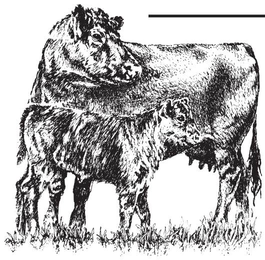

Western Beef Resource Committee

Cattle Producer's Library

Drought and Other Natural Disasters Section CL1175

Nutritional Requirement of the Beef Cow During Drought

John A. Paterson
Extension Beef Specialist, Montana State University, Bozeman

During periods of extended drought, the rancher is faced with management decisions on the best ways to provide adequate nutrition for the cow herd. These decisions range from doing nothing all the way to complete dispersal of the cow herd.

Consequences of Inadequate Nutrition for the Cow

Producers generally have two options for meeting the nutrient requirements of cattle on drought-affected pastures and ranges. The first is to provide supplemental feed to ensure the cow herd has adequate energy, protein, vitamins, and minerals. The second is to reduce the nutrient requirements of the cow to a point where they can be met with available forage.

Table 1 summarizes several of the consequences of inadequate intakes of energy, protein, vitamins, and minerals by beef cattle (Bearden and Fuquay 1992). The data show that reproduction is impacted the most by these deficiencies.

A rancher should keep in mind the following concepts with regard to cow reproductive efficiency during periods of drought:

- Fertility of cows may decline when their body condition score (BSC) drops below a 4; especially at time of calving and when they go into the breeding season in poor condition. In the absence of sufficient nutrients, particularly energy, cows lose considerable weight. When such weight losses occur, milk production decreases and reproductive activity may cease. The end result is lightweight calves and open cows. To prevent such undesirable effects, cows either must be provided sufficient nutrients to avoid weight losses and maintain production requirements or they must be relieved totally or partially from these stressors.
- Early weaning of calves is one option that allows cows to rebuild body reserves and rebreed the next year.
- Money and diminishing feed reserves are too valuable to waste on cows that are unproductive, not

Table 1. Influence of inadequate and excessive dietary nutrient intake on reproduction in beef cattle (Bearden and Fuquay 1992).

Nutrient consumption	Reproductive consequence
Inadequate energy intake	Delayed puberty, suppressed estrus and ovulation, suppressed libido and spermatozoa production
Inadequate protein intake	Suppressed estrus, low conception, fetal resorption, premature parturition, weak offspring
Vitamin A deficiency	Impaired spermatogenesis, anestrus, low conception, abortion, weak offspring, retained placentae
Phosphorus deficiency	Anestrus, irregular estrus
Selenium deficiency	Retained placenta
Copper deficiency	Depressed reproduction, impaired immune system, impaired ovarian function
Zinc deficiency	Reduced spermatogenesis

pregnant, or are unsound. These animals are candidates for culling at any time and especially during drought conditions.

- Don't forget about development options for the replacement heifers. The rancher must decide if replacement heifers should be developed on the ranch or if it is cheaper and/or more cost effective to have this done by a commercial feedlot or other ranch.

Protein and Energy Supplements

Pastures that have become dormant because of drought conditions are usually deficient in protein. If these conditions occur during the breeding season, reductions in pregnancy rate can result. Providing dry cows with approximately 0.5 to 0.75 pound of supplemental crude protein and lactating cows with 0.9 to 1.2 pounds of supplemental crude protein per day may be necessary.

Protein-based supplements (soybean meal and canola meal), commercial protein blocks, liquids, and tubs would be appropriate. Alfalfa hay, sunflower meal, safflower meal, as well as other protein meals may also be used as protein supplements.

Moore et al. (1999) constructed a large data base from published articles in an effort to determine how supplementation strategies influenced both animal performance and voluntary forage intake. Their conclusion was that supplements generally, but not always, increased daily gain (ADG). In many cases, small amounts of supplemental total digestible nutrients (TDN) increased daily gains, especially with native forages and straws.

The least ADG response to supplementation was seen with native forages supplemented with molasses alone or with low intakes of molasses containing high levels of nonprotein nitrogen (e.g., urea). The greatest response was measured with improved forages, when supplemental TDN was > 60 percent of OM (either dry feeds or molasses plus added protein), and when supplemental crude protein intake was >.05 percent of the animals body weight.

From the data base it was concluded that the changes in voluntary feed intake due to supplement ranged from -1 to +1 percent of body weight (BW). Generally, supplements decreased intake with improved forages, but with native forages and straws, supplements both increased and decreased forage intake. **This discrepancy was thought to be related to the ratio of TDN to CP in forages, an indicator of the amount of N relative to available energy (Table 2).**

When supplements increased forage intake, forage TDN:CP ratio was >7 (deficit of N relative to available energy). Supplements decreased intake when the TDN:CP ratio was <7 (adequate N) except for ammoniated straws, when forage intake fed alone was >1.75 percent of BW, or when supplemental TDN intake was >.7 percent of BW. There was little difference between sources of supplemental CP or TDN relative to changes in forage intake.

When forage intake was increased by supplement, liquid and dry feeds were equivalent as energy sources as long as the supplement contained added protein. As protein sources, NPN and protein meals were apparently equivalent for increasing intake.

McCollum (1997) provided one example of using the TDN:CP ratio approach in selecting a supplement for animals grazing lower protein native range (Table 3). This example demonstrates the logic in how the protein supplement was selected rather than the grain-based supplement for cattle grazing dormant native range. By providing the protein supplement the overall target TDN:CP ratio was closer to 5 compared to the grain-based supplement, which would have been closer to 9.

Researchers and many producers have known for many years that supplemental protein can stimulate voluntary intake of low quality forages. Table 4 is a summary of intake responses measured by Bob Cochran from Kansas State University (cited by McCollum 1997).

Table 2. Requirements for crude protein (CP) and total digestible nutrients (TDN), and the resulting TDN:CP ratio for beef cattle (from Moore et a 2000).

Age class of female	Requirement, % of DM Protein	Requirement, % of DM TDN	TDN:CP ratio
Heifer, 800 lb body weight (BW): Non-pregnant, 0 lb gain/day	7	54	7.7
Pregnant, 1.0 lb gain/day	8	55	6.9
Heifer, 600 lb BW, 1.25 lb gain/day	9	59	6.6
Lactating cow, 1,000 lb BW, 15 lb milk/day	11	62	5.6

Table 3. Example of using the TDN:CP ratio in selecting a supplement for cattle grazing dormant native range with a protein content of 5 percent (from McCollum 1997).

Item	Protein supplement	Grain-based supplement
Forage protein, %	5	5
Forage TDN	45	45
Supplement protein, %	45	10
Supplement TDN, %	76	88
Forage TDN:CP ratio (45/5 = 9)	9	9
Supplement TDN:CP ratio	1.7	8.8
TDN:CP target ratio	4 to 6	4 to 6
Best supplement choice	XXXXX	

Table 4. Average forage intake response to supplements containing various concentrations of crude protein (McCollum 1997).

Supplement crude protein content, %	Intake response, %
Less than 15	+9
15 to 20	+23
25 to 35	+60
Greater than 35	+36
Overall average	+33

Supplements containing between 25 and 35 percent crude protein were most effective for stimulating forage consumption.

High Energy-Low Protein Supplements

Drought-affected pastures and native range generally do not produce adequate forage to maintain "normal" stocking rates, so producers often provide supplemental energy to meet the needs of the cow herd. During drought conditions, energy may be the most limiting nutrient for grazing cattle. Several options are available for supplying energy to cattle on drought stressed pasture. Hay, grain, and crop processing byproducts can all be used to supply energy to grazing cattle. Low-quality forages can also be ammoniated to increase digestibility and protein content.

Grain supplementation on pasture has often resulted in a "catch 22" problem. Excess supplemental grain can reduce forage intake and digestibility, resulting in less energy available to the animal from available forage. However, this reduction in forage intake may not be undesirable during a drought.

Generally, up to 0.2 percent of body weight of supplemental grain per head per day will not result in large decreases in forage intake and digestion. For example, a 1,200-pound cow could receive 2.4 pounds of grain per day without drastically reducing forage utilization. When starch-based supplements were fed in a Texas study (Roquette 1995, as cited by McCollum 1997), the efficiency of supplement use and rate of gain became poorer as level of supplement increased (Fig. 1).

These data show that an intermediate level of corn supplementation (1.43 lb/day) stimulated rate of gain of steers without causing a depression in feed efficiency compared to feeding higher levels of grain, which actually reduced gain and caused poorer feed conversions. For some grains, processing may be necessary for optimum use by cattle. Corn and oats can be fed whole but may be utilized better if coarsely rolled before feeding. However, barley and wheat should be coarsely rolled.

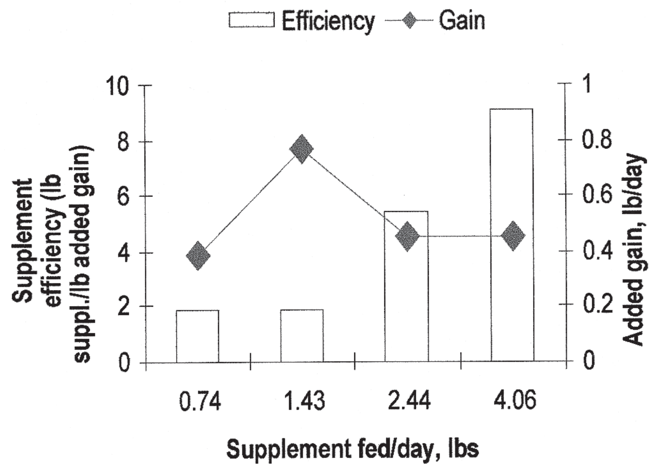

Fig. 1. Effects of corn-based energy supplement on daily gains of stocker steers grazing winter annual pasture (Roquette 1995, as cited by McCollum 1997).

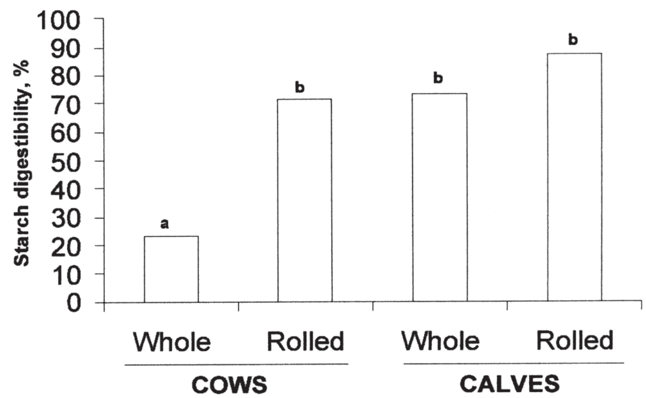

Fig. 2. Effects barley processing and cattle age on diet starch digestibility (Rainey et al. 2002).

Producers should avoid fine grinding and rolling, which results in excess fines and dust. These can result in increased incidence of acidosis and founder. Extremely dusty supplements are unpalatable. However, the producer must weigh the additional costs of processing vs. the value of the grain.

Recent data from Montana (Rainey et al. 2002) compared starch utilization from barley-based supplements fed to either calves or 3-year-old cows. The lightweight barley grain (42 lb/bu) was supplemented at .5 percent of body weight and animals were consuming an 11 percent protein grass hay. Barley was fed either whole or dry rolled. Processing the barley did not change organic matter, protein or fiber digestibilities. However, starch digestibility was greatly improved when barley was first rolled and then fed to cows (Fig. 2). This response was not measured when rolled barley was fed to calves.

Because hay frequently costs 50 to 100 percent more than corn, feeding limited concentrate during periods of short hay supplies makes economic sense (Loerch 1996).

Table 5. Effects of limit-feeding corn grain on wintering performance and subsequent conception rates of beef cows in Ohio (Loerch 1996).

	Trial 1		Trial 2	
Item	Limit-fed corn	Hay	Limit-fed corn	Hay
No. of cows	29	41	30	41
Initial wt., lb	1,367	1,347	1,360	1,358
Final wt., lb	1,250	1,296	1,311	1,221
Wt. change, lb	-117[a]	-51[b]	-49[c]	-137[d]
DM intake, lb				
Hay	1.8	28.1	2.2	29.5
Corn	10.8	-	12.6	-
Protein/mineral supplement	2.6	-	2.2	-
Conception rate, %	93.1	85.4	90.0[e]	73.2[f]
Feed costs, $/day[g]	.75	1.36	.81	1.37

[a,b]Trial 1 (Means differ, $P<.05$).
[c,d]Trial 2 (Means differ, $P<.05$).
[e,f]Trial 2 (Means differ, $P<.08$).
[g]Feed costs: corn, $2.00/bu; hay, $80/ton and supplement, $150/ton.

Table 5 shows winter performance of beef cows from Ohio fed limited amounts of corn vs. ad libitum hay feeding.

Results of these two studies showed that feed costs could be reduced by up to 50 percent when corn was used as an energy source rather than hay (average 78¢ vs. $1.38/day). Subsequent conception rates were not affected in the first year and were improved in the second year with the limit-fed corn ration.

There's one caution, however, even though energy intakes were calculated to be similar between treatments: it was suspected that cold temperatures may have been responsible for greater weight loss in Trial 1 for cows limit fed corn. It was suggested that when starting the program, about 3 to 4 days are needed for cows to adjust to the concentrate and decrease the forage levels. Producers should make sure that bunk space is adequate so all cows get their share and that cows are in a securely fenced area.

Available crop residues, such as small grain straws and other byproducts of crop production, represent important methods of stretching tight feed supplies during drought conditions. Grain processing co-products, such as wheat midds, soybean hulls, and corn gluten feed, contain highly digestible fiber, which provides energy while alleviating much of the negative impact that grain supplementation may have on fiber digestibility. Also, these byproducts provide protein that may also be limiting in drought-stressed forages.

When using byproduct feedstuffs, producers should make sure that the mineral program is balanced. These feeds are typically high in phosphorus and potentially high in sulfur, which may lead to mineral imbalances. The trace mineral levels may be somewhat low as well.

Minerals

It is recommended that ranchers provide the same salt and mineral mixture during drought as they would during normal conditions. However, during drought phosphorus supplementation may be more critical. A complete mineral supplement containing 12 percent calcium, 12 percent phosphorus, 5 percent magnesium, 0.4 percent zinc (4,000 ppm), 0.2 percent copper (2,000 ppm), and 25 ppm Se has worked well under Montana conditions..

Be aware of antagonistic minerals in both forages and water, which may be elevated during a drought. Swenson's Ph.D. dissertation (personal discussion 2000) from Montana State University showed that when diets contained high levels of dietary antagonists (Mo, SO_4, Fe), the inclusion of complexed Cu, Zn, Mn, and Co in the mineral supplement helped reduce the negative effects of the antagonists on reproductive efficiency.

Producers should not forget to evaluate their sources of water. As an example of what to evaluate, Table 6 provides recommended levels of minerals for livestock water vs. a recent water analyses from the central part of Montana, which had experienced 3 consecutive years of drought.

Vitamin A

Lack of vitamin A may become a problem during the fall and winter for cows that grazed drought-affected pastures during the summer. Vitamin A could be lacking in forages grown under drought conditions and hay produced from drought-affected forages. Cows should receive vitamin A and D booster shots approximately 30 days before calving if they have not been previously supplemented with vitamins. Table 7 demonstrates the positive impact that vitamin A had on reproduction of cows and replacement heifers.

Vitamin E

Relying first on the passive immunity acquired from colostrum and then on its own still-developing immune system, a young calf is exceptionally vulnerable to disease—scours and respiratory infections in particular. Research suggests that supplemental vitamin E can permit the newborn or young calf to mount an optimum immune response.

Perhaps the most dramatic results to date have occurred in a Canadian study (Zobell et al. 1995) in which beef cows received 1,000 IU of supplemental vitamin E per head daily for the last 60 to 100 days of pregnancy. Incidence of scours in the calves was 62 percent less than in calves from the unsupplemented controls.

Fennewald (2002) evaluated approximately 15,000 calves from six states and fed in a Colorado feedlot to determine if drought influenced morbidity of freshly received animals. These data did not show that calves raised in a drought environment had higher morbidities than calves from states that had adequate moisture.

Early Weaning to Save Cow Body Condition and Development of Replacement Heifers

Results of a survey conducted with 2,700 producers from 23 states showed that calf age/weight was the most important factor in determining when to wean calves (47 percent), followed by cow body condition and forage availability (21 percent; NAHMS 1997) (Fig. 3). Interestingly, tradition had one of the highest rankings (11 percent) in determining when to wean calves.

How Early Can Calves Be Weaned?

Calves have been weaned successfully at less than 2 months of age, but this is younger than is practical under most conditions (Bagley et al. 1997). The rumens of calves are normally functioning sufficiently at 120 days of age to provide satisfactory gains without the benefit of milk or milk replacers. Therefore, weaning March and April born calves in late July-early August may be preferred to an earlier weaning date. Utah workers concluded that early weaning of calves did not result in an increased rate of illness or in a lack of gain (Bagley et al. 1997).

Aside from drought issues, there are other reasons to early wean calves. Kansas workers (Blasi and Marston 2001) summarized the following advantages of early weaning programs.

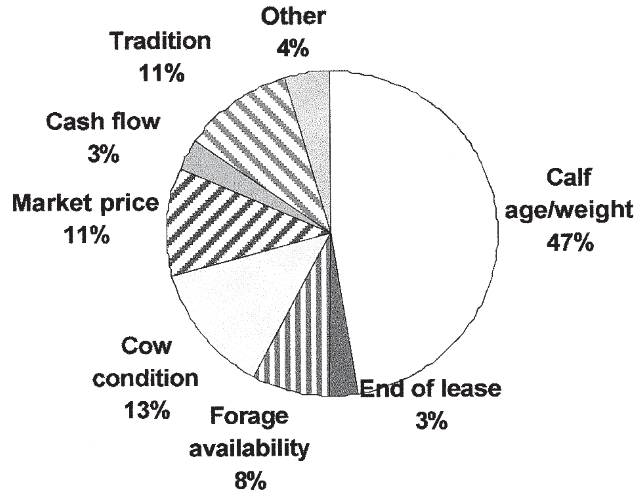

Fig. 3. Factors considered important in determining when to wean calves.

- Early weaned cow-calf pairs consumed about 25 percent less feed than normally weaned pairs.
- Calf performance was not compromised.
- Dry, early gestation beef cows required only 60 percent of the energy and 50 percent of the protein of lactating cows.
- Dry cows consumed 30 percent less forage than lactating cows.
- It was more efficient to feed calves directly than to feed cows to sustain milk production.
- It was much cheaper to maintain or regain cow body condition during the summer and fall months than to

Table 6. Livestock water quality guidelines and an example of a water sample from central Montana (Hager 2002, unpublished data).

Item	Recommendation of desired upper limit (NRC 1980)	Water sample from central Montana	Comment
Nitrate (NO_3), ppm	0 to 44	0	Safe
Calcium, ppm	100	353	Interferes with absorption of other minerals
Magnesium, ppm	50	157	May cause diarrhea
Sulfate (SO_4), ppm	50	4,049	May interfere with Cu; can cause polio
Total dissolved solids, ppm	960	3,991	May influence milk production

National Research Council 1980.

Table 7. Effect of vitamin A supplementation on reproduction of cows and replacement heifers. (Bradfield and Brehens 1968).

	Control group		Vitamin A treatment group*	
Age group	No. animals	% pregnant	No. animals	% pregnant
Mature cows	58	70	109	84
First-calf heifers	12	74	24	8
Replacement heifer	10	64	26	79

*Treatment group received injection of 2,000,000 IU of vitamin A.

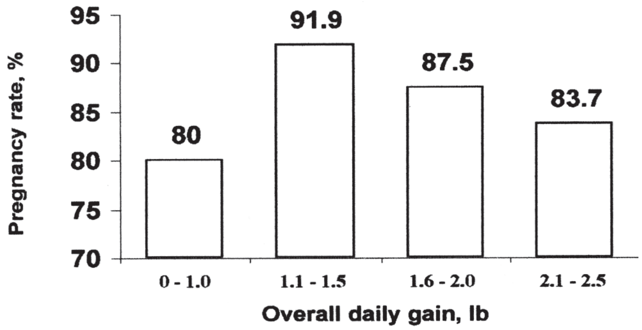

Fig. 4. Influence of replacement heifer daily gain on pregnancy rates (Houghton 2002 unpublished).

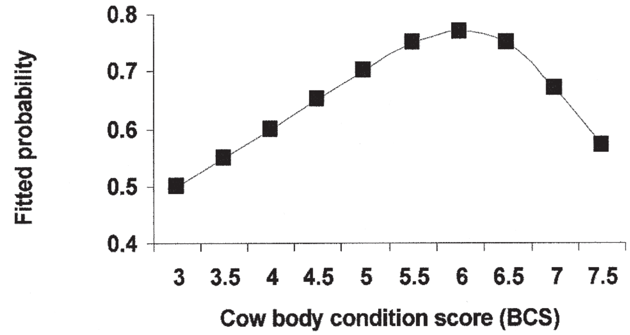

Fig. 5. Influence of body condition score on heifer first service conception rates (Houghton 2002 unpublished).

attempt to increase cow weights during the winter and spring months. By avoiding thin cows, suboptimal reproductive rates will be avoided.

- Dry cows required 60 percent less water than lactating cows.
- Young cows (first and second lactation) were the ideal candidates for early weaning. This is because of their additional requirements for growth besides maintenance and lactation.

The Effect of Drought on Replacement Heifers

The replacement heifer represents the future genetics of the cow herd, and drought may impact her first year development and hence lifetime productivity. Houghton (2002, unpublished data) showed the importance of proper nutrition and body score on pregnancy rates of the replacement heifer. Data were collected from several thousand heifers professionally developed at Heartland Cattle Company in McCook, NE (Figs. 4 and 5).

Observations suggest that the highest pregnancy rates occurred when heifers (primarily British breeds) were grown at approximately 1 to 1.5 lb/day. Similarly, the highest conception rates were when the heifers reached a BCS of approximately 6. If gains were less than or more than 1.5 lb/day, and body condition score more than 6.5, pregnancy rates apparently declined.

The importance of these observations is that if forage quantity and quality are such that rate of gain by developing heifers is unacceptable, pregnancy rates will suffer. These data also strongly suggest that professional heifer development may be one option for saving limited forage on the ranch while maintaining desired cow herd reproductive efficiency.

Summary

The constant challenge for the cow-calf producer is to match forage nutrients with animal requirements. Often, because there is not synchrony between these two as well as conditions of drought, supplemental feedstuffs are required to maintain productivity (lactation, body condition, growth of the calf). It has been shown that diets low in protein have resulted in weak calves at parturition.

After 3 years of drought in many parts of the western United States, a forage and water analysis is critical in determining how well the forage resource meets the nutrient requirements of the gestating cow and replacement heifer. Failure to meet nutrient requirements has been shown to decrease pregnancy rates of replacement heifers and the postpartum interval of the lactating cow.

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Second edition; December 2004 Reprint