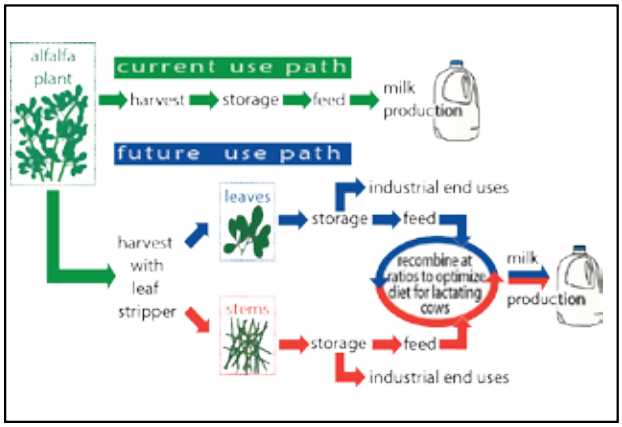
Harvesting Alfalfa Leaves Separately from Stems

Ronald Hatfield, U.S. Dairy Forage Research Center

Harvesting alfalfa has been a balancing act between quality and yield due to differences in leaves and stems. Current practices to minimize total fiber (before stem gets too mature) require cutting alfalfa frequently (every 4-5 weeks). This creates an economic disadvantage to produce a high-quality forage due to the physical and mechanical inputs and the challenge of having good weather for frequent harvests. These challenges are one of the reasons corn silage has replaced so much alfalfa haylage in dairy cattle diets.

Alfalfa is a high-protein perennial forage with many environmental and nutritional advantages for dairy production; what could make it the forage of choice more often? U.S. Dairy Forage Research Center (USDFRC) researchers believe there is a need for a harvest/management system requiring fewer harvests and extending the window for each harvest, but producing the desired amount and quality of forage. With colleagues at the University of Wisconsin, we're in the early stages of developing a system that harvests alfalfa leaves separately from stems creating two component streams: protein-rich leaves and fiber-rich stems.

Figure 1: Separating leaves from stems opens new possibilities for the use of alfalfa and gives dairy producers more options in terms of harvesting and feeding the crop.



Previous research at the USDFRC estimated this strategy could reduce the risk of adverse weather on crop harvest and increase yield by capturing 30% of plant material typically lost with current harvest practices. This alternative reduces the frequency at which the crop needs to be harvested by at least 25%, a potential major savings in labor and fuel. This system also provides the producer with the opportunity to recombine these in proper proportions to create the desired quality of diet for many classes of cattle. Because of the high protein content in the leaves, there also are new possibilities for utilizing this material for alternative uses of animal feed such as an enriched protein source for aquaculture, poultry feed, or even as a protein supplement in human diets. It also creates possibilities for using the components for industrial or other end uses (Figure 1).

You won't find this type of forage harvester at your local implement dealership anytime soon; building a novel concept such as this from start to finish requires years of research. Here's an update on that research.

The first several prototypes of the machine, colloquially called a "leaf stripper," were developed by Kevin Shinners, an Agricultural Engineer in the Department of Biological Systems Engineering at the University of Wisconsin-Madison, with support from USDFRC and the UW College of Ag and Life Sciences. His former graduate student, Matthew Digman, built the recent prototype (cover photo) while a researcher at the USDFRC.

These prototype machines work by stripping leaves from stems, collecting the leaf portion, and leaving the stems behind to be cut and windrowed at a later date. Since leaves are ensiled directly after harvest and not allowed to wilt, early studies utilized "mini silos" (a.k.a. glass jars) to determine if this high-moisture leaf fraction could be ensiled. When that proved successful, small silage bags were tried next; while there was a lot of effluent, the leaves ensiled successfully.

First farm-scale trial . . .

Research was scaled up in 2013. We wanted to determine if leaves and stems harvested separately from mature alfalfa could be recombined in appropriate ratios to perform as well as whole-plant alfalfa haylage in dairy cow diets. For the control diet, alfalfa was harvested with conventional methods in the typical early-bud stage (4th cutting, August 25, 2013) and ensiled in regular silage bags. Silage inoculant was applied at the time of ensiling. On September 12, 2013, when the alfalfa was at the late full-bloom stage, leaves were harvested separately from the stems with the prototype leaf stripper; the leaf fraction still contained 35% stems. The leaf and stem fractions were ensiled separately in regular silage bags.

Although the leaf fraction was only 22-24% dry matter at the time of ensiling, it ensiled nicely and produced a high-quality silage. We are currently analyzing samples of this silage to determine the quality and extent of fermentation and whether or not it varies greatly from normal haylage. It is most likely that successful ensiling at this relatively low dry matter content is due to the high level of sugars captured in the leaves at the time of ensiling.

For the feeding trial, 44 first-lactation cows were randomly assigned to one of two diets. The experimental diets were formulated to provide similar concentrations of crude protein and neutral detergent fiber (NDF) by blending two whole-plant alfalfa silages or by blending separately ensiled alfalfa leaves and stems. The feeding trial lasted 24 days. Cows were milked three times a day and averaged 90 lbs of milk per day.

There were no significant differences between the two groups. Cows had similar levels of intake between the two diets, and there was no body weight change for the cows during the experiment. Milk production and milk composition did not differ between the two diets.

Left of photo shows alfalfa stems remaining in the field after leaves were removed.

Nitrogen use efficiency (as measured with MUN) did not differ between diets. A longer-term feeding study is needed in order to evaluate the impact of the diets on body weight gain or loss, and to assess any collateral effects on lactation performance.

Based on these preliminary research results, we believe this system has promise and we will continue to pursue various possibilities. We will soon be building the next generation of leaf stripper in an attempt to improve its efficiency at separating leaves and stems. Anyone with comments or suggestions from a forage grower's point of view is welcome to email me at Ronald.Hatfield@ars.usda.gov, please put "leaf stripper" in the subject line.