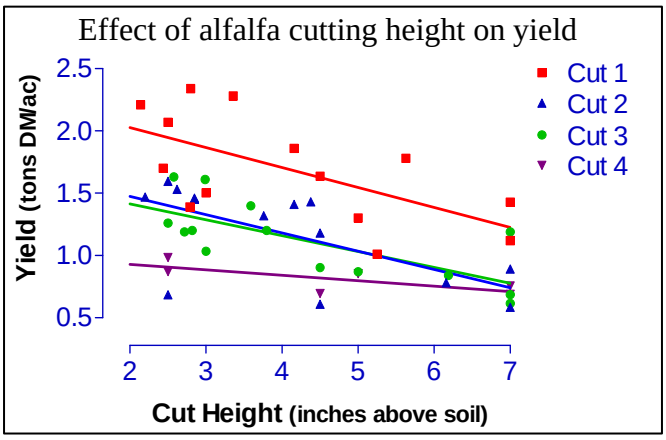
The size of machinery has increased to allow more-efficient harvesting. Some of this equipment will be used on larger operations and some will be used for contract forage harvesting, which has expanded rapidly across the U.S. in the last 15 years. Currently, self-propelled disc mowers have increased to almost 32 feet (in three banks), the largest rakes and mergers are 30 feet or wider, and the largest forage harvester has a 1020 Hp V-12 engine and can harvest up to 400 t/hour.

The purpose of this paper is to give a few principles of hay and silage making and discuss machinery available relative to these principles.

Mowers

Some design improvements in mowers include differing knife types for different needs and changes with weight load distribution. Most growers are rapidly switching from sickle to disc mowers due to reduced maintenance requirement.

Data is clear that the disc mowers do not reduce alfalfa yield or stand life more than that of sickle bar mowers.



Differing knives are available for disc mowers and the choice among them should be made with some deliberation. The most common are knives that are angled at about 14^{o} to enhance picking up downed forage. Mowers with these knives really do pick up downed forage better than those with flat knives. However, angled knives pick up soil more when the ground is dry. Angled knives can add 1 to 2% ash to the harvested forage. So the grower must decide which is more important – picking up downed forage or having less ash in the forage.

Cutting height should be adjusted according to management goals. Lower cutting height results in higher yield (graph as left) of alfalfa (as long is crown is not cut) but

should be 3 to 3.5 inches if grass is included to allow rapid regrowth. Higher cutting height will also reduce ash content.

Some are concerned that driving over a swath will increase soil (ash) content in the forage. In Table 1, the ash content of haylage from wide-swath alfalfa was actually less than from narrow windrows. While narrow windrows are not usually driven over, they tend to sag to the ground, causing soil to be included with the windrow when it is picked up. Wide swaths tend to lay on top of the cut stubble and stay off the ground. Further driving on the swath can be minimized by driving one wheel on the area between swaths and one near the middle of the swath where cut forage is thinner.

Grasses, especially if no stems are present, must be into a wide swath when cut. When put into a windrow at cutting, the forage will settle together, dry very slowly and be difficult to loosen up to increase drying rate.

Conditioning Equipment to Enhance Drying

As the industry has realized the value of making a wide swath for drying, it has changed equipment designs to allow wider swaths. Some farmers are now asking for disc mowers without conditioners when haylage is the only form of forage to be harvested, since conditioning is not necessary for haylage.

The argument continues as to which of the current conditioner types are best. Flail conditioners were developed in Europe for grasses and are generally the least expensive. Roller conditioners were developed in the U.S. for alfalfa. Some data has shown that roller conditioners will dry alfalfa faster than flail conditioners and that the opposite is true for grasses. However, the difference is small and in individual field trials one may indicate faster drying depending on machine adjustments and drying conditions. Clearly, flail conditioners will increase leaf loss in alfalfa by 1 to 4%, resulting in quality loss. They also make a less uniform windrow, which can result in less consistent chop length.

Steel roller conditioners, rubber roller conditioners, and combinations of the two are available. Data has shown little difference among them. The sharper, firmer corners of the steel rollers may break stems slightly better in some circumstances, but they also suffer more damage from stones and other foreign materials.

The key to increased drying and minimized leaf loss with flail and roller conditioners is proper adjustment for field conditions.

Some new forage harvesting methodology has become available in recent years. This includes macerating, superconditioning, and reconditioning.

Macerator technology was initially invented by the USDA Dairy Forage Research Center, Madison, WI, and further developed by the Prairie Machinery Agricultural Institute (PAMI), Portage la Prairie, Manitoba. It clearly enhanced drying rate (Savoie et

al., 1993) and improved animal performance (Charmley et al., 1999) by shredding the forage and pressing it into a mat that is laid on top of the forage stubble. The challenge has been the low throughput and high energy requirement, making development of field units slow. A macerating unit is currently on the market that does enhance drying rate compared to standard conditioning but the unit macerates less than the original design to facilitate throughput.

Superconditioning (breaking/smashing the stems more thoroughly than standard conditioners) has been commercially available for several years. Tests have consistently shown 3- to 6-hour drying advantages of superconditioners with steel rolls over standard conditioners. However, the units have significant additional cost and horsepower requirement. One unit is available with “high impact” conditioning where the rubber rolls are solid except for narrow ‘v’ slits.

Reconditioning is running the windrow through a conditioner a second time after partial drying has occurred. Some farmers have fabricated such units by removing the mowers of mower conditioners, and some units are commercially available. Reconditioners are generally used on the day of baling after the dew is gone to help remove the last 5% of water prior to baling. Such units help in baling timothy for export where forage must be 12% or less at baling. Little advantage has been demonstrated for reconditioning alfalfa. Alfalfa will also suffer some leaf loss during the reconditioning.

Wide-thin fins are attachments to the back baffle of conditioners that spread the windrow wider (up to 100% of the cut width). If your mower-conditioner is making a swath less than 70% of the cut area these would be a good addition.

Generally speaking, wide swaths provide the greatest improvement in drying rate of hay. Other technologies provide lesser drying rate gain and have marginal cost effectiveness.

Raking

Swaths or windrows should always be combined to make the largest windrow the harvesting machinery can handle. Large windrows are the most energy and labor efficient for harvesting. Large windrows also reduce wheel traffic on the field resulting in less soil compaction and plant damage.

Raking should occur without the rake tines touching the ground. Tines scraping the ground add soil to hay reducing forage quality. Thus powered rakes are better than wheel rakes which are ground driven by the tines.

Mergers are another excellent tool where the hay is picked up and moved on a conveyer across the field into a windrow. Mergers result in less leaf loss and less ash in the hay than rakes which move the hay across the ground. However, one should examine the cost of mergers and compare to the value of the product obtained.

Baling

Several manufacturers are marketing features on the balers that take advantage of electronic technology to produce more consistent bales: with round bales this means more uniform density and shape; with square bales this means more uniform bale flakes for breaking apart to feed.

Moisture sensors are available that determine bale moisture. When these are tied to preservative applicators the opportunity exists to only apply preservative when needed and at the needed rate for the particular moisture of hay being baled.

The newest thing on the market for balers is bale cutters. This option for either round or square bales cut the hay length. The final theoretical cut length can be as short as 1.5 inches. However, the shorter the hay is cut the more energy required, more knives, greater maintenance and number of knives that need replacing. Using fewer than the total knives to get final hay to be 4 to 6 inches long will provide the most economical benefit with less knife expense and energy cost. Hay harvested with bale cutter has no benefit in hay making or silage fermentation (if wrapped in plastic) but data has shown that animals will have higher forage intake and less feeding losses. Additionally cut-hay bales will break apart easier when used in a TMR or for bedding.

Other new features on bales include more detailed electronic monitoring and control of baler functions, constant bale flake size, tighter round bales and other modifications.

Summary

Mowing and conditioning equipment should be bought with the essentials to drying hay or haylage in mind:

- Use a roller conditioner for alfalfa, and a flail conditioner for grass hay.
- Can the mower conditioner make a wide swath (greater than 70% of cut area) to maximize leaf drying and stop respiration?
- Reconditioners, maceraters, etc will increase drying rate but at greater cost in terms of initial capital investment and fuel use.

Raking should occur with tines not touching the ground. Windrows should be merged to the biggest that harvesting equipment can handle. Use of a merger will reduce leaf loss of alfalfa and ash contamination.

Bale cutters will improve quality of final product in terms of reduced feeding losses and improved animal performance.