Proceedings, Applied Reproductive Strategies in Beef Cattle
November 1 and 2, 2005, Lexington, Kentucky

SUPPLEMENTATION AND WEANING STRATEGIES TO OPTIMIZE REPRODUCTIVE PERFORMANCE

John Thomas Johns
Extension Professor, Beef Cattle Extension
University of Kentucky

For beef cattle producers selling calves at or near weaning time, the economic value of reproductive traits is estimated to be of much greater importance than either production or carcass traits, (Melton, 1999). Data derived from CHAPS records of the North Dakota Beef Cattle Improvement Association (Ringwall2000) have very high cull rates, 13.8 and 16 % respectively, primarily due to reproductive failure. These young cows weigh less and have lower body energy reserves in terms of body condition than older cows (Ringwall, 2000). Attrition of young cows is a major cost to the producer due to high developmental expense. These expenses cannot be recovered when young cows leave the herd due to reproductive failure. Meek et al., 1999 has estimated that the value of a 1% increase in pregnancy rate of two year old cows is approximately double the value of a similar increase in yearling virgin heifers. This paper will discuss nutritional and management considerations for optimizing reproduction in beef cows.

Nutritional considerations should start with the nursing heifer calf that may become a replacement heifer. Creep feeding or early weaning and feeding of high energy diets to heifers may reduce future milk production ability. Sexten et al., 2005 early weaned calves at 89 days or normal weaned calves at 232 days of age. After weaning, heifers were placed on growing rations of either 12 or 17% crude protein. Early weaning increased pregnancy rate compared to normal weaning. Increasing ration protein had no effect on normal weaned heifer ADG or pregnancy rate. In early weaned heifers, increasing ration protein increased heifer ADG and pregnancy rate, Table 1. In this case, increasing levels of ration protein had positive reproductive effects on early weaned calves with no detrimental effects on normal weaned calves.

Table 1. Effect of Weaning and Supplemental Feed Protein % on Replacement Heifer Calf Performance

	Early Weaned		Normal Weaned	
	12% CP	17% CP	12% CP	17% CP
ADG, lbs	2.59	2.77	3.01	2.68
% Pregnant	86.7	93.3	75.0	73.3

Gain from weaning to breeding is also an important management consideration. Heifers managed to obtain 65% of their mature body weight at breeding time will have improved reproductive performance. The enhanced reproductive benefits will be improved calving ease and decreased post partum interval as a two year old cow. The timing of the

gain from weaning to breeding is not important as long as the animals reach the proper % of their mature body weight, Lynch et al., 1997. In this study, heifers were fed to gain evenly (1 pound per day) from weaning to breeding or to make the majority of their gain in the last 47 to 56 days prior to the beginning of breeding (Table 2). The Even Gain heifers also

Table 2. ADG (lbs) of Heifers Developed on Two Feeding Regimens				
	Year 1		Year 2	
	Period 1 (112 d)	Period 2 (47 d)	Period 1 (112 d)	Period 2 (56 d)
Late Gain	.55	2.50	.11	2.90
Even Gain	.97	2.13	.86	1.62

experienced an increased gain during the second period likely due to increased efficiency of utilization of net energy for gain. Even with this, Late Gain heifers made the majority of their gain during period two. There was no difference in first service conception or total conception (Table 3) between the feeding programs in either year. Post partum interval was measured only in year 1 but also was not different between the feeding programs.

Table 3. Reproductive Performance of Heifers Developed on Two Feeding Regimens				
	Year 1		Year 2	
	Late Gain	Even Gain	Late Gain	Even Gain
1st Service Conception %	55.5	55.3	71.1	56.4
Total Conception %	86.8	87.2	87.5	87.5
PPI, days	63.7	69.3	NA	NA

Cow body condition score is closely related to body fat and energy content (NRC Nutrient Requirements of Beef Cattle, 1996) thus the level or adequacy of pre-partum nutrition is evidenced by the body condition score at calving, Whittier et al., 2005. Body condition score at calving is the major factor determining post partum interval (Lalman et al., 1997). In this study, heifers were fed rations with 4 energy densities. A direct positive relationship between diet energy density and ADG and decrease in post partum interval was shown. However, these factors accounted for less variation than body condition score at calving. Days of PPI could be reduced by gains in BCS after calving but only to a lesser degree than by having the higher BCS at calving.

Post partum nutrition is also an important factor in determining reproductive success regardless of pre-partum nutrient status. In a study by Ciccioli et al., 2003 first calf heifers were calved in a BCS of 4 or 5 and fed to gain either 1 or 2 pounds per day for the first 71 days post partum. Increasing the level of post partum energy intake decreased PPI and increased first service conception regardless of the body condition score at calving. The total pregnancy rate was not reported. However, in a similar study, Spitzer et al., 1995 reported increased total pregnancy rates for cattle fed to gain 2 pounds daily compared to those fed to gain 1 pound daily from calf birth to breeding. Rutter and

Randel, 1984 calved both mature cows and first calf heifers in good body condition. Females were assigned to 1 of 3 levels of energy intake for the first 20 days post partum such that they lost or maintained their calving body condition score. Cattle losing body condition required almost twice as long (60 ± 7.5 days) as those females maintaining body condition (31.7 ± 2.8 days) to return to estrus and be ready to breed. For optimal rebreeding efficiency, both pre and post partum nutrient status must be considered.

Nutrients other than just energy affect reproductive performance as well. In a review by Randel, 1990 both pre and post-calving protein intakes were shown to affect pregnancy rates of lactating beef cows and heifers. In many of these studies; however, there are also differences in energy content of the diets thus a potential confounding effect exists. Sasser, et al., 1988 fed isocaloric diets with either adequate or inadequate levels of crude protein to pregnant heifers starting 150 days prior to expected calving date and continuing until 110 days post partum. Significantly fewer protein restricted heifers exhibited estrus (89 vs 63%) and of those showing estrus, fewer (71 vs 25%) conceived on first service and overall (74 vs 32%). This study cannot determine whether pre or post-partum protein restriction was most important in affecting reproduction but it certainly identifies protein as a necessary nutrient for adequate reproduction in both cows and heifers. Much of the mature grass hay fed in the eastern United States can be border-line in protein content. Without protein supplementation, forage intake will likely be decreased resulting in even lower protein intakes.

The studies noted above were using the Crude Protein system. Protein requirements were changed to Metabolizable Protein with the publication of the Beef Cattle Nutrient Requirements booklet in 1996. The MP system uses the concept of rumen degradable protein and rumen undegradable protein. Degradable protein (DIP) sources supply nitrogen for rumen bacteria and are necessary in the proper amount for optimum rumen fermentation. Deficiencies of DIP result in sub-optimal fermentation and fiber digestion and may be manifested as lower DMI and an energy deficiency. Undegradable protein sources escape the rumen but are digested and absorbed in the intestinal tract. They along with microbial protein from the rumen supply the amino acid needs of the animal. Together they compose the Metabolizable Protein system for cattle.

Mature grass hay is often a major ingredient for winter feeding beef cows in the eastern U.S. In such cases cows, especially younger ones, may be deficient in MP when no supplementation is provided. Research has shown mixed results from supplementation studies with UIP and/or DIP containing supplements. Patterson et al. (2003a, b) conducted a large study with first calf heifers on ranches in Nebraska fed supplements to ensure their MP needs were met vs using the Crude Protein system. Heifers supplemented for their MP needs had improved ADG (.90 vs .30 lbs), positive vs negative BCS change and increased pregnancy rate (91 vs 86%). Regression analysis indicated that supplementation to meet MP needs had a greater effect on heifers with lower BCS before calving and at weaning of their first calf. This finding may explain some of the discrepancies in the research trials thus far. It should be clear that if low protein feeds are all that is available for heifer development or maintenance of young lactating cows, supplementation to meet their MP needs will be worth while.

Many studies have explored the use of supplemental fat on reproduction of heifers and cows. Results have been variable and inconsistent. In a study by Myers et al. 2003, fat supplementation of heat stressed, lactating beef cows improved conception in a manner other than nutrient supplementation (Table 4). Control cows were fed a corn – soybean meal supplement targeted to provide similar daily consumption of digestible energy and crude protein as cows provided a liquid fat supplement. Cows consuming the fat supplement had improved body weight gain , condition score and a lower body

Table 4. Effect of Liquid Fat Supplementation on Response of Lactating Beef Cows		
Supplement	Control	Liquid Fat
Weight Change, lbs	11	32
BCS Change	-.18	+.22
Body Temp Change ^{o}C	+.08	-.28
% Pregnant	56.4	75.3

temperature as well as a large increase in conception rate. These cattle were on endophyte infected fescue with no shade. Fat supplementation helped over come some of the detrimental effects of heat/endophyte fescue on reproduction.

Two other management procedures, temporary calf removal for 48 hours and early weaning have been shown to improve reproduction in lactating beef cows. Geary et al. 2001 used 48 hour calf removal in lactating cows ranging in age from 2 to 5+ years. Pregnancy rate to a timed insemination was increased (62 vs 53%; P=.09). The effect was most pronounced in 3, 4 and 5+ year old cattle that were cycling. There was no effect with the two year old heifers and less effect with older cattle that were not cycling.

Thrift and Thrift, 2004 reviewed the ramifications of early weaning spring and fall born calves. Removal of the stress and nutrient demand of lactation will allow the cow to regain body weight and condition score resulting in the initiation of estrus cycles. An increase in pregnancy rate appears to be dependant on when the calves are removed from their dam, Table 5. Dams with calves nursing for 100 days or longer exhibited a small and inconsistent response in pregnancy rate. Dams with calves removed prior to 100 days of lactation consistently exhibited a positive response in pregnancy rate.

Producers can have the greatest impact on reproduction in cow herds by optimizing body weight and condition score at calving and rebreeding time. Feeding specific nutrients or sources of nutrients may have positive impacts especially when females are under nutritional or environmental stress. Management techniques such as temporary calf removal or early weaning have been shown to create positive effects on reproduction.

Table 5. Effect of Early Weaning vs Conventional Weaning on Pregnancy Rate %				
	Early Weaned		Conventional Weaned	
Trial	Days	% Pregnant	Days	% Pregnant
1	156	73.1	187	73.1
2	156	68.1	187	64.9
6	177	78	231	67
8	152	67	215	67
13	150	92.5	210	92.5
20 Fall	110	85	220	91
3	49	100	205	81
4	49	97	210	59
7	90	79	215	67
11	90	64.5	200	21.5
12	30	55	NA	44
21 Fall	55	72.6	NA	56.2
22 Fall	49	100	205	83
23 Fall	89	100	293	77
Adapted from Thrift and Thrift, 2004, Table 4				

Literature Cited

Ciccioli, N. H., R. P. Wettemann, L. J. Spicer, C. A. Lents, F. J. White and D. H. Keisler. 2003. Influence of body condition at calving and postpartum nutrition on endocrine function and reproductive performance of primiparous beef cows. J. Anim. Sci. 81:3107.

Geary, T. W., J. C. Whittier, D. M. Hallford and A. D. MacNeil. 2001. Calf removal improves conception rates to the Ovsynch and CO-Synch protocols. J. Anim. Sci. 79:1.

Lalman, D. L., D. H. Keisler, J. E. Williams, E. J. Scholljegerdes and D. M. Mallett. 1997. Influence of postpartum weight and body condition change on duration of anestrus by undernourished suckled beef heifers. J. Anim. Sci. 75:2003.

Lynch, J. M., G. C. Lamb, B. L. Miller, R. T. Brandt, Jr., R. C. Cochran and J. E. Minton. 1997. Influence of timing of gain on growth and reproductive performance of beef replacement heifers. J. Anim. Sci. 75:1715.

Meek, M. S., J. C. Whittier and N. L. Dalsted. 1999. Estimation of net present value of beef females of various ages and the economic sensitivity of net present value to changes in production. Prof. Anim. Sci. 15:46.

Melton, B. E. 1995. Conception to consumption: The economics of genetic improvement. Proc. Beef Improvement Federation 27th Res. Symp. Annual Mtg., Wyoming.

Myers, E., E. Vanzant, L. Anderson, R. Burris, B. Hightshoe, J. Johns and K. Schillo. 2003. Improving reproductive performance of beef cattle through fat supplementation. Kentucky Research and Extension Beef Report, SR-2004-2:33.

Patterson, H. H., D. C. Adams, T. J. Klopfenstein, R. T. Clark and B. Teichert. 2003a. Supplementation to meet metabolizable protein requirements of primiparous beef heifers: II. Pregnancy and economics. J. Anim. Sci. 81:563.

Patterson, H. H., T. J. Klopfenstein, D. C. Adams and J. A. Musgrave. 2003b. Supplementation to meet metabolizable protein requirements of primiparous beef heifers: I. Performance, forage intake and nutrient balance. J. Anim. Sci. 81:800.

Randel, R. D. 1990. Nutrition and postpartum rebreeding in cattle. J. Anim. Sci. 68:853.

Ringwall, K. 2000a. Beeftalk: Consider production potential when buying cows. Online at http://www.ext.nodak.edu/extnews/newsrelease/2000/122100/06beefta.htm. Accessed October 11, 2005.

Ringwall, K. 2000b. Beeftalk: Give special care to cows that will be three years old. They need it. Online at http://www.ext.nodak.edu/extnews/newsrelease/2000/113000/11beefta.htm. Accessed October 11, 2005.

Rutter, L. M. and R. D. Randel. 1984. Postpartum nutrient intake and body condition: Effect on pituitary function and onset of estrus in beef cattle. J. Anim. Sci. 58:265.

Sasser, R. G., R. J. Williams, R. C. Bull, C. A. Ruder and D. G. Falk. 1988. Postpartum reproductive performance in crude protein restricted beef cows: Return to estrus and conception. J. Anim. Sci. 66:3033.

Sexten, W. J., D. B. Faulkner and J. M. Dahlquist. 2005. Supplemental feed protein concentration and weaning age affects replacement beef heifer performance. Prof. Anim. Sci. 21:278.

Spitzer, J. C., D. G. Morrison, R. P. Wettemann and L. C. Faulkner. 1995. Reproductive responses and calf birth and weaning weights as affected by body condition at parturition and postpartum weight gain in primiparous beef cows. J. Anim. Sci. 73:1251.

Thrift, F. A. and T. A. Thrift. 2004. Review: Ramifications of weaning spring- and fall-born calves early or late relative to weaning at conventional ages. Prof. Anim. Sci. 20:490.

Whittier, J. C., G. P. Lardy and C. R. Johnson. 2005. Symposium paper: Pre-calving nutrition and management programs for two-year-old beef cows. Prof. Anim. Sci. 21:145.