MAXIMIZING THE USE OF THE FARM PRODUCED FORAGES*

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INTRODUCTION

The combination of the milk assessment which effectively reduces the milk price and increased prices for purchased feeds resulting from PIK and reduced yields due to drought have produced an unfavorable economic climate for dairy producers. Although no stone can be left unturned in searching for ways to improve productivity, the area with greatest potential for improvement is feed acquisition, feeding management and nutrition. We have found that two out of every three dollars of cash expenditures on New York dairy farms is for growing or purchasing feed.

The analysis which Charles Sniffen, a Cornell dairy nutritionist, and I have completed indicates that tremendous opportunities exist for greater utilization of forages, especially farm produced forages. There are at least three reasons why optimum use of forages is crucial. The first reason is that forages are cheaper on a dry matter and a per nutrient basis. Secondly, Maine and the Northeast have soil resources best suited to the production of forages. Third, and perhaps most important, the dairy cow is a ruminant and, therefore, is best equipped to utilize forages.

In this presentation I will look at three ways to optimize the use of forages. A fourth, production of high quality forages, is not new but becomes more crucial when combined with the three discussed here. First, however, we will quickly look at the importance of feeding a ruminant.

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The Dairy Cow Vs A Ruminant

As Dr. Sniffen and I have worked together on economic dairy cattle feeding, we have often talked about feeding the "bugs" in the rumen. Although I am not a nutritionist, there are two aspects of feeding the "bugs" that have impressed me as I have listened to Dr. Sniffen and others. The first is that the "bugs" are actually several classes of organisms and second that effective digestion by the "bugs" requires maintenance of a rumen mat.

Forages, as the primary source of fiber, are crucial to both points mentioned above. There is a delicate balance among the bacteria in the rumen. Table 1, developed by Dr. Sniffen contains several characteristics of the classes of bacteria. Of particular importance are the fiber bacteria requirement for a neutral ph and their relatively slow growth. In addition they die off if no fiber is available for digestion. The impact of these characteristics are that the rumen ceases to function effectively when the rumen becomes acidic due to too much grain or the fiber mat disintegrates due to too little fiber in the rumen.

A Balanced Ration

Balancing the ration is crucial to all aspects of feeding and the optimal use of forages is no exception. In order to balance the ration we must know:

1. The nutrient requirements of the animal. Although nutritionists are continuing their research, we have a good estimate of nutrient requirements.

2. The nutrients provided by the available feeds. Feed analyses, especially for forages, are essential.

3. The dry matter intake of the animal or group of animals. Because intake cannot be accurately estimated, continual monitoring of intake is crucial.

Table 2 provides an actual farm example where simply correctly balancing the ration reduced costs and especially purchased feed cost significantly. With current feed prices the savings would be greater. The third column illustrates that additional savings were made when it was determined that intake was higher than it had been estimated.

Table 1: Characteristics of Classes of Organisms

Class of Organism	Substrate Preference	Major Need	Major Product of Importance	Ph Tolerance	Time to Double
Fiber Bacteria	Cellulose Hemicellulose	NH_3 Iso-acids	Volatile fatty acids	Neutral	8-10 hrs.
General Purpose Bacteria	Cellulose Starch	NH_3 Amino acids	Volatile fatty acids NH_3	Acid	6-8 hrs.
Starch & Sugar Bacteria	Starch Sugar	Amino acids NH_3	Volatile fatty acids Lactic acid NH_3	Acid	1/4-2 hrs.
Secondary Bacteria	Bacterial Fermentation Products	Amino acids	Iso-acids	Neutral	6-8 hrs.
Protozoa	Starch Sugars Bacteria	Amino acids	Volatile fatty acids	Neutral	15-24 hrs.

Table 2. Savings from Correctly Balancing a Ration for 65 Pounds of Milk

	Price	Current Ration (lbs.)	Least Cost Balanced (lbs.)	Increase Intake 1 lb.
Mixed mainly grass hay crop silage	$25/ton	32	22.3	32.0
Mixed mainly grass hay	$55/ton			
Corn silage	$20/ton	26	40.5	35.9
High moisture ear corn	$50/ton	10	10.0 (fixed)	10.0 (fixed)
26% commercial concentrate	$180/ton	16	14.8	13.3
Soybean meal	$240/ton	—		
Corn grain	$100/ton	—		
Minerals		0	.12	.15
Feed cost per cow per day		$2.35	$2.28	$2.24
Purchased feed cost per cow per day		1.44	1.35	1.23
Savings Per Year Over Current Ration:[a]				
Total Feed Cost		—	$894	$1,405
Purchased feed		—	$1,150	$2,683

[a]80 Cow herd with these savings only from high group of a two production group system.

Maximize Dry Matter Intake

Dr. Peter Van Soest, world famous Cornell nutritionist, repeatedly tells the students in his course titled Forages, Fiber and the Rumen, that intake is the most important priority in feeding. Intake is crucial because it can be significantly altered, thus changing productivity of the animal and/or nutrient density of the ration.

If we consider a ration fed to an individual cow or group of cows, an increase in dry matter intake will usually result in some combination of the following two benefits:

1. The cows will produce more milk since nutrient intake has been increased. Since the increase comes from roughage as well as concentrate, the increased costs will be substantially less than the value of the increased milk and profitability will increase.

2. For cows that genetic potential, stage of lactation, or environmental factor inhibit increased production commenserate with increased intake, the nutrient density can be decreased while meeting nutrient requirements. The economic advantage of reduced nutrient density is that lower cost forage can be substituted for higher cost concentrates. An increased butterfat test could also result.

The economic benefit of increased dry matter intake of two pounds per cow per day is quantified by comparing three production levels and ration combinations for a current herd production level of 16,000 pounds of milk per cow per year. The four situations are:

1. Base: 16,000 pounds with balanced rations for three production groups with typical dry matter intake.

2. Same Production: Same production levels with balanced rations based on increased intake and with resulting reduction in nutrient density.

3. Same Production plus 0.2 percent increase in fat test.

4. Increased Production: Increased production level determined by nutrients available with increased intake of ration in the base situation.

Tables 3 and 4 contain the quantification of the above situations for 16,000 pound production level with Table 3 containing the results for the production year and Table 4 detailing average daily results for the high group. As can be seen, significant increased returns are obtained by the reduced nutrient density situation. The increase in return over feed is more than doubled when production responds to the increased intake. The greatest impact of the reduced nutrient density on profitability is observed in the high group with the greatest response to increase in production coming in the low group. The increased return in this example from the two pound intake increase would completely compensate for over 80 percent of the $1.00 assessment when production responds.

Table 3. Ration Composition and Economic Consequences of Increased Dry Matter Intake with 16,000 Pounds Production -- Per Cow Per Production Year Results

	Base	Decreased Nutrient Density	Increased Fat Test[a]	Increased Production
Milk Production, Pounds	16,000	16,000	16,000	17,360
Dry Matter Intake, Tons[b]	6.46	6.77	6.77	6.77
Ration Cost[b]				
Total	$691.13	$640.19	$640.19	$724.68
Change	---	$-50.94	$-50.94	$+33.55
Purchased Feed Cost[b c]	$389.18	$282.43	$282.43	$405.61
Return Over Feed Cost[b d]				
Total	$1,188.87	$1,239.81	$1,294.21	$1,315.12
Increase	---	$50.94	$105.34	$126.25
Per Hundredweight	$7.43	$7.75	$8.09	$7.58

[a]0.2 increase at 17 cents per point. No change in total production.

[b]Total of 305 production days.

[c]Concentrates are purchased, forages are farm produced.

[d]$13.20 price minus $1.00 assessment and 45 cents marketing equals net price received of $11.75 per hundredweight.

Table 4. Ration Composition and Economic Consequences of Increased Dry Matter Intake with 16,000 Pounds Production -- Daily High Group Results

	Base	Decreased Nutrient Density	Increased Production
Milk Production, Daily Average	69	69	73.76[a]
Ration Balanced for	75.9	75.9	81.1
Dry Matter Intake	44.8	46.8	46.8
Percent Forage	52.1	64.8	52.1
Total Ration Cost			
Per Day	$3.26	$3.00	$3.40
Per Hundredweight	$4.72	$4.35	$4.61
Purchased Feed Cost[b]	$2.46	$1.96	$2.57
Return Over Feed Cost			
Per Day	$4.85	$5.11	$5.27
Per Hundredweight	$7.03	$7.41	$7.14

[a]Additional energy in the two pounds of dry matter (1.50 Mcals) divided by energy requirement per pound of 3.5 percent fat milk (0.314) equals 4.76 pounds additional milk.

[b]Concentrates are purchased, forages are farm produced.

The following management strategies have been shown to increase dry matter intake at least in higher producing cows:

1. Removal of stress on cows produced by environmental conditions or poor herd health.

2. Access to fresh feed and water at all times.

3. Improvement in quality of forage.

4. Allocation of forages to minimize feed changes and maximize utilization of highest quality feeds.

5. Manage the sequence in which feeds are fed.

6. Balance rations for protein solubility and degradability.

7. Maintain rumen function by including adequate fiber.

Allocation of Forages

Once forages are in storage they are a scarce resource that must be allocated where it will return the most profit. Given an inventory of available forages, we must consider three allocation:

1. Allocation through the year or lactation to avoid shortages and/or unneeded carryover of inventories.

2. Allocation to production levels or groups of a given daily quantity of farm produced feeds.

3. Allocation within the day.

The third allocation, often referred to as feeding strategy, is not discussed but is crucial to maintain rumen function and fat test.

Table 5 contains an example of a worksheet to use to determine the quantity available for daily use based on the forage inventory. Two points need emphasis. The first is that the daily allocation may be different from the average daily supply. This potential difference is reflected in the final two columns and could result from seasonality of milk production, minimum quantities to avoid spoilage, and extra allocation until another forage is harvested. The final deviation will be necessary at times but should be minimized since large ration changes should be avoided if at all possible.

The second point is that this worksheet should be updated every month or two and with increasing frequency as harvest approaches. Estimation of silage inventories and measurement of quantities are both subject to major errors. Only with frequent checking will allocation continue to work effectively.

We are now ready to allocate the daily allowance. Although replacements must eventually be an integral part of forage allocation, for now their daily feed requirement should be subtracted from the daily inventory available. Although generalizations are dangerous, we are suggesting the following allocation procedure until more rigorous techniques are available.

Allocate high quality hay and hay crop silage first, corn silage second, and low quality hay crops third. Each should be allocated to higher producing groups first. In order to provide maximum flexibility in allocating hay crops, different qualities; whether they result from species composition, rain damage, or harvest date; should be stored separately to the extent possible.

Table 5. Example of a Worksheet to Calculate Daily Allocation Available to Herd

INVENTORY ALLOCATION WORKSHEET

Date ____________

Feed Ingredient	Unit	% Dry Matter	Total Quantity Available	Days Before Next Harvest	Daily Supply (Total/Days)	Amount to be Allocated Daily*

*Daily supply adjusted for circumstances that would warrant feeding daily supply: seasonality of production, minimum quantities to avoid spoilage, etc.

Two guidelines should be followed when allocating high quality hay crops. When quantities are limited, priority should be given to early lactation, high producing cows. When large quantities of hay crop silage, especially when it is low dry matter, are available; careful attention must be given to the soluble protein level of the total ration.

To quantify the importance to productivity and profitability of forage allocation to production levels or groups, we will use a 120 cow herd with three production groups (Table 6). The rations are formulated and the forages allocated by simultaneously solving four least cost balanced rations with constraints attached to each ration to limit the forage to the quantities available. Each ration is balanced with constraints for maximum dry matter, minimum energy, minimum crude protein, minimum calcium, minimum phosphorus, and minimum and maximum calcium to phosphorus ratios according to National Research Council (NRC) requirements. In addition the dry matter intake constraint is increased slightly as legume is included in the ration (based on work of Mertens at Georgia), fiber is maintained using minimum neutral detergent fiber (NDF) of 1.1 percent of body weight (based on work of Mertens and Sniffen) and a maximum soluble protein of 35 percent of crude protein is allowed.

The daily allocation of farm produced forage is:

1.0 tons corn silage dry matter
0.5 tons legume hay dry matter
0.5 tons mixed mainly grass with additional available at $60 per ton.

We will compare three situations similar to those used to analyze increases in dry matter intake. The situations are:

1. Proportional Allocation: This is the base situation with all groups being fed the same roughage proportions.

2. Minimize cost: The forage is allocated in the proportions that minimize cost given the current production.

3. Increased production: Production responds to the availability of better feed for early lactation cows. In this example production increases from 13,900 pounds to 14,800.

The economic importance of allocating the scarce resource and utilizing the highest quality forages where they do the most good is illustrated in Table 6. The purchased feed (additional hay and grain) is reduced more than $15 per day ($5,700 per year with 120 cows) by allocating the forage with production unchanged. Table 7 illustrates why this is the case with forage intake increasing more than 10 percent and concentrate decreasing nearly 20 percent in the high group when the forage is optimally allocated with no increase in production. For the total herd, concentrate requirement decreases over 30 percent.

An even more dramatic return is found when the improved ration to the early lactation cows results in a production response. In this example, a 900 pounds per cow per year response increases return over feed after the assessment and milk marketing $13,644 or $114 per cow (Table 6). With the optimal allocation of forage this increase can be produced without increasing purchased feed costs. Remember, farm produced forage quantities are constant at 2.0 tons dry matter per day (6.08 per cow per year).

Conclusions

I would hope that you are more cognizant of the critical importance of forages and have an increased awareness of three keys to utilizing forages to increase productivity and profits without increasing purchased feed costs. The three keys are (1) continual monitoring of dry matter intake, (2) maximization of dry matter intake and (3) allocation of forage inventories, especially of high quality forages, to maximize the use of scarce resources.

Table 6. Ration Composition and Economic Consequences of Improved Allocation of Forages -- Daily Results for a 120 Cow Herd with Three Production Groups

	Proportional Allocation	Minimize Costs	Increased Production
Annual Milk Production	13,900	13,900	14,800
Daily Forage Fed, tons dry matter	2.00	2.11	2.12
Daily Concentrate Purchased, pounds	888	615	747
Daily Purchased Feed Cost			
Total	$103.94	$88.16	$102.93
Change	—	-$15.76	-$1.01
Daily Return Over Purchased Feed Cost			
Total	$456.86	$472.64	$494.24
Increase	—	$15.78	$37.38
Annual Increase in Return Over Purchased Feed Cost	—	$5,760	$13,644
Percent of Legume Hay			
High	27.2	22.8	22.6
Medium	33.9	77.1	76.6
Low	29.5	0	0.7
Dry	9.4	0	
Value of Additional Ton of Legume Hay	$49.78	$99.86	$99.86

Table 7. Ration Composition and Economic Consequences of Improved Allocation of Forages -- Daily High Production Group Results for a 120 Cow Herd[a]

	Proportional Allocation	Minimize Costs	Increased Production
Milk Production, Daily Average	64	64	67
Ration Balanced for[b]	70	70	73
Dry Matter Intake	48.4	48.3	49.2
Roughage Dry Matter			
Total	31.1	34.5	32.8
Corn silage	15.5	28.0	26.3
Legume hay	7.8	6.5	6.5
MMG hay	7.8	0	0
Percent of ration	64.3	71.4	66.7
Concentrate			
Corn grain	15.8	10.4	12.9
Soybean meal	5.9	7.2	7.6

[a]35 cows in group for average of first one-third of lactation.

[b]Lead factor of 1.1. See Table 11 and associated discussion.