AS-1117

Quality Forage for Maximum Production and Return

Roughage is the term used to define a feed containing a large percentage of fiber. Forage refers to well-made hays and silage harvested from grass or clovers. While these designations certainly aren't perfect, the role of roughage is clear, to insure proper rumen function. Forage plays a significant role as a primary source of roughage. Forages remain the one feedstuff most likely to be of low quality on the farm.

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NDSU EXTENSION SERVICE

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Role of Forages

In general, forages are the vegetative parts of plants containing a high proportion of fiber (more than 30% neutral detergent fiber). They are required in the diet in a coarse physical form because they:

- stimulate rumination and salivation, which are important processes in maintaining a healthy rumen environment;
- stimulate ruminal contractions and passage rate of digesta through the rumen, which improves the efficiency of rumen bacterial growth;
- counter milk fat depression in dairy cattle that occurs when rations high in concentrates are fed. Rations that contain less than about 35% forages will result in milk of low fat content.

Usually, forages are grown on the farm. They may be grazed directly or harvested and preserved as hay or silage. Forages tend to be one of the cheaper sources of feed for cows. Depending on the stage of lactation, they should contribute from almost 100% (for non-lactating cows) to no less than 35% (for cows in early lactation) of their ration dry matter.

The general characteristics of forages are as follows:

- **Bulk:** Bulk refers to the forage particle's unit of weight and is influenced by the length and density of forage particle size. This feature determines how long forages stay in the rumen. Intake may be limited when a ration is too bulky.
- **High Fiber and Low Energy:** Usually forages contain more than 30% fiber (neutral detergent fiber). In general, the higher the fiber in a forage, the lower the energy content of the forage.
- **Protein:** Forages vary in protein content. Depending on the stage of maturity, legumes may contain 15 to 23% crude protein; grasses typically contain 8 to 18% crude protein (depending on the level of fertilization); crop residues, such as straw, may have only 3 to 4% crude protein.
- **Minerals:** Generally, forages are higher in calcium, potassium and trace minerals than most concentrates. Phosphorus in forages is usually low compared to the animal need.
- **Vitamins:** Forages are higher in fat-soluble vitamins (A, D, E, K) than most concentrates. Legumes are good sources of B vitamins.

From a nutritional standpoint, forages may range from very good (lush young grass, legume at a vegetative stage of maturity) to very poor feeds (straw, some browse). Nevertheless, all of them can be used advantageously, provided: a) they are properly prepared and supplemented and b) the good quality forages are saved for the animals with high requirements (early lactating dairy cows) and the lower quality forages are fed to the animals with lower requirements.

Components of Forage Quality

From the beginning of livestock agriculture, farmers and ranchers have realized that not all forages are equal in their ability to produce animal products. The first assignment given newly established experiment stations as agriculture developed in this and other countries was to develop a system for measuring the differences in forages. For some reason, this difference became known as "forage quality."

Measuring quality in forages and other roughages involves more than mere chemical composition. Forage quality is based on the following factors.

High digestibility

The major contribution of forages to the ration are fiber and carbohydrates, which are a source of energy. Energy value is expressed in terms of calories and really is the ability to produce heat when burned. As an example, Table 1 lists some values for the same hay harvested at four stages of maturity.

Table 1. Comparison of hay at four stages of maturity.

	Digestibility of Hay as Influenced by Maturity			
	Very High	**High**	**Moderate**	**Low**
Gross energy (Mcal/lb)	1.92	1.90	1.92	1.93
Digestibility (%)[1]	67	61	51	47
Digestible energy (Mcal/lb)	1.28	1.16	0.98	0.91
Net energy (Mcal/lb)	0.73	0.65	0.49	0.41

[1] Read the percent digestibility as percent TDN since these are practically the same for hay.

Roughage for Dairy Cattle, M. E. McCullough, 1989, Hoard's Dairyman

The four hays are listed according to their digestibility. The hay with the *very high* digestibility was 67 percent digestible, the *high* hay was 61 percent digestible, the *moderate* hay was 51 percent digestible and the *low* hay was 47 percent digestible.

The first important point is the ***gross* energy values** and the heat that would be produced if you burned the hays and measured the heat production. Note that all four hays had the same gross energy. This is true for all plant materials from sawdust to the most digestible fibers.

The second value is ***digestible* energy**. Because the cow only can use that portion of the energy that is digested, this measurement has real value. The amount of digestible energy is the gross energy multiplied by the percent digestibility.

The final value is the ***net* energy for lactation** — a value that is familiar since it appears on forage analyses and in feed programming. This value is that portion of the digested energy available for the cow to use for maintenance and milk production. Remember that all of the values that measure availability are determined by the percent of forage that the cow can digest.

There is a natural tendency to say that the more digestible the forage, the better. Unfortunately, this is not entirely true. Dairy cows work best when the digestibility of the total ration is somewhere between 68 and 74 percent. Above this range, feed may move through the digestive tract too rapidly for good utilization, the cow may not do enough cud chewing and there may not be enough useable fiber in the ration.

Roughage value (cud chewing time)

Forages have the ability to provide three-fourths of the needed ADF and NDF in the total ration and as much as 90 percent of the cud-chewing time required for normal milk composition and good rumen health. This latter contribution is what researchers have talked about for generations as the "roughage value" and "scratch factor."

Researchers have measured the amount of cud chewing time generated by several feedstuffs. Research in several countries has established that cows need to do about 14 to 16 minutes of cud chewing for each pound of dry matter in the ration to maintain optimum rumen conditions for good feed utilization. Such values have limited use in dairy herds unless they can somehow be included in feed programming. To do this, there is continuing research on the role of fiber type and fiber length in the promotion of cud chewing.

When forage is scarce and must be fed in minimal quantities, major emphasis must be placed on its value as a roughage to maintain rumen health and function. Conversely, when a forage will be used with other forages that provide an abundance of cud chewing, the very early cut forage would be the one to choose. Under most conditions where only one forage is used, selection would be based on needed ADF and NDF along with good usable net energy.

Low fill factor

Roughage rarely constitutes the entire ration for milking cows. Generally, adding grain to the ration increases total dry matter intake. The decline in roughage intake for one unit of grain added varies from as low as 0.2 unit of roughage to 1.0 unit. The smaller the decline in roughage intake per unit of grain added, the greater the increase in total dry matter consumed. The ideal roughages are those with smaller reductions in intake when grain is fed. Overall, legumes permit greater intake than grasses at the same digestibility of dry matter.

There is considerable research on the "fill (bulk) factor" of roughage. The fill factor recognizes that individual roughages occupy more or less space (bulk) in the digestive tract per unit of dry matter. Those occupying the smaller amount of space should permit greater increases in total dry matter intake from added grain.

Nutritive Value of Forages

Feeding value of forages is greatly influenced by the growth stage of the forage when harvested or grazed. The feeding value of a forage is the highest during vegetative growth and the lowest during the seed formation stage. Therefore, when forages are grown for the purpose of feeding cattle, they should be harvested or grazed at early stages of maturity.

Most of the nutrients in both grasses and legumes at the vegetative stage are contained in the leaves. As the plant grows, the stems make up a larger proportion of the total dry matter and the proportion of leaves decreases. The stems are fibrous and rather indigestible compared to the leaves, so the vegetative parts of a plant are usually low in fiber and high in protein. However, as the leaf to stem ratio decreases with advancing maturity, the plant contains less protein and more fiber (Table 2). In addition, as the plant matures, the plant cell wall of the stem becomes more lignified. Not only is there more fiber, but the fiber itself becomes less digestible. In summary, the decrease in nutritive value of a grass or a legume with increased maturity is due to:

- The decreased proportion of leaves and the corresponding decrease in protein.

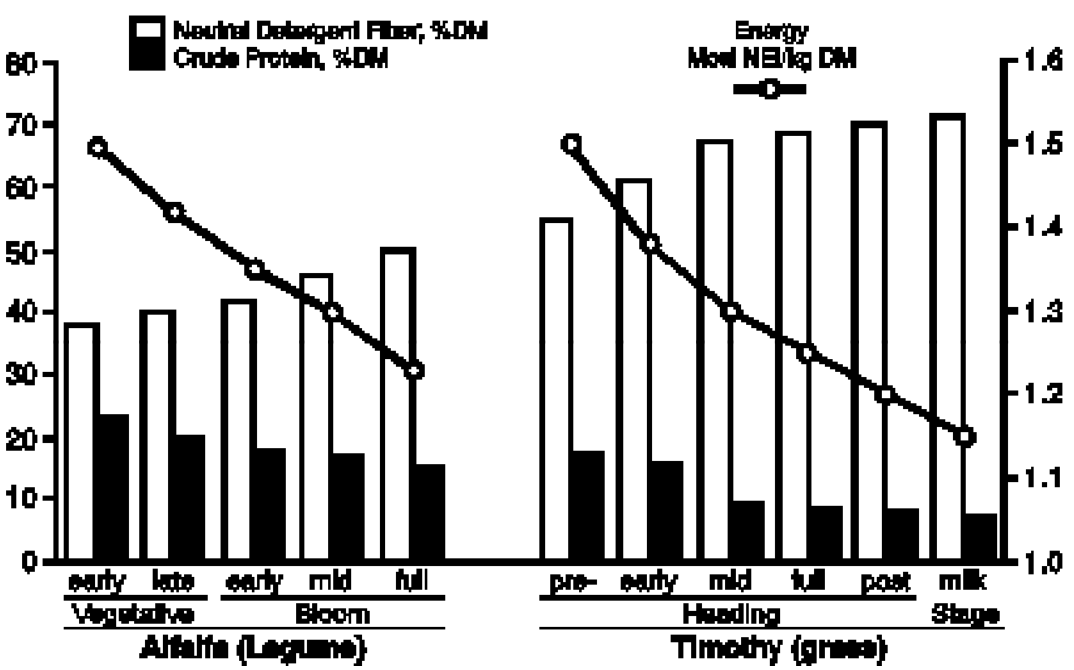
Table 2. Stage of maturity and composition of grass.

		Composition, % DM	
Stage of Maturity	**Percent Leaves**	**CP[1]**	**NDF[2]**
Grasses –			
Pre head	>50	>18	<55
Earlyhead	40-50	13-18	55-60
Head	30-40	8-12	61-65
Post head	20-30	<8	>65
Legumes –			
Pre bloom	40-50	>19	<40
Early bloom	35-45	17-19	40-46
Mid bloom	25-40	13-16	47-51
Full bloom	<30	<13	>51

[1] CP = crude protein.
[2] NDF = neutral detergent fiber.

- The increased proportion of stem and the corresponding increase in fiber.
- The increased lignification of the stem and the corresponding decrease in energy value.

As a result, the protein and energy available to the animal tend to fall sharply as the plant matures (Figure 1).



Nutrition and Feeding, Technical Guide. 1994. University of Wisconsin

Note:
Cows will tend to eat more legumes than grasses at a similar stage of maturity.

Figure 1. The protein and energy available to the animal decrease sharply as the plant matures.

Optimizing the Stage of Maturity

The value of a forage is determined by the yield of dry matter and the nutritive value of that dry matter. Total yield of dry matter increases, but the nutritive value of a forage decreases as the crop grows and matures. The quality of the forage is high for a young plant at a vegetative stage of growth, but the total dry matter yield is much less. As the plant starts flowering, dry matter yield (or total tonnage harvested) continues to increase. Unfortunately, the digestibility of the maturing forage decreases. As a result, the maximum amount of digestible dry matter produced per acre is obtained earlier than the maximum amount of total dry matter (Figure 2). The maximum yield of digestible dry matter is obtained at the late boot to early head stage of maturity for grasses and mid- to late-bud stage of maturity for legumes. For each day of delayed harvest after the optimum stage of maturity, the potential milk production of cows eating the forage will be penalized.

So, it becomes apparent that the number one factor affecting forage quality of alfalfa, or any forage for that matter, is MATURITY or growth stage. As maturity increases, the crude protein decreases and the fiber fractions (NDF and ADF) increase. As the fiber fractions increase, digestibility and intake decrease. In addition, the palatability and mineral content of the hay decrease and the rate of passage from the rumen slows down. Therefore, milk production or calf growth will decrease as growth stage increases.

Maturity effects are more pronounced during the first harvest than during aftermath (second or third) harvests. The warmer growing temperatures push maturity much faster in aftermath growths. As a result, ADF and NDF do not increase as fast. Therefore, a 10% bloom second-harvest hay generally is higher in forage quality than a 10% bloom first-harvest hay assuming no rain damage.

The forage quality of alfalfa and quackgrass at three maturity stages was evaluated at NDSU in 1993 (Table 3). The relative feed value (RFV) of mid-bud alfalfa hay sampled by hand harvest was nearly 200, and it decreased to 125 by the 80% bloom stage. The prehead quackgrass harvested the same day as the alfalfa was excellent quality for a grass, with 22% protein and 28% ADF, very similar to the mid-bud alfalfa. However, note that the RFV was only 119 due to the very high NDF, which reduces dry matter intake. The forage quality of quackgrass will surpass brome, intermediate wheatgrass, and crested wheatgrass at similar growth stages. Yet, this high-quality forage grass could not compete with a mature alfalfa hay in quality due to the high fiber content (NDF).

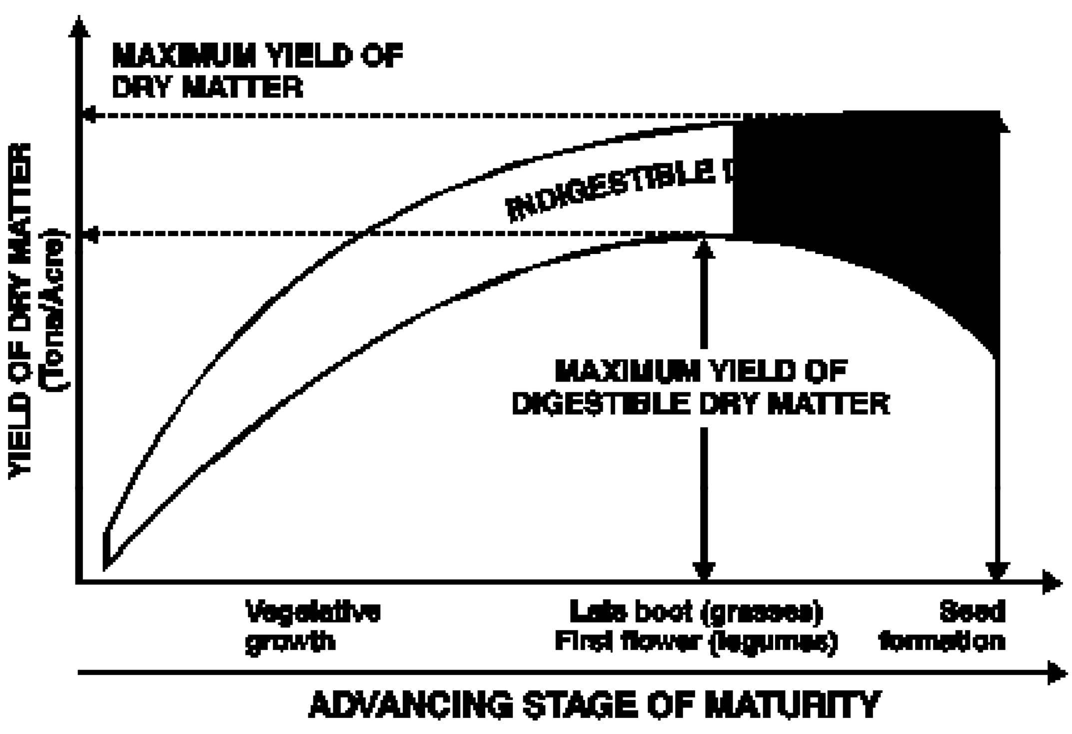


Figure 2. The maximum yield of digestible dry matter is obtained at a late boot to early head stage of maturity for grasses (except corn silage) and first flower stage of maturity for legumes.

Table 3. Maturity effects on forage quality of alfalfa and quackgrass hand-harvested the same day in 1993 (NDSU).

Growth stage	CP	ADF	NDF	DDM	DMI	RFV
	%				% body wt	(no units)
Alfalfa –						
Mid-bud	22.2	25.2	33.3	69.2	3.6	199
10% bloom	20.7	30.6	39.4	65.1	3.0	159
80% bloom	18.4	37.4	48.2	59.8	2.5	125
Quackgrass –						
Pre-head	22.2	27.7	53.5	67.3	2.3	119
Heading	19.4	32.9	58.5	63.3	2.0	98
Anthesis	15.0	35.7	62.6	61.1	1.9	89

CP = crude protein　ADF = acid-detergent fiber
NDF = neutral-detergent fiber　DDM = digestible dry matter
DMI = dry matter intake　RFV = relative feed value

Data shown in Table 3 have no harvesting losses since the hay was harvested by hand, but typical harvest losses are 10 to 15%. The RFV of 10% bloom hay decreased from 159 to 136, from prime to low No. 1 hay (also see Table 6). These data suggest that harvesting must begin prior to initiation of bloom, probably mid-bud to first flower, to obtain prime hay.

Forage quality or hay grade is directly correlated with milk production. The milk production/acre decreased as the hay grade decreased (Table 4). Note that the crude protein concentration decreased 5 units and the ADF and NDF increased only 5 units from prime to No. 2 hay, yet the milk production was reduced by more than half. High-quality/prime hay is a must for top milk production.

The optimum stage to harvest alfalfa is a compromise between forage quality and quantity (yield). The highest quality alfalfa occurs at the vegetative stage, but the forage yield is too low for economic yields. University of Minnesota research found that three cuttings at the first flower growth stage plus a fourth on October 15 gave the greatest forage yield, highest RFV, and greatest estimated milk yield. Likewise, an alfalfa varietal experiment harvested three times at first flower plus October 21 at NDSU in 1994 yielded 5.9 tons/acre, but only 5.0 tons/acre when harvested three times at first flower. Four cuttings were obtained in 1995 due to favorable moisture conditions. Early harvesting allows for additional cuttings and greater forage yields when adequate moisture occurs.

Table 4. Estimated hay grade, chemical composition and milk yield in Wisconsin Forage Council Green Gold Project, 1984-1986.

Estimated Grade	Number of Cuttings	CP	ADF	NDF	Milk Yield
		%			lb/acre
Prime to 1	5	22	31	43	10,688
No. 1	4	21	32	44	9,120
No. 1 to 2	3	19	35	46	7,022
No. 2	2	17	36	48	4,259

CP = crude protein, ADF = acid-detergent fiber, NDF = neutral-detergent fiber

Adapted from Rohweder et al., University of Wisconsin

Table 5. Forage quality and estimated milk yield by harvesting schedules in alfalfa at St. Paul, Minnesota

Cutting Schedule	No. Cut	Forage Yield	CP	ADF	NDF	RFV	Estimated Milk Yield
		tons/A	%				lb/a
First flower 3x by Aug. 31	3	4.9	20	34	42	140	9,336
Bud stage 3x by Aug. 31	3	4.4	21	34	41	141	8,575
First flower 3x + Oct. 15	4	5.4	21	30	38	162	11,262
Bud, first flower 3x + Oct. 15	4	4.9	21	29	40	156	10,904
Bud, first flower 4x by Aug. 31	4	4.2	22	30	37	165	9,699

CP = crude protein, ADF = acid-detergent fiber, NDF = neutral-detergent fiber, RFV = relative feed value

Adapted from Alfalfa Management Guide, University of Minnesota

Forage Utilization Begins with a Representative Sample

All too often, forage testing consists of someone collecting a few handfuls of silage or a small quantity of a single bale of hay, cramming it into a bag and throwing it in the mail. A one-pound sample sent to the lab at the beginning of the feeding season is a very small sample that must represent an enormous quantity of feed. Surely, expecting so much from so little should require a great deal of care when selecting the sample.

The most important part of analyzing forages is taking a representative sample. Hay probes are effective tools for sampling dry forages. Follow these guidelines when taking hay samples.

- Use a core sampler specifically designed for hay.
- Make sure the sampler has a sharp cutting surface. A dull blade tends to collect more leaves, creating an unrepresentative sample.
- Take samples from 10 to 20 small square bales or four to seven large square bales or round bales. Take samples from each cutting of hay.
- Take one sample per bale from small square bales and three or four samples per bale from large square or round bales.
- Sample small square bales from the center of the small end. Large square bales should be sampled at the center and on the edge of the long side (round side). The probe should be long enough to reach halfway through the bale. Keep the hay probe parallel to the ground when taking a sample.
- Place core samples from each group of bales in a single plastic bag. Do not divide the sample. This causes separation of leaves and stems. Send the entire bag to the lab for testing.
- Hay being placed in protective storage can be sampled any time after harvest. If bales remain outside, wait until just before feeding to sample.

NDSU Extension circular AS-1064, Sampling Feed for Analysis, discusses in detail procedures for sampling various feedstuffs.

Evaluating Forages

Two methods can be used to evaluate hay and haylage, wet chemistry or NIRS (near infrared reflectance spectroscopy). For common forages, NIRS can be used and often is the method of choice due to speed and reliability of the procedure. For uncommon forages and forage mixtures always request wet chemistry. Once you have obtained a feed sample, immediately send it to the laboratory. Feed companies, elevators, and private laboratories analyze feeds.

Your local NDSU Extension Service county office can provide you with a partial list of laboratories capable of evaluating feeds.

Using Forage Quality Measures

Forage production can be big business. Forage quality can greatly affect animal production and, therefore, farm profitability. Nutrient analysis of forage is necessary for accurately balancing rations and figuring lowest costs. Ration balancing uses CP, ADF, NDF, K, Ca, and P as direct inputs for cattle, sheep and horses. Farmers can use ADF and NDF values to estimate digestibility and intake for each forage lot tested.

Large amounts of dairy quality hay are bought and sold throughout the country. Quality factors are as important when purchasing hay as when producing it. When buying hay, visual appraisal of quality can be deceiving. Quality is important to the seller as well — high-quality hay tends to sell at a premium. Market hay grades are based on forage quality and reflect forage species, composition and maturity (refer to Table 6). Legumes tend to grade highest, followed by legume/grass mixtures, grasses and heavily weathered forage.

Hay dealers report purchasing much of their hay one day and selling it the next. Time doesn't permit obtaining a wet chemistry analysis for forage quality. NIRS analysis provides a rapid, precise evaluation of hay and haylage. Mobile NIRS vans permit on-site testing at hay auctions where dairy and livestock producers can obtain a reasonable estimate of how their animals will perform on each hay lot.

Table 6. Legume, grass and grass legume mixture quality standards.

Quality Standard	Analysis[a] CP	ADF	NDF	DDM[b]	DMI[c]	RFV[d]
	% of Dry Matter			DDM[b]	% of DM	% of BW
Prime	>19	<31	<40	>65	>3.0	>151
1	17-19	31-35	40-46	62-65	3.0-2.6	151-125
2	14-16	36-40	47-53	58-61	2.5-2.3	124-103
3	11-13	41-42	54-60	56-57	2.2-2.0	102-87
4	8-10	43-45	61-65	53-55	1.9-1.8	86.75
5	<8	>45	>65	<53	<1.8	<75

[a] Analysis associated with each standard:
CP = Crude Protein; ADF = Acid Detergent Fiber; NDF = Neutral Detergent Fiber

[b] DDM = Digestible Dry Matter = 88.9-(0.779xADF)

[c] DMI = Dry Matter Intake (% of body weight) = 120 ÷ forage NDF

[d] Relative Feed Value = (DDM x DMI)/1.29

Valuing Quality Forage

Relative feed value (RFV) has been adopted by most hay markets as the standard by which quality hay is marketed. RFV is calculated as:

DDM (digestible dry matter) = 88.9 - (0.779 x % ADF);
DMI (dry matter intake, as a % of body weight) = 120 ÷ % NDF;
RFV = (% DDM x % DMI) ÷ 1.29.

In recent years, markets have penalized hay by $.90 per ton for every unit of RFV below 150. RFV is being recognized by the dairy industry and for backgrounding beef operations as very important when high quality forage is used as the major feed.

There are two aspects over which the cash hay producer has some control which will determine the relative value of forage.

1. *Stage of harvest affects RFV.* Determine RFV by feed analysis and calculate from the ADF (which determines digestibility) and the NDF (which determines intake). As the plant matures, the fiber levels in the plant increase, reducing the RFV of the forage. In most years, cutting at an early stage, mid to late bud, will result in a high RFV. To have the maximum quality and yield, most producers target the first bloom or a late bud stage. However, in some years with cool weather, bud development is slow and lower RFV can result if harvest is delayed until the first flower. Fiber levels apparently continue to increase even through bud development is retarded. Many forage producers now target their first cut not only according to plant development, but also according to the calendar.
2. *Forage composition affects RFV.* Pure stands of alfalfa will usually have the highest RFV. Forage mixtures with grasses will have a lower RFV than a pure alfalfa, because the fiber levels, particularly the NDF level of grasses, is much higher than that of alfalfa. It has been estimated that the RFV will be reduced by one point for every 1% grass in the stand compared to a pure alfalfa stand. For example, a mixture with 25% grass will likely have an RFV 25 points lower than pure alfalfa.

Timing Forage Harvest

At no other time during the year can alfalfa quality fall so fast as first-cutting. The harvest window for our region is so short that spring-growth forage can drop from the best to the worst in a matter of days. Quality declines four to five points a day in RFV in the spring. Second-cutting may average a daily drop of a couple of RFV points and the third crop, one point per day. But the significance of first-cutting quality declines is the fact that it accounts for 40% of the forage yield. That quick quality change calls for strategic planning.

If you want to inventory 150 RFV, start cutting a field at 170 RFV, because of a 15% loss in quality during harvest. Since first-cutting generally averages 120-130 RFV, and you want a 30-point improvement, that means moving first-cutting up a week to 10 days.

There are strategies to spread that harvest window. One way is to plant a high-quality variety in some fields and a standard quality in others. Varieties of high quality can be 15 to 20 points higher in RFV on any given day than standard varieties. When the standard reaches 170, the high-quality variety is still 190. Figure a decline of four points per day and you've given yourself an extra five days to get to those fields. High quality varieties now have some good supporting data, but your ultimate yield should still be the most important factor when making a seed selection.

The rapid decline in first crop forage quality points to the importance of having equipment appropriately sized to harvest hay in a short period of time. Spending three weeks harvesting will certainly result in some low-quality forage. Ideally, harvest should only take a week to 10 days. So plan you labor and equipment needs accordingly.

To help in timing of harvest, some states are able to track alfalfa's RFV through a program called Scissor Cut Projects. Field samples from several sites are taken weekly, starting as early as May 10, analyzed and publicized over the radio, in local newspapers and even through e-mail. The idea is to get the information out as soon as possible. Since alfalfa often doesn't flower normally on first-cutting, producers may wait too long for the desired stage of growth.

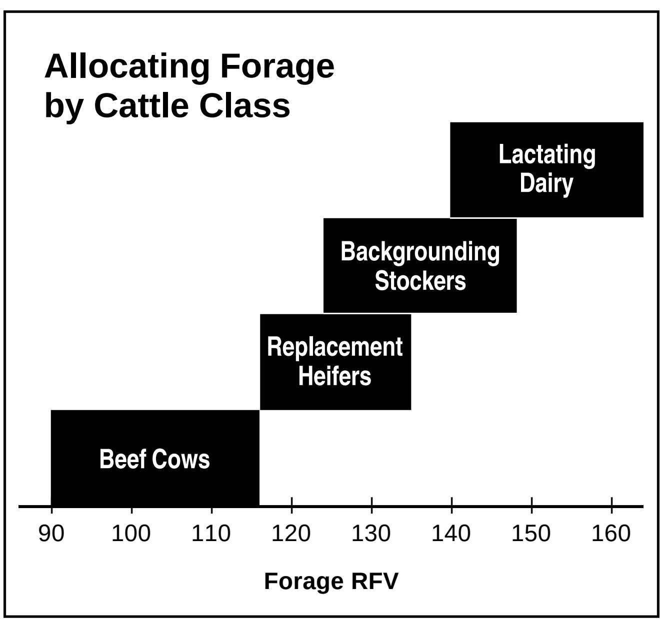
Contact your county extension office or forage and grasslands council as to whether a similar service is being offered in your area.

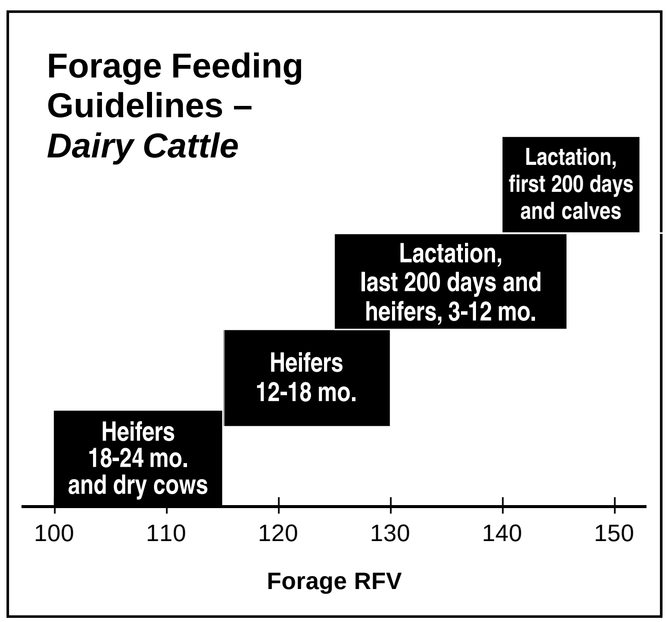
Allocating Forage by Cattle Class

Any forage production system will produce a variety of hay quality in any one given year due to variability in weather conditions, labor availability and equipment limitations. Whether you're buying or selling hay, it is important to know what you have and how to use it. For the end-user, allocating forage by cattle class is imperative for maximizing efficient use. Relative feed value provides an indication of the digestibility and how much an animal can eat of a forage. It's an easy method of ranking a forage and more accurate than using protein content alone as a quality indicator.

Use the following figure as a quick guide to forage allocation by cattle class. Dairy producers will refine this system further to accommodate their herd needs, which vary significantly as noted in the figure.

The key to any successful forage feeding program is to properly allocate your forage. Compare your forage inventory to projected needs and adjust forage harvesting and purchasing plans accordingly. Make an inventory and allocation worksheet (similar to the following pages) part of your forage record keeping for an organized, well thought-out forage feeding system. For top managers this means producing high yields, capturing the best quality when harvesting, buying forages at the best possible value and utilizing feeds in a manner to generate more farm profit.





FEED INVENTORY WORKSHEET

I. Cattle Inventory

Number of milk cows ______

Number of calves divided by 4 ______

Number of yearlings divided by 2 ______

Total number of animal units ______

II. Feed Needs

	lbs/Day		Days	=	lbs/ Animal Unit	tons[a]/ Animal Unit		Animal Units	=	Tons Deeded
Hay	______	X	______	=	______	______	X	______	=	______
Hay silage	______	X	______	=	______	______	X	______	=	______
Silage	______	X	______	=	______	______	X	______	=	______
Grain	______	X	______	=	______	______	X	______	=	______
Grain	______	X	______	=	______	______	X	______	=	______

III. Feed Resources

A. Forage

	Bales		Pounds/Bale		Pounds	Tons[a]
Hay (1st crop)	______	X	______	=	______	______
Hay (2nd crop)	______	X	______	=	______	______

	Silo Size		Depth Settled Silage		Tons	Correction Factor	Tons[a]
Silage (corn)	______	X	______	=	______	______	______
Haylage	______	X	______	=	______	______	______
Silage	______	X	______	=	______	______	______

B. Grain

	Bushels		lbs/Bushel		lbs	Tons[a]
Oats	______	X	______	=	______	______
Ear corn	______	X	______	=	______	______
Shelled corn	______	X	______	=	______	______
Barley	______	X	______	=	______	______

IV. Summary

	Hay	Silage	Haylage	Grain	Grain
Amount needed (tons)					
Amount available (tons)					
Shortage (tons)					
Excess (tons)					

[a] Tons = lbs ÷ 2,000

FEED INVENTORY WORKSHEET

I. Cattle Inventory

Number of milk cows ______

Number of calves divided by 4 ______

Number of yearlings divided by 2 ______

Total number of animal units ______

II. Feed Needs

	lbs/Day		Days	=	lbs/ Animal Unit	tons[a]/ Animal Unit		Animal Units	=	Tons Deeded
Hay	______	X	______	=	______	______	X	______	=	______
Hay silage	______	X	______	=	______	______	X	______	=	______
Silage	______	X	______	=	______	______	X	______	=	______
Grain	______	X	______	=	______	______	X	______	=	______
Grain	______	X	______	=	______	______	X	______	=	______

III. Feed Resources

A. Forage

	Bales		Pounds/Bale	=	Pounds	Tons[a]
Hay (1st crop)	______	X	______	=	______	______
Hay (2nd crop)	______	X	______	=	______	______

	Silo Size		Depth Settled Silage	=	Tons	Correction Factor	Tons[a]
Silage (corn)	______	X	______	=	______	______	______
Haylage	______	X	______	=	______	______	______
Silage	______	X	______	=	______	______	______

B. Grain

	Bushels		lbs/Bushel	=	lbs	Tons[a]
Oats	______	X	______	=	______	______
Ear corn	______	X	______	=	______	______
Shelled corn	______	X	______	=	______	______
Barley	______	X	______	=	______	______

IV. Summary

	Hay	Silage	Haylage	Grain	Grain
Amount needed (tons)					
Amount available (tons)					
Shortage (tons)					
Excess (tons)					

[a] Tons = lbs ÷ 2,000

The key to any successful forage feeding program is to properly allocate your forage

AS-1117

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