GROWING ALFALFA FOR HAY (MT8505)

by
Donald E. Baldridge, Howard F. Bowman and Raymond L. Ditterline[1]

Alfalfa, queen of forage crops, is the nation's most important forage, and Montana's leading hay crop. Most authorities believe that alfalfa, which means "Best Fodder" in Arabic, originated in southwestern Asia. Alfalfa was brought to the New World by 16th Century Spaniards and introduced to the United States by missionaries from Mexico. Alfalfa was reportedly grown in the Yellowstone Valley as early as 1884.

Alfalfa is adapted to a wide range of environments and is grown on more than 1.3 million acres throughout Montana. Alfalfa can produce abundant forage and is ideal for improving the soil nitrogen levels while providing erosion control. Its extensive root system often penetrates to depths of 20 feet or more, extracting water from great depths. This characteristic makes it well adapted for recharge areas that contribute to saline seep.

For maximum returns, alfalfa producers should strive to: 1) establish good stands, 2) maintain high yields, 3) maintain quality forage, 4) maintain stand life, and *5)* use efficient marketing practices. Recognizing these goals is one thing, but making it all happen on the farm may not be feasible.

Stand Establishment

Alfalfa seed is relatively small (200,000 per pound), but generally easy to establish in a firm, well-prepared seedbed. The ideal seedbed should be weed free, well pulverized, firm and moist. The footprint of an average person should not be more than one-eighth inch deep.

Germination is improved by firming the soil with some type of roller-packer prior to planting to insure good seed and soil contact. Seed drilled at a uniform depth of one-half inch provides the best stands. Depth control can be accomplished by using depth bands on the drill. Good stands can be obtained by drilling directly into standing cereal grain stubble, provided moisture is available.

Better stands and yields are obtained without a companion or nurse crop. Cereal grain sown with alfalfa competes with alfalfa seedlings for light, water and nutrients. Research has shown that this type of competition reduces yields by 20 to 25 percent (Table 1). The following procedures can minimize the competitive effects if cash flow needs require a grain crop during alfalfa establishment:

1. Seed cereal grain first at a depth of 2 inches, in 18-to 24-inch rows.
3. Repack the seedbed.
4. Seed the alfalfa ½ inch deep and at an angle to the direction the grain was seeded. A drill equipped with depth bands and packer wheels will improve establishment.
5. Keep the alfalfa root zone moist during the growing season and irrigate immediately after the grain is harvested.
6. Harvest the companion crop early for silage, hay or high-moisture grain, if possible, to allow the alfalfa seedlings more time to grow and build up carbohydrate reserves in the root system.

Selecting a Variety

Commercial seed company (private), USDA and Experiment Station (public) alfalfa breeders release varieties regularly. The Montana Agricultural Experiment Station alfalfa breeding project is directed by Raymond L. Ditterline at Montana State University, Bozeman.

The Montana Agricultural Experiment Station evaluates many public and private varieties for yield performance. New varieties are recommended when shown to be equal or superior to check varieties. Performance data on yield, winter and drought hardiness, disease and insect resistance and quality is available in Extension Service publications. Montana's wide range of growing conditions necessitates alfalfa growers to carefully study characteristics of the recommended varieties. Yield and persistence are the first factors to consider. Resistance to disease and insects also determines how well a variety will yield or persist.

It is almost impossible to detect varietal differences, or to recognize an undesirable variety, by examining alfalfa seed. Buying certified seed is the only way to be assured of getting the variety chosen.

Cultural Practices

Preplant herbicides, which keep weeds from competing with young seedlings, provide the best control during establishment of alfalfa. There are several herbicides registered for weed control in alfalfa. Several excellent herbicides also are available for use on established stands. Information on weed problems and control can be obtained from Extension Service publications, weed specialists and county agents. Read all label instructions and follow them carefully.

Alfalfa fertilization should be based upon soil tests. Providing adequate plant nutrients increases the crop's ability to withstand environmental stress such as drought and winter injury. Phosphorus is the most important nutrient to apply in Montana. It is relatively immobile and must be incorporated deep enough to be readily available to the roots. Enough phosphorus to meet crop needs for three or four years should be plowed down prior to seedbed preparation. A phosphorus deficiency results in inefficient alfalfa plants and low protein hay.

Table 1.
The Effect of a Companion Crop on Alfalfa Hay Yields

	Hay yield by years (% of check)			
Companion Crop	**1**	**2**	**3**	**4**
None	140*	82	86	87
None + Eptam (check)	100	100	100	100
Barley-6 inch rows**	0	61	69	77
Barley-18 inch rows**	0	86	79	84
Wheat-6 inch rows**	0	74	78	78
Wheat-18 inch rows**	0	96	84	86

* *50-60 percent weeds*

** *Cereal grains were allowed to mature as grain*

Insect feeding can reduce yield and quality. The proper use of cultural practices (early cutting) and insecticides reduces such losses. The scouting of fields is necessary to identify insect problems early, before damage becomes excessive. Several good publications in insect control are available at county Extension Service offices.

A good stand of alfalfa (36 or more plants per square yard) with proper fertility and pest control, can yield 5 to 7 tons per acre under irrigation. This compares to a state average of 2.8 tons per acre as reported by the Montana Crop and Livestock Reporting Service. Growers who identify yield limiting factors and correct them can obtain substantial yield increases.

Alfalfa is easy to harvest and cure under good weather conditions. The leaves contain a high percentage of protein and vitamins, so harvest techniques must retain as many leaves as possible.

Stage of growth when alfalfa is harvested (Table 2) is the major factor in determining forage quality. Total Dry Matter (DM) yield increases at a constant rate from first growth until the half-bloom stage. Dry matter in the leaves increases until the early-bloom stage, with little increase thereafter. Allowing alfalfa to grow beyond the early-bloom stage (when new growth starts from the crown) decreases the leaf-to-stem ratio, resulting in low quality forage. A change in the ratio has a drastic effect upon the energy and protein content (B.R. Moss, MSU Animal and Range Sciences Department).

Recent studies show that whole-plant digestibility decreases by 0.3 to 0.5 percent per day from early flowering to near maturity (Table 3). The crude protein decreases at similar rates in the stems and leaves, but the leaves contain a much higher protein content. This loss of energy and protein emphasizes the importance of early harvest and harvest methods that preserve the leaves.

Table 2. Analyses of Alfalfa Hay Cut at Stages of Maturity

Stage	%Leaves	%Protein	%ADF[2]	%NDF[2]	RFV[2]
Bud	>40	>18	<30	<40	>140
Early Bloom	30-40	16-18	30-35	40-45	124-140
Mid-bloom	20-30	13-16	35-40	45-50	100
Full-bloom	< 20	< 12	>40	>50	< 100

[1]*(Stivers, J., B.R. Moss & L. Welty, 1983. New trends in Forage Analysis, MSU Research Report 202 61-70).*
[2]*ADF (acid detergent fiber) an indicator of digestibility*
NDF (neutral detergent fiber) an indicator of intake
RFV (relative feed value) digestibility x intake

Table 3. Alfalfa Maturity and Digestibility

Stage	%Digestibility
Pre-bud	66.8
Bud	65.0
Early bloom	63.1
Mid-bloom	61.3
Full-bloom	59.4
Late-bloom	57.5
Mature	55.8

Alfalfa becomes more difficult for livestock to digest as it matures beyond the optimum (early-bloom) stage. The intake decreases as the digestibility decreases. Research indicates that intake drops about 2 percent for each day that cutting is delayed after early bloom.

Harvesting

Quality alfalfa can be harvested in several ways. The harvest system can significantly affect forage quality, and quantity. The most common systems include:

1. **Hay**—Alfalfa dried in the field to a dry matter content of 80 percent or greater (less than 15 to 20 percent moisture).
2. **Haylage**—Alfalfa swathed, chopped and stored in an oxygen-limiting structure at 40 to 60 percent dry matter.
3. **Silage**—Alfalfa swathed, chopped and stored in a silo at 30 to 40 percent dry matter.

Harvesting as silage results in 7 to 12 percent dry matter losses. The losses as haylage are about 14 percent and field-cured hay losses about 25 percent. Protein losses range from 5 percent for silage to 25 percent for field-cured hay.

Alfalfa harvested after peak maturity becomes more difficult for livestock to digest. Its value as roughage for livestock is related to its nutritive or feed value, combined with its voluntary intake or consumptive rate. High quality alfalfa hay can supplement rations that contain straw to provide a relatively low cost ration for wintering beef cows.

Quality alfalfa hay should possess several observable characteristics: leafiness, bright green color, pleasant aroma, fineness and pliability of stems, absence of foreign material and freedom from mold.

Livestock production can be substantially increased when forage is harvested at the proper stage, properly cured, or harvested as haylage or silage and stored to avoid exposure to rain or snow.

Unfavorable weather during hay harvesting, which is likely in Montana in June, can result in excessive dry matter losses and poor feeding quality. USDA studies show that alfalfa hay harvested without rain damage has substantially more protein.

Most losses occur when leaves and small stems are shattered during harvesting. A good haying operation may capture 60 percent of the leaves, while a silage system can retain 80 percent. Rain damage that required several turnings can result in only 40 percent of the leaves ending up in the stack.

A uniform, even job of cutting is important for proper curing of hay. Conditioning equipment on the swather reduces the field drying time by one-half to two-thirds, depending upon weather. Weather damage losses can be reduced by using harvest equipment that reduces field curing time and using weather aids or preservatives.

Hay and silage preservatives can reduce storage losses and improve feed quality, under certain conditions. For example, if rain is imminent when hay is to be baled, preservatives will allow baling at a higher moisture content. There are many good preservatives on the market, but none are “miracle cures.” They will not improve poor forage or substitute for good management. Before spending money for a preservative, producers should be sure that weather conditions or management restrictions warrant its use. Select a preservative on the basis of sound research and apply it at the recommended rates.

Propionic acid is the primary preservative presently recommended. It can be used in mixtures with acetic acid, formaldehyde and other organic compounds. Future research will help to clarify the best uses of preservatives. The judicial use of forage preservatives can be a “real” improvement. Producers should keep informed on current recommendations.

Harvest Timing and Fall Management

Carbohydrates in the roots of alfalfa plants decrease as growth begins and build back up to reach a peak at the one-tenth-bloom stage. Alfalfa plants are injured or weakened if cut when the root reserves are low— usually three weeks after growth begins or after cutting. Harvest timing is most critical in the fall. Alfalfa plants must be able to make sufficient fall growth to store large quantities of carbohydrates in the roots. These reserves help to prevent winterkill and provide rapid spring growth. To assure adequate food reserves in the roots, the alfalfa plants should have at least 30 days of regrowth before being killed by frost. Determine when the first killing frost for your area occurs, and make your last cutting 30 days before that date. Alfalfa regrowth should not be harvested or pastured in the fall until several killing frosts cause the plants to become dormant. Average dates of killing frosts for most areas of Montana are available and should be considered when scheduling the last hay harvest (Ditterline, R.L., et a!., 1979, "Growing Alfalfa in Montana," MSU Agricultural Experiment Station Bulletin 684).

Harvesting at the early-bloom stage will reduce leaf and stem shatter and cut the losses. Harvesting the forage as silage can save considerable feed value. Weather forecasts should be watched closely, since it is better to delay cutting than to suffer excessive rain damage.

Steps to Reduce Harvest Losses

1. Keep harvest equipment in good condition. Check all equipment before harvest to insure top performance and reduce chances of a breakdown.
2. Check weather forecasts. The weather for harvest is critical, because rain damage increases total harvest time as well as reducing quantity and quality. Delay cutting if repeated rain damage and windrow movement is likely. Consider putting up the first cutting as silage.
3. Use a conditioner on the swather. To avoid excessive leaf loss, don't move windrows that have less than 30 percent moisture. Begin baling when moisture content is near 20 percent.
4. Store bales immediately. Reduced exposure to the elements results in higher quality hay.

Marketing

Despite improved nutrient analyses, most buying and selling of hay is on a subjective basis. The Hay Marketing Task Force of the American Forage and Grassland Council has established a Forage Analysis Subcommittee to propose standards for grading hay on the basis of more objective analysis. The hay grades probably will be based upon stage of maturity, leafiness, color, protein analysis, Acid Detergent Fiber (ADF indicates digestibility), Neutral Detergent Fiber (NDF indicates intake), Relative Feed Value (RFV) and foreign matter. RFV is an estimate of overall forage quality that permits evaluation on a common basis that considers both intake and digestibility. The RFV will be valuable in comparing the feed value of different lots of hay and in marketing, but will probably not be used to formulate rations.

Hay producers and buyers have needed a rapid method of determining forage quality to accurately estimate hay value. Infrared machines, previously used for grain analysis, have been used by John Shenk, Pennsylvania State University forage professor, to analyze forages. It requires less than two minutes to prepare and analyze a sample, and no "wet chemistry" is required. Simultaneous analyses can be made for protein, digestibility, fiber, feed value and other criteria.

More information is needed to determine whether calibrations used in other states can be utilized for forages grown under Montana conditions. Montana State University scientists are working with researchers at Utah State, Pennsylvania State and other universities to test the reliability of the infrared method.

The basis for marketing hay should be its potential to produce meat or milk. A rapid, accurate analysis of forage quality would provide a basis for producers to be paid for superior hay quality and livestock feeders would be sure of getting their money's worth. These analyses also provide feeders with nutritional information for balancing rations.

Alfalfa is a major Montana crop that could be even more valuable. Marketing quality hay on the basis of quality analysis would benefit both producers and buyers. The first step toward fair pricing would be setting the market price on feed value determined by nutritional analysis. A fast, accurate method of analysis, soon to be available, will help make it well worthwhile to "save the leaves, where the value is."