REDUCING HAY LOSSES - FROM STANDING CROP THROUGH STORAGE

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Introduction

Alfalfa management for maximum economic productivity is quite complex. Many factors ranging from cultivar selection and establishment to storage and feeding must be considered. In some cases these factors, yield and quality of a particular cutting of forage for example, are negatively correlated. Following good establishment of an adapted cultivar, cutting management has important effects on forage yield, forage quality, stand persistence, weed encroachment and other important responses. Maturity stage at the time of cutting greatly affects quality. After cutting, hay curing, packaging and storage conditions also affect quality. Clearly, in order to achieve the optimum combination of yield and quality, a number of factors must be considered.

Cut early for high quality

Our data with alfalfa and red clover (Lang, 1985) illustrates the importance of the timing and number of cuts. Alfalfa cut four times during the year after seeding in 1983 yielded as much DM as stands cut three times. In the second production year, however, yields were 1.3 tons/acre higher for the three-cut system. Clearly, management in a given year affects future yield potential. Crude protein concentration was significantly higher in forage from the more intensively manageed stand, resulting in equal crude protein yields for the two treatments over the two year period. The latter data emphasize the importance of evaluation of forage quality as well as yield. The less mature forage produced from the four-cut system was higher in in vitro dry matter disappearance (IVDMD) in the second year and lower in neutral detergent fiber (NDF) in both years. Visual estimates in early spring of 1985 showed higher weed and bare ground percentages in plots cut four times per season. The latter results indicate significant management effects on stand life.

Cutting alfalfa at later maturity stages may increase DM yield but at the expense of CP concentration and digestibility. For example, taking the first cut at mid bud and regrowth harvests every 35 days gave lower DM yields than alfalfa cut first at mid bloom and every 42 days thereafter (Table 1). The more mature alfalfa, however, was lower in digestibility and CP concentration and had lower yields than the mid bud alfalfa. First growth alfalfa declined in IVDMD from 76% to 56% between early bud and late bloom, an average of 0.6 units per day over the 28 day period. Alfalfa cut at first flower and every 35 days thereafter produced high yields of DM and N and high concentrations of N and IVDMD. Cut early to take advantage of the high quality of the immature forage.

Table 1. Dry matter yield and quality of alfalfa hay.

Cutting Schedule			CP	CP
First Cut	Interval	DM Yield	concentration	N yield
--stage--	--days--	-tons/ac-	------%------	-lb/ac-
Mid bud	35	3.6*	20.0	1430
First flower	35	4.3	19.6	1670
Mid bloom	42	4.0	15.6	1250

*Unpublished data of Collins (1983).

Field Losses

Unfortunately, hay curing reduces DM yield and quality because of respiration, leaf loss and leaching (Collins, 1982; 1983). Data from 16 weekly observations on hay production during an entire season from a pure sward of alfalfa illustrate these losses (Table 2). Dry matter loss during curing averaged 17% of the initial DM. Across the 16 dates, rain occurred during curing in 8 cases.

Table 2. Yields of dry matter, crude protein in vitro digestible dry matter and neutral detergent fiber from alfalfa hay and forage collected immediately after cutting and from field dried hay (1983).

Time of sampling	Dry matter yield	CP yield	IVDMD yield	NDF yield
	tons/ac	lb/ac	tons/ac	tons/ac
Immediately after cutting	4.2*	1570	2.62	1.87
Hay	3.5**	1190**	1.98**	1.83**
% loss	17%	24%	24%	2%

*Unpublished data of Collins, 1983.
**Significant at the 0.01 level.

The yield of CP was reduced more than the yield of DM. The yield of digestible DM was also reduced more than DM yield. Fiber yield represented by NDF, was reduced very little. The reason for the differences just described in losses is clear from data or quality of the same samples (Table 3). Hay averaged 1.6 percentage units lower in CP than alfalfa sampled immediately after cutting. In vitro disappearance was reduced by nearly 6 percentage units. All of the fiber constituents, including NDF, ADF and ADL were increased.

Table 3. Concentrations of CP, in vitro dry matter disappearance, and fibrous constituents in alfalfa collected immediately after cutting and in field dried hay (1983).

Time of sampling	CP	IVDMD	NDF	ADF	ADL
			%		
Immediately after cutting	18.9*	62.9	43.8	33.8	8.6
Hay (field dried)	17.3**	57.3**	51.6**	38.4**	10.3**

*Unpublished data of Collins, 1983.
**Significant at the 0.01 level.

The loss of both DM and quality was related to the amount of rain that fell during curing (Table 4). Dry matter loss during curing increased by 3.3 percentage units for every inch of rain that fell. When rainfall did occur during curing, the amount varied from 0.1 to 2.2 inches. In vitro dry matter disappearance decreased by 3.3 units per inch of rain. At the same time, NDF increased by 4.3 units per inch of rain. Because forage intake declines as NDF concentration increases, rain damaged hay would have greatly reduced digestible dry matter intake levels.

Table 4. Linear regression of dry matter and quality change in alfalfa hay on the amount of rainfall that occurred during curing.

Constituent	Equation
	- Percentage units difference between standing crop and hay -
In vitro dry matter disappearance	IVDMD loss = 4.4* - 3.3 Rain**
Neutral detergent fiber	NDF increase = 6.4 - 4.3 Rain
Acid detergent lignin	ADL increase = 1.3 + 0.8 Rain
Dry matter loss	DML = 16.2 + 3.8 Rain

*Unpublished data of Collins, 1983.
**Rain in inches.

Reducing the risk

Rain damage during hay curing can be reduced by hastening drying. For example, the probability of having three consecutive dry days in Wisconsin was only 24% during the first week of June. Surprisingly, the percentage never rose above 47%, even in late August. Thus, hay drying time could be reduced by one or two days, the risk of rain could be reduced.

Chemical desiccants such as K_2CO_3 can hasten drying, even in conjunction with mechanical conditioning. It is apparent that conditioning either mechanically or chemically was an improvement over unconditioned forage of either alfalfa or red clover (Table

5). Five to 7 lbs of K_2CO_3 in 30 gal/acre of water are recommended for alfalfa. Sodium carbonate can also be used. How effective the treatment is appears to be related to environmental conditions. The drying enhancement may be minimal when wind, sunlight and humidity conditions are not conducive to drying.

Table 5. Influence of conditioning and the desiccant potassium carbonate (K_2CO_3) on hay drying.

		Hours after clipping			
Species	Treatment	0	24	48	72
Alfalfa	None	23.9*	41.3	51.4	72.4
	Cond.		48.2	59.4	79.8
	K_2CO_3		46.8	54.8	80.8
	Both		51.0	63.9	83.6
Red Clover	None	19.6	33.0	36.8	65.3
	Cond.		49.5	56.0	80.3
	K_2CO_3		35.2	46.0	72.3
	Both		51.7	58.1	83.2

*Unpublished data of Collins.

In addition to losses that occur during curing and raking, the total loss also includes baling loss. Of the three, more was lost up through raking than during the pick-up process or during actual baling (Table 6) (Koegel et al., 1984). Hay moisture level affects DM loss level. Baling loss using a belt-type round baler making 0.5 ton bales was affected to some extent by DM level in the hay being baled (Table 7). Machine type also has an effect on losses. Koegel et al. (1984) reported average baling losses of 3.8%, 10.9% and 2.8% for a belt-type round baler, a fixed chamber round baler and a rectangular baler, respectively.

Table 6. Seasonal dry matter losses and mean loss fraction from mower-conditioning and raking, baler pick-up, and bale chamber during 1984.

		Percentage of the total loss		
Cutting	Avg.	Mow Cond and rake	Pick-up	Bale Chamber
---% of Total DM---		---------- % of Total Loss ----------		
Total*	15.68	47.8	31.9	21.6
First	8.51	48.9	27.6	23.5
Second & Third	16.84	47.6	31.5	21.3

*Number of observations = 65 for all cuttings, 9 for first cutting and 56 for second and third cutting.
SOURCE: Koegel et al., 1984.

Table 7. Relationship between alfalfa hay DM level and DM loss during baling.

Hay DM	Baling Loss
	-% of hay DM-
75	3.3*
76	3.8
79	4.7
81	5.2

*Unpublished data of Collins, 1984. Means of 3 observations except for the first value which is a single observation.

The losses caused by leaf shatter at high DM levels can be reduced by baling at lower DM levels. Also, earlier baling reduces field time and thus reduces the likelihood of rain damage. Preservatives and barn drying are alternatives for handling this high moisture hay. The acid application rates recommended range from 0.5% (10 lbs/ton of hay) for hay between 20 and 25% DM to 1.5% (30 lb/ton of hay) for hay between 31 and 35% DM (Rohweder et al., 1984).

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