Matching Hay to the Cow's Requirement Based on Forage Test

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The conventional method for matching hay to the cow is to feed the most mature hay to the dry cows, then feed earlier-cut hay to late-gestation cows, and the best hay to lactating cows. If no supplemental feeds are purchased, this method is a fairly good approach. The question is, does the hay meet the animal's nutritional requirement or is there a deficiency that will limit animal production or health, causing a significant loss of income? On the other hand, producers sometimes feed supplements as a safety factor or insurance, not knowing if they are needed. This can be a waste of feed and money. Testing a hay crop for nutritional quality is the only way to know its nutritive value. Then, matching the hay to the animal's nutritional requirement limits purchased feed and saves money.

A very short course in ruminant nutrition

This fact sheet presents a quick but effective way of balancing low-cost hay rations for beef cattle. However, it is important to understand a few basic principles of ruminant nutrition to avoid making some common mistakes.

We feed bacteria, the bacteria feed the cow

When we feed a cow we are really feeding rumen bacteria. The bacteria digest the forage in the diet and much of the grain if any is in the ration. The cow then digests the rumen bacteria and any remaining grain as they pass out of the rumen and into the true stomach.

Livestock need pounds, not percentages, of nutrients

We measure major nutrients in feeds and rations as a percentage of dry matter (DM).
The nutritional needs of the animal are met by pounds of nutrients consumed, digested, absorbed, and then metabolized by the body.

Forage maturity controls dry matter intake (DMI) and digestible nutrient intake

Forage maturity is the factor the farmer controls through harvest management. Forage maturity (along with forage species) determines the rate of digestion and passage of the feed from the rumen. This determines DMI and intake of digestible nutrients. Young, immature forage has thin cell walls that are low in fiber and high in non-fiber carbohydrates and protein. Non-fiber carbohydrates and protein are rapidly and nearly completely digested in the rumen. The fiber in immature forage is also rapidly digested. This causes a rapid passage rate from the rumen and high DMI of the immature forage. As forage matures, plants build up more fiber in their cell walls that is less digestible and the cells contain less non-fiber carbohydrates and proteins. This greater amount of fiber that is less digestible reduces DMI since it takes more time for the residue to pass from the rumen. There are differences between forage species. Legumes have less cell wall fiber and more non-fiber carbohydrates than grasses at a given stage of maturity, allowing livestock to eat more DM from legumes than grasses.

Animal nutritionists usually use neutral detergent fiber (NDF) for measuring the fiber limiting DMI. The use of NDF accounts for forage maturity (as forage matures NDF increases) and for differences in forage species (grasses are higher in NDF than legumes and forbs at the same maturity).

As maturity progresses, forage crude protein (CP) content can decrease to the point where it is the limiting factor to rumen digestion and DMI. When hay with less than 8% CP is fed, the rumen bacteria are starved for protein and cannot reproduce, grow, and digest the forage as rapidly as possible. This reduces the rate of digestion and passage, causing the cow to have low DMI of this hay. By feeding supplemental protein with low-protein hay, the bacteria reproduce, grow, and digest the hay more rapidly and the cows are able to eat more hay, achieving a greater TDN intake.

Fiber vs. starch digesters

There are two general classes of bacteria in the rumen: fiber digesters and starch digesters. Fiber digesters cling to the particles of forage to digest them while starch digesters live free in the rumen fluid and on starch particles. Starch digesters have a faster reproductive rate than fiber digesters.

When low-CP hay is supplemented with protein the fiber digesters reproduce and grow more rapidly since they have their needed energy source in the hay fiber. Starch digesters are limited in growth since they do not have much of their needed energy source (starch) since mature hay is low in non-fiber carbohydrate.

When low CP hay is supplemented with starch-based energy such as shell corn, starch-digesting bacteria will reproduce rapidly since they have more of their needed energy source. The starch digesters will then use up what CP is available in the rumen fluid, reducing the CP available to fiber digesters, thus reducing their growth and reproduction. If too much starch is fed, the rumen pH will become acid, further reducing the vigor of fiber digesters since they are less tolerant to low rumen pH than are starch digesters. At higher levels of starch feeding the net result can be no net increase in TDN intake, since the decrease in hay digestibility offsets the increase in starch being digested, and DMI decreases.

Using supplements that are low in starch and high in protein solves this problem. These feeds include soybean hulls, wheat midds, distillers grain, and corn gluten feed. Soy hulls have no starch. Wheat midds may have a little starch left over from milling wheat into flour. Distillers grain and corn gluten feed have been processed to remove the starch for making ethanol or corn starch. These low-starch feeds provide energy in the form of highly digestible fiber, thus feeding the fiber digesters. These feeds also provide supplemental protein (Table 4), which is needed with low-CP hay to enable the fiber digesters to grow and reproduce.

Remember the major and minor minerals
Rumen bacteria also need adequate amounts of minerals in order to grow and digest feed rapidly. Using the forage test for major minerals will give good guidance to major minerals needed in a supplemental. Since most forages are adequate in phosphorus (P) and since P content in the mineral mix is a major cost, it is good economics to keep mineral mixes as low in P as possible. Hay crops that have been rain-damaged are likely to be low in magnesium (Mg), requiring Mg supplementation for lactating cows.

In West Virginia, supplemental copper (Cu), zinc (Zn), iodine (I), selenium (Se), and cobalt (Co) manganese (Mn) are usually needed by cattle, since the locally grown forages are generally deficient in these trace minerals.

Developing low-cost hay rations for beef cattle

To optimize the use of home-grown hay, here are a few steps for developing a feeding program.

1. Sample hay by field and date of harvest.
2. Have the hay samples analyzed by a certified forage testing laboratory.
3. Inventory all hay lots by bale size and count and forage quality.
4. Store hay so that hay from any lot can be fed to any animal class.
5. Inventory livestock by age, size, and production class with expected changes over time.
6. Compare the hay quality to the animal requirements.
7. Hay low in a nutrient can be fed with hay excessive in that nutrient to meet requirements.
8. If there is not adequate hay quantity or quality, supplemental hay or concentrates are needed or livestock can be sold.

Sample hay by lot
A hay lot is the hay harvested from a given field on a given day. Fields usually differ in forage species or variety, which can cause differences in maturity and quality. Plant maturity and harvest conditions change as time progresses over the harvest season. Hay from small fields can be fed with hay made on large fields harvested on a similar date to reduce sampling cost and simplify management.

Sample each hay lot using the guidelines presented in the WVU-Extension fact sheet *Sampling Hay and Haylage*.

Analyze hay at a certified lab
Send the prepared sample to a certified forage testing laboratory for analysis. A list of labs certified by the National Forage Testing Associations is available at:
http://www.foragetesting.org/index.php?page=certified_labs

Inventory hay by lot
Count the number of hay bales in each hay lot and estimate how many animal-days of feed each bale will provide based on past experience. On average, cattle eat 2.5% of their body weight in

hay dry matter. Cow size, bale size, and hay loss during storage and feeding determine how many cow-days of feed is in a bale of hay. When hay is in short supply evaluate alternative storage and feed management that will save hay and improve feeding efficiency. Summarize the hay inventory and quality to facilitate making management decisions (Table 1).

Table 1. Example hay inventory and nutritional value summary for seven hay lots.

Hay lot	# Bales	DM %	CP %	NDF %	TDN %	Ca %	P %	Mg %	S %
1 South HF	60	93	9.2	64.1	49	0.94	0.27	0.22	0.12
2 Mid BHF a	60	92	7.2	69.6	51	0.58	0.21	0.17	0.16
3 Mid BHF b	60	92	8.4	69.6	55	0.58	0.21	0.17	0.16
4 West HF	30	92	9.5	65.6	56	0.58	0.24	0.24	0.16
5 South BHF	50	92	8.4	66.5	57	0.68	0.26	0.25	0.12
6 North HF	30	92	12.3	62.2	58	0.91	0.29	0.22	0.19
7 North BHF	25	91	8.6	64.0	60	0.58	0.17	0.21	0.21

Store hay so more than one lot can be fed at a given time

Have all hay lots stored so that any hay can be fed to any group of animals. This allows the mixing and matching of different hays to meet the nutritional needs of the animals. For example, if one hay is low in protein, another hay high in protein can be fed with it to meet the animal's protein requirement. When this is not possible, base management decisions on what hay is available to the group of animals at a given time during the feeding season.

Inventory livestock by age, size, and production class

Inventory the cow herd by age (cows, bred heifers, yearlings, calves), production class (lactating cows, dry cows, growing heifers, bulls), and calving date (Table 2). It is important to know where in the production cycle the animals are on any given day of the year since age, size, and production status determine the animal's nutritional requirements.

Compare the hay quality to the animal's requirements

There are three levels of complexity for comparing hay quality to the animal's nutritional requirement (Table 3). Level 1 is the simplest and consists of just comparing the nutritional components in the hay to the nutritional requirements of the animal as a percentage of the ration DM. Level 2 is more complex and consists of estimating the animal's DMI of hay. Then, from the estimated pounds of DMI, calculating the expected intake of nutrients in pounds. This is then compared to the animal's nutritional requirement in pounds. If DMI is inadequate, then we evaluate how to increase DMI and appropriate supplements. Level 3 is the most complex and is reserved for use with computer ration-balancing programs. These programs allow for more complex ration balancing that can include different supplements, including high-carbohydrate grains such as corn or barley.

Level 1 matching hay to cow by % TDN and CP

When the forage test reports come back, rank each hay lot by quality from low to high. Use the TDN value for ranking since most cool-season forages are more likely to be limiting in energy than protein (Table 1). Next, rank the livestock by nutritional requirement from high to low. Dry beef cows in the second trimester of pregnancy (90 to 120 days before calving) are usually the animals with the lowest requirement during the hay feeding season. Compare the hay's nutritional quality to the animal's nutritional requirement as a percentage of DM. For example, hay lot *1-South HF* has a TDN content of 49% and CP of 9.2% (Table 1) and the mid-trimester cow (Table 3) has a TDN requirement of 49% and CP of 6.9%. This hay is adequate in TDN and more than adequate in CP. On the example farm it takes 1.5 bales to feed 30 mature cows for one day. So the 60 bales in hay lot *1-South HF* will feed the mature cows for 40 days.

Table 2. Example herd inventory by animal class, number of head, average weight, and gestation or wintering period dates.

Animal class	# Head	Average Wt.	Period Start Date	Period End Date
Mature cows				
Last trimester	24	1200	Dec 1	Mar 1
Early lactation	24	1200	Mar 1	Jun 1
Bred heifers				
Last trimester	6	1000	Dec 1	Mar 1
Early lactation	6	1000	Mar 1	Jun 1
Growing heifers				
Early winter	9	700 (660 to 736)	Dec 1	Feb 14
Late winter	9	775 (736 to 811)	Feb 15	Apr 30

Continue this process for the remaining animal classes and hays. When you run into a hay that does not meet one of the nutrient requirements, say CP, look to see if there is a hay that has a higher CP percentage that could be mixed with the deficient hay to obtain the desired percentage CP. The second hay will also need as high or higher TDN percentage as the first to meet the animal's TDN requirement. If either one or both of the CP or TDN percentages in the available hays are lower than the animal's requirement, move on to Level 2.

Level 2 estimating pounds of total digestible nutrients (TDN) and CP intake

The National Research Council (NRC) beef cattle nutrient requirements are based on DMI levels expected when cattle are fed a ration that just meets the animal's CP and TDN requirement. However, when hay is higher quality than these table values, animals will have higher DMI levels than indicated in the tables. Based on the research at WVU and other institutions beef cattle on average consume forage diets at about 2.5% of their body weight. If CP is limiting (less than 8% CP or a CP:TDN ratio less than 0.20) CP limits DMI (Fig 1 and 2). Low CP decreases DMI since the rumen bacteria are starved for protein and cannot digest the forage as fast as possible.

When looking at the combined effect of supplemental protein and energy on DMI the use of the CP:TDN ratio is preferred to using the 8% CP value that applies to hay alone. Hay crops with CP values over 10% can be looked at as protein supplements for feeding with lower CP hay.

When CP is not limiting, then fiber will most likely limit DMI. High fiber decreases DMI. Most nutritionists use neutral detergent fiber (NDF) as the fiber limiting DMI (Fig. 3). The use of NDF accounts for forage maturity (as forage matures NDF increases) and also accounts for differences in forage species (grasses are higher in NDF than legumes and forbs at the same maturity).

Table 3. Nutrient requirements for selected classes and weights of beef cattle.

Nutrient requirements of selected classes of beef cattle.							
Avg. Daily Gain lbs	Dry Matter Intake lbs	Crude Protein %	Crude Protein lbs	TDN %	TDN lbs	Ca %	P %
Dry pregnant 1200-lb mature cows, middle third of pregnancy.							
0.0	20.8	6.9	1.4	49	10.1	0.19	0.19
Dry pregnant 1200-lb mature cows, last third of pregnancy.							
0.9	22.3	7.8	1.7	53	11.8	0.26	0.21
Nursing 1200-lb mature cow first 3-4 months, average milking ability.							
0.0	23.0	9.3	2.1	56	12.8	0.27	0.22
Nursing 1200-lb mature cow first 3-4 months, superior milking ability.							
0.0	23.8	11.5	2.7	64	15.2	0.36	0.26
Pregnant 900-lb yearling heifers, last third of pregnancy.							
1.9	19.2	9.0	1.7	65.4	12.6	0.32	0.21
Two-year-old 1000-lb heifers nursing calves first 3-4 months.							
0.5	20.8	10.0	2.1	61.9	12.9	0.31	0.23
Growing 700-lb medium-frame heifers.							
1.0	15.1	8.4	1.4	62	9.4	0.25	0.19

See WVU-ES fact sheet *Nutrient Requirements for Beef Cattle.*

Since the NRC table values for DMI are conservative, we can estimate the expected DMI based on the hay's CP and NDF using Figures 1, 2, and 3.

CP limiting DMI

In Level 2 we estimate the expected DMI as a percentage of body weight (%BW). First look at the CP percentage or the ratio of CP:TDN. If CP is less than 8 or CP:TDN ratio less than 0.20, then CP is limiting intake and Fig. 1 can be used to estimate DMI. In this case, a small amount of CP supplement such as soybean meal can be used to provide the needed CP to stimulate the rumen microorganisms to grow and digest the hay more rapidly, which in turn stimulates the cow to eat more hay.

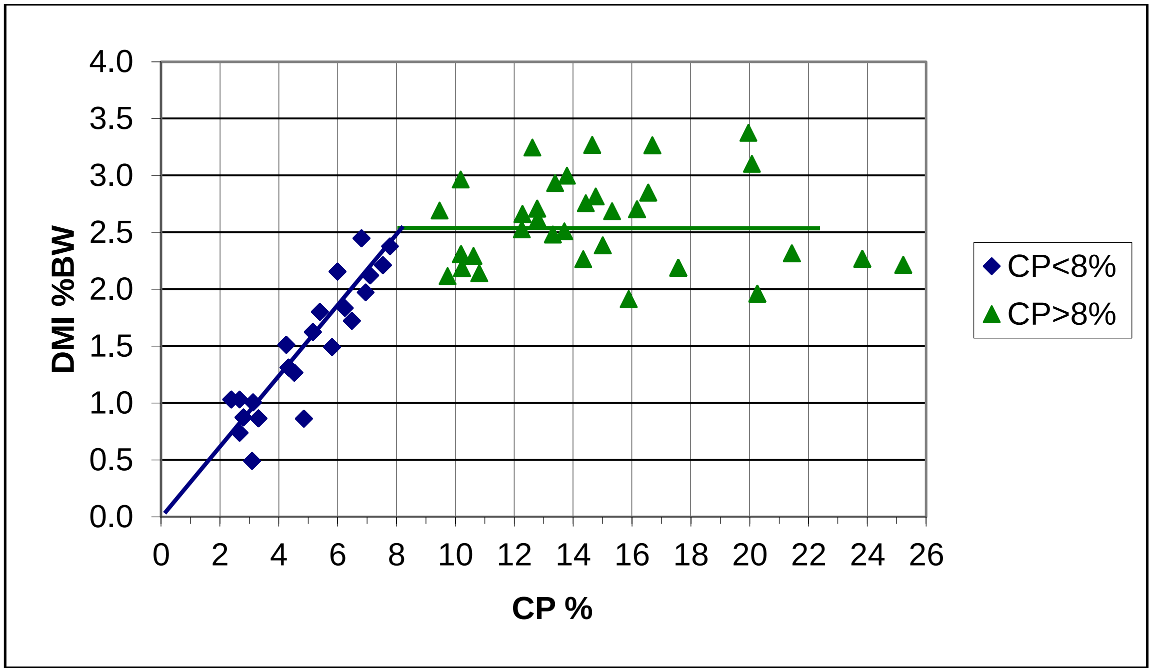

Figure 1. As the crude protein (CP) of a hay drops below 8% the animal's dry matter intake (DMI) of the hay decreases. Hay with a CP greater than 8% has DMI controlled by NDF content or other factors (John Moore).

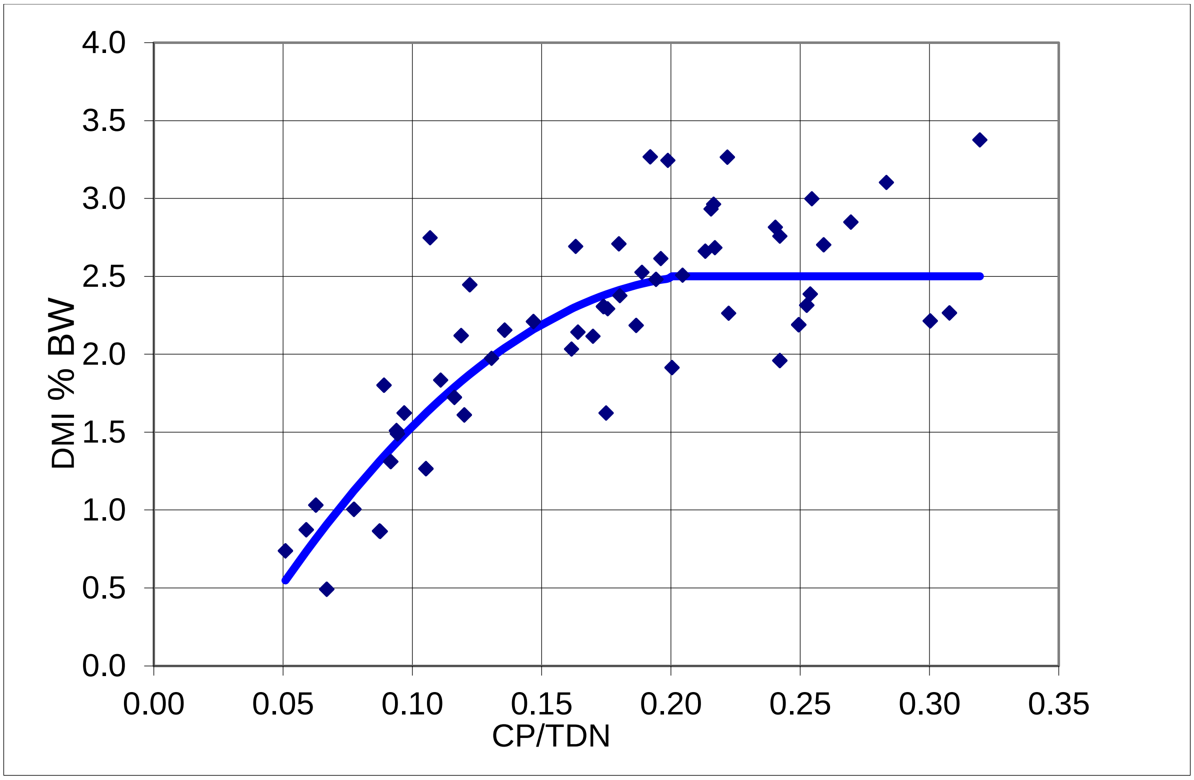

Figure 2. As the crude protein to total digestible nutrient ratio (CP/TDN) of a hay drops below 0.20, the animal's dry matter intake (DMI) of the hay decreases (John Moore). Hay with a ratio greater than 0.20 has DMI controlled by NDF content or other factors.

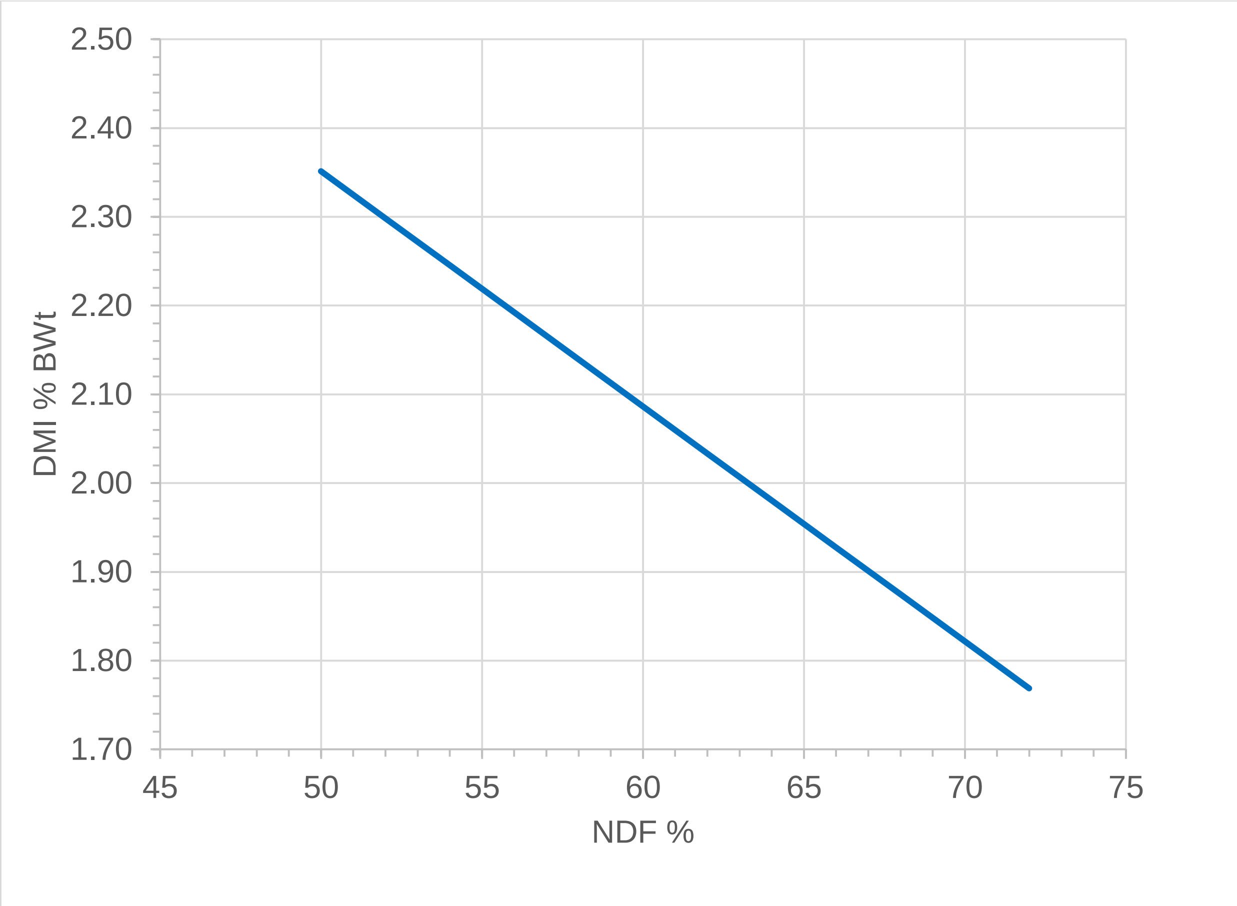

Figure 3. As forage matures, NDF increases and DMI decreases (Reid 1988). Legumes have less NDF per unit ADG and therefore livestock have higher DMI of legume than grass forage at similar maturities or ADF content.

Example: supplementing CP to increase DMI

We have a hay testing 6.5% CP, 53% TDN, 65% NDF that we need to feed to a 1200-lb cow in the last trimester requiring 7.8% CP (1.74 lbs CP) and 53% TDN (11.8 lbs TDN) at a 22.3 lbs DMI. On a percentage basis this hay is deficient in CP and just adequate in TDN. Based on Fig. 1, CP is limiting DMI. Adding 1 lb of soybean meal (SBM, 46% CP as fed) to the 22.3 lbs of hay the cow eats, the combined hay and SBM will be 8.2% CP [(22.3*0.065+1.0*0.46)/(22.3+1))=0.0820]. At this point CP would not be expected to limit DMI. The hay has 65% NDF so NDF would be expected to limit DMI to 1.95% DMI (Fig. 3). For the 1200-lb cow this would be 23.4 lbs DMI. At this level of DMI the combined CP from 23.4 lbs of hay and 1 lb of SBM would be 8.1% [(23.4 * 0.065+1.0*0.46)/(23.4+1.0)=0.081] which would not significantly limit DMI. Thus the combined hay and SBM would provide 1.98 lbs CP (1.52 from hay, 0.46 from SBM) and 13.2 lbs TDN (12.4 from hay, 0.8 from SBM). So by supplementing the hay that was deficient in CP with just a little SBM, the hay DMI increased to provide adequate CP and more than adequate TDN.

Using a CP supplement to increase DMI of low CP hay is displayed by the research findings presented in Fig. 4. The solid curve is the average DMI due to a rations CP:TDN ratio (Moore et. al). The square at point “1” represents DMI of a low CP hay. At points 2, 3, 4, and 5 we have the effect of four rates of SBM on the DMI of the hay (square) and hay plus SBM (triangle).

Hay that is well fertilized with nitrogen or grown with legumes seldom has CP concentrations less than 8% or CP:TDN ratios below 0.20. Grain and grain by-products commonly used as protein and energy supplements are listed in Table 4.

NDF limiting DMI

When CP is greater than 8 percent (CP:TDN > 0.20) NDF is most likely controlling DMI. As the NDF content of hay increases, the cow’s DMI decreases (Fig. 3). Hay with 55% NDF on average has an expected intake of 2.22% BW (Fig. 3). For a 1200-lb cow this is an intake of 26.6 lbs DM (0.0222 x 1200 = 26.6), which is greater than the 22.3 lbs DMI (1.86% BW) listed for a 1200-lb cow in the last trimester of pregnancy (Table 3).

Example: the expected DMI at a given NDF

We have hay testing 8.1% CP, 51% TDN, and 70% NDF (hay 2, Table 1). This hay’s TDN is lower than the 53% TDN required by a 1200-lb mature cow in the last trimester of pregnancy when consumed at 22.3 lbs DM (Table 3). We see that CP should not be limiting DMI (Fig. 1). Using 70% NDF to estimate DMI, we expect on average a DMI of 1.82% BW (Fig. 3). This represents 21.8 lbs DMI, which would provide 11.1 lbs TDN which is just a little less than the required 11.8 lbs TDN (Table 3). Here a pound of soybean meal would provide the needed energy and may increase DMI some since the CP:TDN ratio of the hay is below 0.20 (8.1/51=0.159).

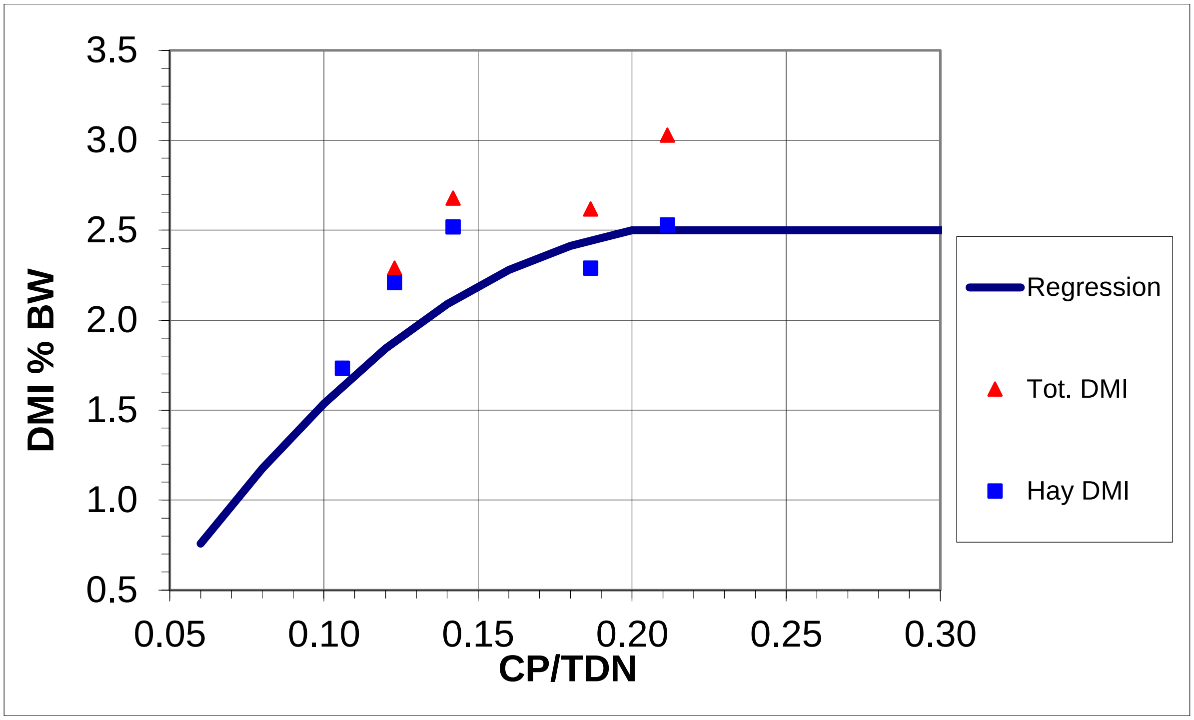

Figure 4. As a low crude protein (CP) hay (square) is supplemented with soybean meal, the DMI of the hay increases as the rumen microorganisms are supplied with the protein needed to digest the hay more rapidly; this stimulates the cow to increase its intake of hay, and the intake of the hay and soybean meal (triangle) increases even more (Mathis, 1999).

Table 4. Grain and grain by-products commonly used as protein and energy supplements, listed in decreasing order of protein.

Supplement	DM %	CP %	NDF %	TDN %	Ca %	P %	Mg %	S %
Soybean meal	90.1	51.3	13.2	79.9	0.42	0.74	0.32	0.39
Distillers grains	88.1	31.2	34.0	83.0	0.08	0.88	0.32	0.64
Corn gluten feed	89.2	23.8	35.8	73.3	0.11	1.04	0.43	0.50
Wheat midds	89.7	18.5	38.0	73.3	0.15	1.07	0.42	0.19
Soybean hulls	91.0	13.9	62.7	63.2	0.64	0.18	0.26	0.13
Oats	90.2	12.7	26.8	80.2	0.12	0.40	0.14	0.17
Shell corn	89.1	9.1	10.0	88.1	0.04	0.33	0.12	0.10

DM dry matter
CP crude protein
NDF neutral detergent fiber
TDN total digestible nutrients
Ca calcium
P phosphorus
Mg magnesium
S sulfur

Example of CP supplement on DMI and TDN intake

We have hay testing 6.5% CP, 50% TDN, and 70% NDF. We have to feed this to a 1000-lb two-year-old heifer in early lactation requiring 10.0% (2.1 lbs) CP and 61.9% (12.9 lbs) TDN (at 20.8 lbs DMI). The CP indicates a DMI of 2.25% BW (22.5 lbs DM) while NDF indicates a DMI of 1.82% BW (18.2 lbs DM). At a DMI of 18.2 lbs hay (DMI limited intake due to NDF) the hay provides 1.18 lbs CP and 9.1 lbs TDN. The CP intake is 0.92 lbs less than requirement. This can be provided by 3.87 lbs corn gluten feed DM (0.92/0.238=3.87) or 4.3 as fed (3.87/0.892=4.33). This corn gluten feed also provides 2.84 lbs TDN (3.87 x 0.733=2.84) which, added to the hay TDN of 9.1, provides 11.9 lbs TDN. This is 0.96 lbs TDN short of the indicated requirement. This can be provided by 1.5 lbs of soy hulls DM (0.96/0.632=1.52).

<u>Level 3 balancing with computer software</u>

When we evaluate hay based on Levels 1 and 2 and it still does not meet the animal's need, we have to look at providing a more complex supplement. At low rates of feeding supplemental CP we do not need to worry about the supplement displacing hay since DMI of low CP hay will increase. However, when feeding high-fiber supplements at high rates we do have to consider the effects of the supplement displacing hay from the ration. This is also a concern when feeding high rates of starchy feeds that may impact rumen bacteria. When large amounts of supplements are needed to balance the ration it is best to move on to a computer program or spreadsheet that is designed to balance rations. This occurs mainly with high-producing cattle such as finishing beef and lactating dairy cattle and when feeding by-product feeds in limited hay rations when hay is in short supply.

Example of matching hay to cow requirement and hay inventory
The following table shows the end result of using Level 1 and 2 to match hay to a set of cattle over the winter feeding season. There is not one correct answer for this problem. The final mix is based on management issues considered most important to the producer.

Situation:

- Hay feeding Dec 15 to May 1
- Last trimester Dec 1 to Mar 1
- Cows and heifers calve Mar 1
- Early lactation Mar 1 to May
- Cows eat 1.5 bales/ 24 head 1200-lb cows/day (based on experience)
- Heifers eat 1.0 bale/ 6 head 1000-lb heifers/3 days
- From Dec 15 to Mar 1 calving, 75 days
- From Mar 1 to May 1 turn out, 61 days
- From Dec 15 to Mar 1, 75 days, cows need 113 bales
- From Mar 1 to May 1, 61 days, cows need 92 bales
- From Dec 15 to Mar 1, 75 days, heifers need 25 bales
- From Mar 1 to May 1, 61 days, heifers need 21 bales

	NDF %	DMI % BW	DMI Lbs	CP %	CP Lbs	TDN %	TDN Lbs	# Bales
Dec 15 to Mar 1 Last trimester of gestation (75 days)								
1200-lb Mature Cow			22.3	7.8	1.7	53	11.8	112
Hay 1	64.1	2.4		9.2		49		57
Hay 2	69.1	2.3		7.2		51		57
Fed 1:1		2.3	27.6	8.2	2.26	50	13.8	114
1000-lb Heifers			19.2	9.0	1.7	65.4	12.6	25
Hay 6	62.2	2.4		12.3		58		13
Hay 7	64.0	2.4		8.6		60		13
Fed 1:1		2.4	28.8	10.4	3.0	59	17.0	26
Mar 1 to May 1 Early Lactation (60 days)								
1200-lb Mature Cow			23.0	9.3	2.1	56	12.8	90
Hay 3	69.6	2.1		8.4		55		30
Hay 4	65.6	2.4		9.5		56		30
Hay 5	66.5	2.4		8.4		57		30
Fed 1:1:1		2.2	26.4	8.7	2.30	56	14.8	90
1000-lb Heifers			20.8	10.0	2.1	61.9	12.9	20
Hay 6	62.2	2.4		12.3		58		10
Hay 7	64.0	2.4		8.6		60		10
Fed 1:1		2.4	24.0	10.5	2.52	59	14.2	20

The mature cows in early lactation are 0.6% short CP on a percentage of ration basis or 0.138 lbs CP. If using a 25% CP supplement 25% CP, 0.55 lb/day supplement is needed. This can be fed daily or twice as much every second day.

Summary

Level 1

1. Compare the TDN and CP percentages of DM on the forage test to the animal's nutrient requirement.
2. If the percentages on the forage test are greater than the requirement, the hay meets the animal's need.
3. If the TDN or CP percentage is less than the animal requirement, look for a second hay that has a higher percentage of that nutrient to feed along with the first so that the average percentage meets the requirement.
4. If the hays cannot be matched to the cow's requirements based on percentages, then go to Level 2.

Level 2

1. Identify if CP or NDF limit DMI.
2. Calculate the expected pounds of hay, CP, and TDN intake.

3. Compare expected intake to the animal's requirement to determine the limiting nutrient.
4. If CP is limiting, calculate pounds of CP supplement needed to meet the CP requirement.
5. If NDF is limiting TDN intake, calculate the amount of TDN supplement needed to meet the TDN requirement.
6. When substituting high fiber supplements for hay, use the difference in TDN value per pound of hay (substitution rate) to calculate the amount of supplement needed to bring the ration up to the TDN requirement.

Conducting a hay inventory and forage analysis of the different hay lots on the farm each fall enables the manager to properly allocate and supplement livestock being fed. Proper livestock nutrition maintains animal health and productivity.

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