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SUPPLEMENTATION AND WEANING STRATEGIES TO OPTIMIZE REPRODUCTIVE PERFORMANCE

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Introduction

Understanding nutrient requirements of the cow, nutrient content of grazed forages and how nutrient requirements of the cow interact with nutrient content of grazed forages is essential to manage cow body condition score (BCS) and reproductive efficiency in extended grazing systems. Weaning the calf and supplementation of the cow are means to manage cow body condition and reproductive efficiency in extended grazing systems (Adams et al., 1996). Decisions of incorporating weaning and supplementation practices into extended grazing systems should be made on expected impacts on the full production system rather than a segment or segments of a system.

Cow Requirements, Plant Nutrients, Plant Animal Interactions

Nutrient requirements of the cow. Briefly, nutrient requirements of cows with two levels of peak milk production for a 12-month production cycle are shown in Table 1 (NRC, 1996). Nutrient requirements of the cow increase with increasing milk production and advancing pregnancy. Cows that give more milk have greater nutrient requirements than cows that give less milk. During the 12-month production cycle of a cow, protein and energy requirements are greatest during peak lactation (e.g. about 6 weeks after calving) and are lowest for a dry cow (e.g. at weaning) in early pregnancy. Nutrient requirements of the cow increase rapidly during the last 3 months of gestation.

Nutrients in grazed plants. Seasonal changes in nutrient density of rangeland and pasture forages are primarily associated with plant maturity. Plants in a vegetative state generally contain over 10 % crude protein and may be 70% digestible (Adams and Short, 1988; Lardy et al., 1997). After grasses reach maturity, they rapidly decline in protein content and digestibility. Digestibility of diets from cows grazing mature range forage may be near 50% (Fig. 1). In general, diets from dormant range contain between 5 and 7% crude protein with higher concentrations occurring in late summer and early fall and lower concentrations occurring during late fall and winter (Fig. 2). Crude protein content of 5% is common in range forages during late fall and winter (Adams and Short, 1988; Lardy et al., 1997). Nutrient deficiencies in the cow are probable during lactation (Adams and Short, 1988; Adams et al., 1993; Lamb et al., 1997; Lardy et al., 1999), late gestation and/or in the fall and winter when nutrient content of grazed forages is low (Villalobos et al., 1997; Patterson et al., 2003). Dormant fall-winter range will not likely support milk production or late gestation and maintain cow body condition without supplementation (Lamb et al., 1997; Short et al., 1996; Ciminski, 2002).

Table 1. Milk production, protein and energy requirements for a 1200 lb cow with either 20 lb/day or 25 lb/day peak milk production.[a]

Item	Month since calving											
	1[b]	2	3	4	5	6	7[c]	8	9	10	11	12
20 lb peak milk production												
Milk, lb/day	17	20	18	14	11	8	0	0	0	0	0	0
MetProt[d] gram/day	824	903	856	772	688	20	443	456	479	518	583	684
NE_m[e] Mcal/day	15.8	16.9	16.3	15.1	14.0	13.1	9.0	9.3	9.9	10.8	12.1	14.1
25 lb peak milk production												
Milk, lb/day	21	25	23	18	14	10	0	0	0	0	0	0
MetProt[d] gram/day	923	1021	963	857	752	666	443	456	479	518	583	684
NE_m[e] Mcal/day	17.2	18.6	17.8	16.3	14.9	13.7	9.0	9.3	9.9	10.8	12.2	14.2

[a] Data was generated by “Tables” in NRC (1996) computer model
[b] Months 1 through 6, the cow is lactating
[c] Months 7 through 12, the cow is dry (shaded area)
[d] MetProt is metabolizable protein
[e] NE_m is net energy maintenance

Plant animal interactions. As forages mature, passage of forage through the cow’s digestive tract becomes slower and volume of undigested forage increases in the reticulo-rumen (Lamb, 1996). Slower passage rate and increased fill or undigested forage can restrict the amount the cow can eat (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. A cow consuming a forage containing 5 to 6% crude protein is not likely to consume enough forage to meet protein requirements during lactation or late gestation (NRC, 1996). Winter forages are generally low in protein and digestibility (Adams and Short, 1988; Lardy et al., 1997). Nutrient intake (quantity and quality of diet), amount of nutrient reserves (measured by body condition) and competition for nutrients for other functions such as lactation can affect the ability of the

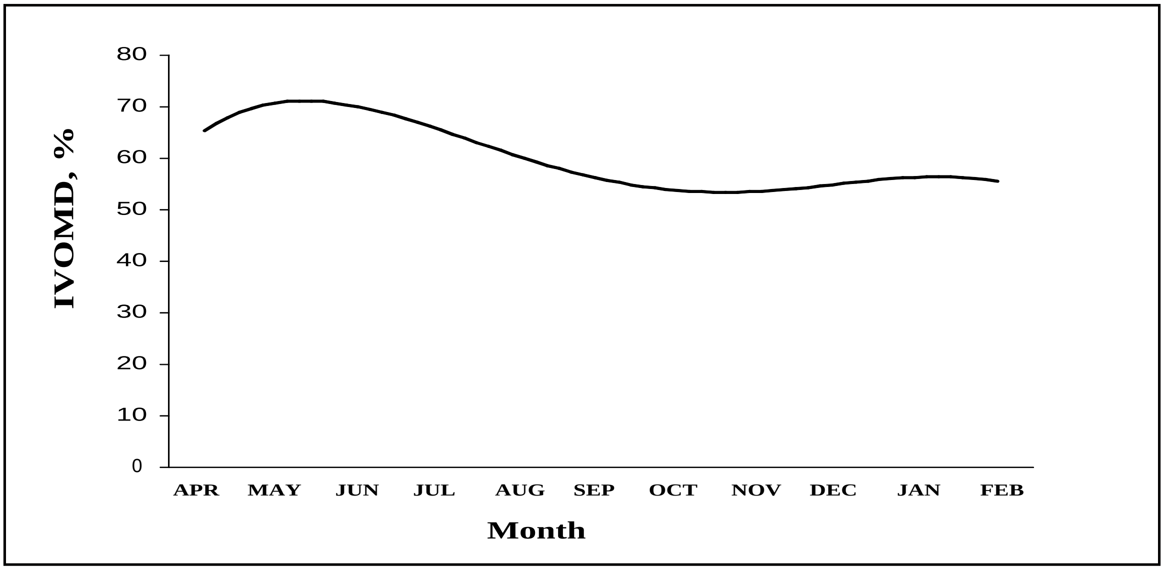

Fig. 1. *In vitro* organic matter digestibility (IVOMD, % OM) of cattle diets on Sandhills range. Adapted from Lardy et al. (1997).

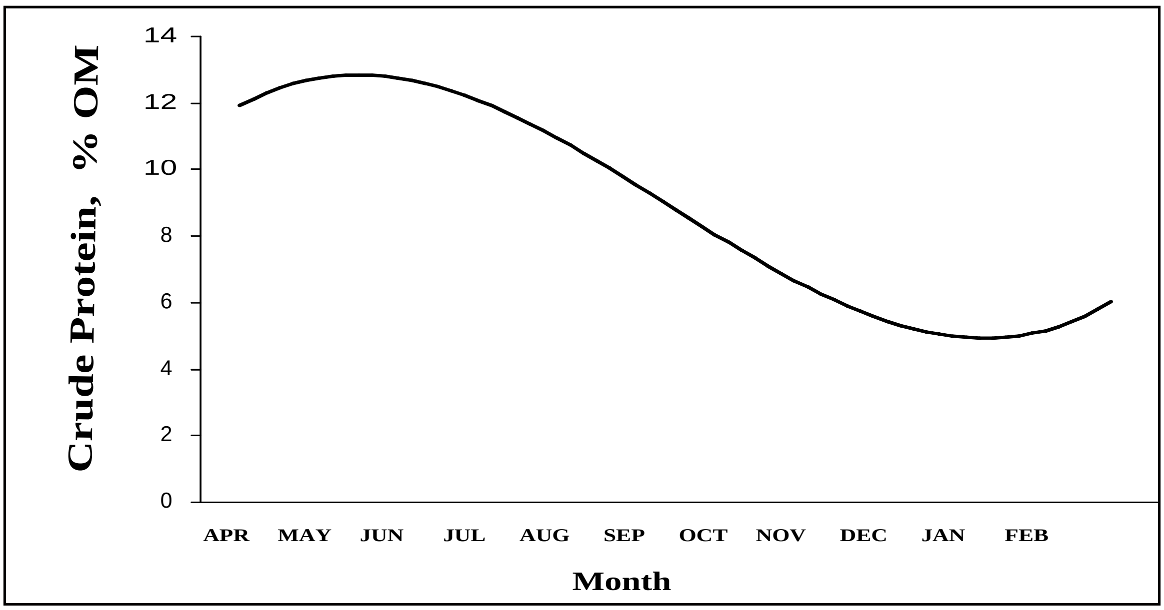

Fig. 2. Crude protein in cattle diets on Nebraska Sandhills range. Adapted from Lardy et al. (1997).

cow to become pregnant (Short and Adams, 1988). A mismatch between nutrients the cow can consume from grazed forages and cow requirements may result from several situations related to lactation and pregnancy: 1) high nutrient requirements during late pregnancy for cows grazing winter range when forages are low in protein and digestibility; 2) weaning in late fall; 3) milk production when grazing mature forages. The amount of milk produced by the cow (Adams et al., 1993) and when milk production occurs are tools to synchronize animal requirements with forage nutrients (Adams et al., 2001) and improve profitability (Carriker et al., 2001).

Managing Cow Body Condition Score

In spring calving systems on the Northern Great Plains, cow body condition at the beginning of the winter grazing period is important. Cows generally do not gain body condition while grazing low quality winter forages with or without supplements (Villalobos et al., 1997; Ciminski, 2002). If cows are thin at the beginning of winter grazing, they are likely to be thin in the spring at calving (Adams et al., 1987; Ciminski, 2002). Weaning late in the fall (Short et al., 1996; Ciminski, 2002) and/or high milk production (Adams et al., 1993) can result in low body condition entering winter grazing.

Weaning, feeding supplements, grazing complementary forages or combinations of weaning and feeding supplements or grazing complementary forages can be used to prevent loss of BCS during late summer-fall grazing (Lamb et al., 1997; Short et al., 1996; Ciminski, 2002). Range forages are higher quality (e.g. they are more digestible and contain more protein) during late summer-early fall than during late fall-winter (Adams and Short, 1988; Lardy et al., 1997). The relatively high forage quality during late summer-early fall compared to late fall-winter provides an opportunity to either maintain or increase BCS of cows by weaning the calf (Ciminski, 2002), and/or weaning the calf and feeding a protein supplement during late summer or early fall grazing (Short et al., 1996). Grazing complementary forages in lieu of dormant range may also be a means to increase or maintain cow BCS during fall grazing (Lamb et al., 1997). Weaning, supplementation and complementary forage effects will likely be greater for cows that produce more milk than those that produce less milk (Adams et al., 1993).

Amount of milk production. The amount of milk produced by the cow is affected by selecting genetics for milk production that fit the forage resource. In Montana (Adams et al., 1993), spring calving cows with peak milk production of 23 lb lost 1.0 BCS grazing during August and September, while cows with peak milk production of 15 lb maintained body condition (i.e. no loss or no gain) during the August-September period. If cows regularly lose body condition in the late summer or early fall, the cows may have more potential to produce milk than the forage resource will support. Weaning, supplementation and bull selection are tools to manage BCS.

Weaning. Weaning the calf lowers the cow's nutrient requirements by eliminating nutrients needed for milk (Table 1). A dry cow will maintain body condition on lower quality forages than lactating cows. In Nebraska, March-born calves on 2-year-old cows were weaned in early September or early November (Lamb et al., 1997). Dry and lactating cows grazed on upland or subirrigated meadow during September and October. Dry cows on range maintained body condition (i.e. no gain or loss), while cows suckling a calf on range lost about 0.5 BCS. Dry cows on subirrigated meadow gained 0.6 BCS while cows suckling calves on subirrigated meadow had no gain or loss of BCS. Crude protein and digestibility were 7.6% and 55%, respectively, for range and 12.3% and 61%, respectively, for meadow. In another Nebraska study (Ciminski, 2002), calves were weaned at 2-week intervals beginning 18 August and ending 24 November. Body condition score from 18 August to 24 November declined linearly (0.1 body condition/2 weeks) as weaning date was moved to later in the fall. Cows weaned earlier than 13 October gained BCS over August-November, whereas cows weaned 13 October or later lost body condition.

Supplementation. In late gestation or if the cow is lactating and grazing low quality winter forages, the cow may not be able to eat enough to meet her nutrient requirements (Lardy et al., 1997). Protein supplements improve the nutritional status of cows by increasing digestibility and intake of low quality forages (Kartchner, 1980) and/or increasing nutrient flow of protein from the rumen to the intestines of cattle (Villalobos, 1993). When diets of cows grazing winter range were protein deficient, supplemental corn grain lowered digestibility and intake of forage (Kartchner, 1980) and resulted in loss of body weight (Sanson et al., 1990).

Feeding a protein supplement to cows during winter grazing has generally increased cow body weight and body condition at calving (Sanson et al., 1990; Villalobos et al., 1997; Ciminski, 2002). Protein supplements have also been effective in maintaining body condition of lactating cows during fall (Lardy et al., 1999; Short et al., 1996) or winter grazing (Hopkin, 2001). If feeding supplements is to be profitable, they must improve net returns.

Supplements need to be practical to handle so that associated delivery costs are kept to a minimum. It is generally accepted that pelleted protein supplement can be fed every other day or every third day without adversely affecting animal performance (McIlvain and Shoop, 1962). If the supplement is to be fed in a block or other free choice form, consumption must be regulated so cattle do not increase cost by over consumption. Remember that supplements are not a substitute for lack of forage.

Weaning And/Or Supplementation in Beef Systems

Summer-fall weaning date and supplementation of dry March calving cows during winter grazing (Ciminski, 2002). The impacts on economic returns of an August or November weaning date in combination with protein supplement or no protein supplement during winter grazing were studied in Nebraska. Cow BCS and body weights were lower throughout the year for cows with calves weaned in November compared to cows with calves weaned in August. Cow BCS for cows fed protein supplement were higher in March, May and June than for cows not fed protein supplement. The low cow BCS were 4.8 for supplemented cows vs. 4.4 for non-supplemented cows in May.

From December to March, cows from both August and November weaning dates lost 0.6 BCS. This loss in body condition was gained back May to June. Cull cow values were higher for cows with calves weaned in August than for cows with calves weaned in November due to a higher seasonal price received when sold and greater BCS and body weight at market time. Pregnancy rate and calving date were similar for weaning dates with and without protein supplement. Calves from cows fed protein were heavier than calves from cows not fed protein in August and November.

Supplemented cows had higher costs than non-supplemented cows and August weaning had lower cow costs than November weaning. Calves from the November weaning had higher gross revenues of $49.60/cow and $28.83/cow than the August weaned calves from both supplemented and non-supplemented cows, respectively. Net returns at weaning were $41.83/cow and $21.93/cow greater for non-supplemented cows than supplemented cows at August and November weaning dates, respectively.

August weaned calves were in the feedlot 50 days longer than November weaned calves. Feed cost was $56.75/steer and yardage cost was $15.20/steer greater for the August and November weaned calves from supplemented cows. August weaned steers were slaughtered in mid-May versus mid-June for the November weaned steers. August weaned calves were marketed $2/cwt higher than the November weaned calves. November weaned steers from supplemented cows were 55 lb and 101 lb heavier at slaughter than August weaned steers from non-supplemented cows and November weaned steers from non-supplemented cows, respectively. Additionally, hot carcass weight was 62 lb heavier for calves from supplemented cows than calves from non-supplemented cows. Calves weaned in November from supplemented cows returned $31.11/cow more net revenue through the feedlot than calves weaned in August from supplemented cows.

Winter-spring weaning date and supplementation during winter grazing of dry and lactating June calving cows. Hopkin (2001) evaluated the effects of protein supplement for non-lactating gestating June calving cows and extending grazing of June calving cows and their calves January through March. Non-lactating cows grazed sandhills range without supplement or grazed sandhills range with 1.0 lb/day of supplement. The supplement for the non-lactating cows was 47.9% cottonseed meal, 50% sunflower meal and 2.1% urea. Lactating cows were fed 2.26 lb/day of a supplement containing 69.3% soybean hulls, 25.2% soybean meal, 0.9% tallow and 4.6% urea. Supplements were formulated to meet degraded intake protein (DIP) and undegraded intake protein (UIP) requirements of non-lactating and lactating cows. Non-lactating cows that received supplement gained 0.24 BCS, non-lactating cows that did not receive supplement lost 0.55 BCS and lactating cows lost 0.72 BCS January through March. However, at the beginning of the breeding season, BCS was about 5.5 for non-lactating cows fed supplement, non-lactating cows not fed supplement and for lactating cows. The subsequent pregnancy rate was about 89% for all groups of cows. Total cost for the January through March grazing period were greatest for lactating cows and lowest for non-lactating cows not fed supplement (Table 2). Body weights of steers on to summer grass, off summer grass/into feedlot, slaughter weight, costs and breakevens are shown in Table 3 for 1999 and 2000. Feed and yardage costs were about $70.00 lower in 1999 and $77.00 lower in 2000 for calves wintered on cows on range compared to calves wintered in drylot. The lower wintering costs resulted in lower breakevens at the end of summer grazing as yearlings and at the end of finishing (e.g. slaughter) in both 1999 and 2000 for steers wintered on range compared to steers wintered in drylot.

Supplementation to meet metabolizable protein requirements of gestating March calving heifers during fall-winter grazing. Patterson et al. (2003) fed gestating heifers grazing fall-winter range protein supplements that met protein requirements based on either the crude protein (CP) system (NRC, 1984) or the metabolizable protein (MP) system (NRC, 1996). Body condition score at the beginning of calving in March was similar for heifers on the CP and MP regimes. However, pregnancy rate at the end of the subsequent breeding season was higher for heifers on the MP (91%) regime than for heifers on the CP (86%) regime. The improvement in the pregnancy rate of 2-year-old cows by supplementing to meet MP requirements improved the value of each bred heifer by $13.64.

Table 2. Cost of winter grazing and supplement for lactating and non-lactating June-calving cows grazing native winter range from January 6 to March 30.

Item	Treatment [a]		
	NLAC-NS	NLAC-S	LACT-S
Forage			
AUE[b]	1.1	1.1	1.5
Cost, $/AUM	15.00	15.00	15.00
Total cost of winter grazing, $	46.20	46.20	63.00
Supplement			
Cost, $/kg	-	0.09	0.09
Total cost of supplement, $[c]	-	9.68	17.64
Total costs, $	46.20	55.88	80.64

[a] Treatments: NLAC-NS = non-lactating cows without supplement, NLAC-S = non-lactating cows with protein supplement, LACT-S = lactating cows with protein and energy supplement

[b] Animal unit equivalent (Waller et al., 1986)

[c] Includes labor and equipment costs of feeding supplements

Recommendations

It is difficult to increase BCS of cows grazing low quality winter forages even when appropriate supplements are fed. Therefore, cows thin in the fall that graze low quality forages during winter will likely be thin at calving in the spring. The most effective ranch management scheme would be to have the cow in moderate body condition going into the winter, especially if low quality forages are the primary feed source for wintering the cowherd. To meet this objective, the following management strategies could be considered for the cow grazing dormant range through the late summer and fall.

Table 3. Costs, steer weights, and breakevens for steer calves wintered in drylot or on the cow on range followed by summer grazing and finishing in the feedlot (for 1999 and 2000).

Item	Drylot 1999	Range 1999	Drylot 2000	Range 2000
Body weight on summer grass, lb	536	478	564	507
Opportunity cost/weaned calf, $	351.66	365.52	394.66	387.52
Health, $	25.00	25.00	25.00	25.00
Winter feed cost, $	66.26	24.76	77.02	25.01
Yardage, $	28.25		29.00	
Summer grass costs, $	66.00	66.00	56.50	56.50
Interest at end of summer, $	21.62	19.42	22.41	19.03
Total cost end of summer, $	558.79	500.7	604.59	513.06
End of summer breakevens, $	77.14	68.96	76.64	68.53
Body weight end of summer, lb	686	683	757	703
Finishing feed cost, $	195.80	181.10	208.69	201.16
Yardage for finishing, $	44.70	44.70	45.00	45.00
Interest during finishing, $	18.57	16.72	20.07	17.39
Total costs, $	817.86	743.22	878.35	776.61
Slaughter weight, lb	1297	1284	1323	1219
End of finish breakevens, $	67.06	63.91	69.01	65.68

1. If cows are thin or appear to be losing condition, wean at an early date followed by protein supplementation. Remember, cows that produce more milk will be more adversely affected by declining nutrient content of forages in the late summer and early fall than cows that produce less milk.

2. If cows are in moderate body condition and a later weaning date is desirable, begin protein supplementation in late summer or early fall when forage nutritive value declines.

3. If cows are in moderate or higher body condition and an earlier weaning date will fit the production system, then wean the calf in early fall and delay feeding of supplement until later in the fall.

4. Late weaning (i.e. October or later) without supplemental protein is not recommended.

5. Feed a protein supplement to cows during winter grazing on range so that cows are in moderate body condition at calving.

6. Feed protein supplement to meet the metabolizable protein requirement with harvested forages to pregnant heifers as needed during winter grazing to maintain a BCS above 5.

7. Effects of weaning, supplementation and other practices on net returns will vary depending on marketing.

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NOTES