BEEF COW NUTRITION

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Most reproductive failures in beef females can be attributed to improper nutrition and thin body condition. Monitor the effectiveness of the nutrition program in the long-term by herd performance records but in the short-term, by keeping an eye on the flesh or body condition score (BCS) of the cows.

Table 11. When To Evaluate BCS

1. Mid-Summer

2. Weaning

3. 60 days before calving

4. Calving

5. Beginning Of The Breeding Season

The cow's priorities for nutrition are maintenance, lactation, growth (young females) and reproduction. Consequently, reproduction is the first to go and the last to return in cases of inadequate nutrition.

The nutrition level pre-and post-calving affects the conception rate of the subsequent breeding seasons. Cows that are thin prior to calving will have a delayed onset of estrus. Thin cows after calving will have reduced conception rates.

Obesity is a problem in heifers that become fat during the growing phase. Fat heifers normally have lower than average reproductive rates. It is less serious in mature cows. However, obesity is uneconomical since fat cows are more expensive to maintain. The Ohio State University Extension has a fact sheet with pictures corresponding the body condition scores (Mangione 1992).

Immature cows continue to grow until approximately 4 years of age. These young cow should be maintained through the yearly cycle about one BCS higher than mature cows to achieve the same reproductive performance.

Body condition changes are a more reliable guide than body weight changes for evaluating the day-to-day nutrition status of a beef cow. Body condition scoring also has an advantage over body weight in that scales or corrals are not needed.

The scoring system currently advocated is outlined in the following table. The important thing in scoring is to be consistent. You may not fully agree with everyone who scores the cows, but the relative distribution of cows within the herd can be measured.

Table 12. Body condition Scoring (BCS) System for Beef Cattle

BCS, Description

1. EMACIATED: Starving and weak. No palpable fat detectable over back, hip bones or ribs. Tail-head and ribs project quite prominently.
2. POOR: Poor milk production and reproduction. Chances of rebreeding slim. Cow still emaciated but tail-head and ribs less prominent. Backbone is still rather sharp to the touch but some tissue exists along the backbone.
3. THIN: Poor milk production and reproduction. Ribs are still individually identifiable but not quite as sharp to the touch. Obvious palpable fat along the spine and over the tail-head with some tissue over top portion of the ribs.
4. BORDERLINE: Reproduction bordering on inadequate. Individual ribs no longer visually obvious. Individual spines can be identified on palpation but fell rounded rather than sharp. Some fat cover over ribs and hip bones.
5. MODERATE: Minimum necessary for efficient rebreeding and good milk, production. Cow has generally good overall appearance. Upon palpation, fat cover over ribs feels spongy and area on either side of tail-head now has palpable fat cover.
6. OPTIMUM: Milk production and rebreeding very acceptable. Firm pressure now has to be applied to feel spinous processes. A high degree of fat is palpable over ribs and around tail-head.
7. GOOD: Maximum condition needed for efficient reproduction. Cow appears fleshy and obviously carries considerable fat. Very spongy fat cover over ribs and around tail-head. Some fat around vulva and crotch.
8. FAT: Very fleshy, no advantage in having cow this condition. Backbone almost impossible to palpate. Cow has larger fat deposits over ribs, around tail-head and below vulva.
9. EXTREMELY FAT: The fat may cause calving problems. Cow extremely wasty and patchy. Tail-head and hips buried in fatty tissue. Bone structure no longer visible and barely palpable. Animal's mobility maybe impaired by fat deposits.

Body Condition Scoring During Summer

The normal grazing program can be followed if cows appear to be in adequate body condition. However, thin cows during mid-summer will likely be thin cows at weaning. When adequate amounts of low quality forage are available, feeding a small amount of protein supplement during the late summer can efficiently increase cow body condition. Feeding .6 pound per head per day of protein supplement such as soybean meal (about 1.5 lbs. per head, three times per week) during late summer months (August and September) can increase cow weight by 25 pounds and condition score by 0.5 units. It has been indicated by some scientists that a supplement level of 1 to 1.5 lbs. per head per day may be more desirable to provide greater weight gains.

Body Condition Scoring Prior to Calving

Ideally, sort cows by condition at weaning time or 90 to 100 days before calving. Continue monitoring cow condition because weather and feed quality affects condition. Group cows by condition score and feed them to reach condition score of 5-7 by calving. An example would be placing all of the BCS 1, 2, 3 and 4 cows in one pen or pasture and allowing them access to higher quality feed. Using a deworming product on the cows or at least the thin cows is advisable. The BCS, 5, 6, and 7 cows can be fed as usual (maintain BCS). The BCS 8 and 9 cows could be grouped together and fed a lower quality diet during the middle 1/3 of gestation.

A higher plane of nutrition may be required for cows with condition scores of 4 or less earlier than the last third of pregnancy. It will be easier to get weight gains in early fall before cold weather occurs, helping with insulation during the cold winter months.

Body Condition Score After Calving

Body condition at calving is the most critical factor in determining reproductive performance. High pregnancy rates will not occur in first-calf heifers unless they are able to gain some fat cover during the breeding period. This can be difficult to do for young stock with calves at side. Thin cows need to increase body condition and moderate condition cows need to maintain body condition. Correcting deficiencies prior to calving is easier and cheaper.

BCS 4: If a cow is BCS 4 or thinner, she will be slow to return to heat and may not rebreed on time. Feeding a high level of nutrition after calving can sometimes shorten the postpartum interval from calving to first heat in thin cows (BCS 3-4), but the postpartum interval will usually be longer than if the cows had calved in good condition (BCS 6-7). Therefore, early weaning the calf at 50 days of age or at the start of the breeding season may have to be considered. Manage these cows with those in the BCS 6 group. The calves can be raised on self-feeders using an early weaning ration. The cows, even if quite thin, should return to estrus within three weeks after weaning and will thus rebreed to have a calf next year. It is far easier and cheaper to make cows gain weight before calving than after calving when the added requirement of lactation is present. A parasite evaluation is certainly merited.

BCS 5: If a cow is a BCS 5, continue to feed hay or grain and protein supplement to insure she doe not lose condition before the breeding season. Many cows calve at condition scores less than 5 and still have excellent rebreeding rate when weather and nutrition conditions do not cause extraordinary stress during this critical period (two months before calving through the breeding season). A borderline 4-5 BCS cow that is exposed to severe environmental stress may require the calf to be removed for 48 hours, 10 days before the breeding season. This should help a stressed BCS 5 cow to return to heat and rebreed on schedule. This program will probably not work with very thin cows. The calves should be offered palatable feed and plenty of water while they are separated from their dams.

BCS 6: If she is a BCS 6 (or even fatter), continue with normal management and feeding. While good body condition at calving time is an indication that rebreeding should proceed without difficulty, good condition at calving does not guarantee acceptable rebreeding performance. Cows losing condition after calving have lower conception rates than do cows maintaining condition.

Body Condition and Weaning Time

The key to cow management in winter is to insure that moderate body condition is achieved before the onset of cold weather. Studies have shown it is very difficult to put body condition on a thin cow during the cold conditions. Cows can make substantial recovery in body condition during the post-weaning period if temperatures are moderate and the forage is readily available. These conditions can be accomplished by weaning calves by early to mid-October. Weaning calves later than this may not be conducive to a "year-round" grazing program.

PLANNING A SUPPLEMENTATION PROGRAM

Estimating Intake

In the case of gestating beef cows grazing winter stockpiled fescue or eating poor quality hay, there becomes a problem of how much can the rumen physically hold. A thumb rule is that the maximum NDF dry matter content of the dry matter of the daily ration can only be 1.2-1.5% of the cow's body weight. The higher the quality of the forage, the closer to the top end of the range (1.5% NDF) can be consumed. The poorer the quality of the forage, the closer to the bottom end of the range (1.2% NDF), may be consumed. For example, a 1,200 pound gestating beef cow may be able to consume and digest enough of a sixty percent NDF forage to meet her daily needs. Assuming a 1.5% NDF capacity, she could eat thirty pounds of this forage dry matter (2.5% of body weight) and contain 18 pounds of NDF dry matter. This would be her physical limit, increased nutrition needs brought about by severe weather or early lactation must be supplemented by a more digestible feed source of simply providing a higher quality (lower in NDF) forage.

Table 13. Guidelines to estimate feed intake of beef cows[a].

Forage Type	Class of Cattle	Dry Matter Intake Capacity, %	as Fed Intake, lbs
Low quality forages	Dry	1.5	17-18
	Lactating	2.0	23-24
Average quality forages	Dry	2.0	22-24
	Lactating	2.3	25-28
High quality forage Alfalfa	Dry	2.5	28-30
	Lactating	2.7	30-32
Green Pasture	Dry	2.5	80-100
	Lactating	2.7	100-110
Silage	Dry	2.5	80-85
	Lactating	2.7	90-95

[a]Rasby (1997)

Supplementation and Substitution

Supplementing nutrients to offset deficiencies or to meet production demands is more often practiced during periods of summer dormancy or during the fall and winter months. Substitution can be practiced when forage resources are in short supply (Caton and Dhuyvetter, 1996). When forage intake is greater than 1.75% of bodyweight, supplements may decrease forage intake. When forage intake is less than 1.75% of bodyweight, supplement almost always increases forage intake.

Forge intake response is affected the forage ratio of digestible organic matter to crude protein (DOM:CP). When DOM:CP ratio is less than 7, supplements decrease forage intake; when DOM:CP falls between 7 and 12, intake may both increase and decrease with supplements. When DOM:CP is greater than 12, all type of supplements increase forage intake.

Grouping The Herd Based on Supplement Needs

Not all the cows in a herd need the same amount and quality of feed. One of the best ways to reduce supplemental feed costs during the winter is to separate the cow herd based on feed needs and feed accordingly. A logical separation would be into three groups:

1. Replacement Heifers
2. First-calf heifers and thin older cows
3. Mature cows in adequate condition

Two-year-old, first-calf heifers do not have a mature set of teeth. That limits her bite size and she cannot match mature cows for forage intake. Replacement heifers, first-calf heifers and thin older cows might be combined if pasture areas are limited.

How Cattle Use Energy

The visceral organs (liver, digestive tract, heart, and kidney) comprise only 6% of total body weight but consume 50% of the maintenance energy (Ferrell, 1988). The largest single tissue that consumes maintenance energy is muscle (41% of body weight; Ferrell, 1988); however muscle consumes only 23% of the total energy consumed for maintenance. Muscle tissue use does not greatly add to the maintenance energy requirements of penned animals but could be considerably larger for animals walking, grazing, and processing forage.

Energy Supplementation With Grain

When the protein content of the forage is high (> 10% crude protein), grains or low protein supplements (< 20% CP) can be used. Henning et al. (1980) reported that low levels of corn supplementation (7.8% of DM intake) actually increased forage intake. However, with higher levels of corn supplementation (greater than 23% of DM intake) forage intake reduced compared to that of control sheep. Reports that low levels of energy supplementation increasing forage intake seem to occur more frequently in studies with sheep than in those with cattle (Caton and Dhuyvetter, 1997). Horn and McCollum (1987) have suggested that an energy supplement level that would minimally affect forage intake would be .7% of animal body weight. However, level of grain supplementation can vary with forage quality.

Digestible Fibers as Energy Sources

Studies with readily degradable fiber sources as energy supplements for grazing and forage-fed ruminants have yielded different responses than research with grains (Caton and Dhuyvetter, 1997). Soybean hulls result in only a small decrease in forage intake (Martin and Hibberd 1990; Grigsby et al., 1992). Other sources of readily degraded fiber such as wheat midds, beet pulp, and corn gluten feed have generally not decreased forage intake as much as grain-based supplements (Caton and Dhuyvetter, 1997).

Many fibrous feeds also have high energy values. The following are a list of fibrous feeds that offer potential for replacing hay or traditional grain sources. The research that suggests these products may actually perform better than these numbers would indicate.

Table 14. Protein, fiber, and every values of selected feedstuffs.

Feed	CPa, %	NDFb, %	NEmc, %	NEd, Mcal/lb
Corn	9.8	10	1.02	0.70
Beet Pulp	9.7	54	0.79	0.52
Citrus Pulp	6.7	23	0.91	0.61
Corn Gluten Feed	25.6	45	0.92	0.62
Cottonseed, whole	23.0	44	1.09	0.77

Dried Brewers Grains	25.4	46	0.68	0.41
Soybean Hulls	12.1	67	0.65	0.39
Wheat Middlings	18.4	37	0.73	0.45

aCrude Protein
bNeutral Detergent Fiber
cNet Energy Maintenance
dNet Energy Gain

REPLACING HAY WITH A DIGESTIBLE FIBER: Various researchers have conducted winter feeding experiments to determine the feasibility of using digestible fiber in lieu of hay as a winter feed. In one study, cows were grazed on stockpiled tall fescue and fed hay (tall fescue) ad-libitum when pasture became limiting. Feeding 4 pounds of soybean hulls from December through March saved approximately 625 pounds of hay per cow and less body weight loss (13 pounds) than feeding hay only (86 pounds). Estimating hay costs at $80 per ton and soybean hull costs (delivered) at $80 per ton, greater than $6 per cow was saved by feeding soybean hulls.

Cottonseed hulls are very palatable but are low in nutrient content. Cottonseed hulls should be considered a source of roughage rather than a supplemental source of energy or protein.

REPLACING CORN WITH A DIGESTIBLE FIBER: Other work has been done using digestible fibers as a replacement for corn. In one study steers were maintained on tall fescue. One set of steers were fed 4 pounds of soybean hulls and another set was feed 4 pounds of corn while on grass. A third set of steers received no supplement. The steers gained similarly on soybean hulls and corn (2 pounds per day gain), with both being greater than the gain of steers that were not supplemented (1.5 pounds per day gain). Digestible fibers appear to be beneficial as a supplement for growing animals that are grazing or fed hay, compared with high energy, feedlot diets.

Protein Supplementation

Limited amounts (approximately 1-2 lbs) of high protein supplements (> 30% CP) can be utilized with low quality forages. Low quality forages would be less than 8% crude protein and 45% total digestible nutrients. Protein supplementation has been shown to increase digestibility approximately 15% and increase forage intake approximately 25% (Table 15) . There is no way to be sure, in every circumstance, that the expected increase in intake and digestibility actually occur. The condition of the cow herd must be monitored.

Table 15. Example to illustrate the affect protein supplementation has on low quality foragea.
Without supplementation cow can consume 18 pounds of dry matter from low quality forage source.
18 Forage intake without supplementation
X 1.25 Increase in forage intake with adequate protein
22.5 Total forage intake with supplementation

.40 TDNb content of the forage
X 1.15 Increase in digestibility with adequate protein
.46 TDN content of forage with supplementation

aWagner and Goetz (1989)

bTotal digestible nutrients.

High protein supplements that do not contain urea or other nonprotein nitrogen sources do not need to be fed every day. Simply double the amount and feed every other day. Range cake or cubes (20% crude protein) can be utilized with intermediate quality forages. Altering body condition with supplements prior to cold weather may be more effective than waiting until cold weather occurs.

Table 16. Energy and protein supplementation of forage diets.

Protein Level of Supplement	Low Protein			
14%	Intermediate Protein			
20%	High Proteina			
30%	Digestible Fiber			
Forage CP	10%	6-10%	6%	6-10%
When Feed	Every Day	Every Day	Alternate Day	Every Day

aAlternate Day programs only suitable for all natural protein sources.

NONPROTEIN NITROGEN SOURCES: Nitrogen sources, such as feed grade urea, are an excellent supplement for high grain diets. Urea and biruet can be utilized in range situations but utilization will not be 100%. Nonprotein nitrogen sources should be fed in small amounts and at frequent intervals. The following are examples of calculating the value of protein in various supplements.

Table 17. Approximate Urea utilizationa

Conditions	Dry Supplement	Block/Liquid Supplement
Weathered grass	0-25	50
Crop Residues		
Poor-quality hay		
Medium-quality hay	40-60	80
Silages		
Summer pasture		
High-energy diets	90-100	90-100

aWagner and Goetz (1989)

The following example demonstrates the use of "cost per unit of protein" for comparisons of protein supplements when urea is fed once a day with medium quality hay (approximately 50% utilization).

Nutrient Utilization

Product A	Product B
40% Crude Protein	40% Crude Protein
$300/ton	$225/ton
	20% CP equivalent from NPN
	20 x 50% = 10
	Therefore 30% CP
	(40%-10%=30%)
$300/2000 lbs. = $.15	$225/2000 lbs. = $.1125
$.15/.40 = $.375/lb of CP	$.1125/.30 = $.375/lb of CP

*At these prices, both products are of equal value to the beef cow.

Methods of Feeding Supplements

TROUGH SPACE: Changes in trough space per animal can influence competitiveness and variations in supplement consumption (Bowman and Sowell, 1997). Wagnon (1966) observed with 3 feet of bunk space per cow, less fighting and dominance/submissive behavior occurred during supplementation than when 6 feet was allow per cow. The 3 feet of bunk space did not allow cows to fight without backing away from the trough, and therefore fewer animals were pushed away from the supplement. When excessive trough space was allowed, dominant cows were observed to chase others away from one side of the trough and to spend more time fighting.

FEEDING ON THE GROUND: One of the ways to feed on the ground is the place the feed under an electric wire. The wire is placed about 12 inches above the ground. Allocate 2 feet for each beef cow.

EFFECT OF SUPPLEMENT FORM ON CONSUMPTION: Bowman and Sowell (1997) summarized the percentage of non-feeders for blocks, dry, and liquid supplements. Over the range of animals, environments and supplement formulations, the percentage of non-feeders averages 14.3% for blocks, 15% for dry supplements, and 23.5% for liquid supplements. The variation in supplement consumption was greater for blocks and liquids than dry supplements. Supplement characteristics such as hardness and nitrogen content may influence variation in consumption.

Mineral Supplementation

In formulating supplements for cows grazing winter forage, two often overlooked nutrients are minerals and vitamins. They have less impact than protein and energy on cow/calf performance and economics but they should not be overlooked (Corah, 1990). While supplementation is important, over supplementation of minerals should be avoided to prevent possible environmental problems associated with runoff from waste or application of cattle waste to soil. Certain minerals can actually be toxic if supplemented in excessive amounts.

SALT: Forages do not contain adequate amounts of salt (sodium). Sodium can be supplement as sodium chloride or sodium bicarbonate and both forma are highly available. Iodized salt should always be used to avoid a iodine deficiency. Cattle fed maintenance rations while confined in drylot often consume high levels of mineral mixtures, perhaps from boredom (Sewell, 1990).

CALCIUM: Calcium is the most abundant mineral in the body. Vitamin D is required for active absorption of calcium. Forages are generally good sources of calcium, and legumes are higher in calcium content than grasses. Alfalfa has relatively high levels of calcium but 20 to 33% is unavailable to the animal.

PHOSPHORUS: Drought conditions and increased forage maturity (eg. stockpiled forage) can result in low forage-phosphorus concentrations. Phosphorus supplementation becomes far more critical in cases of winter grazing than feeding hay.

Reproductive problems are common if phosphorus is deficient. Plasma phosphorus concentrations consistently below 4.5 mg/dL are indicative of a deficiency, but bone phosphorous is a more sensitive measure of phosphorus status. The ideal diet calcium:phosphorus ratio is 2:1 but ratios of 7:1 are acceptable.

Cows around calving time should have free choice access to 10-12% phosphorus mineral. An example would be 1/2 salt and 1/2 dicalcium phosphate. Cows at other times of the year and stockers would need a mineral consisting of 25-35% dicalcium phosphate or 7-8% phosphorus. Varying the phosphorus level is one means of saving money.

POTASSIUM: Potassium levels of 0.6 to 0.8 percent of ration dry matter are considered adequate for cattle. In general, potassium levels of Ohio forages are adequate to "excessive" in potassium content. These high levels can be associated with reducing magnesium absorption and thus causing grass tetany problems. Therefore always check potassium levels before any supplemental additions.

Low concentrations of potassium have been observed in stockpiled fescue during winter (Clanton, 1980). Leaching during the winter may cause potassium levels in fescue pasture to drop as low as 0.24-0.3 percent of dry matter during winter months (Sewell, 1990). Potassium can be supplemented to cattle diets as potassium chloride, potassium bicarbonate, potassium sulfate, or potassium carbonate. All forms are readily available. If potassium is added for winter feeding, remove it from the mixture when fescue starts to growing in the spring. Growing forages are usually high in potassium.

MAGNESIUM AND GRASS TETANY: Grass tetany is most common in lactating cows grazing lush spring pastures. During the early spring, wet climatic and soil conditions are cool and wet, plants will not contain adequate levels of phosphorus or magnesium. While both these minerals may be in adequate amounts in the soil, plant uptake is slow due to the cool, wet conditions. Fertilizing pastures with nitrogen and potassium is associated with increased incidence of grass tetany. Cows depend on a frequent supply of magnesium via the feed since mobilization of magnesium from the bone is not very efficient.

Kemp and t' Hart (1957) observed that the K:(Ca + Mg) ratios of normal and tetanigenic pastures were 1.67 and 2.37, respectively. In another study a mean K:(Ca + Mg) ratio of 2.45 was reported in pastures of 19 farms that collectively had a 10% incidence of tetany in beef cattle.

Magnesium absorption has been improved by feeding grains and ionophores. Legumes are usually higher in magnesium than are grasses. Magnesium oxide and magnesium sulfate are good sources of supplemental magnesium. Including 15-20% magnesium oxide in the mineral mix should reduce the problem. Adding 6-10% molasses or soybean meal will assure intake.

FERTILIZATION AND GRASS TETANY: As with all crops, proper pH is the most important factor in crop management. If the soil does need lime, use a dolomitic source if soil test magnesium levels are less than 50 ppm. If the field has recently received manure, the importance of soil test information cannot be overstated. At the rate used by some producers, a single manure application may supply several years worth of phosphorus, and sometimes potassium. Do not apply excessive rates of nitrogen early in the spring because high nitrogen levels can reduce magnesium availability in ruminants. Maintain relatively high soil test phosphorus levels as some research has shown that phosphorus additions can increase tissue magnesium levels and potentially even decrease potassium uptake. Delay potassium application on grasses until late spring as high potassium fertilization decreases magnesium uptake. Consider interseeding clover since legumes are higher in magnesium than grasses.

SELENIUM: Selenium deficiency will cause retained placentas, infertility, and white muscle disease in calves. The normal cow requirement is .1 ppm. The maximum tolerable concentration of selenium has been estimated to be 2 ppm.

Selenium is generally supplemented in animal diets as sodium selenite, while seleno-methionine is the predominant form of selenium in most feedstuffs. Selenium from seleno-methionine or a selenium-containing yeast was approximately twice as available as sodium selenite or cobalt selenite in growing heifers (Pehrson et al., 1989). Availability of selenium from sodium selenate was similar to sodium selenite (Podoll et al., 1992). Vitamin E should be added to the diet along with selenium. Calves should be injected with a selenium-vitamin E solution at birth where a problem exists.. Alternate methods of supplementing selenium include injecting selenium every 3 to 4 months or at critical production stages and using boluses retained in the rumen that release selenium over a period of months (Hidiroglou et al., 1985; Campbell et al., 1990).

Liver samples are the ideal way to determine a deficiency, with .25 to .5 ppm considered normal and .1-.15 ppm considered deficient. Blood can also be used as an indicator with normal levels being .08-.3 ppm with deficiencies considered being .002-.025 ppm.

SULFUR: Requirements of sulfur for grazing cattle is not well defined (approximately .15%). In Australia, sulfur supplementation increased gain by 12% in steers grazing sorghum-sudangrass containing 0.08 to 0.12 percent sulfur (Archer and Wheeler, 1978). The sulfur requirement of ruminant grazing sorghum-sudangrass may be increased because of the need for sulfur in the detoxification of cyanogenic glucose found in most sorghum forages.

Dietary sulfur requirements may be higher when diets high in rumen bypass protein are fed because of the limitation of sulfur for optimal ruminal fermentation. When urea or other nonprotein nitrogen sources are fed, sulfur supplementation may be needed. Mature forage, forages grown in sulfur deficient soils, corn silage, and sorghum-sudangrass can be low in sulfur. The typical nitrogen to sulfur ratio of a complete diet should be 10:1, nitrogen to sulfur.

COPPER: Copper deficiencies can cause poor reproduction, broken bones, weak calves and light color hair. Discoloration is normally occurs first around the eyes and tips of the ears. Sometimes, changes in hair color are not noted and the affect of a copper deficiency simply occurs as reproductive problems, scours, or calves older than 4 months ceasing to perform. Simmental and Charolais cows and their calves were more susceptible to copper deficiency than Angus cows fed the same diet (Ward et al., 1995).

Unfortunately with copper, the forage may contain an adequate level, but if the diet contains either high levels of molybdenum (2 ppm) or sulphur (.25%), both of these tie-up copper rendering a deficiency. Ideally the copper to molybdenum ratio should be 5:1 or greater (Munshower and Neuman, 1979). Legumes were blamed for increasing the molybdenum levels on reclaimed strip ground in Montana (Munshower and Neuman, 1979). High concentrations of iron and zinc (Davis and Mertz, 1987) also reduce copper status and may increase copper requirements.

Recent studies indicate that copper oxide is very poorly available relative to copper sulfate (Langlands et al., 1989; Kegley and Spears, 1994). Copper sources are copper sulfate, copper carbonate, copper proteinate, and copper lysine. Injectable forms of copper such as copper glycinate or copper EDTA have been given at 3- to 6-month intervals to prevent copper deficiency (Underwood, 1981). Although feed-grade copper oxide is largely unavailable, copper oxide needles, which remain in the gastrointestinal tract and slowly release copper over a period of months have been used as a copper source for cattle (Cameron et al., 1989).

Sewell (1990) suugested that producers look at the commercial mineral supplement that they are using for cattle fed fescue and similar forages to see if it has approximately the following percent amounts of trace minerals on the label: Selenium .0008 to .0016; cobalt .0008, copper .04, zinc .08; and manganese .08. Steeds (1991) recommended that Manitoba producers should only buy mineral supplements containing more than 2000 ppm (.2%) copper.

IODINE: The iodine requirement is 0.2 to 0.3 ppm in the total diet. Goitrogenic substance in the feed may substantially increase the requirement (2- to 4-fold) depending upon the amount and type of goitergens present. Plant sources that can increase the iodine requirement are white clover and some Brassica forage such as kale, turnips, and rape. They impair iodine uptake but can be overcome by increasing dietary iodine.

ZINC: A zinc deficiency can affect reproduction, the skin and cause swelling of the bone joints or slow healing wounds. Zinc deficiencies tend to impair sperm production and sperm quality in bulls. Cows require 30-40 ppm zinc with diets containing 2-10 ppm considered deficient. Legumes are generally higher in zinc than grasses.

IRON: In general, iron deficiency are unlikely unless parasite infestation or disease exist and cause chronic blood loss. Availability of iron from forage appears to be lower than from most supplemental iron sources (Raven and Thompson, 1959). Iron is normally supplemented in the diet as ferrous sulfate, ferrous carbonate, or ferric oxide. However, ferric oxide is basically unavailable (Ammerman et al., 1967).

MANGANESE: Manganese can cause infertility, light hair color and calves with weak pasterns. Manganese requirements are approximately 40 ppm. A deficiency has sometimes been noted with feeding corn silage diets.

COBALT: Cobalt affects reproduction, growth, and causes pale skin. Cobalt supplementation plus an injection of vitamin B12 should alleviate symptoms. Both cobalt and iodine requirements can be met by using blue salt free choice (Steeds, 1991). Red salt is plain white salt plus iodine. Blue salt is red salt plus cobalt.

Table 18. Mineral requirements of beef cattle.

	Requirement			
	Growing Cattle	Pregnant Cows	Lactating Cows	Maximum Level
Calcium, %	0.45	0.3	0.45	2
Phosphorus	0.3	0.2	0.3	1
Magnesium	0.1	0.12	0.2	0.4
Potassium, %	0.6	0.6	0.7	3
Sodium, %	0.08	0.08	0.1	---
Sulfur, %	0.15	0.15	0.15	0.4
Iron, PPM	50	50	50	1000
Manganese, PPM	20	40	40	1000

Zinc, PPM	30	30	40	1000
Copper, PPM	10	10	10	100
Iodine, PPM	0.5	0.5	0.5	50
Selenium, PPM	0.2	0.2	0.2	2
Cobalt, PPM	0.1	0.1	0.1	10
Molybdenum, PPM	---	---	---	5

FESCUE AND TRACE MINERAL DEFICIENCIES: Indications are that fescue is deficient in certain trace minerals (Sewell, 1990). Selenium, cobalt, copper and zinc may be borderline or deficient in fescue and other forages, such as crop residue and mature grasses. Sewell (1990) suugested that producers look at the commercial mineral supplement that they are using for cattle fed fescue and similar forages to see if it has approximately the following percent amounts of trace minerals on the label: Selenium .0008 to .0016; cobalt .0008, copper .04, zinc .08; and manganese .08. Ohio may require somewhat high copper levels than this.

Vitamins

Cattle exposed to winter feed are susceptible for vitamin A deficiencies. In most cases, early spring grass will contain fairly high levels of carotene (precursor to vitamin A) and will adequately meet the cow's requirement. Ensiling effectively preserves carotene but the availability of carotene from corn silage may be low.

Vitamin A can be supplemented in the mineral or by an injection. One million International Units of vitamin A palmitate intramuscularly or intraruminally when cows are palpated for pregnancy will meet their vitamin A needs for 2-4 months (Wagner and Goetz, 1989). In the mineral, add 10,000 to 50,000 International Units per 0.1 to .2 lb of mineral mix. Be very cautious if you are mixing your own vitamin-mineral mix. Only a very small amount of vitamin A premix is needed and mistakes in mixing can lead to toxicity situations. Vitamin A will not remain stable very long in homemade mineral mixes (approximately 2-3 weeks). Utilize or request protected forms of vitamin A for your vitamin-mineral mix.

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