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PROTEIN VERSUS GRAIN SUPPLEMENTATION FOR COWS GRAZING WINTER RANGE

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INTRODUCTION

Grazing rangeland during the fall-winter is common on many cattle ranches. Fall-winter grazing of cows generally reduces production costs when compared to feeding a full ration of harvested feeds. Fall-winter range forages alone may not maintain body weight and condition of the cow. Grazing fall-winter range generally has associated cost for supplemental feeds. This paper will look at the effects of protein and grain supplementation on cow performance and the costs of supplements.

ASSESSMENT OF NEED FOR A SUPPLEMENTAL NUTRIENT

Wallace (1988) suggested that the first question to be answered before developing a supplementation program is whether or not there is a real need for a supplemental nutrient. Composition of the animals diet, amount of the diet consumed and requirements of the animal must be considered to assess the need for supplements. If it is determined that a supplement would likely be beneficial, then the costs should be weighed against the projected returns. One might also consider the risks associated with not feeding a supplemental nutrient

A common question from many ranchers is how to assess the nutrient quality of a standing range forage. Samples obtained from esophageal-fistulated cattle are considerably different from the total forage available. Fistula samples generally represent the best estimate available of the diet of the grazing animal (Van Dyne and Torell 1964). Because it is impractical for ranchers to sample range forage with fistulated cattle and clipped samples are generally regarded as unreliable, a rancher should develop an understanding of forage quality through results in the published literature or by consultation with those who have the knowledge.

NUTRIENT VALUE OF FALL-WINTER RANGE FORAGES

Understanding the value and limitations of forage resources is essential to developing an effective supplementation program. Three general factors determine the productivity of cattle on rangeland: (1) the concentration and availability of nutrients in the forage for the animal, (2) the quantity of forage available and consumed by the animal, and (3) the nutrient requirements of the animal.

The nutrient value of range forage is cyclic and highly variable during the year and among years. Figures 1 and 2 show the seasonal variability of protein and metabolizable energy (ME) in the diets of cattle on the Northern Great Plains. While these models are not precise for all geographic locations or years, they do show a general relationship which applies to a large geographic area and variety of conditions.

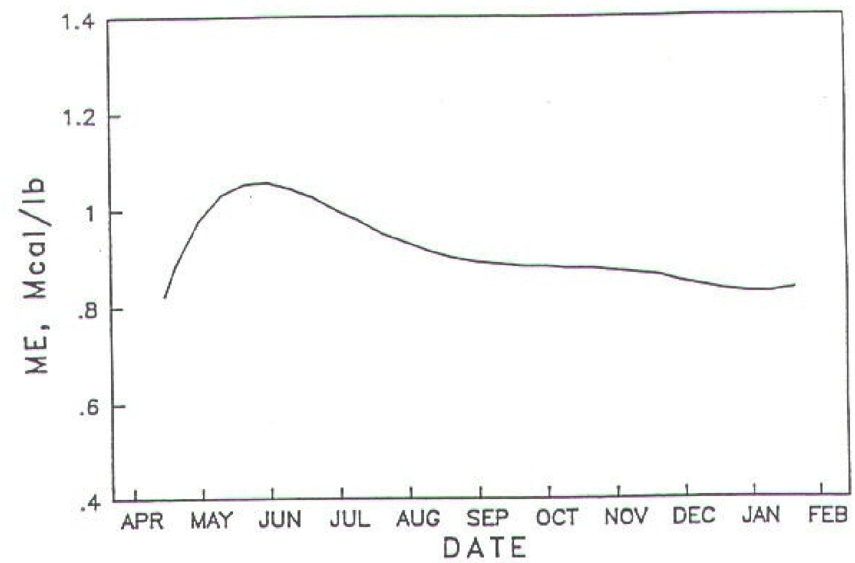

Figure 1. Concentration of metabolizable energy in cattle diets on Northern Great Plains rangeland (adapted from Adams and Short 1988).

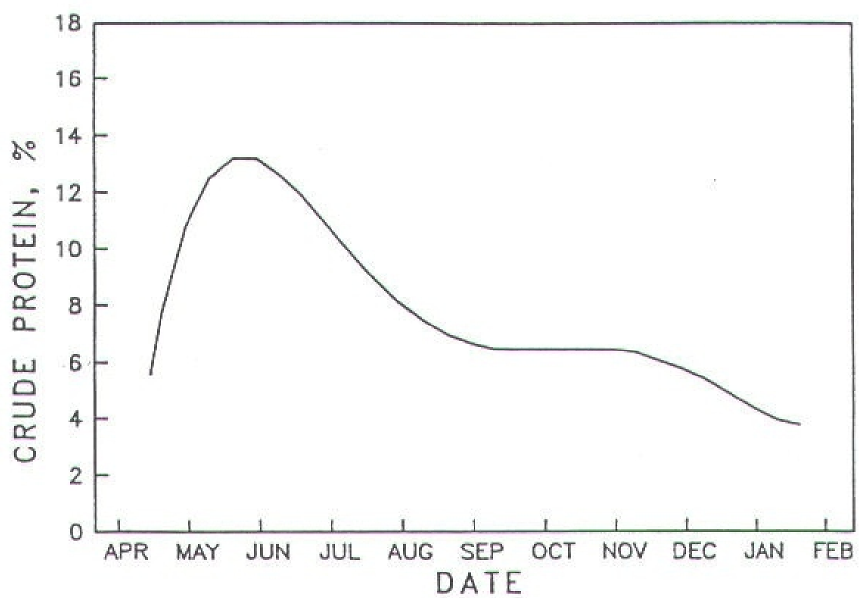

Figure 2. Concentration of crude protein in cattle diets on Northern Great Plains rangeland (adapted from Adams and Short 1988).

For the fall-winter period (fig. 1), the energy value of grazed range forage is similar to that of mature crested wheatgrass (ME = about .82 Mcal/lb, NRC 1984). About 19 pounds of this forage will meet the energy requirement of an 1100 pound cow during the middle third of pregnancy and about 22.5 pounds would meet the same cow's requirement during the last third of pregnancy. During the fall-winter period, range forage averaged between 3.5% and 6% crude protein (fig. 2). The lowest protein values were prevalent December through February. If the dietary protein level is 4%, an 1100 pound cow would need to consume about 35 and 40 pounds of the forage to meet her protein requirements during the middle and last third of pregnancy, respectively. Although the energy requirements of a grazing cow are increased above those given in the NRC (1984) by 20% or more (Havstad and Malechek 1982) and by cold temperature (NRC 1981), generally the first limiting nutrient in fall-winter range forage is crude protein, providing forage is readily available.

INTAKE OF RANGE FORAGE DURING THE FALL-WINTER

Intake of range forage by cattle may vary from 1% to 4% of body weight (Cordova et al. 1978). Primary factors affecting intake of range forage are: (1) the bulky, fibrous nature of most range diets, (2) body size of the animal, (3) lactation, (4) supplementation, and (5) cold temperatures and wind (Allison 1985, Adams 1987). Intake of winter forages has generally been between about 1.2% and 2.2% of body weight or between 12 and 25 pounds/day.

Dry cows in the middle third of pregnancy grazing range in the fall will often consume enough forage to meet their protein and energy requirements, because: (1) maintenance requirements are low during the middle third of pregnancy, (2) the diet often has a protein content of up to 6%, and (3) weather related stress is generally lower in the fall than winter. Lactation may increase the cow's requirement to a point that she is unable to consume enough forage to meet protein or energy requirements during the fall period (Adams and Short 1988).

In contrast to the fall period, it is generally more difficult for spring calving cows to meet their nutrient requirements when grazing winter range for three reasons: (1) protein and energy requirements are greater during the last third than middle third of pregnancy (NRC 1984), (2) protein content of the diet is generally at its lowest for the year (fig. 1), and (3) cold ambient temperatures increase the cow's energy requirement (NRC 1981) and reduce forage intake by the cow (Adams et al. 1986). Ames (1985) concluded that for each degree (F) coldness (i.e., windchill) below the animal's lower critical temperature, the energy required for maintenance is increased by 1%. The lower critical temperature is the lower limit of the thermal neutral zone, or the point where the animal must use energy for the sole purpose of maintaining body temperature. When crude protein of a diet is below 6 to 7%, forage intake is often reduced (Allison 1985). Cold ambient temperatures and low dietary protein further contribute to an energy imbalance during winter grazing by lowering digestibility of the diet (Ames and Brink 1977, Adams et al. 1986). Forage intake and digestibility by cows grazing fall-winter range under a variety of environmental conditions is presented in table 1.

Table 1. Intake and Digestibility of Range Forage by Cows at Various Air Temperatures During Fall-Winter[a]

Intake lb/day	Intake lb/100 lb BW[b]	Digestibility %	Ambient Air Temperature °F	Reference
18.9	1.9	54.9	mild	Kartchner 1981
15.0	1.4	40.6	28 to -37	" "
25.5	2.3	55.4	-5	Adams et al. 1986
26.2	2.4	59.6	-4	" "
20.9	1.9	55.9	10	" "
19.1	1.7	52.5	-22	" "
14.9	1.3	38.2	-17	" "
19.1	1.7	43.0	32	Adams et al. 1987
16.9	1.5	36.5	16	" "
15.4	1.3	59.9	9	Adams unpublished
13.9	1.2	44.6	-8	" "

[a]Each intake reported is an average of intake measured over a 5 to 15 day period.
[b]BW = body weight.

PROTEIN VERSUS GRAIN SUPPLEMENTS

As conjectured earlier, the first limiting nutrient in a grazed fall-winter range forage is crude protein. A number of studies have evaluated the effects of supplemental grain and protein on the performance of cattle grazing fall-winter range. Studies generally have shown that grain such as corn or barley have little beneficial effect and may even be detrimental to the performance of range cattle. In contrast to grain supplements, protein rich supplements have shown beneficial effects on cattle performance, but the effects are often variable.

A study in the Sandhills of Nebraska, (Sanson et al. 1990) compared grain to protein supplements. In this study, cows grazed native range from November 16 through March 8, and were supplemented with either (1) 3.5 lb of ear corn/day, (2) 3.0 lb ear corn and 1 lb of a 40% protein supplement/day, or (3) 2 lb of a 32% protein supplement/day. Supplements 1 and 2 provided equal energy (2.6 lb TDN/day) and supplements 2 and 3 provided equal crude protein (.6 lb crude protein/day). Cows fed supplement 1 (ear corn only) lost 121 lb, those fed supplement 2 (ear corn + protein) lost 40 lb, and cows fed supplement 3 (protein only) gained 15 lb during the 105-day trial.

Response differences to grain and protein supplements are best explained by their effects on forage intake and digestibility. Kartchner (1980) imposed three treatments on cows grazing native winter range in Montana: (1) control, or range forage only, (2) range forage and 1.6 lb soybean meal/day, and (3) range forage plus 1.5 lb cracked barley/day. The barley and soybean supplements provided similar amounts of energy to the cow. A summary of the effects of supplements on forage intake and digestibility are presented in table 2.

Table 2. Intake and Digestibility of Range Forage by Cows Grazing Winter Range with Grain or Protein Supplements[a]

	Supplement		
Item	No supplement	Barley	Soybean meal
Forage intake, lb/100 lb BW[b]	1.41	1.38	1.63
2Forage intake, lb/day	15.0	13.9	17.6
Total intake, lb/day (forage + supplement)	15.0	15.3	19.1
TDN intake, lb/day[c]	7.1	7.1	10.1
Digestibility, %	40.6	34.3	43.6

[a]Adapted from Kartchner (1980).
[b]BW = body weight.
[c]TDN estimated from figure 1 with conversion factors from NRC (1984), intake values in table 2 and NRC (1984) values for supplements.

The protein supplement greatly increased forage intake and digestibility of range forage over cows consuming range forage only or those consuming barley in addition to range forage. Barley grain reduced forage intake and digestibility compared to the control cows. The end result was that cows did as well when consuming range forage only, as when consuming range forage and 1.5 lb of barley/day.

In general, when cows are grazing poor quality winter forages, protein supplements are much more effective than grain supplements for maintaining cow weight and body condition. However, some benefit has been shown when grains were fed to cattle grazing moderate to high quality forages (i.e., above 6% crude protein; Horn and McCollum 1987, Adams 1985) or when fed at low levels with hay (Sanson 1989). Research in Montana shows that feeding protein supplements may not always improve performance over nonsupplemented cows (Black et al. 1938, Kartchner 1980, Cochran et al. 1986) although a consistent benefit from protein supplements has been reported for cold, harsh winters. The consistent benefits of protein during cold probably resulted from improved ammonia-N status in the rumen and reducing the negative effects of cold on range forage intake by cattle during periods of inclement weather (Adams 1987). Research in the Sandhills of Nebraska shows a consistent favorable response to supplemental protein even during mild winters (Sanson et al. 1990, Villalobos et al. 1991). Need for protein supplementation is variable among geographic areas and from year to year.

In general, feeding protein supplements is a good practice for maintaining body weight and condition of cattle on winter range. However, protein supplements are not effective for putting body condition on thin cows during the winter (Adams et al. 1987). Management practices should be imposed during the late summer and fall to keep cows from becoming thin if range forage and protein supplements are to be the cow's nutrient source for the winter. Supplements, grazing complementary forages and weaning date are all tools for managing body condition during the late summer and fall. Remember, supplements are not a substitute for lack of forage.

AMOUNT AND SOURCE OF SUPPLEMENTAL PROTEIN

The amount of supplemental protein can be estimated by subtracting the expected protein consumed in the forage from the cow's requirement. For example, from fig. 2 and table 1 we estimate that an 1100 lb cow in the middle third of pregnancy will consume 18 pounds of a forage containing 4% crude protein (protein intake = .72 lb/day) and the cow's requirement is 1.4 lb crude protein/day (NRC 1984). The recommended amount would be .68 lb crude protein/day. If we planned to feed a 40% protein cake then .68 lb crude protein divided by .40 or 1.7 lb of supplement/day dry basis would meet the required .68 lb protein/day. In practice, .5 to .75 lb crude protein/day has generally been effective.

Selection of a protein supplement should be based on price and the practicality of a supplement for a given ranch. A variety of supplements have been effective protein supplements, including cottonseed cake (Black et al. 1938), soybean meal (Kartchner 1980), alfalfa hay (Cochran et al. 1986), high quality grass hay (15% crude protein; Villalobos et at. 1991), cottonseed meal-barley cake (Cochran et at. 1986) and commercial supplements (Sanson et at. 1990).

The following procedure is recommended for comparing protein supplements varying in percent protein and price on a per unit of protein basis:

$$\text{Value of protein in the feedstuff} = \frac{\text{cost \$/lb of feedstuff}}{\text{\% protein in feedstuff}}$$

For example:

Alfalfa costs $60.00/ton ($.03/lb) and contains 18% crude protein then:

$$\frac{\$.03}{.18} = \$.167\text{/lb of crude protein from alfalfa.}$$

A 40% protein cake costs $220.00/ton ($.11/lb) then:

$$\frac{\$.11}{.40} = \$.275\text{/lb crude protein for the 40\% cake.}$$

The cost of the two supplements are now readily compared, additional supplements can be compared following the same procedure. Rush (1987) concluded that supplements containing non protein nitrogen (NPN) are often priced considerably less than all natural supplements; but, because of poor NPN utilization with poor quality diets (typical of winter range forages), they generally are not a more economical source of supplemental protein for cattle on winter range. If

NPN supplements are considered, the value of the crude protein coming from the NPN should be reduced about 50%.

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