

THE IMPORTANCE OF FALL DORMANCY TO YIELD, PERSISTENCE AND FORAGE QUALITY

Bill Knipe, Peter Reisen¹ and Mark McCaslin²

ABSTRACT

Fall dormancy (FD) has long been recognized as the most important single factor determining the adaptation of alfalfa varieties. In general, more dormant varieties tend to have better winterhardiness and persistence than less dormant cultivars; however, they also have less vigor, less late summer and fall growth, and lower forage yield potential than the less dormant types. Field studies were conducted in Wisconsin, Idaho and California where the relationship between fall dormancy, forage yield, persistence and forage quality were evaluated. New lines were identified that had less fall dormancy, accompanied by higher forage yield, and better persistence than would be predicted based on their fall dormancy ratings. Within narrow ranges of FD there was not a consistent relationship between FD and forage quality.

Key Words: Alfalfa, *Medicago sativa* L., fall dormancy, persistence, forage quality, forage yield

INTRODUCTION

Fall dormancy (FD) in alfalfa refers to the reduction in growth which occurs in late summer and fall months. It is a response to reduced daylength and temperature and is probably the most important single trait in determining the adaptation of an alfalfa variety. Alfalfa varieties are rated on a scale of 1 to 9 with the 9 rating being the least sensitive to day length and having the most fall and winter growth. Several plant growth factors are related to FD including general plant vigor, speed of recovery following harvest, dry matter production, stand persistence and reaction to certain diseases. Also, it is possible that fall dormancy indirectly influences forage quality.

For many years it has been recognized that reduced levels of FD are generally associated with increased plant vigor, earlier maturity, increased rates of recovery following harvest, increased yield potential (which is influenced by the increase in vigor) and greater use of the longer growing season in southern latitudes. Unfortunately, reduced levels of FD are also known to be associated with negative factors such as lower levels of tolerance to freezing winter temperatures, water saturated soils in central California and possibly reduced stand life in general. Additionally, in central California increased winter growth associated with less fall dormant varieties may render them more sensitive to *Sclerotinia* as the abundant foliage that is produced provides a favorable environment for development of the disease during wet winter months. Obviously, removal of this forage through some form of harvesting would greatly reduce this problem.

¹ B. Knipe, Forage Genetics Inc., 1918 South Middleton Road, Nampa, ID 83686; P. Reisen, Forage Genetics Inc., 1918 South Middleton Road, Nampa, ID 83686

² M. McCaslin, Forage Genetics Inc., N5292 Gills Coulee Road, West Salem, WI 54669

In situations where less FD is associated with earlier maturity, forage quality could be adversely affected on any given date of harvest due to the negative relationship between maturity and quality.

Significant changes are taking place regarding areas of adaptation for most FD classes. There are now FD 4 varieties that have the winterhardiness more typical of FD 3 types; in the Sacramento Valley of California the varieties of choice 15-20 years ago were of fall dormancy groups 5-6 (Lahontan and Lahontan types). Today varieties of dormancy groups 6-7 seem to be favored. They have the increased vigor and yield associated with their respective FD groups with the persistence equal or superior to the more dormant varieties used 20 years ago. Varieties with FD 6-7 and even 8-9 are performing well in areas of the Intermountain West that a few years ago were almost exclusively growing areas for FD 3-4 types. Additionally, we are seeing FD 9 varieties that are yielding and persisting well in Central California and new FD 10 types are demonstrating improved forage yield and good persistence in the Imperial Valley.

The presentation which follows is a report from a continuing program whose objectives are the improvement of forage yield, persistence and forage quality in alfalfa.

PROCEDURES

Fall dormancy, winter survival and persistence estimates were made under field conditions in Wisconsin, Idaho and multiple locations in California. Forage yield and quality determinations were obtained in Idaho and from several locations in California.

RESULTS AND DISCUSSION

Field trials in Wisconsin indicate that the strong negative relationship between later fall growth and winter injury has been altered. The older check varieties demonstrated the expected association between fall growth and winter injury and persistence but the newer and experimental varieties exhibited less winter injury and better persistence than would be predicted based on their fall growth habit (Table 1).

Table 1. ¹FD/WH/PI indices of several alfalfa lines and cultivars at West Salem, WI. 1994 Test.

<u>Cultivar</u>	FD	WH	PI
	<u>10/94</u>	<u>5/95</u>	<u>5/96</u>
Vernal	2.4	2.4	5.8
Arrow	2.8	3.3	5.5
Saranac AR	3.8	4.2	3.3
Tahoe	5.8	6.3	0
5312	3.3	3.0	6.7
Mag 1V	4.0	3.6	6.5
Rushmore	4.0	3.2	6.0
WL 322	4.0	4.5	2.3
4L Exp	4.8	1.3	6.0
4L Exp	5.2	2.6	8.3

¹FD=fall dormancy which was estimated from fall growth measured in October following transplanting in May 1994 (Wisconsin). 9 = most growth; 1 = least.

WH=winterhardiness score estimated from plant survival in May 1995 from the transplants of May 1994 (Wisconsin). 1 = best survival; 9 = least.

PI= persistence index; based on plant survival in May 1996 from the transplants of May 1994. 9= best survival; 1 = least.

In areas of the Intermountain West which have relatively mild winters such as the Treasure Valley (Boise Valley) of Idaho (4-5 cut area) varieties in FD groups 6-7 yield significantly more than varieties of FD 3-4 types which are the types traditionally grown in the area. However, in areas with more severe winters such as eastern Idaho the varieties currently available in FD groups above 4 often suffer winter damage and consequently have low yield and short stand life (Table 2). Many areas of the Intermountain West have winters that damage these varieties but with a modest improvement in cold tolerance or winterhardiness in varieties of the 6-7 types they could be grown throughout most of this region and we believe increase forage yield substantially.

Table 2. Yield (DM T/A) of FD 6 vs FD 3-4 types

	Nampa, ID 95-96	Fruita, CO 95-96	Eastern ID 95-96
FD 6 Types	15.43	12.23	9.96
FD 3-4 Types	14.29	11.88	11.43
gain/loss yield	+1.14	+0.35	-1.47

Experimental lines now exist that have FD of approximately 6 and a winterhardness rating of less than 4. They also demonstrate excellent forage yield (Table 3).

Table 3. Fall dormancy, winterhardness ratings and forage yield for alfalfa lines and varieties

<u>Line</u>	¹ <u>FD</u>	² <u>WH</u>	³ <u>T/A</u>
Comm. var.	6.2	5.0	6.3
Exp 1	5.9	3.6	6.0
Exp 2	5.9	4.3	6.4
Exp 3	5.3	2.9	6.6
Comm. var.	4.0	2.9	5.8
LSD 0.05	0.5	0.7	0.5

¹ FD=Fall dormancy based on fall growth in October following transplanting to field in May 1994 (Idaho). 9= most growth; 1= least.

² WH=Winter hardiness based on plant survival May 1995 (Wisconsin). 1= best survival; 9= least.

³ Yield in tons/acre Nampa, Idaho 1997 following planting in 1996.

Significant changes are also taking place regarding the areas of adaptation for alfalfa in fall dormancy groups 8-9. Some FD 8, 9 and 10 varieties are demonstrating good performance in the Treasure Valley, Sacramento, San Joaquin and Imperial Valleys, respectively (Tables 4-6).

Table 4. ¹Yield (T/A) of FD types 4-9 at Nampa, ID

<u>FD type</u>	<u>T/A 1994-96</u>	<u>Rank</u>	<u>% Stand May 1997</u>	<u>Rank</u>
FD 9 (new)	24.1	1/48	75	3
FD 9 (Cuf 101)	20.7	43/48	30	48
FD 8 (new)	23.2	8/48	68	9
FD 8 (old)	21.9	30/48	43	46
FD 7(new)	23.1	9/48	65	14
FD 7(old)	21.2	42/48	80	2
FD 4(new)	18.9	48/48	48	43
Mean	18.9	xxx	60	xxxx
LSD .05	1.4	xxx	10	xxxx
CV %	4.4	xxx	12	xxxx

¹Trial planted April 1994.

Table 5. Yield (T/A) of FD types 4-9 in Central California

<u>FD Type</u>	<u>¹Location</u>					
	<u>1994-95 Stockton, CA</u>			<u>1994-95 Visalia, CA</u>		
	<u>T/A</u>	<u>Rank</u>	<u>%Stand May 97</u>	<u>T/A</u>	<u>Rank</u>	<u>%Stand May 96</u>
FD 9(new)	19.5	1/48	90	19.7	3/48	82
FD 9 (Cuf 101)	18.0	43/48	45	18.4	21/48	43
FD 8 (new)	19.3	14/48	80	19.1	6/48	65
FD 8(old)	18.9	22/48	65	19	10/48	55
FD 7(new)	19.4	9/48	75	18.4	17/48	66
FD 7(old)	18.9	20/48	80	18.2	25/48	67
FD 4(new)	17.9	47/48	55	15.9	47/48	32
Mean	18.8	xxx	72	18.2	xxx	59
LSD .05	1.03	xxx	11	0.95	xxx	11
CV%	4.20	xxx	8.0	3.7	xxx	13

¹Trials at Visalia and Stockton planted in October and November 1993, respectively.

Table 6. Yield (T/A) of FD types 8-10 in Imperial Valley and central California

	<u>Imperial Valley</u>	<u>Visalia</u>
<u>FD type</u>	<u>T/A 1995-96</u>	<u>T/A 1994-95</u>
FD 10	24.7	18.9
FD 9 (new)	22.2	19.7
Cuf 101	22.1	18.4
FD 8(new)	20.1	19.1
FD 6	16.6	18.4
FD 4	11.3	15.9
Mean	19.4	18.2
LSD .05	1.9	0.95
CV%	7.2	3.7

We continue to strive to improve forage quality for all types of alfalfa including the less dormant types and are optimistic that progress is being made. There is variation for forage quality in each dormancy class and it continues to be the objective of our program to improve both forage yield and forage quality simultaneously. We are not willing to sacrifice forage yield to improve forage quality.

In summary, traditional views of dormancy and adaptation of alfalfa varieties are changing. Less dormant types are showing greater stand persistence under a wider range of growing conditions than would have been expected in the past. This is true for both "dormant" and "non-dormant" alfalfa. Improved forage yield is often associated with the less dormant types. As part of our continuing genetic improvement program we are working to improve the forage quality of these higher yielding less dormant types.

When Does Alfalfa Become Too Expensive To Feed? What Is The Cost Of NOT Including Alfalfa In A Dairy Ration?

C. Collar and G. Higginbotham, Farm Advisors
UC Cooperative Extension, Kings, Fresno and Madera Counties

Alfalfa hay prices are higher than ever before. Supply and demand drives the market price for alfalfa, but during times of relatively high prices, dairy producers ask themselves, "Can alfalfa become *too* expensive to feed to dairy cows?" The answer depends on the quality and price of the alfalfa, milk production level, and availability and prices of other feed commodities. In this paper we review the nutritional merits of alfalfa hay and discuss points to consider prior to reducing or eliminating alfalfa from rations for dairy cows. Finally, estimates of costs of not including alfalfa, and relative values of varying alfalfa hay quality are presented.

Nutritional Attributes of Alfalfa Hay

Alfalfa hay has certain attributes that make it an excellent forage for dairy cows. It is lower in fiber and higher in protein and minerals than many other forages. As an ingredient in a ration for high producing cows, no other single forage can contribute in more ways than alfalfa hay. Table 1 shows a sample ration for a pen of high cows and the contribution that alfalfa makes to four nutrients. Eighteen pounds of alfalfa provide one third of the fiber (ADF), over a third of the crude protein (CP), a fourth of the energy (TDN) and half of the calcium required for a high level of milk production. High quality alfalfa hay is also very palatable which is important for maintaining high levels of consumption to support high milk yields. These characteristics make substitution with other forages a challenge.

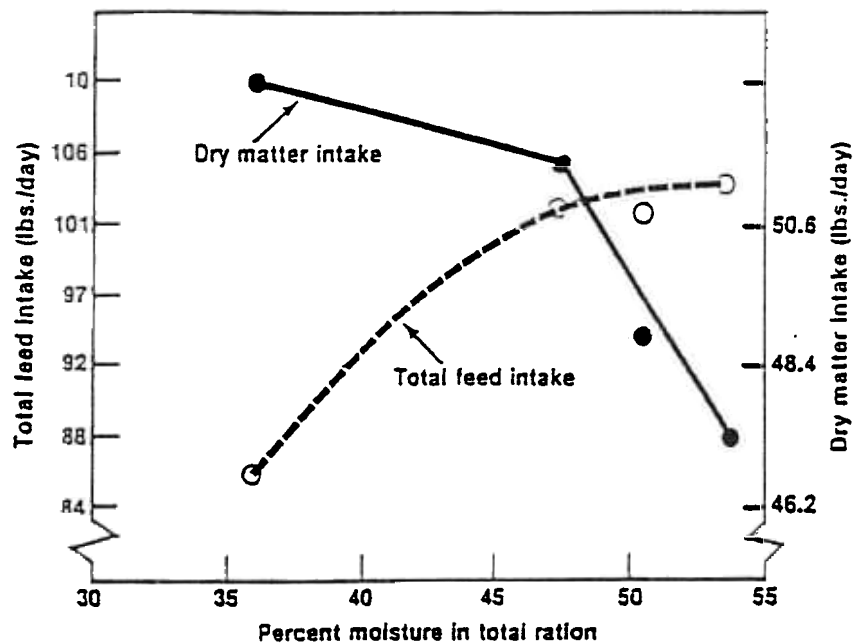
Table 1. Contribution to four nutrient parameters made by each dietary ingredient of a high cow ration.

	LB As-Fed	DM Basis			
		ADF % Total	CP % Total	TDN % Total	Calcium % Total
Alfalfa hay	18.00	33.4	39.5	25.0	51.6
Corn silage	25.00	14.9	5.2	10.0	3.0
Canola meal	4.50	6.9	16.3	7.0	6.0
Whole cottonseed	7.50	21.9	16.6	16.1	2.4
Cottonseed hulls	0.75	4.3	0.3	0.7	0.2
Hominy	3.50	3.5	3.7	6.5	0.4
50/50 Barley/Corn	14.00	6.3	14.1	25.7	1.3
Beet pulp	4.50	7.6	3.5	7.7	5.0
Mineral	0.70	1.2	0.9	—	30.2
Tallow	0.30	—	—	1.3	—
Formula Totals	78.75	100.0	100.0	100.0	100.0
Dry Matter	54.6				

Importance of Dry Matter Intake

It is possible to formulate rations for dairy cows without alfalfa hay. Early cut boot stage cereal forage, legumes like berseem or clover, and an assortment of by-products have potential to replace some, or all, of the alfalfa in a ration. In the East and mid-West where supplies of alfalfa hay may be very limited, corn silage is the main, and sometimes only forage. High milk yields in these herds is difficult to maintain because feed intake and rumen health suffer when rations are too wet and/or acidic. The effects of high moisture rations on feed intake are shown in Figure 1. When total mixed ration (TMR) moisture levels rise above 45%, dry matter (DM) intake declines rapidly. Maintaining high DM intake is critical for providing the energy to support high milk yield. When DM intake declines, milk production generally suffers and high producing cows often lose weight which can cause health problems that may not be observed for weeks or months. It is no accident that the states with the highest milk production per cow are also those where plentiful supplies of good quality alfalfa hay are available. Substitution for alfalfa hay is possible, but often costs more in lost milk production and/or health problems than what is gained in feed savings.

Figure 1. How ration moisture affects feed intake



Fiber and Energy

The fiber and energy content of alfalfa are inversely related. While dairy cattle need sufficient energy to support milk yield, they also require a minimum amount of fiber, of the proper quality and physical form, to maintain normal rumen function and milk fat production. There are various fiber fractions in feeds that are measured by chemical analysis. Crude fiber (CF) represents the fiber fraction that is resistant to degradation in acid or alkali. This is an obsolete assay that most dairy nutritionists no longer use for ration formulation. There are now more meaningful fiber assays available which can be used to estimate energy content and feed intake potential of forages more accurately. Acid detergent fiber (ADF) consists primarily of cellulose and lignin while neutral detergent fiber (NDF) consists of hemicellulose, cellulose and lignin. ADF and NDF offer a means of comparing plant fiber components in common forages. Generally, ADF gives a good indication of forage digestibility and NDF is a good indicator of its intake potential. The optimum amount of ADF and NDF in the diet varies with milk production level and forage source. For example, a minimum of 21 percent ADF and 28 percent NDF is

recommended by NRC for cows during the first 3 weeks of lactation. Various fiber fractions in legumes and grasses are shown in Table 2. Alfalfa is lower in NDF than corn, wheat, barley and oats, and alfalfa NDF is more rapidly degraded by microbes in the rumen of the cow. Alfalfa also contains a greater percentage of very digestible cell solubles. This, combined with its rapidly degraded NDF, explains why alfalfa is more digestible than these other forages. Although corn silage and early maturity alfalfa have similar ADF levels, alfalfa has greater intake potential since its NDF content is lower and more rapidly degraded.

Table 2: Various fiber fractions and protein in common legumes and grasses

	Percent of DM				
	NDF	ADF	CF	Lignin	CP
Alfalfa					
Early vegetative	38	28	21	5	23
Late vegetative	40	29	22	7	20
Early bloom	42	31	23	8	18
Mid bloom	46	35	26	9	17
Full bloom	50	37	29	10	15
Winter Forages					
Boot stage	58	35	29	3	18
Corn Silage					
Well eared	51	28	24	4	8

Sources: 1989 Nutrient Requirements of Dairy Cattle, NRC; C. Collar, 1997.

To further complicate the fiber picture, fiber sources have varying capacities to stimulate digestive activities that are important for ruminant animals. The ability of fiber to stimulate ruminative chewing, salivation and rumen acetate production has been termed fiber "effectiveness". Chewing time, saliva production, acetate to propionate ratios in rumen contents and milk fat percent have been used with varying degrees of success to quantitate the "effectiveness" of fiber. Table 3 shows the effect of fiber in the ration from long hay on these attributes. Salivation is particularly important as saliva is a good buffer, like sodium bicarbonate, which slows the decline in rumen pH due to excessive production of acid. Rations that lack sufficient "effective" fiber can lead to reduced ruminative chewing and saliva production which cause rumen dysfunction and health problems like rumen acidosis (low rumen pH), displaced abomasum and lameness.

Table 3. Typical effect of fiber content of the ration upon metabolic state of the dairy cow

Measurement	Long Roughage in the Ration			
	100%	60%	40%	0%
NDF%	70	48	36	14
Chewing (minutes/day)	960	900	820	340
Saliva (gallons/day)	50	47	45	33
Rumen acetate %	70	61	55	40
Rumen propionate %	15	22	27	40
Milkfat %	3.7	3.5	3.4	1.0

Source of Data: Dr. D. R. Mertens, U. S. Dairy Forage Research Center, Madison.

Protein and Buffering Capacity

Alfalfa is higher in protein than other forages (Table 2). Alfalfa is higher in soluble or rapidly degraded proteins which are utilized by rumen microbes to grow microbial protein. Microbial protein is digested further along the digestive tract where it provides 40 to 60% of the absorbable protein requirements to support milk production and other animal functions. Since the rumen is really a large fermentation vat, it must be maintained within a relatively narrow pH range for optimum growth of the rumen microbes. High acid levels in the rumen (i.e. low pH) can kill off some types of microbes causing digestive upsets and resulting health problems. Diets of high producing cows often contain high levels of starch rich grains that contribute to lactic acid production in the rumen. Among forages, alfalfa has the highest buffering capacity, exchanging cations for hydrogen to slow pH drop. Corn silage only has about one third of the buffering capacity and since it also contains starch, it contributes to lactic acid production, rumen acidosis and laminitis.

Reducing or Eliminating Alfalfa

When alfalfa hay prices are high, dairy producers typically look for ways to *reduce* the level in the ration. The common response of dairy nutritionists is to reduce alfalfa to no less than 8 to 12 lb., ensure that it is of the highest quality and then balance the ration with a variety of by-product feeds. California dairy producers are so accustomed to alfalfa hay based rations that systems which *eliminate* alfalfa altogether go outside their comfort zone, even though rations can be successfully formulated and fed without alfalfa hay. Either option requires careful attention to short term milk production responses as well as long term health and reproductive performance.

The prevailing notion that there is no substitution for alfalfa hay is extreme. Consider the first option of reducing the level of alfalfa in a ration. Protein and energy can be balanced with more by-product concentrates and corn silage, but the effective fiber that is so important for proper rumen function is more difficult to replace, especially when the alfalfa retained in the ration is premium quality low fiber hay. Instead of insisting on premium hay, a step down to high quality, somewhat higher fiber hay may be warranted. This strategy has the potential to save dollars on total hay purchases as well as on the cost per ton of the hay.

The second option of eliminating alfalfa altogether will not be considered viable by most California nutritionists, where reducing the level would be the most popular option. Nevertheless, a few points must be made for anyone contemplating such an action. If corn silage is the only forage, its quality becomes extremely important. The corn should be chopped longer to encourage chewing normally stimulated by alfalfa fiber. Kernel processing would not be recommended or the increased starch digestion in the rumen would compound rumen acidity. Since kernel processing also shreds fiber in the corn stalk, there would be less "effective" fiber to stimulate chewing. Silage higher in DM (30% instead of 25%) would be necessary to maintain DM intake. Inclusion of cereal forage, or sorghum-sudan silage or hay, in a TMR with the corn silage would help to provide fiber that more effectively stimulates chewing and salivation.

Regardless of the option, meticulous attention to feeding management is required. It is relatively easy to get cows to consume very high quality alfalfa hay. Intakes of a less palatable hay might be improved by dividing meals into more frequent feedings, mixing the hay into a TMR, ensuring that feed bunks are clean and chopping or shredding the hay so that cows don't roll it. If the alfalfa hay is fed separately and a step down in quantity and quality has been made, one should feed the hay before the silage/grain mix to encourage cows to eat *all* the hay. A higher level of management skill is required to successfully feed a lower quality hay!

Estimating the Relative Economic Value of Alfalfa Hay of Varying Quality

In the example above, the 49 TDN hay did not get used in any of the rations. Its value is low relative to other qualities of hay. The 58 TDN hay produced IOFC that was similar to the 55 TDN hay. PCDairy can also be used to estimate the relative value of different qualities of hay. If the 52 TDN hay costs \$145/ton, how much *less* should you pay for the 49 TDN hay or how much *more* should you pay for the 55 or 58 TDN hay to get the same IOFC? Rations were formulated with the 52 TDN hay at \$145/ton to get a baseline IOFC for the four milk production levels used in the previous example. Then, the process was repeated for the other three qualities of hay, except that the hay price was allowed to vary to achieve the same IOFC as that attained with the 52 TDN hay (Table 5).

Table 5. Relative economic values (\$/ton) of alfalfa hay varying from 58 to 49% TDN (90% DM basis)

Hay TDN	Milk Production Level (lb/day)			
	Low	Medium	High	Super
58 TDN	\$153	\$154	\$166	\$197
	\$152	\$154	\$163	
	\$145	\$145	\$145	
	\$133	\$127	\$42	
Difference in value (58 vs. 49 TDN)	\$20	\$27	\$124	\$239

The relative value of the 49 TDN hay was \$133/ton for the low, \$127/ton for the medium, \$42/ton for the high and -\$42/ton for the super high milk production group when compared to the standard hay at \$145/ton. To get the same IOFC as that with the standard hay, you would need to pay \$12/ton less if you were feeding low cows, \$18/ton less for medium cows, \$103/ton less for high cows and you would need to get *paid* \$42/ton to take the hay for the super milk production group! A balanced ration could not be formulated for more than 80 lb. of milk with the 49 TDN hay even if large amounts of grain-concentrates were fed. This illustrates the fact that high producing cows must be fed high quality hay in addition to liberal amounts of grain-concentrates in order to maintain high milk yields. Yielding to the temptation to feed very low quality hay when prices are high can be a costly mistake.

The relative value of the 55 TDN hay was \$152/ton for the low, \$154/ton for the medium, \$163/ton for the high and \$190/ton for the super milk production group when compared to the standard 52 TDN hay at \$145. That means if you were feeding low producing cows, you could afford to pay \$7/ton more for the high quality hay to get the same IOFC. However, if you were feeding cows producing over 100 lb. of milk, you could afford to pay \$45/ton more.

The relative value of the 58 TDN hay was \$153 for the low, \$154/ton for the medium, \$166/ton for the high and \$197/ton for the super milk production group when compared to the 52 TDN hay at \$145. The 58 TDN hay had increased value, but not to the level that one might expect. In fact, its value was similar to that of the 55 TDN hay for low and medium producers, and only slightly higher for high and super producers. This means that at \$175/ton, the 58 TDN premium hay was **too expensive** relative to the 55 TDN high quality hay at \$160/ton! Because the "candy" 58 TDN hay has such a low fiber content, meeting the requirement for fiber is more economical with the 55 TDN hay in this example. Premium hay puts cows on a knife-edge with regards to the ration fiber balancing act. Feed intake potential, which can be assumed to be greater for the 58 than for the

Estimating Costs of Eliminating Alfalfa

PCDairy, a computer ration formulation program developed at UC Davis, was used to estimate costs of not including alfalfa in a ration. Unfortunately, it is impossible to exactly predict animal response to a specific ration. Although computer ration formulation programs can be used to balance nutrients and estimate performance, not all factors can be considered that impact animal productivity. For example, a ration may support short term high levels of milk production, but production and health may be adversely affected long term. It is with these precautions in mind that the following calculations were made.

Rations were formulated with and without alfalfa hay to estimate the cost of not including alfalfa. Milk production levels of 46, 66, 86 and 104 pounds per cow per day, representing low, medium, high and super high production were used. The milk price was set at \$12 per hundred weight. Grain and by-product commodities and corn silage were available at current market prices. The calculations were repeated four times; once each for alfalfa hay that was 49, 52, 55 or 58% TDN on a 90% DM basis. The hay was priced at \$130, \$145, \$160 and \$175/ton respectively for the low, medium, high and premium quality hay. Income over feed costs (IOFC) were compared for rations with and without alfalfa at each milk production level (Table 4).

Table 4. Income Over Feed Costs (\$/cow/day) for Varying Milk Production With and Without Alfalfa

Hay TDN	Hay Price	Milk Production Level (lb/day)			
		Low	Medium	High	Super
58 TDN	\$175	2.44	4.39	6.24	8.10
55 TDN	\$160	2.44	4.39	6.25	8.12
52 TDN	\$145	2.44	4.39	6.19	8.02
49 TDN	\$130	2.44	4.39	6.15	7.65
No Alfalfa	\$0	2.44	4.39	6.15	7.65

PCDairy would not use any hay, regardless of its quality, to maximize IOFC for the low and medium milk groups, so IOFC for these columns are the same as that for the no alfalfa ration. Also, the 49 TDN hay was not used for the high and super groups. However, the rations with no alfalfa contained very high levels of corn silage and grain. Based on the preceding discussion, such rations would be difficult to sustain, but they are used here to illustrate that even at hay prices ranging from \$145 to \$175, there is more income potential from high producing cows when alfalfa hay is included in the ration than when it is not.

Income increases with increasing milk production, as one would expect. Income also increases with increasing hay quality up to the 55 TDN hay and then drops slightly with the 58 TDN hay. For the high milk production group, the difference between feeding and not feeding high quality alfalfa is 6.25 - 6.15 or \$0.10/cow per day. For the super production group, the difference is even greater; 8.12 - 7.65 = \$0.37/cow per day. In other words, the cost of eliminating alfalfa is \$0.10 to \$0.37 per cow per day under the conditions stipulated in this exercise. Rations for high and super production were formulated for 86 and 104 lb. milk, but the rations without alfalfa hay could only support 82 and 96 lb. of milk. The costs of not including alfalfa only reflect lost milk production, making them conservative. Additional costs related to health impacts of removing alfalfa hay from the ration would need to be included to get more accurate costs, but such costs are difficult to predict.

Forage for thought...

The importance of alfalfa hay quality on animal performance is clear. However, the distinction between high and premium quality hay is less clear from a profitability standpoint. Field experience indicates that milk production goes up when dairy producers incorporate premium hay in a ration, but one must always weigh the feed cost of getting the extra milk against the value of that milk. When shopping for hay, take a hard look at the price spread between 55-56 TDN hay and 58-59 TDN hay.

Summary

Poor quality hay is generally too expensive for lactating cows. Premium quality hay *can also* be too expensive if its price relative to high quality hay is too great. A decision to reduce alfalfa quantity or quality in rations for high producing cows when prices are high must be made very carefully after considering all the options, as well as alternative feeds and risks. Eliminating alfalfa may cost more in the long term than any short term gains might contribute. The nutritional attributes of high quality alfalfa for high producing cows is unmatched by any other forage. For this reason, high quality alfalfa will frequently provide a reasonable return on investment, even at very high prices, when fed to high producing dairy cows that can benefit most from its use.

References

- Bath, D. S. Strausser and A. Ahmadi. 1994. PC Dairy- 2. A ration program for dairy cattle. Dept. of Animal Science, Univ. of Calif., Davis.
- Bath, D. L. 1990. Using a computer program to determine the value of hay quality for lactating dairy cows. Proceedings of the 1990 California Alfalfa Symposium.
- Kawas, J. R., N.A. Jorgensen, A.R. Hardie and J.L. Danelon. 1983. Change in feeding value of alfalfa with stage of maturity and concentrate level. J. Dairy Sci. 66:181. (Suppl. 1).
- National Research Council. 1989. Nutrient requirements of dairy cattle. Sixth Revised Ed. (Update 1989). National Academy Press. Washington, D. C.
- Van Soest, P. J. 1984. Cation exchange capacity of feeds for dairy rations. Proceedings of the 1984 California Animal Nutrition Conference.

TDN hay, is not totally accounted for in this exercise. Greater intake potential for the higher quality hay would increase its value. Table 6 shows the effect of forage quality on feed intake.

Table 6. The effect of forage quality on predicted forage dry matter intake of ruminants.

Forage Quality	% Forage NDF (dry basis)	Dry Matter Intake As % of Body Weight
Excellent	38	3.16
↓	40	3.00
↓	42	2.86
↓	44	2.73
↓	46	2.61
↓	48	2.50
↓	50	2.40
↓	52	2.31
Poor	54	2.22

Adapted from data by Mertens, 1985. As measured by neutral detergent fiber (NDF)

Figure 2 further illustrates the importance of hay quality for high milk production. This information comes from a study in which cows fed pre-bloom alfalfa with only 20% grain concentrates produced more milk than cows fed full bloom alfalfa with 71% grain concentrates. Concentrate feeding can not substitute for forage quality.

Figure 2: Yield of 4% Fat Corrected Milk (FCM) in pounds per day from four alfalfa hays fed at four concentrate levels.

