William H. Miner Agricultural Research Institute

A.M. vs. P.M. Harvest of Alfalfa as Medium-Moisture Silage

William H. Miner Agricultural Research Institute
P.0. Box 90, Chazy, NY 12921
Everett D. Thomas
Catherine S. Ballard

University of New Hamshire
Kristi Sayer

Louisiana State University
Ian Norris

02-1

Research Report

A.M vs. P.M. Harvest of Alfalfa as Medium-Moisture Silage

Everett D. Thomas, Catherine S. Ballard, William H. Miner Agricultural Research Institute; Kristi Sayer, University of New Hampshire;
Ian Norris, Louisiana State University

Overview and review of literature

Plants go through a daily cycle, converting sunlight into sugars that are stored temporarily as starch. Under sunny conditions, the sugar and starch content of plants are lowest in the early morning, increasing until they are highest in the late afternoon. Some of these starches and sugars are then lost during the night through respiration. Research by Ward Laboratories found that alfalfa hay cut in the afternoon had lower fiber content and 10% higher Relative Feed Value (RFV) than alfalfa cut in the morning. Similarly, a University of Missouri study concluded that alfalfa mowed in the afternoon had higher TDN and was worth about $15 per ton more in feed value than alfalfa mowed in the morning.

These research trials involved harvest of alfalfa as dry hay. However, a large proportion of alfalfa fed to dairy cows is in the form of silage. While alfalfa may have more sugars in the afternoon, the effects of the respiration losses during wilting must be taken into account. Furthermore, if a field is mowed in the morning, with proper windrow management the forage can often be ensiled the same day. However, if the field is mowed in the afternoon there is much less chance that the forage will dry to the 30-45% dry matter normally desired for hay crop silage. If alfalfa mowed in the afternoon isn't ensiled until the next day, what happens to the sugar and starch content, as well as other quality parameters?

Materials and methods

For both 2000 and 2001, second cut forage from two alfalfa fields were selected for evaluation. Each field was divided into four sections, with two sections in each field randomly designated for A.M mowing and two for P.M. mowing. Each of the two year the fields were mowed on consecutive days in July. The A.M. sections of the two fields were mowed between 7:00 and 8:00 A.M. (2000 and 2001), and the P.M. sections were mowed between 3:00 and 4:00 P.M. (2000) and at 4:00 P.M and 8:00 P.M. (2001). The late harvest in 2001 was due to a temporary equipment breakdown.

Freshly mowed forage was randomly sampled from the windrows and analyzed for sugar, starch, NDF, nonstructural carbohydrates (NSC, a combination of sugar and starch), *in vitro* dry matter digestibility and *in vitro* NDF digestibility. The alfalfa was then allowed to dry until it was at approximately 40% dry matter and a second set of forage samples was taken.

In 2000, alfalfa mowed in the morning was ready for harvest about nine hours after mowing, while the alfalfa mowed in the late afternoon didn't reach 40% dry matter content until the following afternoon. In 2001, drying conditions were not nearly as favorable: Alfalfa mowed in the AM didn't reach harvest moisture for 26 and 29 hours, while alfalfa mowed in the PM reached harvest moisture in 23 and 38 hours.

Chopped alfalfa was ensiled in PVC minisilos and fermented. The minisilos were opened following fermentation, and the silage analyzed.

The statistical model used was Analysis of Variance using JMP software.

$$Y = u + field + section\ (field) + time + c$$

Results

2000: Although the differences weren't statistically significant, fresh PM alfalfa had numerically higher sugar content (7.0% vs. 6.4%), starch (14.3% vs. 10.7%), and NSC (21.3% vs. 17.1%) than fresh AM alfalfa. When the forage was wilted to 41-43% DM, any differences had all but disappeared. Both before and after wilting, there were no statistically significant differences in any quality parameter including NDF and *in vitro* digestibility.

With the very small differences in the sugar concentration of the A.M vs. P.M. alfalfa at the time the forages were ensiled in the minisilos, one would expect few meaningful differences in fermentation or silage quality. And that's just what happened: Following three months of fermentation, sugar content had declined to 2.0% for both silages (a normal result of fermentation), silage pH was similar (4.5 for AM vs. 4.4 for PM), while NDF, NSC, *in vitro* dry matter digestibility and *in vitro* NDF digestibility were all almost identical.

2001: PM alfalfa had significantly higher NSC (18.2% vs 16.0%) and sugar (7.8% vs 6.3%) than AM alfalfa. Starch concentration was numerically greater for PM alfalfa (8.6% vs 7.2%), but this difference was not statistically significant. *In vitro* analysis was not done on 2001 alfalfa, but as in 2000 the forages were ensiled in minisilos. There were no differences in lactic acid concentration between PM and AM alfalfa silage (6.0 vs 5.8), but acetic acid concentration was significantly higher in AM alfalfa (1.65% vs 0.95%). This resulted in a significantly higher lactic:acetic acid ratio for PM alfalfa (6.6:1 vs 3.6:1). Silage pH was not significantly different, nor was ammonia nitrogen as a percentage of total nitrogen. Crude protein was higher in AM alfalfa (21.8 vs 20.2), but no reason is known for this difference.

Discussion

These studies did not find as much difference between AM and PM harvest as several other studies have found. What small differences there were, however, favored the P.M. harvest. We expected to find a significant decline in quality when the afternoon harvested alfalfa stayed in the field overnight, but this didn't occur. Perhaps the cool nighttime temperatures slowed down plant respiration. In 2000, minimum temperatures (in the middle of July) were 55° F the first night and 44° F the second night. In effect, Mother Nature refrigerated the forage.

If you're going to make dry hay, mowing in the afternoon seems to make good sense; recent research suggests that there's little to lose and perhaps something to gain. However, if you're going to make hay crop silage, to achieve the most benefit from mowing in the afternoon proper *windrow management* is important. Stretch out the windrow or swath to increase the initial rate of drying, thus reducing respiration losses. In other words, for the first part of the drying process, manage the crop almost like you

would if you were planning to make dry hay. Increased alfalfa leaf loss is always a concern, but shouldn't be a problem if the forage is moved around during the first few hours after mowing.

Table 1. Fresh forage analyses.

	2000		2001	
	AM	PM	AM	PM
Sugar, %	6.4	7.0	7.0.	8.4**
Starch, %	10.7	14.3	9.0	10.0
NSC, %	17.1	21.3	16.0	18.3*
NDF-d, %	39.4	43.6	--	--
DMD, %	75.3	78.4	--	--

*, ** Statistically significant at .05 and .01 respectively.

Table 2. Wilted forage analyses

	2000		2001	
	AM	PM	AM	PM
Sugar, %	6.7	7.0	6.3	7.8*
Starch, %	12.9	9.8	7.2	8.6*
NSC, %	19.5	16.6	13.5	16.4*
NDF-d, %	43.3	43.8	--	--
DMD, %	77.2	70.0	--	--

* Statistically significant at .05.

Table 3. Post-fermentation forage analyses, 2000

	AM	PM
pH	4.5	4.4
Sugar, %	2.0	2.0
NSC, %	19.4	19.0
NDF-d, %	45.8	45.5
DMD, %	75.4	75.7

No statistically significant differences.

Table 4. Post-fermentation forage analysis, 2001

	AM	PM
pH	4.4	4.4
Crude protein, %	21.7	20.2
Lactic acid, %	5.8	6.0
Acetic acid. %	1.65	0.95
Lactic:acetic ratio	3.58	6.65*

* Statistically significant at .05.