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Performance and Economics of Winter Supplementing Pregnant Heifers Based on the Metabolizable Protein System

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Supplementing pregnant heifers grazing winter range to meet metabolizable protein versus crude protein requirements may improve two-year-old pregnancy and profitability.

Summary

In 1997-98 and in 1998-99, pregnant, March-calving heifers (2,375 head) at two locations of a ranch in Nebraska were used to evaluate the production and economic responses of winter supplementation (September to February) to meet metabolizable protein or CP requirements. Net present value was used to determine the economic benefits of supplement treatments. In 1997-98, metabolizable protein heifers had higher pregnancy rates and expected profitability than CP heifers at one of two locations. In 1998-99, metabolizable protein heifers had higher pregnancy rates and expected profitability at both locations.

Introduction

For young cows to recover development costs, they must stay in production for multiple years. Economical nutrition programs that facilitate improved 2-year-old pregnancy rate have the potential to improve expected lifetime profitability.

The undegradable intake protein (UIP) content of grazed winter forage in the Sandhills of Nebraska is low (1997 Nebraska Beef Report, pp. 3-5). Microbial crude protein (MCP) production

often is inadequate to meet the metabolizable protein (MP) requirement of growing heifers, resulting in a need for supplemental UIP. Providing additional MP to pregnant heifers decreased winter body weight (BW) loss in some situations (2000 Nebraska Beef Report, pp. 7-10).

The objective of the study was to document differences in reproductive performance when heifers are supplemented to meet MP rather than CP requirements. We hypothesized supplementing to meet MP requirements would improve 2-year-old pregnancy and lifetime value of the bred heifer.

Procedure

In 1997-98 (1156 head; 772 lb) and 1998-99 (1219 head; 813 lb), pregnant heifers at two locations of a commercial ranch in the Nebraska Sandhills were used following breeding as yearlings through pregnancy testing as 2-year-olds. The average calving date was March 25 of each year. Heifers were allotted randomly to one of two treatments (approximately 300 head/treatment) each year at each location (locations near Ashby and Whitman). Heifers received supplements while grazing fall-winter upland range and meadow from mid-September to mid-February of each year. Treatments were: 1) supplementation to meet MP requirements (MPR) or 2) supplementation to meet CP requirements (CPR). Feather meal was used for the UIP source in the MPR supplement (Table 1), with the supplement composed of 53% CP and 27% UIP (DM basis). The CPR supplement was composed of 51% CP and 13% UIP. The CPR supplement was fed at the rate of .89 lb/day (DM) throughout the trial, supplying 53 grams of UIP/day. The MPR supplement feeding rate increased gradually from .70 lb/day in October to 1.6 lb/day in February, supplying 86 grams UIP/day in October, 120 grams UIP/day in November, December, and January, 135 grams UIP/day in early February, and 203 g UIP/day after Febr. 15. Supplements were fed to treatment groups three times weekly as range cubes.

Meadow hay (7-9% CP) was fed at the discretion of the manager at each location in each year. Hay was typically fed at a rate of 4.5 lb/day (DM basis) starting in mid- to late December and increased to about 18 lb/day in February as heifers approached parturition. Heifers from each treatment at each location were managed in one group from mid-February to October of each year. Approximately 18 lb/day meadow hay (DM basis) and range were available mid-February (no supplement) until calving. After calving, approximately 24 lb of meadow hay and 4 lb of alfalfa hay (DM basis) were fed daily until available grazing. Heifers were exposed to a mix of mature and yearling bulls for 90 days beginning June 10 of each year.

In 1997-98, heifers were individually weighed and assigned a body condition score (BCS) on Sept. 15 and 16, Febr. 27 and 28, and on Oct. 21 and 22 (one day for each location). Weaning weights were taken on calves on Aug. 14 at Whitman and Sept. 3 at Ashby. Pregnancy was determined by palpation on Oct. 21 and 22. In 1998-99, heifers were weighed and BCS on Sept. 16 and 17, Febr. 16 and 18, and Oct. 25 and 27. Weaning weights were taken on calves on Aug. 19 at Whitman and Sept. 2 at Ashby. Pregnancy was determined by palpation on Oct. 25 and 27.

Budgets were set up starting with an arbitrary 100 bred heifers both in 1998 and 1999, corresponding to the years that supplement treatments were applied. Budgets were consistent with management where the experiment was conducted, and actual data from the operation were used to determine pregnancy, weaning, cull, and death rates, annual cow costs, and the weight of cattle marketed (either calves or cull females). All costs were inflated by 2.0% per year. Since costs and performance were similar across locations, one set of costs and performance data were used for both locations within each year. Revenue was calculated using market data for 1998 and 1999 (Crop and Livestock Prices for Nebraska, 1998), and projected prices for year 2000. Market prices for years 2001 through age 15 of the cows were estimated by historical data reported from 1985 to 1996. Annual net cash flow was determined for the original set of 100 females for each year up to when the cattle turned 15 years old. The inventory of heifers changed each year within each budget, as it was reduced by the number of cows sold or dead. All cows remaining at age 15 were considered to be sold.

Since the CPR treatment was the conventional supplementation protocol for this operation, the 2-year-old pregnancy rate for the CPR treatment was used as the "base" for each location within each year. Pregnancy rate of 2-year-old cows from the MPR treatment then was used in the budget to determine change in lifetime cash flow. Effects of treatments on 2-year-old pregnancy were assumed to not affect future production parameters.

Net present value (NPV) of the bred heifers (2-year-old production year) was determined from the budgets using the formula: $NPV = E1/(1+i)^1 + E2/(1 + i)^2 + ... + En/(1 + i)^n$, where E is net cash flow in each year 1 through n (n = 15 in this case), and i is the discount rate. A discount rate of 7.0% was used for all calculations, and this was assumed to be a real rate of discount. The NPV of bred heifers was calculated for both treatments at each location within each year. The NPV for the group was divided by the original 100 head to obtain NPV on a per head basis.

The MPR treatment cost more than CPR in 1997-98 ($2.71 and $3.33 difference in total supplement costs per head at Ashby and Whitman, respectively), and in 1998-99 ($0.58 and $0.59 at Ashby and Whitman, respectively). The different treatment costs were associated with costs of ingredients (Table 1)

(Continued on next page)

Table 1. Composition of supplements fed to heifers grazing winter sandhills range (% of DM).[a]

Ingredient	MPR	CPR
Cottonseed Meal	—	58.8
Feather Meal	40.2	—
Soybean Meal	—	17.8
Sunflower Meal	30.2	13.7
Wheat Middlings	26.2	—
Distillers Grains	—	3.4
Molasses (Cane)	2.1	2.1
Urea	—	2.8
Minerals/Vitamins	1.3	1.4

[a]Supplements were provided as range cubes fed 3 times weekly. MPR: designed to meet the metabolizable protein requirement; CPR: designed as conventional protein supplement.

and the amount of supplement fed. The difference between MPR and CPR supplement costs was lower in 1998-99, because the trial ended earlier in February before the scheduled increase in the amount of MPR to be fed.

Results

No treatment interactions or treatment effects on cow BW or BCS change between September and February, February and October, or September and October were observed (Table 2; P > .15). Calf weaning weights were similar between treatments. A treatment × year × location interaction for pregnancy rate (P = .07) was present. Therefore, pregnancy rate was analyzed within location of each year (Table 3).

In 1997-98, both MPR and CPR heifers at Ashby had a pregnancy rate of 95%. At Whitman in 1997-98, however, MPR heifers had a higher pregnancy rate (P = .01; 84%) than CPR heifers (75%). In 1998-99, the MPR heifers had a higher pregnancy rate (P = .01; 95%) than CPR heifers (88%) at Ashby, and MPR heifers tended to have a higher pregnancy rate (P = .15; 89%) than CPR heifers (85%) at Whitman.

The 95% pregnancy rate of both treatments at Ashby in 1997-98 indicate supplemental UIP above the amount in the CP balanced supplement was not necessary. Based on BW change, BCS change, and pregnancy rate at Ashby in 1997-98, it appears energy intake was not markedly restricted to the heifers. Since MCP production is a function of energy intake, higher energy intakes allow more MCP production and less need for supplemental UIP. The effects of year on fall-winter diet quality in the Nebraska Sandhills have been documented (1998 Nebraska Beef Report, pp. 20-21). An increased diet quality and/or forage intake at Ashby in 1997-98 potentially could explain the lack of response to supplemental UIP.

In the situations in this study where pregnancy rate was improved by supplementing to meet MP requirements, BCS loss over the winter was greater than .5 units. Patterson et al. (2000 Nebraska Beef Report, pp. 7-10) reported supplementing to meet MP versus CP requirements improved heifer BW gain over the winter in one of two experiments. The authors reported substantial BCS losses (-1.5 BCS from October to February) in the study where response to supplementing to meet MP requirements occurred. Energy intake can become low in some situations (2000 Nebraska Beef Report, pp. 7-10), and energy limits heifer performance during the winter instead of MP.

The increase in pregnancy rate in MPR compared to CPR heifers without improved BW or BCS change overwinter was not expected. However, similar responses have been reported with fat supplementation during gestation. The response to fat supplementation has been associated with altered hormone profiles. Supplemental UIP post-partum alters endocrine profiles in 2-year-old heifers. Supplementing UIP

Table 2. Body weight (BW), body condition score (BCS), and calf weaning weight of heifers supplemented to meet metabolizable protein requirements (MPR) or CP requirements (CPR) across two locations and two years (1997-98 and 1998-99) in the Nebraska Sandhills.[a]

Item	MPR	CPR	SEM[b]
Sept. BW, lb	792	787	2
Feb., BW, lb	913	904	7
Oct. BW, lb	937	928	9
BW Change, Sept.-Feb., lb	121	117	4
BW Change, Feb.-Oct., lb	24	26	7
BW Change, Sept.-Oct., lb	146	141	7
BCS, Sept.	5.8	5.8	<0.1
BCS, Feb.	5.2	5.2	0.1
BCS, Oct.	5.3	5.3	0.1
BCS Change, Sept.-Feb.	-0.6	-0.6	0.1
BCS Change, Feb.-Oct.	0.1	0.1	0.1
BCS Change, Sept.-Oct.	-0.4	-0.5	0.1
Calf Weaning Weight, lb	344	342	7

[a]2375 heifers were group fed supplement in treatment groups (approximately 300 heifers per treatment at each location during each year).
[b]Standard error of the mean; n = 8.

Table 3. Pregnancy rate of heifers supplemented to meet metabolizable protein requirements (MPR) or CP requirements (CPR) at two locations in the Nebraska Sandhills in 1997-98 and 1998-99.

	Ashby[a]		Whitman[b]	
Item	MPR	CPR	MPR	CPR
1997-1998, %[c]	95	95	84	75
1998-1999, %[d]	95	88	89	85

[a]n = 531 in 1997-98; n = 527 in 1998-99.
[b]n = 501 in 1997-98; n = 560 in 1998-99.
[c]Treatments different at Whitman (P = .01).
[d]Treatments different at Ashby (P = .01) and Whitman (P = .15).

Table 4. Net present value (NPV) of bred heifers when two-year-old pregnancy rate was affected by supplementing the heifers during the winter prior to calving to meet metabolizable protein requirements (MPR) or crude protein requirements (CPR).[a]

	1997-1998		1998-1999	
Item	Ashby	Whitman	Ashby	Whitman
MPR NPV, $/hd	882.22	830.86	886.10	860.03
CPR NPV, $/hd	882.22	788.84	855.68	842.65
Difference, $/hd[b]	0.00	42.02	30.43	17.38
Return, $/hd[c]	-2.71	38.69	29.84	16.79

[a]Supplements fed from September to February each year.
[b]Difference in NPV between MPR and CPR within location and year.
[c]Advantage of MPR treatment in NPV after additional supplement cost of that treatment was subtracted.

to heifers during gestation may cause post-partum physiological changes in the heifer that positively influence re-breeding performance.

It is important to note effects of gestational UIP supplementation occurred even though supplements were not fed immediately before or after calving. Although heifers started calving in early March, the last day to feed the treatment supplements was 25 and 35 days before the average calving date in 1997-98 and 1998-99, respectively. The 1996 NRC equations predicted the meadow hay and range diet offered during this time was deficient in MP (60 to 100 grams per day). Metabolizable protein requirements increase exponentially in the three weeks before calving. Although it is surprising that reproduction was positively affected without supplementation 25-35 days before calving, it is possible that greater improvements in 2-year-old pregnancy would have been noticed had UIP been supplemented through the calving season. The NRC predicted that cattle were adequate in MP after calving.

The NPV of heifers in each treatment group at each location during each year are shown in Table 4. As expected, in all cases where pregnancy was improved by the MPR treatment (Table 3), NPV was higher for heifers in the MPR treatment. Since the MPR treatment was more expensive, the added costs associated with this supplement strategy were subtracted from the difference in NPV to determine the expected return on the treatment.

Based on NPV figures for the 1997-98 data, the MPR treatment cost the females at Ashby $2.71 over their lifetime compared to the CPR group, but gained those at Whitman $38.69. In 1998-99, the MPR treatment returned $29.84 and $16.79 over CPR females at Ashby and Whitman, respectively. The average difference between treatments in NPV, $20.00 per head, would bring substantial revenue to an operation. The importance of reproduction in young breeding females to profitability has been demonstrated in previous studies.

The heifers in question were only at approximately 67% of their mature BW at yearling pregnancy check time in the fall. The literature would indicate that 65% of mature weight should be obtained before breeding the replacement heifer. Rather modest nutritional inputs into these heifers prior to calving, despite their low BW, showed substantial improvements in profitability in three out of four situations.

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