

Matching the Cow with Forage Resources

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Profitability of beef production depends on quantity of beef produced, prices received, and production costs. Producers generally have more control over the quantity of beef produced and costs than prices received. Reducing production costs while maintaining output levels will reduce costs per unit of output.

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

Background

While grazing lands are the base resource and investment, harvested forages, grain, and supplements made up 35–40% of total variable, cash costs in north central, Great Plains, and western cow-calf operations in 1992 and 1993 (Economic Research Service 1995). Adams et al. (1994b) reported that extending the grazing season in early spring and/or more winter grazing increased returns per cow \$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 nutrient requirements for animals are matched with nutrient output of forages, purchased feeds and labor can be reduced without reducing animal productivity.

Compared to cows in moderate body condition, thin cows or cows in low body condition at calving are more likely to breed late in a 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 rangelands are highly cyclical, within and between years. Precipitation, plant species, and the proportion of cool and warm season species 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 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).

Nutrient Requirements of the Cow

Cow size, milk production, pregnancy, and activity are the primary influences on nutrient needs of cattle. The larger the cow, the more energy and protein required for maintenance. 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 requirements increase with increasing milk production.

Figure 1 demonstrates the relationship between the density of crude protein in a forage and the amount of forage needed to meet the crude protein requirements of a 1000 lb cow during mid- and late-pregnancy and at 2 levels of milk production. As requirements for pregnancy and lactation increase, the amount of forage needed increases at all densities of crude protein. The greatest amount of forage needed is for a cow producing a high level of milk.

Plant-animal Interactions

The fibrous, bulky nature of forage and low concentration of crude protein limit the amount of forage an animal consumes. 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. Figure 2 shows the relationship between crude protein density in the

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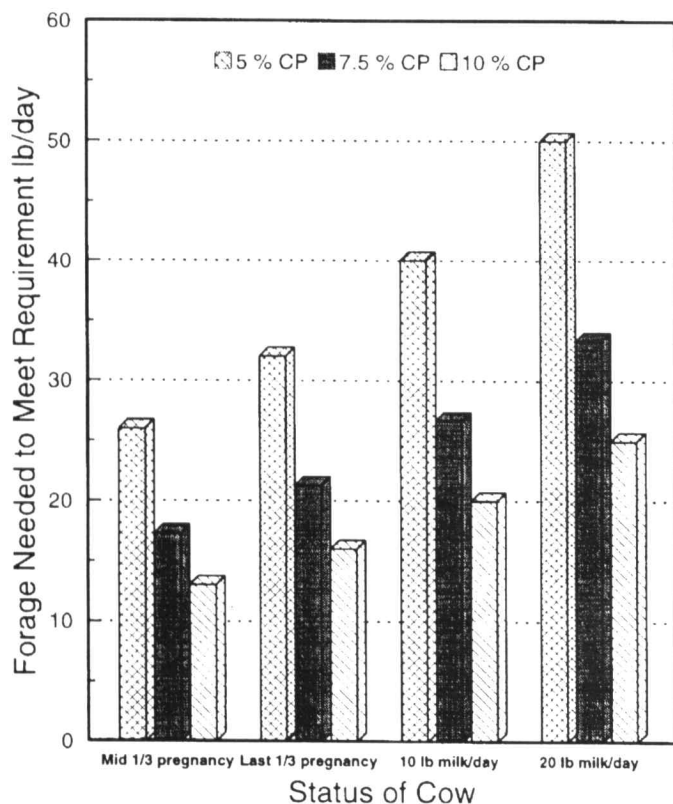


Fig. 1. Amount of forages with differing quality (dry matter basis) to meet protein requirements of a 1000 pound cow during pregnancy and lactation.

forage and the ability of a 1000 lb cow to consume adequate forage to meet crude protein 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. Dormant fall-winter range will likely not support milk production and maintain cow body weight and body condition without supplementation (Adams et al. 1994a, Short 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.

Cows consuming a forage containing 55% or more total digestible nutrients 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. Digestibility values below 50% for range forage are reported for cold winter conditions. A cow would not be able to consume enough of a forage containing 45% total digestible nutrients to meet requirements of the last third of pregnancy or milk production. Protein may be limiting before energy in many western range diets.

Matching the Cow to Range Forage

The mismatch between nutrient density and cow requirements may result from several situations related to lacta-

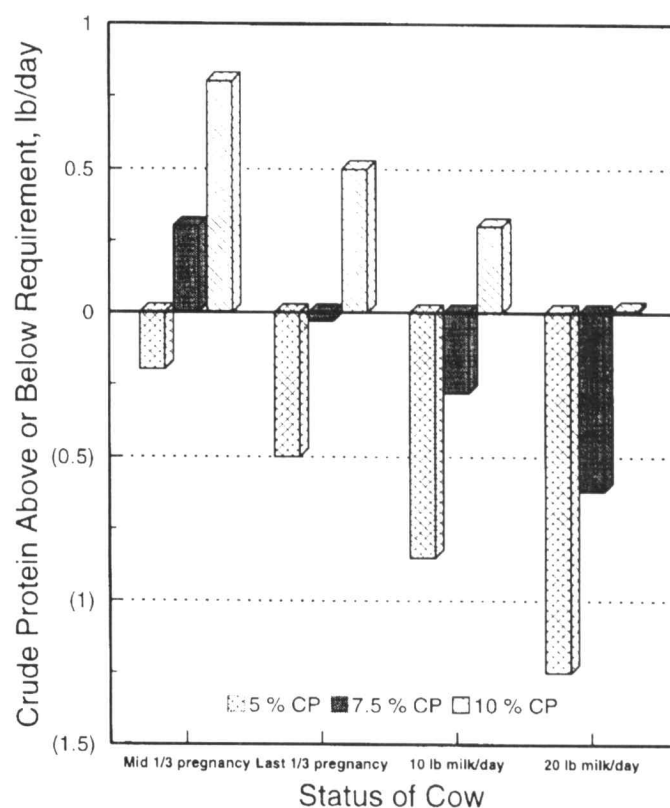


Fig. 2. Relationship between protein density in a forage and protein balance for a 1000 pound cow during pregnancy and lactation. (Daily dry matter forage intake was assumed to be 21, 23, and 25 pounds for the last 1/3 of pregnancy, 10 pounds of milk production, and 20 pounds of milk production, respectively (Villalobos et al. 1993, Hollingsworth-Jenkins/1994)

tion. 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 that which the forage will support at certain times of the year. Third, late fall weaning results in cow requirements greater than low protein forages can support, even at a low level of milk production.

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 3 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.

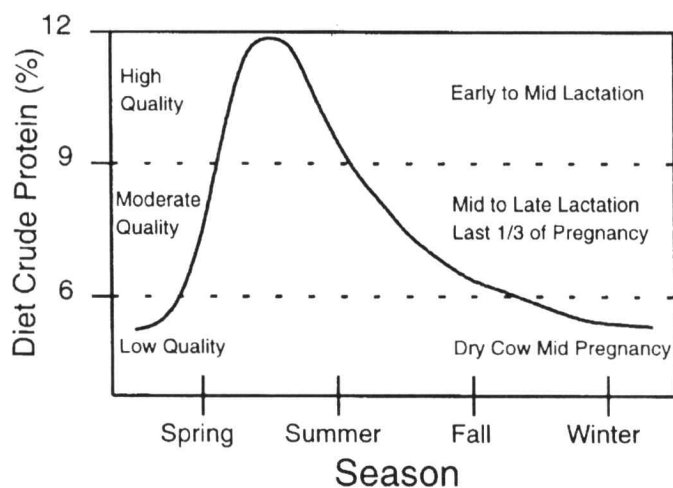


Fig. 3. Matching the cow with forages: General seasonal changes of crude protein (forage quality) in association with requirements at different levels of lactation and stages of pregnancy. Actual relationship of crude protein and season is dependent on location and plant community composition.

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 may be lower during cold weather. A high energy requirement because of cold and low forage intake generally

results in loss of 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, thus limiting access to forage.

In a spring calving system, body condition of the cow at the beginning of the winter grazing period is important. There is evidence that with or without supplemental feeding cows cannot gain body condition during winter grazing (Sanson et al. 1990, Villalobos et al. 1993).

Adjusting Forage to Match the Cow

Seeded cool or warm season forages can 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 complementary grazing include crop residues such as corn and sorghum stalks for fall and winter. If grazing is managed properly, stalks provide a relatively high quality diet. 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.



Early spring calving in the Nebraska Sandhills.



Hay on a subirrigated meadow in the Nebraska Sandhills

When standing range or pasture forages will not meet cow requirements, harvested forages, grains, and protein concentrates are 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. 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 et al. 1993). Grain supplements have not maintained body weight of 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 (Reece et al. 1994). Hays with higher density of crude protein can be fed when nutrient requirements are high 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.

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, but 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 cows with the lowest nutrient value of forages. 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. The concept of adjusting calving date is to synchronize calving season with growth of range and/or pasture. Calving might begin from 2 weeks before to a month after the range is growing. If range is ready for grazing in early May then calving season might begin from



Hay on a subirrigated meadow in the Nebraska Sandhills showing after harvest regrowth.

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 date 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 compared winter and spring grazing and hay feeding systems (Adams et al. 1994b). The most profitable and least risky systems involved winter grazing on range or subirrigated meadow and grazing subirrigated meadow in May. May grazing of meadows places spring calving, lactating cows on green grass earlier than is possible on upland 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.

Conclusions

Reducing 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 prof-

itability over feeding harvested forages. Changing calving and weaning dates 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 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. and R.E. Short. 1988.** The role of animal nutrition on productivity in a range environment. p. 37–43. *In: Achieving Efficient Use of Rangeland Resources.* R.S. White and R.E. Short (Eds.) Published by Mont. Agr. Exp. Sta., Bozeman, Mont.
- Adams, D.C., J.B. Lamb, and G.H. Deutscher. 1994a.** Weaning and forage effects on two-year-old heifers. p. 10–12. *Proc. Univ. of Neb.-Lincoln Gudmundsen Sandhills Res. Rep. 1991–1994.* WCC 94-01.
- Adams, D.C., R.T. Clark, S.A. Coady, J.B. Lamb, and M.K. Nielsen. 1994b.** Extended grazing systems for improving economic returns from Nebraska sandhills cow/calf operations. *J. Range Manage.* 47:258–263.
- 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 Neb.-Lincoln, Res. Bull. RB-316.*
- 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 Neb.-Lincoln, Res. Bull. RB-318.*
- Dziuk, P.J. and R.A. Bellows. 1983.** Management of reproduction of beef cattle, sheep and pigs. *J. Anim. Sci.* 57:355–379 (Supp. 2).
- Economic Research Service. 1995.** Economic indicators of the farm sector? Costs of production 1993—Major field crops and livestock and dairy, 1991. U.S. Dep. of Agr., ECIFS 13-3, Washington, D.C.
- Hollingsworth-Jenkins, K.J. 1994.** Escape protein, rumen degradable protein, or energy as the first limiting nutrient of nursing calves grazing native sandhills range. Ph.D. Thesis, Univ. of Neb.-Lincoln. Lincoln, Neb.
- Klopfenstein, T.J. 1991.** Low-input, high-forage beef production. *In: Sustainable Agr. Res. and Education in the Field. A Proc. Nat. Acad. of Sci.*
- 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. Staigmiller, 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. *In: 1993 Beef Cattle Rep., Agr. Res. Div., Inst. of Agr. and Natur. Resources, Univ. of Neb.-Lincoln.* p. 8–10.