

SUPPLEMENTATION DURING DROUGHT

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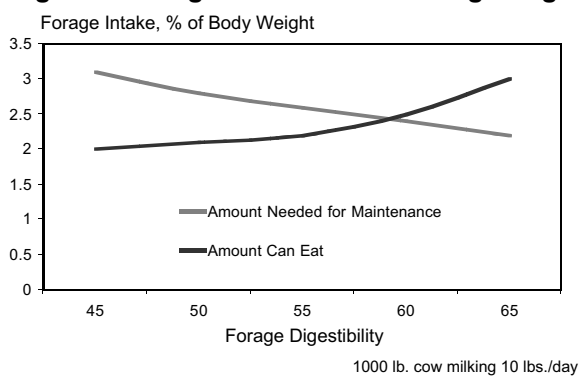
INTRODUCTION

Breeding failure is the most important adverse consequence to the cow herd during drought. This is due to reduced forage quality and availability, resulting in nutritional stress. As forage quality decreases, lignin and other more slowly digestible components of forage increase. This lower quality forage remains longer in the rumen before exiting, reducing forage intake. Thus, the cow may be unable to eat enough forage to maintain body weight (Figure 1).

During early to mid-lactation, a beef cow will consume from 2.5 to 3.0% of her body weight in forage daily. During drought, stocking rates may be adjusted to increase forage for each animal unit, but forage quality may drop thereby preventing adequate digestible nutrient intake. As forage digestibility drops,

passage rate of undigested dry matter decreases and forage intake declines. In Montana, when forage digestibility was 61%, lactating cattle consumed 2.2 to 2.8% of body weight in forage. During a drought year, forage digestibility dropped to 43% and the same lactating cattle consumed 1.2 to 1.3% of body weight in forage (Havstad and Doornbos, 1987). Forage intake at this level is inadequate to furnish the necessary nutrients for milk production and maintenance of cow body condition. To survive drought and maintain acceptable rebreeding percentages and economic viability, the cow herd should be managed for acceptable body condition. Forage should also be monitored for total production and

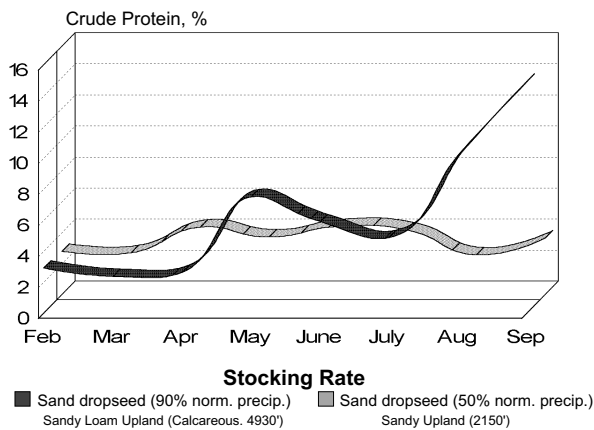
Figure 1. Forage Intake of a Lactating Range Cow



GENERAL RECOMMENDATIONS

1. Evaluate range to determine forage supply.
2. Analyze forage to determine nutrient deficiencies.
3. Start supplementation regime at least 60 days before calving to prevent accelerated weight loss following calving.
4. If forage supply is adequate (less than 50% utilization of forage), supplement natural protein (22% crude protein or greater) to meet forage deficiencies (generally 1 to 2 lbs. of supplement per day for nonlactating cattle). Protein supplements can be given as infrequently as once a week.
5. If forage supply is limited, use a protein/energy or energy supplement. Energy supplements need to be fed daily.
6. Use urea supplements with extreme caution.
7. Use water to help distribute livestock to underutilized areas of the grazing allotment.
8. Cull cows to match animal units to forage available. Cull in this order: open cows, old cows (9 years or older), 2-year-old producing cows, 3-year-old producing cows, replacement heifers.
9. Monitor use of toxic plants by cattle and move cattle if necessary to avoid over-consumption of toxic plants.

Figure 2. Crude Protein in Arizona During Drought



Arizona Strip Range Forage Quality Analysis Study (1996)

Table 1. Production from Cows During Drought

Cow Age (Years)	No Supplement		1 lb./day cottonseed meal	
	Weaning Weight (Lbs.)	Conception Rate (%)	Weaning Weight (Lbs.)	Conception Rate (%)
3	306	45	372	90
4	341	62	376	88
5	366	63	410	92
6	356	73	396	85

Foster, 1996

quality to determine if the cow's nutritional requirements are being met. It may be a cost effective practice to analyze forage or fecal samples for total digestible nutrients (TDN) and crude protein during dormancy or drought and match supplementation strategies to the nutritional deficits in the forage. Your local Cooperative Extension office can provide addresses of laboratories which offer this service.

PROTEIN SUPPLEMENTATION

Figure 2 illustrates crude protein content of sand dropseed (*sporobolus cryptandrus* (Torr.) Gray; warm season grass) at two different range sites in Arizona during the 1996 drought. At one site, precipitation was 90% of normal and protein content increased to

14.92% by September following 2.32 inches of moisture from July through September. At the lower elevation site with 50% of normal moisture, crude protein of the forage never got above 4.4%. At the same low elevation sandy upland range site, even winterfat had only crude protein above 6% for one month (April 96; 7.23% crude protein). Conversely, the crude protein of winterfat at the site with 90% moisture never fell below 6% and was above 11% during April and May. Protein required for a 1000 lb. nonlactating cow is around 1.6 lbs./ day or 7% crude protein in the diet. When the cow is lactating, 2.0 lbs. or 9.6% dietary crude protein is required. Drought accentuates the need for protein supplementation.

Protein supplementation during drought can yield dividends. In a study at Fort Stanton, NM over several years of drought, weaning weights and conception rates for cattle of different ages were compared (Table 1). The supplemented cows in this study were fed 1 lb. of cottonseed meal per day from just prior to calving until grass was green. The effects of the drought were most severe for younger cows, but supplementation increased weaning weights and conception rates in cows of all ages. Other cattle at risk during drought are heavier milking cattle and larger framed cattle. It is well to remember that during drought we are not only supplementing to meet deficits in this year's forage, we are also supplementing next year's calf crop.

When forage contains less than 6% protein, protein supplementation can be effective in enhancing forage intake (Caton et al., 1988). When additional protein is made available, this increases the number and activity of microorganisms in the rumen which are ultimately responsible for fiber digestion. As the microbial population of fiber digesting bacteria increases, passage rate of forage increases, ultimately allowing for greater intake of low quality forage. In some cases, greater digestibility of

forage has also been observed. Figures 3 and 4 illustrate how both forage intake and forage digestibility were increased by protein supplementation for cattle eating poor quality (2% crude protein) prairie hay.

Steers fed the greatest amount of the 33% protein supplement increased forage intake 49% and had 39% greater digestibility of forage than control steers. The amount of TDN required to maintain body weight for nonlactating cattle is around 52%, so steers supplemented the highest level of protein should not have experienced weight loss (although these data were not reported).

When a lower protein supplement (18%) was fed on an equal protein basis (1.7, 3.5, and 5.3 lbs. of supplement per day), forage intake was 1.34, 1.48, and 1.33% of body weight for each increasing supplementation level. Total ration digestibility was 41, 43, and 50%, respectively. Cattle in this study appeared to be limited in protein intake with the low quality forage, and substitution of forage by supplement did not appear to occur with the higher protein supplement. In this same study, some substitution of forage by supplement resulted when alfalfa hay was fed at the same rates as for the medium protein supplement. However, no substitution occurred when alfalfa pellets were fed, presumably because of a positive effect on rate of passage.

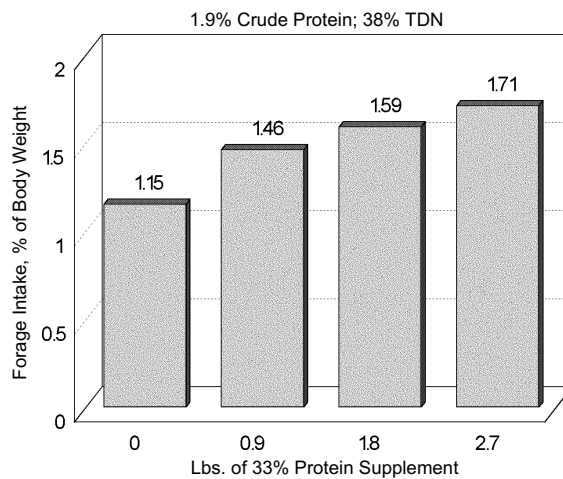
An advantage with protein supplementation is that cattle can be supplemented as infrequently as once a week without detrimental effect (Huston et al., 1997). This is not the case for energy supplements (e.g., corn, milo) which need to be supplemented daily.

ENERGY SUPPLEMENTATION

It is generally acknowledged that forage intake and digestibility of the forage will decrease with energy (grain) supplementation. However, sometimes the

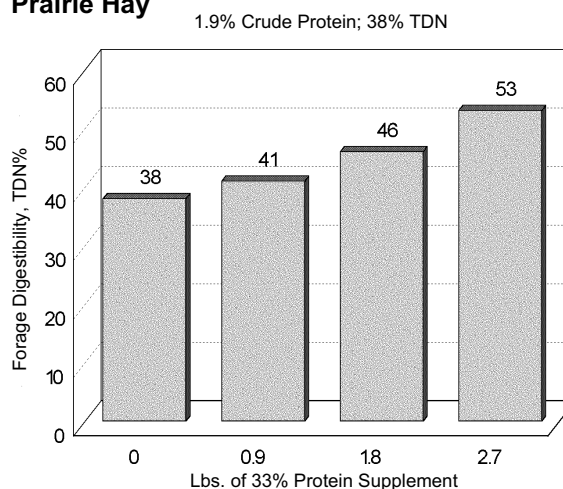
value of the grain to the animal offers a greater advantage than the disadvantage of lowering the forage value. Also, grain can be advantageous for stretching the forage supply. If forage quantity is insufficient, it is probably more economical to supplement with a combination protein/energy ration (20 to 25% protein; 40 to 50% grain) than a high protein ration. **Cattle will be unable to capitalize on the benefits of a high protein supplement when the forage supply is insufficient.** As a general rule, if utilization of available forage is less than 50%, use a high protein ration, but if forage utilization is

Figure 3. Forage Intake on Dormant Tallgrass Prairie Hay



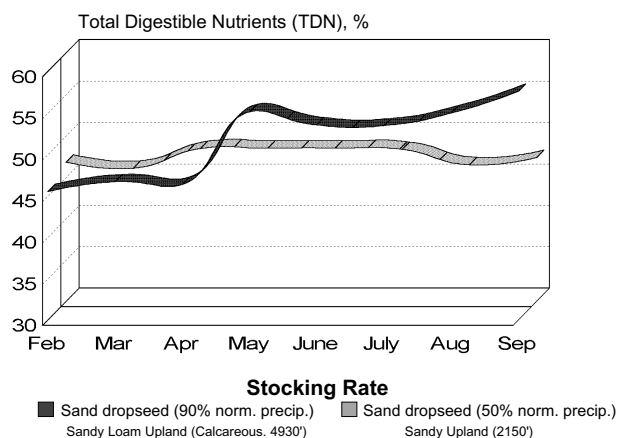
Stafford et. al., March 1996 *Journal of Animal Science*

Figure 4. Forage Digestibility on Dormant Tallgrass Prairie Hay



Stafford et. al., March 1996 *Journal of Animal Science*

Figure 5. Energy Content in Arizona During Drought



Arizona Strip Range Forage Quality Analysis Study (1996)

equal to or greater than 50%, use a protein/energy or energy supplement.

Figure 5 shows the energy content (TDN) of the same grass from the same sites as shown in Figure 2. The energy required for maintenance of lactating cattle is supplied by forage at around 56% TDN and for nonlactating around 52% TDN. At no time during 1996 was TDN above 49% for the low elevation range site with 50% of normal precipitation. Assuming forage availability was adequate, protein supplementation at the low elevation range site could possibly have increased both forage digestibility and intake to more optimal levels.

OTHER SUPPLEMENTS

In stressful situations in which cattle are losing weight, some benefits have been demonstrated by feeding supplements with approximately 40 to 60% of the protein being ruminally undegradable or bypass protein. Feedstuffs high in bypass protein include feather meal, blood meal, corn gluten meal, and fish meal. Due to palatability problems, rendered animal products are usually limited to 25 to 30% of the total supplement and are combined with grain products to increase palatability. Petersen et al. (1996) reported that weight loss has been reduced and

conception rates increased in several experiments by feeding bypass protein. However, they reported that bypass protein supplementation only seems to be effective when animals are losing weight. The additional cost per ton for adding bypass protein is around \$50 to \$80.

Another form of supplementation during drought to increase harvestable forage is the hauling of water to seldom used areas of pastures. Granted, this is labor intensive and requires acreage which is easily accessible. However, in large pastures with few water developments, this can help in grazing distribution. In areas which are not excessively rugged, it is estimated that cattle will use 80% of the allowed harvestable forage up to 1 mile from a water source, but only 40% at 1.5 miles, and 20% at 2 miles from the water source. If there are areas in pastures exceeding 1 mile from water, then in effect you have a "forage bank" which can be utilized.

In order to avoid harming the range resource for subsequent years, maximum utilization of forage should not exceed 60% (Lacey, 1995). Exceptions are crested wheatgrass (Lacey, 1995) and annuals. Annuals should be grazed early and heavily during a drought year while they are still green and have greater nutritive values. Pastures should be rotated frequently and include longer rest periods due to reduced growth during drought. In some instances, it may be advantageous to open up pastures into larger pastures to allow for more selectivity by cattle. This will also help prevent cattle from "bogging down" in earthen water tanks with dropping water levels.

UREA SUPPLEMENTS

When forage quality is low and the TDN or energy value of forage is low (less than 45%), it may be risky to feed protein supplements with urea. However, research in this area is rather limited (Dr. Bob Cochran, Kansas State

University, personal communication). In some cases, urea toxicity may be more related to reduced forage availability than to forage quality. A rule which is widely quoted is that urea should constitute no more than 1/3 of the crude protein of a cow's diet. If this amount of urea in the diet is exceeded, there may be increased risk of urea toxicity and death. Symptoms of urea toxicity have been observed in cattle unaccustomed to urea in doses approximating .4 lbs of urea (equivalent to approximately 1.15 lbs. of crude protein supplied by urea) for a 1000 lb. cow (Radostits et al., 1994). If the protein supplement being fed contains 32% crude protein with 26.5% crude protein being derived from urea, the cow eating this supplement may be at risk if she consumes 4.34 lbs. of the urea based supplement (4.34 lbs. supplement • .265 crude protein for urea = 1.15 lbs. equivalent protein from urea or .40 lbs. urea). The crude protein:urea ratio can be determined by the feed tag, forage analysis, estimated forage intake from Table 2, disappearance of urea supplement, and the formula in the box right.

20% crude protein of which 70% of the ration, or 14% crude protein, was from urea, then cattle could probably consume 4 lbs. of this supplement. If forage quality drops to 4% crude protein and 40% TDN, then cattle can only consume safely 2 lbs. of the 20% protein supplement.

$$\frac{[(12 \text{ lbs. forage} \cdot .04) + (2 \text{ lbs.} \cdot .06 \text{ natural protein}) + (2 \text{ lbs.} \cdot .14 \text{ urea})]}{(2 \text{ lbs.} \cdot .14 \text{ urea})} = \frac{3.14}{1.00}$$

The cutoff value for a urea based supplement with forage of 5% protein and 45% TDN (15% increase in forage consumption factored in for protein supplementation) is 2 lbs. of a 32% protein supplement with crude protein from urea = 26.5% and 4.5 lbs. for a 20% protein supplement with crude protein from urea = 14%.

One may be tempted to control the intake of liquid urea based supplements

$$\frac{(\text{lbs. protein from forage} + \text{lbs. natural protein in supplement} + \text{lbs. protein from urea})}{\text{lbs. protein from urea}}$$

For example, forage analysis reveals that the forage is estimated to contain 5% crude protein and 45% TDN. Forage intake from Table 2 is estimated to be 1.7% of body weight or 17 lbs. for a 1000 lb. cow. Crude protein intake from forage is 17 • .05 or .85 lbs. The feed tag on the supplement contains 32% crude protein and 83% of this, or 26.5% crude protein, is from urea. The cattle are eating 4 lbs. of supplement a day, or .22 lbs. natural protein from supplement (4 • .055) and 1.06 lbs. protein from urea (4 • .265). The crude protein:urea ratio in this instance would be greater than the desired 3:1 ratio.

$$\frac{(.85 + .22 + 1.06)}{1.06} = \frac{2.00}{1.00}$$

If it is desired to continue feeding a urea based supplement in this case, then the amount of urea in the supplement needs to be reduced. If cattle were fed a urea based supplement with

Table 2. Forage Intake of Lactating Cattle at Different Forage Digestibilities

Forage Digestibility or TDN, %	Amount Required to Eat to Meet Maintenance Requirements, % of Body Weight	Amount Can Eat at the Forage Digestibility Listed, % of Body Weight ¹
43	3.2	1.2 to 1.3
45	3.1	1.7 to 2.0
50	2.8	1.9 to 2.1
55	2.6	1.7 to 2.1
58	2.4	1.9 to 2.5
60	2.3	2.0 to 2.5
62	2.3	2.3 to 2.8
64	2.2	2.6 to 3.2
Greater than 64		2.6 to 3.2

¹Research from various sources including Kronberg et al., 1986; Kragner et al., 1986; Havstad and Doornbos, 1987; Sprinkle, 1992.

by locking the wheels on the feeder. However, research suggests that after 3 days of urea deletion from the diet, adaptation to urea based supplements is lost (Davis and Roberts, 1959). It is a much better practice to either eliminate completely the feeding of urea during drought or else significantly reduce the amount of urea in the supplement.

Signs of urea toxicity include rapid, labored breathing, muscle tremors, severe abdominal pain, frothing at the mouth and nose, irritability to sound and movement to the point of being aggressive, slight incoordination followed by severe incoordination and the inability to stand, weakness, bloat, and violent struggling and bellowing (Essig et. al, 1988; Radostits et al., 1994). Treatment, which is often too late, is oral administration of 4 liters of a 5% vinegar solution for a 1000 lb. cow (Davis and Roberts, 1959).

TOXIC PLANTS AND ADDITIONAL CAUTIONS

An additional caution for supplementation during drought is to avoid feeding supplements containing ionophores (trade names of Rumensin® or Bovatec®). Doing so can increase the probability of nitrate poisoning (Radostits et al., 1994). Nitrates can accumulate in forage during drought, and especially in the "green-up" following drought. Plants which are particularly susceptible to nitrate accumulation include kochia, lambsquarters, oat hay, Russian thistle (tumbleweed), sorghum, and filaree. Symptoms of nitrate poisoning are similar to other kinds of poisoning and include rapid pulse rate, labored breathing, and possibly muscle tremors and convulsions. Symptoms which are somewhat unique to nitrate poisoning include darkened membranes in the mouth, nose, and eyes and dark red to brown blood instead of bright red blood (Essig et. al, 1988). Treatment is accomplished with intravenous injection of 100 ml of a 4% solution of methylene blue / 1000 lbs.

body weight (Essig et. al, 1988). According to Radostits et al. (1994), supplemental feeding of sodium tungstate (wolfram) under veterinary advisement can reduce the effects of nitrate poisoning in cattle grazing pastures with high levels of nitrate (greater than 1% nitrate nitrogen; Essig et al. 1988,).

During drought, one also needs to be alert to possibilities of toxic plant poisoning. Oftentimes, the greenest plants may be toxic (e.g., bracken fern, whorled milkweed). Forage production should be monitored closely and cattle should not be subjected to excessive stocking rates on the depressed forage base. Be aware of poisonous plants which exist in your pastures and carefully monitor the use of these plants by livestock.

CONCLUSION

It is important to plan ahead when supplementing cattle during drought. The most effective time to supplement cattle is before calving. It is almost impossible to put weight back on a cow during the first 45 to 60 days after calving. Nutrient requirements at this time are about 50% greater than in the last trimester of pregnancy. Producers should analyze forage for deficits in protein and TDN and supplement accordingly to maintain cow weight before calving (Sprinkle, 1996). Reproduction will drop sharply if cattle are thinner than a body condition score of 4 at breeding.

It is acknowledged that drastic effects can occur in a relatively short period of time during drought. In some cases, cattle may be in adequate body condition shortly before calving and lose weight rapidly as forage supplies and forage quality decline. Cattle should not be allowed to get below a body condition score of 3 in order to avoid increased susceptibility to diseases. Also, conception rates in cattle will possibly drop to 40 to 50% at body

condition score 3 and to practically zero at body condition score 2. **If at all possible, a cow should not be allowed to become protein deficient during drought.** For every 1 lb. of protein deficiency, the loss of 6.7 lbs. of body weight would be required to supply this level of protein. Conversely, if the diet was deficient in energy (TDN), this would only require 1 lb. of body weight loss for each 1 lb. of TDN. If a cow was deficient in TDN by 1.5 lbs. per day and initial body condition score was 4, the cow could lose 1.5 lbs. a day for 53 days and drop to a final body condition score of 3.

In the worse case scenario, some cattle should be sold to stretch forage supplies while also feeding supplement to remaining cows to maintain desirable body condition during breeding. Heavier milking and larger cattle would be good candidates for culling, because their maintenance requirements will be much larger. Since 2-year-old cows will require more supplementation and be more difficult to rebreed, you may want to consider selling these cows as well. Above all else, use pregnancy testing as a tool to reduce herd size and preserve a reasonable calf crop the following year. Income from sale of cattle during drought may be eligible for income deferment for 1 year if in an area that has been declared a drought disaster area. If extreme destocking is expected, early weaning of calves should be considered. Nonlactating cattle will eat only 70% as much as lactating cattle, so this will spare the forage base somewhat during drought.

In conclusion, drought usually requires some type of supplementation to avoid extreme weight loss in cattle. If cattle are allowed to become too thin, conception rates may decrease markedly. By obtaining forage or fecal samples and analyzing for protein and TDN, supplements can be matched to drought conditions.

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