AM-PM Cutting of Alfalfa

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Over the past twenty years of this Conference we have spent considerable time discussing "Alfalfa Harvest Management." We have discussed the importance of stage of maturity and its impact on quality on many occasions. We have presented research on many aspects of hay and haylage management. An overall theme for all the discussions has been "harvest for quality," with emphasis on saving the leaves during the entire harvesting process. Our recommendations have, are, and will continue to be centered around those management practices that will result in the greatest opportunity for preserving alfalfa quality from standing crop to feeding. This requires harvesting at the right stage of maturity, optimize drying rate to reduce moisture rapidly, overall harvest management to "save leaves", storage at a low enough moisture to prevent microbiological degradation and minimum losses during storage and feeding.

Recent magazine articles have reported research that shows alfalfa hay cut in the afternoon (PM cutting) has higher sugars, greater palatability and better animal performance than morning cut hay (AM cutting). It is important to note that this research was conducted in Idaho. A frequent question for us is, "Does this apply to Kentucky?" Let's examine the biological processes involved and evaluate it's applicability to Kentucky.

THE PROCESS. Alfalfa, like all plants, are living (breathing) organisms. Many biological processes and reactions are occurring at all times during the life of an alfalfa plant. Daily changes in physiological activities occur as a result of various environmental changes. The two most important processes in alfalfa are photosynthesis (food making) and respiration (food using). Photosynthesis and respiration are affected by many environmental conditions, especially light intensity and temperature.

Photosynthesis is considered the most important chemical reaction in the world. Synthesis (to make) and photo (light) in its simplest definition is to make food in the presence of light. To accomplish this involves the green plant. Chlorophyll is the green pigment in the chloroplast of plant cells where this important reaction occurs (Figure 1). During this process, light and chlorophyll converts carbon dioxide and water into sugar and oxygen. The sugars are temporarily stored as starch which can be considered a chemical form of storage of the sun’s energy. Since light is required, photosynthesis only occurs during daylight hours.
Respiration is a basic definition of life. All living beings (plant-animal-humans) respire. Respiration is the food or energy using process and is basically the reverse of photosynthesis (Figure 2). Aerobic respiration occurs in the presence of oxygen and anaerobic without oxygen. Respiration occurs both during the day and at night. The respiration rate is influenced by many factors but most importantly by temperature.

In normal growing plants, photosynthesis exceeds respiration during the day resulting in the accumulation of sugar and starches. This process whereby photosynthesis exceeds respiration is responsible for normal growth and development in alfalfa. Total Non-Structural Carbohydrates (TNC) (sugars and starches) accumulate in alfalfa during daylight hours and are highest during greatest light intensity usually late morning and afternoon. These accumulated carbohydrates are then respired at night causing a daily (diurnal) change in the plant (Figure 3).

**IMPACT ON FORAGE QUALITY.** Leaf to stem ratio, specific leaf weight and non-structural carbohydrates increase in the afternoon hours, decline at night, and are lowest in early morning. Total digestible nutrients are higher in afternoon cut hay. Acid detergent and neutral detergent fibers are lower in afternoon cut hay. Work in Idaho, under the leadership of Dr. H. F. Mayland USDA-ARS, showed that cattle, sheep and goats had a preference for and ate more afternoon vs. morning cut hay. Dairy cows ate 8% more of a TMR containing 40% PM over AM cut hay. Afternoon cut hay had from 10-30 units higher Relative Feed Value over morning cut. Grazing dairy cows under 24-h strip grazing management produced 8% more milk when the fence was moved at 4 p.m. vs. 6 a.m.

**IMPLICATIONS FOR KENTUCKY.** There is a line in the movie Wizard of Oz where Dorothy reminds Toto “This isn’t Kansas Anymore.” The first consideration
concerning the question at hand is that the research on AM-PM cutting has been done in Idaho with a few studies in California. Although the feeding trials were done in North Carolina, the hay used in these feeding studies was produced in Idaho. Idaho with its low-humidity and cool nights grows alfalfa under irrigation and is very different from our high humidity, frequent rainfall Kentucky conditions.

Cutting in the afternoon would capture the maximum amount of sugar in leaves and stems at that point in time. With the humidity and warm nights here in Kentucky, compared with dry, cool nights in Idaho, respiration continues to burn sugars throughout the night so by morning, the difference between afternoon and morning cut would not be as much. The big factor would be the loss of a day in drying time. Just think of how important a few hours of good drying conditions are in Kentucky, especially on our first cutting (largest cutting of the season).

In general, we do not believe or recommend that we intentionally delay cutting from as early in the day as possible to late afternoon in most situations in Kentucky. Assuming that all the above research on quality and animal performance will work equally well in Kentucky as the west, under what conditions should we consider afternoon harvest?

**Alfalfa haylage** - This is the one situation where we believe cutting in the afternoon is justified. This was our recommendation before we learned of AM-PM cutting. Cutting alfalfa in the afternoon and putting it up as haylage the next day could result in optimizing quality and minimizing harvest losses.

**Grazing** - Interest and use of alfalfa as a grazing crop has increased dramatically over the past few years. Researchers have shown that moving dairy cows to a fresh paddock of alfalfa in the afternoon vs. morning resulted in an 8% increase in milk production. Realizing there are many factors influencing when we rotate cattle in a grazing program. Based on the research to date, if all other factors are equal, then moving to a new paddock in the afternoon could be advantageous.

**Ideal haymaking** - There are some situations in Kentucky in certain years when we can cut alfalfa and bale the next day. Examples include July or August very hot days 90°F+, low humidity, plenty of sunshine and a hay drying breeze. Under these conditions, we could take advantage of the afternoon cutting. One difference even during these conditions is the high night temperatures and respiration is directly correlated with temperature.

At present, we do not have sufficient research on this subject here in Kentucky to answer all the questions. In fact, we agree with recent conclusions in California (Dr. Dan Putnam, Univ. of California-Davis) who stated, "Further research is needed to confirm trends and to characterize post harvest changes in ADF, CP and TDN."