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## **NUTRITIONAL VALUE OF GRAZED FORAGES AND HOW IT FITS THE COW'S REQUIREMENT**

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### **INTRODUCTION**

The concept of matching nutrients available in grazed forages with nutrient requirements of the cow has been reviewed and recommended as a means to most efficiently utilize grazed forages (Valentine 1990, Vavra and Raleigh 1976). We further develop the principles and concepts necessary to improve the match between forage quality and the cow's nutrient needs and discuss potential impacts on management and production cost.

### **Background**

While grazing lands are the base resource and investment, harvested forages, grain, and supplements made up over 40% of total cash costs in North Central, Great Plains, and western cow-calf operations in 1990 and 1991 (Economic Research Service 1994). Adams et al. (1994) reported that extending the grazing season by grazing meadow in early spring and/or more winter grazing increased returns per cow about \$50 to \$90. When the cow and range resource are well matched, the cow should receive most nutrients from grazed forages. Extending grazing and/or matching the cow to the range forage will likely result in lower production costs and greater net returns.

Two general factors determine how well the animal and range resource match: 1) genetic potential for milk production in the cow, and 2) synchrony between the animal's requirement during lactation and the highest nutrient value in the forage. When cows expend more nutrients than they consume, they lose body condition. Thin cows or cows in low body condition at calving are more likely than cows in moderate body condition to breed late in a controlled breeding season or not breed at all which reduces the net calf crop (i.e., number of calves weaned per cow exposed to the bull; Dziuk and Bellows 1983). The pounds of beef produced declines with a declining net calf crop. To be profitable, a grazing-based system must maintain a moderately high net calf crop.

### **Cyclical nature of plant nutrient density**

The quantity and quality of forage produced on pasture and rangelands are highly cyclical, within and between years. Several factors, including precipitation, plant species, and the proportion of cool and warm season species will affect the overall forage quality of rangeland at any point in time. Seasonal changes in nutrient density of rangeland forage are primarily associated with plant maturity. Plants contain their greatest nutrient value for cattle before

maturity. In general, diets from dormant range contain between 4 and 7% crude protein with higher concentrations occurring in late summer and early fall and lower concentrations occurring during late fall and winter. Plants in a vegetative state generally contain over 10% crude protein (Adams and Short 1988, Lardy et al. 1994).

### **Nutrient requirements of the cow**

Cow size, milk production, pregnancy, activity, and environment are the primary influences on nutrient needs of cattle (NRC 1984). The larger the cow, the more energy and protein required for maintenance. The total-digestible-nutrient (TDN) and crude protein requirements during the last third of pregnancy are about 20 and 14% greater than during the middle third of pregnancy, respectively. Cow protein and energy requirements are greater during lactation than any other time of the 12-month production cycle, and the requirement increases with increasing milk production. Energy requirements are increased by cold and hot ambient temperatures, and wind exacerbates the effects of temperature.

As requirements for protein and energy increase, cows must consume additional protein and energy to meet requirements or they lose body weight and body condition. Nutrient intake from forages is the product of the amount of forage consumed and the concentration of the nutrient in the forage. Figures 1 and 2 demonstrate the relationship between nutrient density in a forage and the amount of forage needed to meet the crude protein and TDN requirements of a 1000 lb cow during the mid- and last third of pregnancy and 2 levels of milk production. The densities of crude protein and TDN in the forages used in Figures 1 and 2 encompass most forages expected on range, except diets of immature forage which will exceed 10% crude protein. As crude protein and TDN requirements for pregnancy and lactation increase, the amount of forage needed increases at all nutrient densities for both crude protein and TDN. The greatest amount of forage needed to meet a protein or TDN requirement is for a cow producing a high level of milk (e.g., 20 lb/day).

### **Plant animal interactions**

The fibrous, bulky nature of forage and low concentration of crude protein limit the amount of forage an animal consumes (Allison 1985). Inability of an animal to consume enough nutrients in a forage diet is greatest when density of the nutrient is low and/or when animal requirements are high. Figures 3 and 4 show the relationship between nutrient density in the forage and the ability of a 1000 lb cow to consume adequate forage to meet crude protein and TDN requirements. A cow grazing a forage containing 5% crude protein is not likely to consume enough forage to meet protein requirements at any phase of the production cycle. A forage containing 5% crude protein is common in late fall and winter range forages. Dormant fall-winter range will likely not support milk production and maintain cow body weight and body condition without supplementation (Short et al. 1994, Adams et al. 1994). Cows would likely consume enough forage to meet requirements at all production phases when the forage contains 10% or greater concentration of crude protein. Adams et al. (1994) found that dry cows gained or maintained body condition from September to November on dormant range (7.6% crude protein),

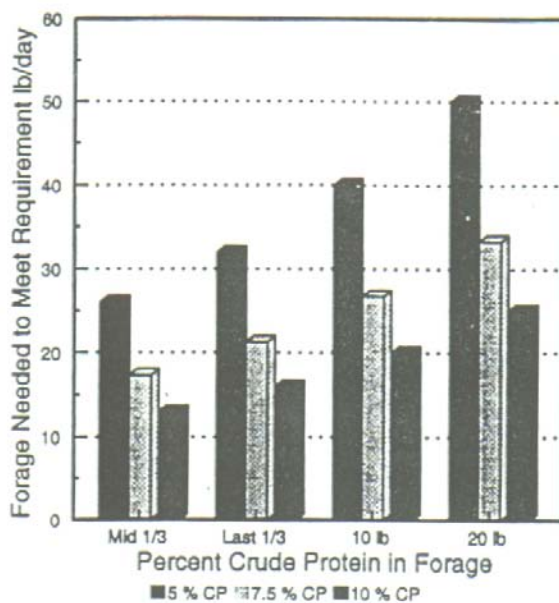


Fig. 1. Amount of various forages (dry matter basis) needed to meet protein requirements of a 1000 pound cow during pregnancy and lactation

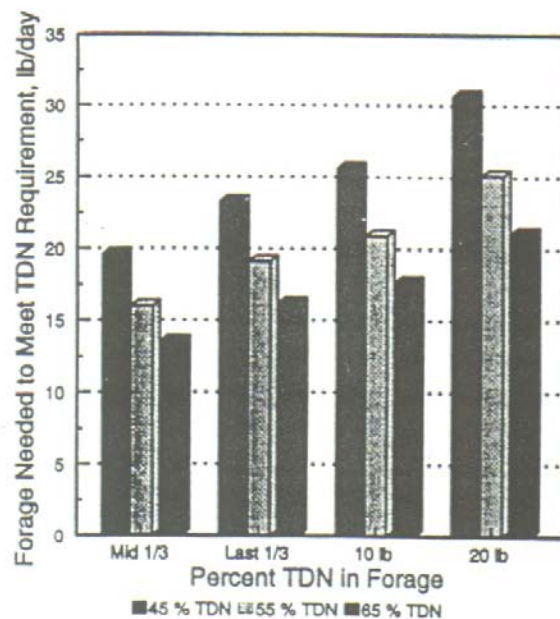


Fig. 2. Amount of various forages (dry matter basis) needed to meet TDN requirements of 1000 pound cow during pregnancy and lactation

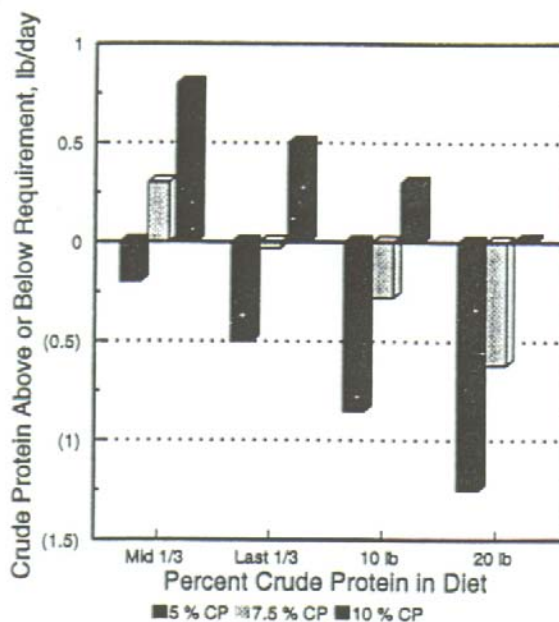


Fig. 3. Relationship between protein density in a forage and protein balance for a 1000 pound cow during pregnancy and lactation

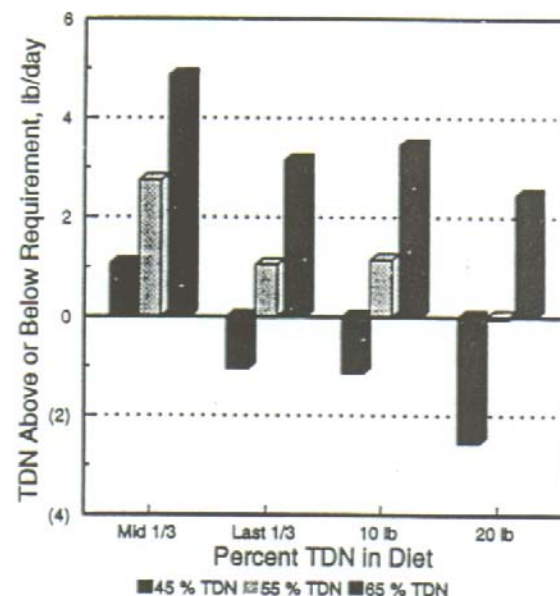


Fig. 4. Relationship between protein density in a forage and protein balance for a 1000 pound cow during pregnancy and lactation

For Figs. 3 and 4, daily dry matter forage intake was assumed to be 21, 23, and 25 pounds for the last 1/3 of pregnancy, 10 pounds of milk production, and 20 pounds of milk production, respectively (Villalobos et al. 1993, Hollingsworth et al. 1994).

while lactating cows grazing range at the same time lost body condition. They also found that lactating cows grazing subirrigated meadow regrowth (12.3% crude protein) gained body condition from September to November.

Cows consuming a forage containing 55% or more TDN would meet requirements for all stages of the production cycle and up to 20 pounds of milk production. Many studies report digestibility values for range forage of over 50% during most of the year. Low digestibility values for range forage are reported during cold or harsh winter conditions. A cow would not be able to consume enough of a 45% TDN forage to meet requirements of the last third of pregnancy or milk production. Protein may be limiting before TDN in many western range diets (Adams and Short 1988).

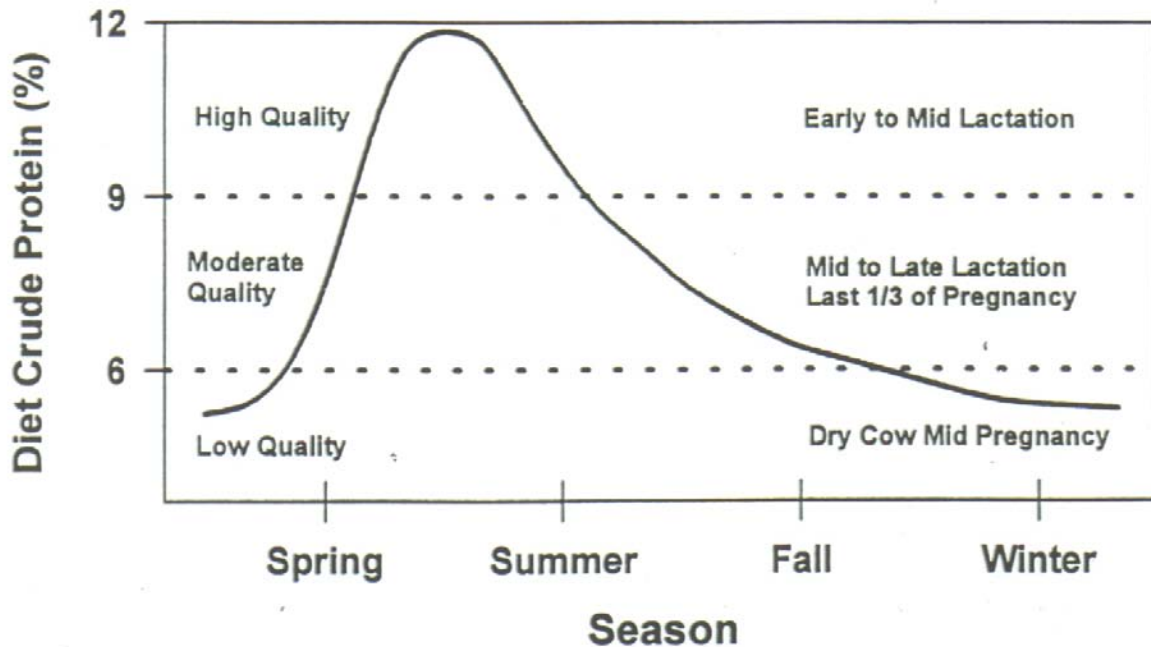
### **Matching the cow to range forage**

The mismatch between nutrient density and cow requirements may result from 1 or more of 3 situations related to lactation. First, high requirements (i.e., late pregnancy and lactation) for cows calving in late winter or early spring occur before green grass when grazed forages have low concentrations of protein and energy. The problem is exacerbated by high milk production and usually mitigated by feeding of hay or supplements. Second, the amount of milk a cow produces may exceed what the forage will support at certain times of the year (Adams et al. 1993). Third, late fall weaning results in cow requirements greater than low protein forages can support, even at a low level of milk production (Short et al. 1994).

We suggest that the cow is matched best with the range forage when peak lactation occurs near the highest density of protein in the forage and when milk production potential in the cow herd is moderate and weaning occurs before significant amounts of body condition are lost. Conversely, low requirement stages (e.g., dry cow) are matched with low nutrient density in the forage. Figure 5 illustrates the seasonal forage quality changes and cow status association.

Lactation and pregnancy are more critical in matching the cow to the forage resource than body size because of the need for greater nutrient density in the forage. Increased requirements for cow size do not require greater nutrient density because large cows have increased capacity to eat. However, both cow size and amount of milk produced affect stocking rate. Increasing either body size or milk production increases the amount of forage needed to sustain the cow.

Winter weather can result in a nutrition imbalance for cattle grazing on range. Intake and digestibility of range forage are likely to be lower during periods of cold weather (Adams 1987). Results of a high energy requirement because of cold and low forage intake generally result in loss of body weight and body condition. The coldness and length of cold weather determine impacts on the cow. Snow presents a nutritional limitation when it is deep or when it thaws and freezes creating a crust. In both cases, the problem is limited access to forage.



**Fig. 5. General seasonal changes of crude protein in association with requirements at different stages of lactation and pregnancy. Actual relationship of crude protein and season is dependent on location and plant community composition.**

In a spring calving system, body condition of the cow at the beginning of the winter grazing period is important. There is little evidence that cows can gain body condition during winter grazing (Sanson et al. 1990, Villalobos 1993). Generally, cows will be in similar condition at calving as to when they entered the fall-winter grazing period or they will be thinner.

### **Adjusting forage to match the cow**

Seeded range or pasture provide an opportunity for cool or warm season forages to fill a void in the natural production systems. Grasses such as crested wheatgrass and Russian wildrye have potential to provide green forage up to 3 weeks earlier in the spring than native range.

Coady and Clark (1993) found that producers in Nebraska's Sandhills seldom graze cattle on meadows in the spring despite the fact that meadows are dominated by cool season species and would offer a relatively high quality forage sooner than uplands. The general spring management practice is to feed hay, which is expensive.

Other opportunities for extending grazing with complimentary grazing include crop residues such as corn and sorghum stalks for fall and winter. If grazing is managed properly, stalks will provide a relatively high quality diet (Clanton 1989). Crop residues are not always located adjacent to range or pasture but even with trucking costs, residues may be an economical way to extend grazing and reduce feed costs.

When standing range or pasture forages will not meet cow requirements, harvested forages, grains, and protein concentrates have generally been fed as either supplements or the full diet. Supplements with grazed forages are likely to have lower costs and greater net returns than feeding a full diet (Adams et al. 1994). Generally, protein supplements have been more effective for utilizing low quality forages than energy from grain supplements. Protein supplements have maintained body condition of cows nursing calves on dormant forages in the fall (Short et al. 1994), and dry cows during winter on range (Villalobos 1993). Grain supplements have often not maintained cows grazing winter range (Sanson et al. 1990). The first limiting nutrient is rumen degradable protein. Grain supplies energy for both the rumen microorganisms and the cow, but exacerbates the degradable protein deficiency. If sufficient rumen degradable protein is supplied, then grain is an effective source of energy.

Adjustments in date of harvest of forages can help reduce costs for systems requiring hay. Harvesting forages when plants are immature increases the concentration of crude protein and TDN (Nichols 1991, Reece et al. 1994). Hays with higher density of crude protein and TDN can be fed when nutrient requirements are high, such as after calving, and reduce the need for supplements. Additionally, high protein grass or legume hay can be fed as a protein supplement for cows grazing low quality forages. Harvesting younger forage for high protein often sacrifices yield. Therefore, portions of hay acreage could be harvested at later dates for higher yield and that lower quality hay can be used for maintenance when cow nutrient requirements are lowest (i.e., dry cow in mid pregnancy).

### **Adjusting the cow to match the forage**

The amount of harvested and purchased feeds required to sustain a cow herd is highly correlated with dates of calving and weaning. Researchers and others have long been aware of these facts, and the majority of research has been directed towards adjusting the forage system to meet animal requirements and maximizing animal production rather than adjusting livestock reproduction cycles to meet the forage resource.

Seventy-five percent of Sandhill producers surveyed calved cows before 10 March (Clark and Coady, 1992). This matches the highest nutrient requirements of the cow with the lowest nutrient value of the forage resource. Thus, significant inputs of harvested and processed feeds are required to ensure that a high percentage of the cows rebreed and produce a calf the following year. Furthermore, fewer producers are utilizing forages for growing calves after weaning due to calf size at weaning and market timing.

Changing calving date is an alternative approach for matching nutrient requirements of cattle with nutrient content of natural forages. Such an adjustment can be made by most producers who utilize range or pasture. The concept of adjusting calving date is to synchronize calving season with growth of range and/or pasture. In some cases, production might be made more profitable by moving calving date a few weeks to several months. The general concept is that calving might begin from 2 weeks before and a month after the range is growing and ready if range is ready for grazing in early May then calving season might begin from late April to early June. Calving then would match the highest nutrient requirements of the cow with the highest

nutrient density of range and pasture forage. We estimate that 2,000 pounds of harvested forage can be saved per cow each year with summer (June) versus early spring (February-March) calving on ranches in Nebraska's Sandhills and other Northern and Central Great Plains states. Changing the calving date may also offer more opportunities to grow calves on a forage diet by overwintering and grazing yearlings on range the next year (Klopfenstein 1991). Changing the calving date affects the entire ranch operation. The profitability of such a change depends on the effects on production levels, marketing, and total input needs, including labor. Peak labor demands will shift and could interfere with labor needs in other parts of the operation. Overall profitability may depend on date of weaning and whether or not ownership is retained on calves through their life cycle. Marketing strategies will change if calving season is changed more than a few weeks. For example, feeder steer prices in western Nebraska and eastern Wyoming tend to peak February to April. Producers who calve later may be able to take advantage of that seasonal price trend. On the other hand, slaughter steer prices tend to be lowest late July to September. Calves from summer calving that are grown for a short period and finished could hit the seasonal low price period for fed cattle.

Adjusting weaning dates is another alternative to reduce nutrient requirements for cows. Weaning calves will remove the nutrient need for lactation and may be helpful when nutrient density of available forages is low.

### **Economic benefit from extending grazing**

A study in Nebraska's sandhills (Adams et al. 1994) compared 6 systems combining 3 winter and 2 spring grazing and hay feeding systems. The most profitable and least risky systems involved winter grazing on range or subirrigated meadow and grazing subirrigated meadow in May (nontraditional in the area). The May grazing of meadows places spring calving, lactating cows on green grass earlier than is possible on upland Sandhills range when their nutritional requirements are high, thus reducing the need to feed hay and supplemental protein. The least profitable and most risky system included hay in both winter and May. Forage and feeding costs made hay feeding systems lower in profitability and higher in risk. The most profitable systems took advantage of matching cow nutritional requirements with the nutritional value of the native grasses. Grazing of both range and meadows in the winter provided adequate energy, but protein supplement was needed.

## **CONCLUSIONS**

Systems which reduce the need for feeding hay can improve profitability of a cow/calf operation. Grazing complementary forages and grazing during the winter are two systems that seem to work. If a ranch does not have complementary forages or range for winter grazing, crop residues may improve profitability over feeding harvested forages. Changing calving and weaning dates are other methods that appear to hold promise as methods to synchronize the cow's nutrient needs with grazed forages. Producers, however, must realize that cow size and milk production potential are important determinants of overall nutrient needs. High milk production potential may create nutrient imbalance in a more subtle manner when nutrient density of forage is low and cows cannot consume adequate volume to meet nutrient needs.

## REFERENCES CITED

- Adams, D.C. 1987. Influences of winter weather on range cattle, p. 23-29. Proc. Grazing Livestock Nutr. Conf. Jackson, Wyo.
- Adams, D.C., R.T. Clark, S.A. Coady, J.B. Lamb, and M.K. Nielsen. 1994. Extended grazing systems for improving economic returns from Nebraska sandhills cow/calf operations. J. Range Manage. 47:258-263.
- Adams, D., J. Lamb, and G. Deutscher. 1994. Weaning and forage effects on two-year-old heifers. p. 10-12. *In*: Proc. Univ. of Nebr.-Lincoln Gudmundsen Sandhills Lab. Field Day Research Rep. WCC 94-01.
- Adams, D.C., and R.E. Short. 1988. The role of animal nutrition on productivity in a range environment. *In*: Achieving Efficient Use of Rangeland Resources. R.S. White and R.E. Short (Eds.) Published by Montana Agr. Exp. Sta., Bozeman, Mont., Feb. p. 37-43.
- Adams, D.C., R.E. Staigmler, B.W. Knapp, and J.B. Lamb. 1993. Native or seeded rangeland for cows with high or low lactation. J. Range Manage. 46:474-478.
- Allison, C.D. 1985. Factors affecting forage intake by range ruminants: A review. J. Range Manage. 38:305-311.
- Clark, R.T., and S.A. Coady. 1992. Ranch management practices in the Sandhills of Nebraska: Managing the ranch business. Agr. Res. Div., Inst. Agr. and Natur. Resources, Univ. of Nebr.-Lincoln, Res. Bull. RB-316.
- Clanton, D.C. 1989. Grazing cornstalks-A review. p.11-15, Beef Cattle Rep., Univ. Nebr.-Lincoln, MP 54. Lincoln, Nebr.
- Coady, S.A., and R.T. Clark. 1993. Ranch management practices in the Sandhills of Nebraska: Managing production. Agr. Res. Div., Inst. Agr. and Natur. Resources, Univ. of Nebr.-Lincoln, Res. Bull. RB-318.
- Dziuk, P.J., and R.A. Bellows. 1983. Management of reproduction of beef cattle, sheep and pigs. J. Ani. Sci. 57:355-379 (Supp. 2).
- Economic Research Service. 1994. Costs of production--Major field crops and livestock and dairy, 1991. U.S. Dep. of Agr., ECIFS 11-3, Washington, D.C.
- Klopfenstein, T.J. 1991. Low-input, high-forage beef production. *In*: Sustainable Agr. Res. and Education in the Field. A Proc. National Acad. of Sci.
- Lardy, G., D. Adams, T. Klopfenstein, and J. Lamb. 1994. Seasonal changes in crude protein of diet samples from sandhills upland range and subirrigated meadow. p. 26-27. Proc. Univ. of Nebr.-Lincoln Gudmundsen Sandhills Lab. Field Day. WCC 94-01.
- Nichols, J.T. 1991. Management practices for subirrigated meadows in Nebraska. p. 39-49. *In*: Gudmundsen Sandhill Lab., Res. Rep., 1987-1991. Univ. of Nebr., Field Day Research Rep. WCC 91-01.
- NRC. 1984. Nutrient requirements of beef cattle. Sixth rev. ed. Nat. Acad. of Sci., Nat. Res. Council, Washington, D.C.
- Reece, P.E., J.T. Nichols, J.E. Brummer, R.K. Engel, and K.M. Eskridge. 1994. Harvest date and fertilizer effects on native and interseeded wetland meadows. J. Range Manage. 47:178-183.
- Sanson, D.W., D.C. Clanton, and I.G. Rush. 1990. Intake and digestion of low-quality meadow hay by steers and performance of cows on native range when fed protein supplements containing various levels of corn. J. Anim. Sci. 68:595-603.
- Short, R.E., R.B. Staigmler, R.A. Bellows, D.C. Adams, and J.G. Beradinelli. 1994. Effects of

- suckling on postpartum reproduction. p. 179-187. *In*: M.J. Fields and R.S. Sand (Eds.), Factors Affecting Calf Crop. CRC Press, Inc. Boca Raton, Fla.
- Valentine, J.F. 1990. Grazing Management. p. 130-136. Academic Press, Inc., San Diego, Calif.
- Vavra, M., and R.J. Raleigh. 1976. Coordinating beef cattle management with the range resource. *J. Range Manage.* 29:449-452.
- Villalobos, G., D. Adams, J. Nichols, T. Klopfenstein, and J. Lamb. 1993. High quality meadow hay as a winter supplement for gestating beef cows in the Sandhills of Nebraska. p. 8-10. *In*: 1993 Beef Cattle Rep., Agr. Res. Div., Inst. of Ag. and Natur. Resources, Univ. of Nebr.-Lincoln. p. 8-10.