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SUPPLEMENTATION, WINTER COW NUTRITION

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INTRODUCTION

It is generally accepted that protein supplements help beef cows efficiently utilize dormant forages and maintain body condition score (BCS) during fall-winter grazing. Additionally, protein supplements fed during fall and winter may impact subsequent cow reproductive performance and calf growth. Applications of supplementation in different extended grazing systems are presented.

PLANT NUTRIENTS

Seasonal changes in nutrient density of range forages are primarily associated with plant maturity. After grasses reach maturity, they rapidly decline in protein content and digestibility (Table 1). In general, diets from dormant range contain between 5% and 7% crude protein (CP) with higher concentrations occurring in late summer and early fall and lower concentrations occurring during late fall and winter. Crude protein content of 5% is common in range forages during late fall and winter (Adams and Short, 1988; Lardy et al., 1997) (Fig. 1). Digestibility of diets from cows grazing mature forage may be near 50% (Fig. 2). Nutrient deficiencies in the cow are more 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).

Table 1. Effect of maturity on digestibility and protein content of crested wheatgrass hay (White and Adams, 1987).

Maturity	Dry matter digestibility	Crude protein (%)
First head (June 13)	63.0	11.7
Seed and soft dough (July 12)	57.8	6.9
Seed ripe (August 8)	55.4	6.6
95% seed disseminated (Sept	51.9	5.6

NUTRIENT REQUIREMENTS OF THE COW

Milk production and pregnancy increase nutrient requirements of the cow. Protein and energy requirements are greater during lactation than any other time of the 12 month production cycle of the cow. Nutrient requirements of the cow increase with increasing milk production and advancing pregnancy. Protein and energy requirements of the cow are about 20% and 14% greater during the last third of pregnancy than during the middle third of pregnancy (NRC, 1996). Net energy requirements of a cow through a 12 month production cycle are shown in Figure 3.

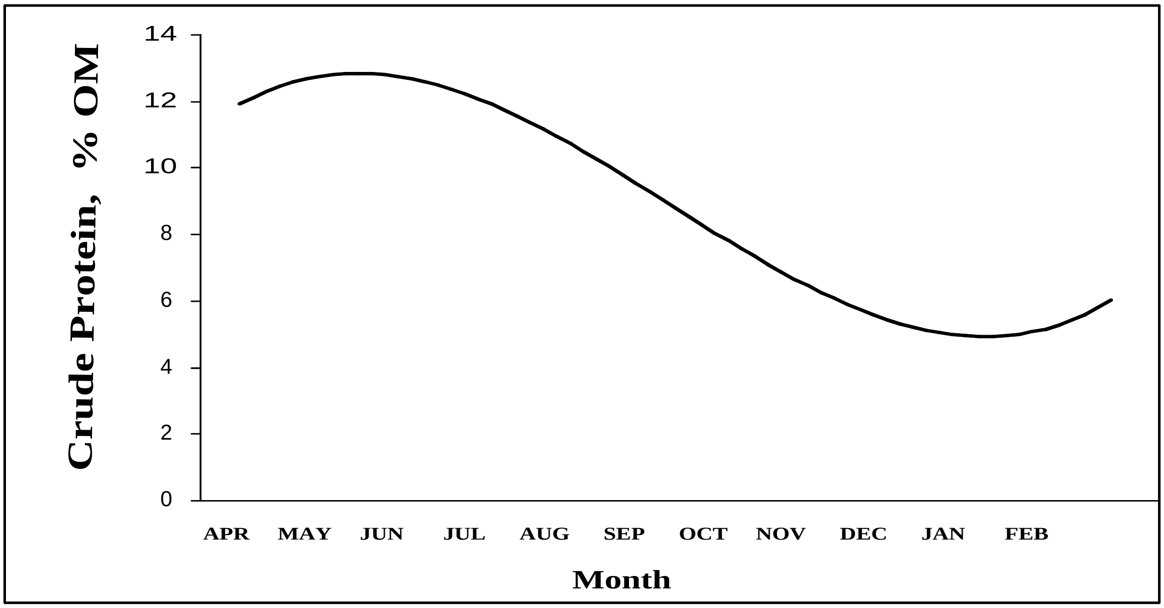

Fig. 1. Crude protein in cattle diets on Nebraska Sandhills range. Adapted from Lardy et al. (1997).

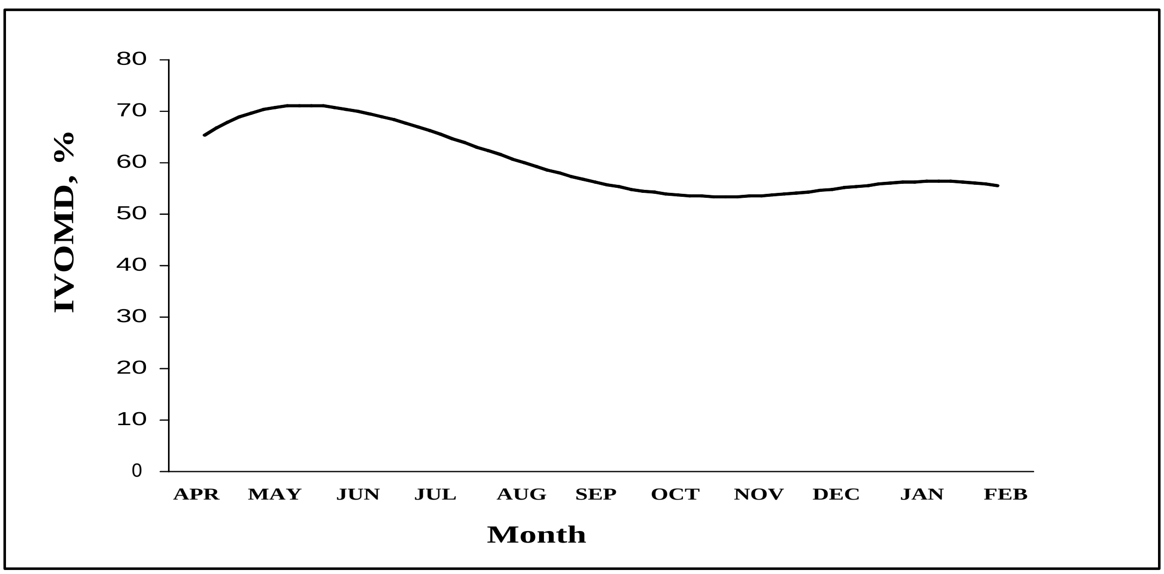

Fig. 2. *In vitro* organic matter digestibility (IVOMD, % OM) of cattle diets on Sandhills range. Adapted from Lardy et al. (1997).

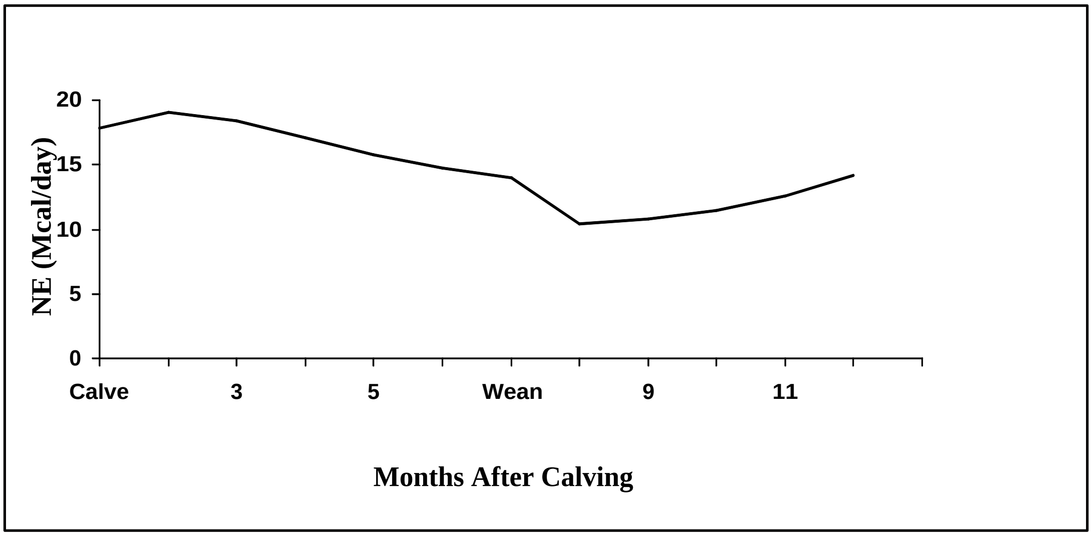

Fig. 3. Net energy requirements through a year-long production of a 1200 lb beef cow with 23 lb peak milk production. Adapted from NRC (1996).

A note on metabolizable protein: We have found the metabolizable protein (MP) system to be an improvement over the CP system for determining the protein needs of beef cattle (Patterson et al., 2003)**.** In 1995, the National Research Council (NRC 1996) adopted MP, a system that accounts for rumen degradation of protein and separates requirements into needs of microorganisms and the needs of the animal. MP is the protein absorbed by the intestine. MP is supplied by microbial crude protein (MCP) and undegraded intake protein (UIP). Some have referred to UIP as "escape protein." Degraded intake protein (DIP) is the protein used by rumen microbes. Some have referred to DIP as "rumen degradable protein." The MP system is particularly helpful in determining the protein needs for growth, pregnancy, and lactation, and in increasing the reliability of protein needs across the wide range of protein and TDN common in grazed forages.

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 may restrict the amount the cow can eat. 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). For example, when a cow is producing milk, her requirements are increased compared to a dry cow. If the cow is grazing an immature forage high in digestibility and protein, she needs to eat less forage to meet her requirements than if the forage is mature and is low in digestibility and protein. The relationship between the amount of forage needed to meet nutrient requirements and protein is shown in Figure 4. A similar relationship exists for energy or TDN. An important fact to remember is that cows generally eat fewer pounds of mature forages than immature forages.

Therefore, with mature forage diets, the cow consumes fewer nutrients in each pound of forage and also fewer pounds of forage. A dry cow in early to mid-pregnancy is more suited to grazing mature forages than a cow producing milk or in late pregnancy.

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, may affect the ability of the 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: first, high nutrient requirements during late pregnancy for cows grazing winter range when forages are low in protein and digestibility; second, weaning in late fall; and third, high milk production during certain times of the year.

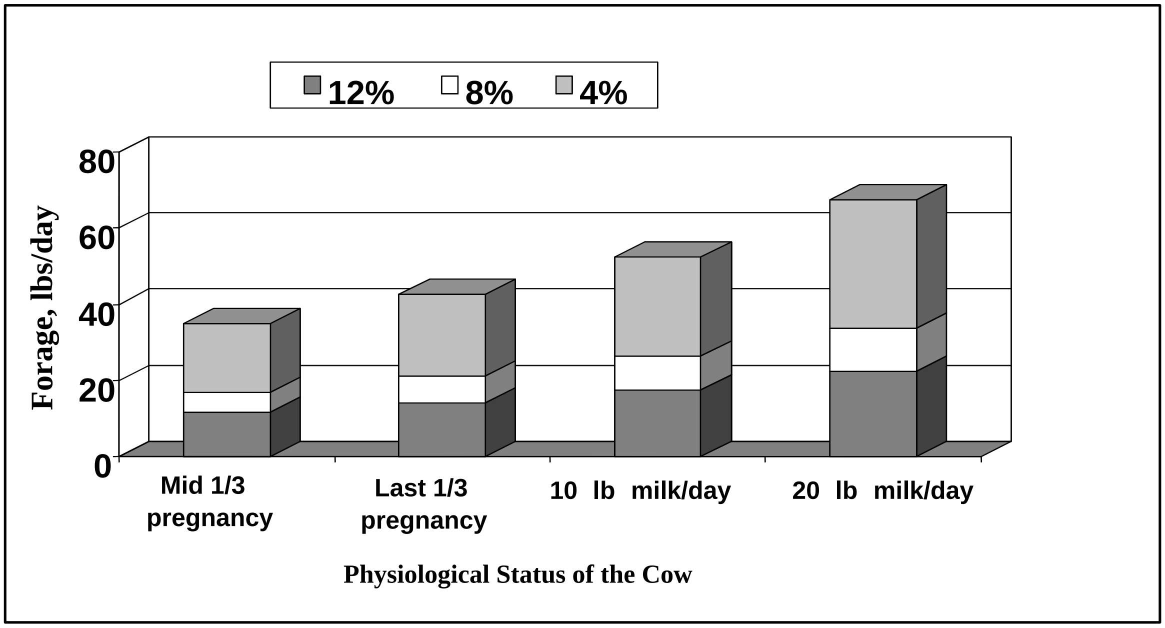

Fig. 4. Forage intake needed to provide protein required for pregnancy and milk (1200 lb. cow).

MANAGING COW BODY CONDITION SCORE

Cows generally do not gain body condition grazing mature 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 (Adams et al., 1987; Ciminski, 2002). Weaning in late fall (Short et al., 1996; Ciminski, 2002) and/or high milk production (Adams et al., 1993) generally result in low body condition entering winter grazing.

Weaning, supplements, grazing complementary forages or combinations of weaning and supplements or grazing complementary forages can be used to prevent loss of BCS during late summer-fall grazing. 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 higher forage quality during late summer-early fall compared to late fall-winter provides an opportunity to either maintain or increase BCS of cows by simply 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). Weaning effects are likely to be greater for cows that produce more milk than those that produce less milk (Adams et al., 1993).

If ample forage is available for grazing, milk production is likely the key factor in managing body condition during late summer and fall. The key questions are: is the cow producing milk, and, if so, how much?

The amount of milk produced by the cow is determined to a great extent by genetics for milk production. 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 the calf lowers the cow's nutrient requirements by eliminating nutrients needed for milk (NRC, 1996). 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 BCS/2 weeks) as weaning date was moved to later in the fall. Cows whose calves were weaned earlier than 13 October gained BCS over August-November, whereas cows whose calves were 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).

EXAMPLES OF SUPPLEMENTATION AND WEANING IN BEEF SYSTEMS

Example 1. Summer-fall weaning date and supplementation of dry cows during winter grazing (March calving cows)

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 (Ciminski, 2002). 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. Body condition scores for cows fed protein supplement were higher in March, May and June than for cows not fed protein supplement. 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. The average low cow BCS during the year-long production cycle of the cow was 4.8 for supplemented cows vs. 4.4 for non-supplemented cows in May.

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 a greater market grade (i.e. greater BCS) and more body weight to sell 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.

Costs, revenues and net returns for August and November weaning dates, and protein supplementation are shown in Table 2. Supplemented cows had higher costs than non-supplemented cows, and August weaning had lower cow costs than November weaning. Gross revenue per cow at weaning was higher for November weaning than August weaning. Net returns at weaning were greater for non-supplemented cows than supplemented cows and were lowest for cows that were supplemented and had calves weaned in August. The greatest net returns at weaning were for cows with calves weaned in August in combination with no protein supplement during the winter. Lowest net returns were for cows with calves weaned in August in combination with protein supplement fed during the winter.

August weaned calves were in the feedlot 50 days longer than November weaned calves. August weaned steers were slaughtered in mid-May versus mid-June for 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 returns through the feedlot than calves weaned in August from supplemented cows. Weaning in August in combination with feeding protein supplement during winter grazing had the lowest net returns at slaughter.

Table 2. Costs, revenues and net returns of cows for August or November weaning with protein supplementation (S) or without protein supplementation (NS) during winter grazing.

Item	August		November	
	S	NS	S	NS
Cow costs, $/hd				
Fall grazing	54.26	52.91	75.16	73.37
Supplement	15.77		15.77	
Total cow costs, $/hd	**70.03**	**52.91**	**90.93**	**73.37**
Calf revenue at weaning, $/hd	374.70	395.47	426.66	421.93
Gain (loss) in sale of culls, $/hd	(11.66)	(5.39)	(22.82)	(16.06)
Net return at weaning, $/hd[a]	**293.01**	**337.17**	**312.91**	**332.50**
Feedlot costs, $/hd				
Calf value	470.51	448.63	474.08	451.06
Feed cost	325.63	300.98	268.88	249.36
Yardage	73.80	73.80	58.60	58.60
Trucking	2.19	2.13	2.69	2.51
Processing & health	25.00	25.00	25.00	25.00
Total feedlot costs, $/hd	**897.13**	**850.54**	**829.25**	**786.53**
Steer revenue, $/hd	872.31	856.81	876.59	809.71
Net return at slaughter, $/hd[a]	**-9.35**	**3.01**	**21.76**	**10.91**

[a] Net return is the sum of all income and/or losses and associated costs on a per cow basis.

In a second trial (Stalker 2005), over 3 years, March calving cows received the same protein treatments as described in the Ciminski (2002) study. Pregnancy rate averaged about 92% and was not affected by protein supplement. Calf weaning rate and weaning weight were greater for cows fed protein during the winter (98.1% and 464 lb) compared to those from cows not fed supplemental protein (91.9% and 444 lb). Carcass weight tended to be higher ($p = .07$) for steers from cows fed supplemental protein than for steers from cows not fed supplemental protein (811 lb vs. 786 lb). Net returns at weaning and at slaughter were $30.46 and $14.93 higher, respectively, for steer calves from cows fed supplemental protein than those from cows not fed supplemental protein.

Example 2. Winter-spring weaning date and supplementation during winter grazing of dry and lactating cows (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/daily 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 all three groups. The subsequent pregnancy rate was about 89% for all three groups of cows. Total costs for the January through March grazing period were greatest for lactating cows and lowest for non-lactating cows not fed supplement (Table 3). Body weights of steers on summer grass, off summer grass/into feedlot, slaughter weight, costs and breakevens are shown in Table 4 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 in both 1999 ($68.96 vs. $77.14) and 2000 ($68.53 vs. $76.64) for steers wintered on range compared to steers wintered in drylot.

Table 3. 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]	1.10	1.10	1.50
Cost, $/AUM[c]	15.00	15.00	15.00
Total cost of winter grazing, $	46.20	46.20	63.00
Supplement			
Cost, $/lb	-	0.09	0.09
Total cost of supplement, $[d]	-	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] Animal unit month (Waller et al., 1986).
[d] Includes labor and equipment costs of feeding supplements.

Table 4. Costs, weights and breakevens for steer calves wintered in drylot or on the cow on range followed by summer grazing and finishing in feedlot (for 1999 and 2000).				
	Treatment			
	1999		**2000**	
Item	**Drylot**	**Range**	**Drylot**	**Range**
Calf and yearling costs, $				
Opportunity cost/weaned calf	351.66	365.52	394.66	387.52
Health	25.00	25.00	25.00	25.00
Winter feed	66.26	24.76	77.02	25.01
Yardage	28.25		29.00	
Summer grass	66.00	66.00	56.50	56.50
Interest at end of summer	21.62	19.42	22.41	19.03
Total calf and yearling costs, $ (end of summer)	**558.79**	**500.70**	**604.59**	**513.06**
Breakevens off summer grass, $/cwt	**77.14**	**68.96**	**76.64**	**68.53**
Finishing costs, $				
Feed	195.80	181.10	208.69	201.16
Yardage	44.70	44.70	45.00	45.00
Interest at end of finishing	18.57	16.72	20.07	17.39
Total finishing costs, $	**259.07**	**242.52**	**273.76**	**263.55**
Total costs, $	**817.86**	**743.22**	**878.35**	**776.61**
Breakevens at slaughter, $/cwt	**67.06**	**63.91**	**69.01**	**65.68**
Body weights, lb				
On summer grass	536	478	564	507
End of summer	686	683	757	703
Slaughter	1297	1284	1323	1219

Example 3. 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 CP system (NRC, 1984) or the 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.

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