Principles of Supplementing the Grazing Beef Cow

Matthew J. Hersom
Assistant Professor
Department of Animal Sciences
UF/IFAS
Gainesville, FL

Introduction

Feeding the cow herd is the largest cost in the cow-calf enterprise. The cow herd's feed requirements amount to 54 - 75% of the annual maintenance costs for the herd (Houghton et al., 1990). Grazed forages comprise the largest and most important feedstuff for the cow. Utilization of forage through grazing is the most economical feed that is available to the cow herd. Grazed forages provide the majority of the nutrients for maintaining the cow during gestation, lactation, and breeding. However, during certain times of the production cycle beef cows require additional nutrients beyond those supplied by grazed forage. Supplemental feedstuffs are utilized to meet cow nutrient requirements when they exceed the nutrients supplied by grazed forage because of an increase in cow requirements, decrease in forage quality or quantity, or a combination of all factors.

Determining and implementing the optimal supplementation program is imperative to maintaining a healthy bottom line in the cow-calf business. You will notice that I used the term optimal rather than maximal. Optimal is defined as the best or most favorable condition or degree, or the amount for a particular situation. This is an important distinction because often maximal production or supplementation is not economical. The idea of optimal supplementation is important because stored/supplemental feeds constitute the largest, potentially most variable, and costliest feedstuff for the cow herd.

Considerations for Starting Supplementation

To implement a supplementation program you as a producer must first define your situation. Defining the situation requires several steps. The first step is to decide what is the overall objective of the supplementation program. Considerations for implementing a supplementation program include extending the forage base in situations where the forage quantity is lacking because of overstocking, seasonal transitions, or drought. A second reason to implement a supplementation program is to alter the level of production of the cows. Changing production levels in the cow herd might include additional feeding of first calf heifers or thin cows, or feeding a supplement with special ingredients. A final reason to start supplemental feeding is to meet nutritional deficiencies. These nutritional deficiencies can include vitamins, minerals, protein, or energy. The important thing to remember is that in order to implement a plan you need to identify what is the goal of the supplementation program and then what will you do to accomplish the stated goal. In addition to implementing the supplementation program, determining a method to measure the effectiveness of the supplementation program is important. Otherwise, how will you know if you ever reach your goal, how soon you got there, and what it costs.

An important consideration to implementing a supplementation program is knowledge of what you have to work with and that starts with the forage base. Effective management of grazing requires determining the quantity, quality, composition, and overall forage utilization rate. Determining pasture yield can be as easy as relying on experience or as complicated as taking forage samples to calculate estimated forage available. Determining quality and composition can be more difficult, but knowledge of the predominated grass species in the pasture and knowledge of the level of maturity are valuable for determining quality of grazed forage. Finally, decide from a management standpoint how much

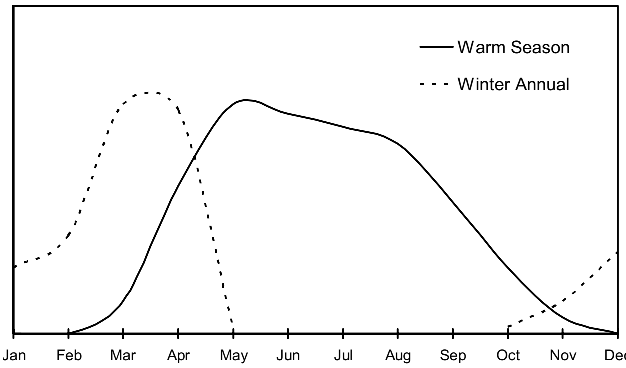

Figure 1. Florida forage/pasture growth.

of the available forage will I make the cows utilize. An important consideration is that increasing the level of forage utilization has two results; the first is that increasing utilization generally decreases the quality of forage consumed as the grazing season progresses, especially during winter grazing. The second result is that by increasing the utilization rate, the cattle remove a greater amount of forage from the pasture. A utilization rate that is too high can compromise subsequent plant growth and can negatively affect future pasture productivity.

The need for supplementation for the grazing cow occurs because of multiple forage factors. The supply of forage for grazing animals is seasonal and dependent on the forage species available for grazing. Figure 1 demonstrates the relative forage availability of warm season and winter annuals. Easily identifiable times of supplementation are apparent when warm season grass production declines and before winter annual growth occurs. Other times include when forage energy and crude protein concentrations fall below the requirement of the grazing cow. Forage deficiency of energy and protein relative to cow requirements occurs during forage dormancy in the fall, winter, and early spring, and during the height of the summer when accelerated forage growth results in lower quality forage. A complication in successfully balancing supplemental feed and grazed forage is the selectivity of grazing cattle. Grazing cattle have the ability to graze through a sward of grass and select a diet that can be 5 - 50% greater in digestibility and protein than what is available (Hitz and Russell, 1998; Hersom unpublished data). Therefore the exact composition of the forage diet is often poorly known when we rely on pasture samples because of the cow's selective ability.

Cow Factors Affecting Need for Supplementation

Equally important to forage issues is the cow herself. The cow introduces as much variation as the forage or the environment. Differences in the amount and type of forage consumed by the cow vary. This variation in forage consumption results in differences in nutrient intake by cows. Differences in supplement consumption also occur among cows regardless of our attempt to feed the desired amounts of supplement. Cow nutrient requirements are affected by numerous variables. Many of the issues concerning the cow haven't changed from 20 years ago. In 1984, Dr. W. E. Kunkle put together a Beef Cattle Short Course talk, "A Winter Supplementation Program for the Cow Herd." The proceedings contained many of the same items I am discussing in these proceedings. Particularly, I will review his discussion of the cow factors that influence the nutrient requirements and their effect on supplementation.

Age. Heifers definitely and older cows possibly require a higher level of supplementation than mature cows. Heifers, if bred to calve at a younger age, still have growth requirements to meet in addition to the demand that pregnancy and/or lactation put on their nutritional status. The heifer generally does not have the body stores, principally fat, on which to draw during times of higher nutritional demands. Additionally, heifers generally are smaller than their mature counter parts and thus have less ability to consume large amounts of high roughage diets.

Level of Production. It is well established that different stages of the production cycle result in different nutrient requirements. Milk production, fetal development, and body weight gain all require additional energy and protein above maintenance. Additionally, higher producing animals have increased nutrient requirements compared with the average of the herd. Requirements for energy

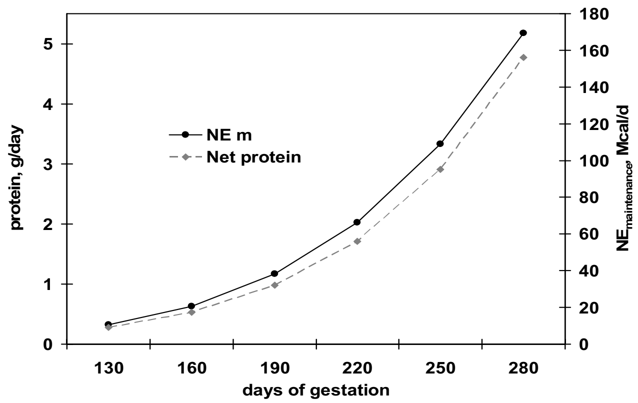

Figure 2. Estimates of energy and protein requirements for pregnancy.

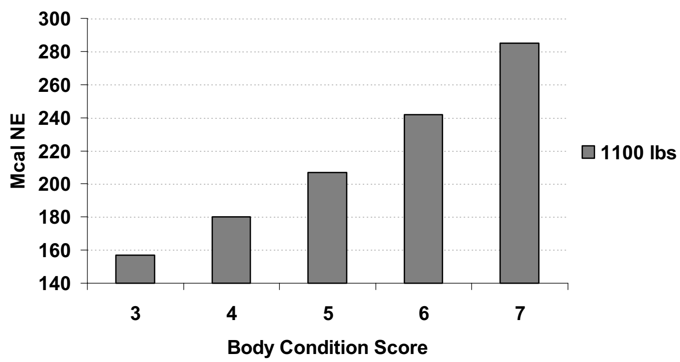

Figure 3. Energy reserve/required to change body condition score.

change by nearly 2.0 Mcal/d and net protein by 0.22 lb/d from week 3 to peak lactation at 9 weeks (NRC, 1996). Differences between low and high milk producers at peak lactation are even more pronounced (2.15 Mcal/d of NE_m, and 0.22 lb/d of net protein; NRC, 1996). During gestation the requirements for energy and protein increase dramatically as the products of conception: fetus and placental tissues grow. The increases in energy and protein for gestation are demonstrated in Figure 2. You can see how closely energy and protein track together during gestation because of the simultaneous need for energy and amino acids for metabolism of the uterus, placenta, and fetus.

Cow Body Condition. Cow body condition score (BCS) in my estimation is one of the easiest and best tools for evaluating nutrition and management decisions. Consistent and timely evaluation of cow BCS allows you to determine if and when supplementation is indicated. Once a supplementation program has been initiated, continued observation of cow BCS will allow you to evaluate the effectiveness of the supplementation program. Without a benchmark like cow BCS how will you ever know when you've reached the goals that you set out at the initiation of supplementation? There are several critical times that cow BCS should be evaluated in the cow herd. Times to evaluate cow BCS also coincide with other management periods essential to profitable cattle production. The logical times to evaluate cow BCS are:

1) 60 days before calving
2) Calving
3) Beginning of breeding season
4) Mid-summer
5) Weaning

These time points are important because they allow you to make decisions regarding the future nutritional program for cows needing additional BCS. Remember BCS at calving and breeding season are important to the reproductive efficiency and success of the cow, and there are few economical ways to increase BCS on dormant forage alone during the winter. Ample evidence exists for the importance of adequate cow body condition for return to estrus, improved pregnancy rate, and adequate weaning weights (Houghton et al., 1990; Sinclair et al., 1998; Wiltbank et al., 1962). Sufficient evidence in the literature recommends that cows be a minimum BCS of 5 on a 9 point scale at calving. The BCS 5 provides adequate body reserves of fat and protein for mobilization during early lactation. Moreover, cows that are thin prior to calving (BCS < 5) but on an increasing plane of nutrition can reap the same benefits, improved time to estrus, improved conception rates, and improved pregnancy rates, that cows in adequate BCS ($\geq$ 5) exhibit. Additional research demonstrates that cows in adequate BCS are capable of withstanding stress associated with cold and wet better than thin cows. In addition, the cost associated with achieving adequate body condition are much cheaper to achieve during early and mid-gestation, when cow requirements are lowest compared with late gestation, lactation, and the breeding season. This becomes particularly important when one considers that 1 Mcal of body energy reserves is utilized at 80% of what dietary energy is utilized to supply maintenance energy. Figure 3 demonstrates the NRC (1996) determined energy required or supplied beyond the current dietary supply for a 1,100 lb cow to move to different BCS. For that cow to move from a BCS of 3 to a 5 requires an extra 387 Mcal above her maintenance requirements which equates to about 177 lb of bahiagrass hay, 103 lb of molasses, or 90 lb of soybean hulls. If you have to do that with very many cows it can start to get expensive. In contrast letting a BCS 6 cow return to a 5 would save 75 lb of hay, 44 lb of molasses, or 39 lb of soybean hulls.

Breed. There are reasons for the amount of research that goes on concerning breed differences and breed adjustment factors in the NRC. Breed of cattle can have a large impact on the nutritional management and accompanying supplementation program. The importance of *Bos indicus* cattle to Florida cattle production goes without saying. Research has demonstrated that *Bos indicus* cattle have a 2 to 3% increase in dry matter digestibility and 3 to 4% increase in protein digestibility. The NRC acknowledges the maintenance difference between *Bos indicus* and *Bos taurus* by assigning a 5 to 10% decrease in net energy for maintenance to *Bos indicus* cattle. This increase in energy efficiency is especially important in forage-based production systems. Breed effects are also indicated in milk production and composition. Increases in milk production and increases in milk fat and protein content increase the net energy for lactation of cows. Milk potential can be especially important during grazing and supplementation periods.

Environment. The key concept is adaptation. The genetic-environmental interaction can have profound effects on cattle production and enterprise profitability. The wrong cow in an environment is a recipe for disaster through increased feed cost, disease and parasite susceptibility, and the effect of weather. Cattle bred and selected for production on improved pastures with abundant supplement will not be economically successful in range-minimal supplementation management programs. Each producer must evaluate their own overall environment: nutritional, weather, and pest to decide on the optimal cow to utilize.

Supplementation Priorities

Vitamins – Minerals. Supplementation of minerals should constitute the first supplementation priority in the cow-calf herd regardless of the time of year. Vitamin and mineral deficiencies cause performance and production problems regardless of any other nutritional or supplementation programs that you have in place. For the effect on animal performance and production, adequate supplementation of minerals and vitamins produces the largest return on investment. Forages in Florida, especially during the dormant cycle of production, can be deficient of several minerals and vitamin A. Winter annuals also incur mineral deficiencies that can result in metabolic disorders of grazing cattle. Cattle grazing wheat, rye, and ryegrass are particularly susceptible to grass tetany. These forages are often high in N, K, organic acids, and have a high K/(Ca + Mg) ratio, and low in Mg and/or Ca (Grunes et al., 1983). The imbalance of minerals occurs during periods of rapid growth during favorable growing conditions in conjunction with N-fertilization.

The addition of other supplement feedstuff may alter the mineral availability of the forage. There are numerous commercial mineral and vitamin sources. Types of supplement include loose, block, or incorporation into molasses supplements. Adequate management practices including storage, feeding, and placement need to be in place for successful utilization of mineral and vitamin supplements. The efficacy of all other supplementation programs depends on the adequate mineral and vitamin status of the animals.

Protein. Protein supplementation is likely the next in the list of priorities for supplementation. Protein supplementation has consistently been shown to increase forage dry matter intake and forage digestibility. The positive effect of protein on intake and digestibility is most apparent in cattle consuming low quality forages. Protein

Table 1. Nutrient composition of selected feedstuff.[a]

Feed	TDN, %	NE_m, Mcal/lb	NE_g, Mcal/lb	CP, %	DIP, % of CP	UIP, % of CP
Bahiagrass hay	51	0.50	0.25	8.2	63	37
Bermudagrass hay	49	0.42	0.18	7.8	85	15
Wheat pasture	69	0.70	0.43	28	95	5
Alfalfa pellets	59	0.58	0.32	17	54	46
Soybean hulls	80	0.88	0.59	12	58	42
Wheat middlings	83	0.92	0.62	18	77	23
Citrus pulp,dehydr.	33	0.91	0.61	9.8	43	57
Corn grain	88	0.96	0.64	9.8	45	55
Corn gluten meal	84	0.94	0.64	47	38	62
Dry distiller grains	88	0.99	0.68	30	26	74
Whole cottonseed	95	1.08	0.76	23	70	30
Cottonseed meal	78	0.85	0.56	44	57	43
Peanut meal	77	0.84	0.64	34	69	31
Soybean meal	87	0.98	0.67	49	65	35
Feather meal	68	0.71	0.44	86	30	70
Molasses, cane	72	0.77	0.49	5.8	100	0
Urea	65	0.67	0.40	291	100	0

[a]Tabular values from NRC, 1996.

supplementation has been associated with decreased loss of cow body weight and BCS during gestation and lactation and increased body weight gain in growing animals. Moore et al. (1999) summarized numerous research trials and concluded that the critical level for additional protein to be effective in affecting animal performance was forage CP less than 7% or TDN:CP greater than 7. In each case, nitrogen for microbial protein synthesis is deficient or out of balance relative to the amount of energy available from the forage. This is the case for much of the mature forages (8 weeks or more regrowth) in Florida.

There are considerations to make when selecting protein supplements. The main consideration is the differences between non-protein nitrogen (NPN) and natural protein containing supplements. The issue of NPN versus natural protein also introduces the concept of degradable intake protein (DIP) and undegradable intake protein (UIP). NPN is a DIP source that supplies nitrogen to meet the ruminal microbial requirement for nitrogen. Generally, NPN is supplied in supplements as urea. Exclusive use of NPN for supplemental protein has demonstrated improved animal performance compared with no supplemental nitrogen. However, the success of NPN utilization is contingent on adequate ruminal energy for the microbes to utilize the nitrogen. The use of NPN exclusively has generally met with the most success in medium- and high-energy diets that contain adequate TDN. A consideration with NPN is that it provides no other nutrients such as energy, vitamins, or minerals. Several other considerations exist for the use of NPN. The use of NPN generally is advised for older rather than young or growing cattle because of the issues regarding energy supply and lack of additional nutrients in NPN that younger animals still require. NPN requires a carrier because of the potential toxicity when directly fed. The need for a carrier substance is met when NPN is incorporated into liquid, particularly molasses supplements. Molasses works well because of the solubility of urea and molasses supplies carbohydrates for microbial energy to utilize the nitrogen from urea. Urea can also be incorporated into pelleted supplements that contain energy sources such as corn or wheat middlings.

Natural protein comes from plant and animal (fish or feather meal) sources. Natural protein presents a combination of DIP and UIP for the animal. The relative proportions of DIP and UIP vary according to the feedstuff. This combination of DIP and UIP is advantageous and allows for tailoring of supplements to meet both the ruminal microbe N requirements and the animal requirements for amino acids. Performance of animals, in general, is greater with natural protein sources compared with NPN sources, but exceptions are common. Utilization of natural protein is similar among different classes of animal, but is favored for use with young and growing cattle because of their additional requirements of growth. Natural protein sources can be fed in dry forms including meals and pellets, or incorporated into liquid supplements. Table 1 presents energy and protein values of several common feedstuffs utilized as supplements.

Utilization of either NPN or natural protein in supplementation programs involves several decisions. First, can NPN be utilized and is there enough energy in the diet to allow the incorporation of NPN? Secondly, is the supplemental protein requirement for only DIP or is UIP also needed to improve cattle performance? Then consider price per pound of crude protein supplied; price may also dictate the need for UIP addition in the diet. Remember supplementation is about optimizing performance and profitability; those two can not be mutually exclusive. Finally consider consumption patterns, over-consumption of protein supplements may improve animal performance. However the additional supplement consumed above the protein requirement must be valued at the cost of energy supplementation only if there is a positive economic benefit, otherwise it is unnecessary expense.

Winter annuals can offer an excellent source of protein, often exceeding 20% CP, and are a highly digestible roughage source. However, because of economic cost of establishment, limited acres for planting, fencing requirements, and high nutritive value of winter annuals as a cow supplement, they can be overlooked. In order to realize any cost savings compared with commodity supplementation, a producer must design and implement some system to regulate the cow's intake of the high quality winter annual forage (Altom and Schmedt, 1983). Research has demonstrated that a grazing frequency of one day per two days up to one day per week can be utilized as a supplement for mature cows grazing dormant forage. In as few as two hours a cow can consume nearly 12 lb of DM of small grain forage containing up to three lb of CP (Altom and Schmedt, 1983). The use of small grain winter annuals and ryegrass as a supplement is dependent on successful establishment, yield, and availability and quality of the base forage supply.

Energy. If there is adequate forage for grazing, then supplementation of additional energy is the last consideration for the grazing cow. Energy supplementation is generally the most expensive because it has the lowest performance return to dollar spent for supplement. Molasses is likely the lone exception because of the low cost in Florida. However, use of traditional energy supplementation may be warranted when a reduction in overall forage consumption is required to stretch the forage supply, cattle have increased energy demands, or diet selection of a low amount of high quality forage is possible. There are a number of considerations associated with utilizing energy supplements for the grazing beef cow. Energy supplements usually contain less than 20% CP, and energy supplements should not be fed when a high CP supplement will improve performance to the desired level. High starch supplements work best with moderate and high quality forage, not low quality dormant forage. Energy supplements, particularly grain, substitutes for forage consumption even at low levels of supplementation. Low levels of energy (without natural protein) supplementation will decrease overall energy intake of cows. This occurs because high starch feedstuffs decrease fiber digestibility (negative associative effect). Inclusion of adequate supplemental DIP in grain based supplements has been shown to overcome the negative associative effects that high-energy grain supplements impart on low-quality forage diets (Bodine et al., 2000).

The decrease in negative associative effects on forage utilization is reduced or eliminated by balancing total diet DIP in relation to total diet TDN (Bodine and Purvis, 2003). Balancing of the dietary DIP and TDN still decreased total forage intake, but fixed the total digestibility problem caused by high-starch supplements. Managing the DIP:TDN ratio allowed the incorporation of corn into a supplementation program and thereby increasing the ADG, supplement efficiency, and reducing the cost.

By-product feeds offer alternatives to traditional feedstuffs for energy supplements. Many of the available by-product feedstuffs are low starch with moderate levels of fiber. These by-products include soybean hulls, wheat middlings, citrus pulp, corn gluten feed, or brewers' grains. The by-product feeds have less impact on forage fiber digestion because the energy supplied is in the form of highly digestible fiber. Many by-products provide a 15-30% increase in performance per unit of TDN. This increase in performance can offset some of the potential increased cost of the by-product feed. An increasing amount of research has examined the incorporation of by-product feedstuffs into supplements for cattle. Like all supplemental feed sources the effectiveness of by-products depends on their cost. One caution is that by-product feeds are still variable in nutrient composition between loads and this needs to be considered when formulating supplement plans.

Things to Consider about Supplementation. Supplementation programs need to be planned. Historical data and experience can help to determine when, what, and to what extent nutrient deficiencies will occur, and what supplementation programs are successful. An important part of supplementation success is to start feeding the cows before it is too late. It is much easier and cheaper to keep BCS on cows than it is to have to re-feed her so she can gain BCS. As Figure 3 demonstrates it can take considerable energy above the current level of feeding to move up the BCS scale. When a cow utilizes body condition to make up for a deficiency in dietary energy she does so at a reduced efficiency. One Mcal of energy from body tissue will only replace 0.8 Mcal of dietary energy, a 20% loss of efficiency. The reduction is efficiency generally is not compensated for when the cow gets adequate nutrition.

Pay considerable attention to the type of supplement the cow actually needs; don't feed an energy supplement when a high protein supplement is all that is needed to stimulate intake of lower quality forages and thus supply adequate energy. Supplementation frequency is a flexible matter. Plenty of research has demonstrated that high protein supplements do not need to be fed on a daily basis. Frequencies as low as 2-3 times per week have been shown to be adequate to support both cow and growing animal performance. Less frequent feeding results in greater amounts of feed at each feeding, reduced disruption of grazing time, and allows for more timid cows access to the supplement. Higher energy supplements require more management and more frequent feeding. Consider the time of day that supplements are fed. Feeding supplements first thing in the morning or in the evening is generally better than midday to minimize the disruption of grazing times. If the supplements are being fed in conjunction with hay, make sure the cows have hay to eat and are not hungry. Allow the cows to be "full" of hay or forage before feeding expensive supplement.

Supplementation decisions are financial decisions and therefore the cost of the supplemental protein or energy must be considered. Calculating the cost of protein or energy is straight forward. The cost ($/lb) is calculated by dividing the unit cost of feed by the protein or energy fraction (% CP or TDN/100). For example wheat middlings cost $90/ton = $0.045/lb ($90/2,000 lb), 1 lb of wheat midds contains 18% CP, and therefore a pound of protein cost $0.25 (0.0455/0.18). The cost/lb of CP can then be multiplied by the pounds needed for daily supplementation to achieve the cost per day (0.25 x 1.75 lb = $0.44/d).

If your feed costs are high it may be an indicator of production/management problems. The first and obvious problem is that the forage nutrient supply and cow nutrient requirements do not match.

If a lack of nutrient synchrony between the cow and available forage is the problem then altering the production calendar may need to be considered. Adjusting the calving time and subsequent lactation period by as little as two weeks could coordinate forage supply and cow requirements to reduce supplement needs. A second question is does the cow match the nutritional environment that you are providing. If the cow's nutrient requirements are greater than what the forage supplies regardless of your management inputs, then she may not be the right cow for the production resources available.

Summary

Supplementing the grazing cow is about striking the balance of input cost with output return. The cow has basic requirements that are often not met by the forage she is grazing and supplemental nutrients are required. Vitamins and minerals are the most important because of their extensive effect on the rest of production. Protein is likely the next limiting nutrient. Protein sources vary in quality, composition, and price. The best protein supplement is one that meets the cow's requirements at the lowest cost. Energy supplementation is the highest cost supplement with the greatest potential negative effect on forage intake. Remember maximal production does not equal optimal production from the cow herd. Keeping the beef production factory which is the cow working and producing at the desired level of output will require diligence and sufficient maintenance to her needs.

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