Successfully Managing A Forage Based Dairy

with the Mineralized Balanced Agriculture Program

Gary Zimmer– dairy farmer- author– educator– president of MBA

Whether she harvests her own forages, or you harvest and store the feed for her, forages are the key to healthy and productive cows and profitable, successful dairying.

How do you grow these high quality forages?

It starts in the soil. Good biology and healthy, mineralized soils produce quality forages when paired with carefully selected plant genetics and good management practices.

Forages are always a part of a dairy cow's diet. The better the quality of that forage, the more of it you can feed, the better cows perform, and the less you have to supplement.

With quality forages, cost of production should go down, cow health go up and it's essential if you want to produce organic milk.

The Two Rules of Mineralized Balanced Agriculture:

1. **Do everything you can to get the soils healthy and mineralized.**
2. **Do everything you can to get the livestock healthy and comfortable.**

Inside:

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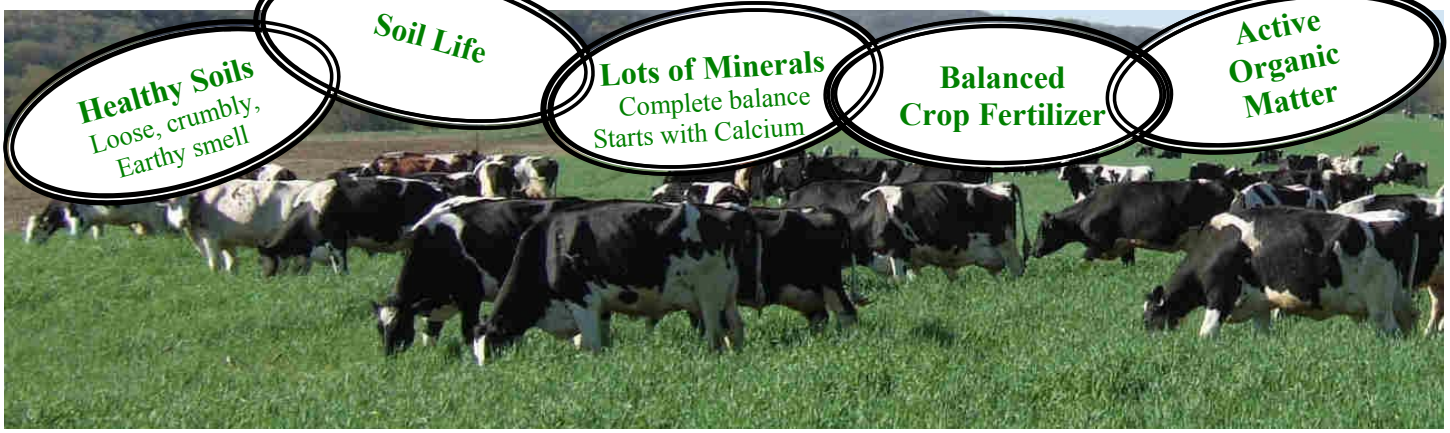
If you can't *lead* with strong links, you will have to *push* with expensive supplements and *risk* cattle health along with profitability.

The Grazing Ground



The Crop

The Cattle

Biological Farming-Biological Grazing

❑Biological Farming/ Grazing is a *system* of farming. Its purpose is to grow healthy, mineralized forages . These quality forages are produced on healthy, mineralized soils with an adequate supply, plus the proper balance, of Nitrogen, Potassium, Phosphorus, *and* Calcium, Magnesium, Sulfur, Zinc, Manganese, Iron, and Boron plus extras. This produces forages which yield healthy productive cattle— good health, good reproduction and good milk flow.

❑It takes time to get soils mineral balanced and healthy.

❑ It's a system which maximizes forage utilization- feeding a cow what she was designed to eat. Supplementation to a cow's ration is providing what's missing in the forages or diluting out something that's in excess.

❑It's a system which requires better understanding and management. Cattle feeding and management change, maybe the cattle also need to change.

❑Many farms are successfully making biological farming work, even though there is so much more we need to study and learn.

❑It takes time for farms to change but things keep getting better and better.

Outgrowing their homes— Healthy calves grow fast with large frames that fit the needs of a high forage ration.

Notes

❑Calcium is the "trucker" of all minerals and affects digestible energy in plants. Make sure you provide enough soluble calcium. Field grade lime is insoluble and performs well with low pHs. Calcium sources include calcium nitrate, gypsum, Bio-Cal and HumaCal. Choose the right source for the situation.

❑Sulfur is needed to make proteins, and build humus in the soil. It is an anion like nitrogen so it needs to be supplied annually (25 lbs. sulfur from sulfates per year). You can grow nitrogen but you can't grow sulfur.

❑Boron is also an anion and leaches. It aids in sugar translocation and calcium movement. One pound actual is needed annually for all crops. Sulfur and boron are the two nutrients you are never done with— you do need to keep adding them.

❑Every nutrient has a function both in plants and animals and they all need to be provided.

❑Nutrients coming through a highly digestible plant have higher availability to animals. That's where livestock minerals should come from, rather than out of a bag.

❑Biological Farming-Biological Grazing is a method of farming which focuses on healthy and mineralized soils.

Managing Nutrients on a Grass-Based Dairy

Manure
Compost
Fertilizers (Nutrients)

❑Cows don't eat around manure piles because those areas are high in soluble nitrogen and potassium: 'bitter.'

❑Manure nutrients aren't a balanced diet, but are short on calcium, sulfur and traces.

❑The nutrients you put on a soil affect the nutrients in the plant, which in turn affect digestibility, energy, flavor, mineral balance and protein quality.

❑There are more nutrients to replace and test than just N-P-K. What about calcium, magnesium, sulfur, zinc, manganese, copper, iron, boron, plus many others in smaller quantities? That is why I like to use natural mined rock material to balance a soil.

❑There are two nutrient areas to consider:

A. Soil balance— If a nutrient is short based on a complete soil test, add it. If it is high, don't add any more.
B. Crop fertilizers are specific blends for the crop you are growing and the soil type you have. A crop fertilizer doesn't correct soil deficiencies and should be a balance of all nutrients, not just N-P-K. A crop fertilizer supplies minerals above and beyond and in addition to what is in the soil.

❑Nutrient source— Fertilizers are sold on water solubility and price per unit. What about its effects on soil and soil life? How plant available is it? And are the nutrients stable, or will they leach away before the plants can use them? You can do things to enhance the nutrients and the fertilizers. I like adding carbon and balancing the soluble to the slow release.

Dairy farms have a valuable nutrient source in manure, if it is managed well.

❑Balancing soluble to slow release fertilizers provides timed release of nutrients.

❑Nitrogen and highly soluble salt fertilizers can stimulate a "big pile" of feed, but also consider energy and cow performance. What impact do these materials have on soil life, root development and plant health?

❑You have to earn the right to reduce or eliminate nitrogen from your fertilizer program. You can "grow" nitrogen. Healthy soils with nutrient balance and plant species balance have nitrogen : carbon balance. Calcium favors legume production; nitrogen favors grasses.

❑Composting manure with lots of carbon stabilizes the nutrients, changing manure from a soluble nutrient source to a slow release.

Cow ration management-points to consider

1. Cow science is cow science, whether you graze or store feeds.

2. Grazing is a less expensive way to harvest, plus it eliminates molds and provides fresh vitamins and exercise.

3. Ration balancing is difficult with grazing. Common sense and 'eye' of the master are essential.

4. Protein, energy, minerals, vitamins and effective fiber are still essential.

5. If a needed nutrient is not in the forage that is being fed, it will need to be supplemented.

6. Free choice minerals in addition to ration supplementation provide nutrient monitoring and management. Consider a salt/kelp blend, a calcium-phosphorus mineral and a buffer.

7. Cows are designed to eat forages. Having a minimum of 60% of the diet in forages is essential.

Cow science is cow science.

8. Corn silage and good "dry" hay help match high protein low fiber, high moisture, out of balance mineral (grass tetany) spring pasture growth.

9. Milk cow feed and dry cow feed are not the same. Grow special forages for each group.

10. Corn silage is low in minerals and. Protein. It can be up to half shell corn on a dry matter basis and does dilute out unbalanced feeds.

11. What ever you need to supplement for your cows is what is missing from your forages. Starting nutrition in the soils can change this. You have to earn the right not to supplement the cows.

12. Water is essential: clean, fresh, and available in adequate amounts.

Mineralized Balanced Agriculture

Here is a list of the ways that Otter Creek Organic Farm strives to meet the standards of Mineralized, Balanced Agriculture.

1. What are you doing to get and keep soils healthy and mineralized?

— We always start with a soil test.
— Add any mineral that is in short supply, starting with calcium and phosphorous and using natural mined minerals where possible.
— In the remineralization we also provide a balanced diet for the crop grown, including the use of compost, rock phosphate, potassium sulfate, humates, kelp, calcium sources, natural mined sea rock minerals and all the trace elements.
— Grow a large diversity of plants to extract natural soil minerals and feed soil life, in a tight crop rotation. We also take every opportunity to grown green manure crops:
— Shallow incorporate the green manure crops and residues to protect the soil and feed soil life
— Minimum tillage, either shallow incorporation and/or subsoiling for air and water management. We like keeping this residue 'blanket' on the soils.
— Nutritional management includes making of compost (stacked, aged manure) which is spread on hay fields during the summer. Yard manure is usually applied to fields that are going to be corn.
— For the aged manure we use a slinger spreader to provide a light coat on a lot of acres
— In summary, for nutrients, we do calcium and soil correctives in the fall, a crop fertilizer in early spring and when planting, and compost type manures in the summer.
— For soil biology, we grow a large diversity of plants, use minimum tillage, make compost and inoculate seeds, compost and fields.
— Rotations— on good land, corn— seed 1-2 yrs hay back to corn, in some cases a second year of corn is added especially if corn silage is harvested and rye planted.
— Soybeans or peas may be added where they fit. Hilly, stony ground is left longer in forages.

2. What are you doing to get livestock healthy & comfortable?

— Grow super quality feeds
— Balance the rations and provide all the extras— kelp, direct fed microbials, yeast, vitamins, Dynamin, Char-Cal

Dairy Quality Pastures

From articles in
The Stockman Grass Farmer
by Allan Nation:
Dec. 1994 & Jan. 1995

Too often we think of pasture as a grassy field that can support calves and some beef cows. Too often we don't lime or fertilize our pastures to increase their forage production and quality, since 'it is cheaper to feed good alfalfa hay and grains.'

Sorry, that's just not true. It is much more economical to be able to feed livestock on pasture, that are usually fed grain or legume hay. The catch is, the pasture must be high quality pasture. It is likely that most farmers don't really know what 'dairy quality' pasture looks like.

High quality pasture is dense with high-TDN grasses and legumes, and relatively weed-free. The soil is loose and well-drained and can soak up heavy rains. It is high in humus and alive with earthworms.

Such 'high-energy' pastures do not just happen. They are created and maintained by careful management. It requires proper grazing, occasional reseeding and frequent inputs of lime and fertilizer. But the results and the long-term increase in profitability are well worth it.

If the forages we grow had the energy and minerals that animals need, we would not have to buy expensive supplements, pay medical bills or make so much hay.

Organic matter is nature's fuel for pastures. The dead roots that naturally result when grasses are cut or grazed are the food for soil microorganisms. The decay of organic matter releases the nutrients it contains, and also the activities of microbes release acids which break out the tied-up nutrients in soil minerals.

Organic matter also gives the soil a porous nature that allows it to 'breathe' and lets oxygen in for roots, and carbon dioxide out. Soil humus can soak up large amounts of rain and hold it for dry periods. Tests have found that grass crops can absorb 87% of rainfall, compared to 70% for a field of corn.

But organic matter can be destroyed. Tillage and growing row crops quickly lowers the soil's store of organic matter. Overgrazing a pasture does the same, since grass roots are a 'mirror image' of the tops, and cropping off grasses too short causes the root system to shrink. High temperatures or hot climates cause soil organic matter to oxidize away. Leaving soil bare in the summer will have the same effect.

Organic matter can be built up in a number of ways. Avoid the things mentioned in the previous paragraph. Also, avoid adding too much raw manure or carbonaceous crop residues, since they will overstimulate soil microorganisms, with the result that available nitrogen will be tied up. Compost is better than manure, but growing grasses in a rotation, or a permanent pasture, is best of all for increasing soil organic matter.

A pulsed or rotational grazing system is much better for keeping grasses or legumes in peak production, and for building soil organic matter as well.

High-energy, high-TDN grasses such as ryegrass, as well as perennial clover, require high soil organic matter. Part of the reason is that soil humus helps them survive hot or dry periods.

Fertilization is also necessary to build high quality pastures. First,

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adequate calcium, usually from a liming material, is very important, for several reasons.

Calcium improves soil structure by causing soil particles to clump together, which allows the soil to 'breathe.' Calcium improves the availability of phosphorus, nitrogen and trace elements. Calcium increases the populations of soil microbes and earthworms, which aid in nutrient release and improve soil structure. Improved soil helps forages survive drought better. Calcium helps prevent infestations of certain weeds, such as dandelion, chickweed, plantain and buttercup. Legume forages require a lot of calcium, and high calcium improves the palatability of grasses and legumes. Some farmers find that livestock are more docile and content after pastures are limed.

Applying liming material frequently in smaller amounts each time is better than large amounts every few years. Lime should not be applied just for pH control. The pH does not depend on calcium, since a soil can be high in pH but low in calcium. Calcium can also be applied in gypsum (calcium sulfate), which will not raise pH (plus gypsum contains sulfur).

Lime should not be applied just for pH control ... a soil can be high in pH but low in calcium.

After calcium, phosphorus is the next most important element for quality pastures. Phosphorus is essential in every living cell, plant or animal. Phosphorus-poor forages lead to unhealthy, unthrifty livestock. Because phosphorus is abundant in plant seeds and animal bones, much of it can leave the farm with sales of grain and livestock. Research at Ohio State University found that the milk from 130 cows completely drained the available phosphorus from the top six inches of one acre of pasture soil.

Although there is a lot of phosphorus in soil, nearly all of it is tied up by other elements-- calcium, magnesium, iron and aluminum. A frequent application of a phosphate source is important for maintaining a quality pasture It is necessary for good growth of high-energy grasses and legumes. Many farmers are using rock phosphates such as North Carolina rock phosphate for pastures in preference to the highly available phosphorus sources such as superphosphate. Addition of a liming material increases the availability of soil phosphorus.

Adding phosphate materials to animal manure is a good way to reduce odor and save nitrogen that would otherwise escape. The phosphate ties up ammonia as ammonium and keeps it for later release by soil microorganisms.

Potassium is needed for plant growth, but too much of a good thing is bad. High potassium intake by animals can lead to health problems, especially in animals being fed supplemental grain. Spreading too much potassium-rich manure on fields is often the source of the problem (composting is a better practice). Potassium is not exported off the farm in milk or animals' bones.

Grass tetany is usually considered a disease resulting from cows eating low magnesium feed, but it can also result from forages that are low in phosphorus and high in potassium and nitrogen. This imbalance causes low magnesium assimilation by animals.

Milk fever is another health problem that is being recognized to be caused by out-of-balance, high potassium feeds, especially in grain-fed, dry and close-up cows. Dry and springing cow forages should not generally contain over 1-1.5% potassium.

The use of highly soluble potassium fertilizers is not good for pastures. Potassium chloride (muriate of potash) can lead to animal health problems. Potassium sulfate is better since it also contains sulfur, and sul-po-mag is also a good material.

Trace elements are too often left out when it comes to fertilizing pastures, yet small amounts of them are just as necessary as are the major nutrients. Boron is important for good legume growth, for example.

A complete soil test, including trace elements, is necessary to build and maintain a high quality pasture.

Guidelines for Top-Quality Forage

By Gary Zimmer

Whether it's a soil test or a feed test, tests can only give us clues about our feeds.

Just as soil tests don't measure what's in a soil (they only measure nutrients that are easily extracted and *assumed* to be usable by the crop), feed tests only measure parts and pieces of the feed but certainly not everything. They can measure nitrogen and calculate an assumed protein, they can measure fibers and estimate digestibility, they can measure minerals and estimate usability, but they are only calculations, assumptions and estimates based on the "normal."

If you raise crops in the "usual" way, such as using N-P-K soluble fertilizers and lime for pH, have pure alfalfa stands and regular corn, the estimates are more accurate because the tests and performance are based on that farming system.

Now, switch to "biological" farming. Add additional soluble calcium, use different phosphorus and potassium sources. Apply sulfur and trace elements, manage manure and rotations to balance soil fertility, encourage soil life to return and flourish. Plant different forage species or blends (alfalfa with highly digestible grasses and/or clover mixed in) and highly digestible forage corn varieties. The feed tests are going to be less predictable and

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The Four Rules of Quality Forage

1. It starts in the soil.

- Get a complete soil test
- Start corrections with Calcium and Phosphorus
- Get all soil tests looking the same
- Keep beautiful stands but run tight rotations
- Use livestock manures wisely
- Every year add Calcium, Sulfur, and Boron

2. Learn the components of quality forage and make the adjustments to obtain it.

- Test
- Use wet chemistry test for minerals
- Test for micronutrients
- Target 1:1 Ca to P for alfalfa
- Measure Sulfur
- Obtain high P and Mg
- Run digestibility tests, RFQ;
- Target protein, ADF, NDF and moisture levels; Get all feeds the same

3. Use forage blends.

- Don't buy— grow your own smorgasbord
- Add grasses and other legumes; Diversity above ground aids diversity below ground

4. Cut, inoculate and store properly.

- Harvest at correct moisture
- Cut after 4 hours of sunshine
- Provide cattle with effective fiber
- Maintain storage facilities
- Cut, fill, bale, bag or pack *fast*
- Use fermentation products
- Watch for mold
- Feed ensiled forages at levels to prevent spoilage

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those calculations and estimates may be far less accurate.

These differences are compounded by the fact that you will get different testing measurements from different labs.

Many farmers comment on or notice a difference with biologically fertilized crops, they feed better but they may or may not test differently.

Because biological farmers use different mineral sources and amounts, we have found that we get a more accurate prediction of what minerals are actually in the feed by using an old style wet chemistry test. Results generally show about a 25% increase which adds up to a lot of saved minerals when feeding cows. (We also find that we can get better utilization of these minerals in the feed as they break down during the digestive process).

Regarding digestibility and usable nutrients in the feed, extraction methods are used to estimate if it is digestible or not. NDF and ADF measurements are extensively used and many calculations are then made from those measurements.

One of the calculations was relative feed value (RFV), a number calculated to try to predict how the feed actually feeds. As has been demonstrated and researched extensively over the years, there were some flaws in this method. (In a *Hoard's Dairymen* article several years ago, University of Wisconsin researcher Randy Shaver called it "obsolete.")

Research has shown that differences occurred depending on whether the feed was grown during cool weather or summer heat. Time of day at cutting, width of cutting swath, time in the field, all affect digestibility or useable energy.

Plant species variations gave different readings and high quality grasses were undervalued. The biological farmer's practices of adding more calcium, getting a solid stem in the alfalfa and having a closer calcium to potassium ratio, seems to change the feed. Although pectins (that's the stuff in beet pulp, soy hull, the highly digestible carbohydrates — the more you get into the plant, the higher the digestibility) have been left unmeasured under these conditions, recent research has shown a correlation: the higher the calcium, the higher the pectins. Maybe the pectins are what gives us those solid stems?

Then there are the proteins. Actually, protein is not measured, nitrogen is, and it is multiplied by 6.25 and the resulting number is *assumed* to indicate protein levels. In truth, proteins are made up of amino acids— carbon chain compounds with nitrogen attached, some also carry sulfur and other minerals. If these minerals are lacking, the amino acids can't be made and you have incomplete proteins. On the other hand, if extra nitrogen is available from N over application or too much manure, then free nitrogen can get in the

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TEST	Ave. OCOF	Range	MBA Target
CP	22.6	21.7-24.35	18-21
Nitrogen:Sulfur	10.6:1	9:1– 13:1	10:1-12:1
Protein solubility	49.5	24.4-63.8	—
ADF	30.0	24.5-35.6	28-30
NDF	40.6	35.0-45.8	ADF+15
NDFd48	54.5	49.7-62.6	60% +
IVTDMP48	81.7	77.3-86.4	80% +
Fat	3.5	2.7-4.1	—
Ash	10.2	8.1-13.0	7-13%
Lignin	6.5	4.4-9.4	7%
Calcium	1.44	1.30-1.57	1.5%+
Phosphorus	.42	.37-.56	.35+
Magnesium	.39	.32-.46	.35+
Potassium	2.19	1.94-3.19	2.0
Sulfur	.35	.28-.43	1:10 S:N
RFV	153	124-185	150
RFQ	176	138-214	175

The above table is a summary of the average results of the fourteen crop forage test results from Otter Creek Organic Farm (OCOF) compared to the MBA recommended target levels. Forages included blends of alfalfa, clover and grasses, from first and second crops on the southwestern Wisconsin farm.

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plant. The conventional test can't tell the difference; this free nitrogen is calculated as protein, but in fact it's not.

With all this information— and sometimes lack of information— how should you use feed testing?

Much effort is being directed toward giving us better information in this detective work of dairy nutrition. The new Relative Forage Quality measurement calculation may be a step forward. Part of the formula utilizes the Ohio test measuring lignin and fat but also using rumen fluid and doing an in-flask in-lab digestibility test.

Just baled forage on its way to being wrapped.

The in-vitro test has drawn some criticism. What were the cows fed that the rumen fluid was taken from? Outside the cow is not the same as inside the rumen, and then there's the additional cost and time this test takes. It has limited use but it does give us clues.

There are just so many things we can't or don't measure, besides the trace elements. There are vitamins, enzymes, hormones, essential oils, pectins, bacteria and other living organisms, to mention a few.

Rules: Limits

My approach to nutrition is simple: Nutrition starts in the soil. Balanced minerals are important, as is the need to harvest, inoculate and store properly. Now it's feeding time.

Part of the reason we test is to evaluate our fertilizer and manure use, and our harvesting times. Our goal is for all our feed tests to look exactly the same. That requires a manure management plan and a soil corrective crop fertilizer program. The table (to the left) shows an average of the first two crops of good dairy hay from different fields on my family's farm (Otter Creek Organic Farm). It's an average of fourteen samples.

…through the benefits of improved digestibilities, cows can actually eat less and give more milk.

The first crop was harvested later than usual due to wet conditions, but we had a good growing year.

Comments on Feed Tests...

The workers on the farm did a great job of cutting on time and managing nutrients. It's part of the reason you test: it's the workers' report card.

Tests were performed on wrapped silage bales.

This forage is not pure alfalfa, but blends including grasses and some clover. Grass blends included soft fescue, perennial ryegrass, timothy and some orchard grass.

Minerals as an average were good . These are measured by wet chemistry so I have confidence in the accuracy of the numbers. It was a wet year: more nutrients in solution, good biological activity?

The ADF-NDF spread: our belief is, the wider the spread, the more digestible carbohydrates. The difference between the numbers is digestibility. We like a low ADF and a higher NDF. It feeds good. Remember, these tests also have limits— they don't tell the whole story. Grasses vary from legumes due to later cutting. These numbers are higher this year.

The NDFd-48 (Neutral Detergent Fiber digestibility in 48 hours as tested and calculated) numbers agree with our observations of the cows and how these feeds performed. Our best performing and preferred feed had a NDF-d 48 at 59 and an IVTDMD-48 at 86. These new tests do certainly give good grasses more credit.

In Vitro Total Dry Matter Digestibility in 48 hours (INVTDMD-48): Consider the intake/efficiency trade off. The message is that through the benefits of improved digestibilities, cows can actually eat less and give more milk. For years, it was all about getting more feed into the animals, not about efficiencies,

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which are now gaining popularity.

Lignin: First crop hay was made later in this year and has higher numbers. Hay made in summer heat can produce more lignin. That is a real advantage in our northern forage production areas. This measurement alone can help predict cow performance.

Relative feed value to relative forage quality: The belief was that average feed would have similar numbers; i.e., with poor feed the RFV would be higher than the RFQ, and with good, highly digestible feeds, highly digestible (especially with the high quality grasses added) the RFV would be lower than RFQ. Note the 20-30 point spread on our feeds. I know if I was going to buy feed, I would do so based on RFQ. (The previous year, when our hay was made earlier, our spread was 30 points.) Our best feeds have a 35 point spread; poorer ones have a 20 point spread. We had one pasture test last year with a 75 point spread.

Feed quality is not just genetics and cutting early. More testing needs to be done and we need to compare conventional fertilized feed to the feeds we are producing biologically. We already know from farmers that our feeds do perform better. Science will eventually get this testing thing figured out and reveal the effect of proper, balanced fertilizers on digestibility.

Due to our forages' higher protein content, we haven't used much protein for six months. Corn silage does fit our program to help lower total protein and some of the minerals. Our ration this winter will be about 25# corn silage as is, 15 pounds High Moisture shell corn, a couple pounds of dry hay and the rest a mix of the haylage bales. We may feed one or two pounds of roasted beans along with the mineral balance, some charcoal, yeast, kelp, direct fed microbials, enzymes and vitamins. We have one group TMR for the whole herd, and offer free choice minerals.

Forage blends provide a smorgasbord of diverse plants contributing key elements to forage quality.

As for balancing rations off the feed test, our belief is that if you can test it, balance it. Many things on feed tests are estimates. Make sure you use 'tested' numbers.

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Things we look at include:

- Total Protein
- Protein solubility
- Nitrogen : Sulfur in ration
- ADF Level
- NDF Level
- Starch Level
- NDF to Starch ratio
- NEL
- Minerals

Keep these things in line, have a good heifer raising program and a dry cow program, and you will have healthy, productive cows. It also takes cow genetics and cow comfort, but with these types of forages you won't be spending as much to produce milk.