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COW CONDITION and REPRODUCTIVE PERFORMANCE

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INTRODUCTION

It has been understood for decades that reproductive performance is the most important factor affecting production efficiency of a cow-calf enterprise. To maintain a yearly calving interval (one calf every 365 days), a cow must re-breed in 80 to 85 days after calving. With the nutrient priority of beef cattle being body maintenance, growth, lactation, fetal growth, breeding, and body reserve according to Short et al. (1990) indicates that reproduction is low on the list. Body condition score at parturition has been implicated as the single most important factor affecting postpartum interval to estrus and pregnancy in multiparous cows.

BODY CONDITION SCORE

Body condition scoring (BCS) is an effective management tool to estimate the energy reserves of a cow. The most commonly used BCS system for beef cattle in the United States use scores from 1 to 9 (Table 1), with 1 being emaciated and 9 being obese (Whitman, 1975). Using BCS to evaluate cattle does not require any special equipment and can be conducted anytime during the year. Poor body condition is associated with reduced income per cow, increased postpartum interval, increased dystocia, and lower weaning weight.

Table 1. Body Condition Scoring System for Beef Cattle.

BCS	Detailed Description
1	Clearly defined bone structure of shoulder, ribs, back, hooks and pins easily visible. Little muscle tissue or fat present.
2	Small amount of muscling in the hindquarters. Fat is present, but not abundant. Space between spinous process is easily seen.
3	Fat begins to cover loin, back and foreribs. Upper skeletal structures visible. Spinous process is easily identified.
4	Foreribs becoming less noticeable. The transverse spinous process can be identified by palpation. Fat and muscle tissue not abundant, but increasing in fullness.
5	Ribs are visible only when the animal has been shrunk. Processes not visible. Each side of the tail head is filled, but not mounded.
6	Ribs not noticeable to the eye. Muscling in hindquarters plump and full. Fat around tail head and covering the foreribs.
7	Spinous process can only be felt with firm pressure. Fat cover in abundance n either side of tail head.
8	Animal smooth and blocky appearance; bone structure difficult to identify. Fat cover is abundant.
9	Structures difficult to identify. Fat cover is excessive and mobility may be impaired.

Adapted from Herd and Sprott, 1986

Age of calf at weaning influences weaning weight more than any other factor. Therefore, producers have chosen to shorten the breeding season from 90 days to 60 days or even to 45 days. The length of time from parturition until the first estrus, referred to as the postpartum interval (PPI), is the main factor that determines if a cow will become pregnant during the breeding season (Wiltbank, 1970). In addition, fertility is decreased for the first 30 days after calving (Short et al., 1990) and the majority of cows experience a short estrous cycle (an estrous cycle of ≤ 10 days) following their first postpartum ovulation (Murphy et al., 1990). When short estrous cycles occur, the cow returns to heat before the body recognizes the presence of a fetus and pregnancy will not occur (Odde et al., 1980). This means that cows need to initiate estrous cycles prior to the start of the breeding season to become pregnant. Cow body condition is an excellent indicator of the potential of cows cycling.

IDEAL BCS FOR MATURE COWS

What is the optimum body condition score for mature beef cows? Lamond (1970) proposed the concept of a target BCS at calving. Numerous researchers have studied the minimum BCS for acceptable reproductive performance. Morrison et al. (1999) reported that pregnancy rates at 20, 40, or 60 days of the breeding season were not affected by prepartum BCS changes (BCS varied from less than 4 to greater than 7), but Dzulk and Bellows (1983), Richards et al. (1986), Houghton et al. (1990) and Morrison et al. (1999) reported that a BCS of 5 at calving seems to be the critical level affecting subsequent reproductive performance in mature beef cows.

Cow BCS at calving affected length of the PPI with thin cows (BCS < 5) exhibiting an extended PPI of over 80 days, which represents a postpartum anestrous interval 28 to 58 days longer than that exhibited by either moderately conditioned or fleshy cows (BCS > 5) (Table 2; Houghton et al. 1990). For optimum production (one calf per year per cow) cows need to maintain an acceptable PPI of 60 days or less.

Producers should also consider time of calving when they decide on a target body condition score at calving. Pruitt and Momont (1988) found that early calving cows can be slightly thinner than late calving cows simply because they have additional time to initiate estrous cycles prior to the breeding season (Table 3).

Table 2. Effect of Body Condition Score (BCS) at parturition on Postpartum Interval (PPI)

BCS	PPI, days
3	88.5
4	69.7
5	59.4
6	51.7
7	30.6

Adapted from Houghton et al., 1990

Table 3. Effect of Body Condition Score on Percentage of Cows Cycling at the Start of the Breeding Season.

		% of Cycling		
BCS*	No. of cows	May	June	July
		Early Calving Cows		
≤ 4	45	10.0	28.2	70.5
5	84	17.8	43.5	85.6
6	43	41.9	77.5	97.5
≥ 7	25	45.9	76.6	94.7
		Late Calving Cows		
≤ 4	14	0.0	0.0	44.7
5	41	0.0	26.0	74.4
6	22	0.0	35.3	98.5
≥ 7	6	0.0	65.8	99.1

* BCS assigned in March prior to calving
(Pruitt and Momont, 1988)

IDEAL BCS FOR PRIMIPAROUS COWS

The greatest single loss in potential calf crop is in the failure of cows to become pregnant during the breeding season (Wiltbank et al., 1961). Goehring et al. (1987) concluded that 2-year-old heifers needed to be at a BCS 6 at calving for a high probability of pregnancy during the following breeding season. Among primiparous beef cows, greater BCS at calving resulted in more cows in estrus and more cows pregnant by 40 and 60 days of the breeding season (Spitzer et al., 1995). Primiparous cows were assigned to one of two postpartum treatments: 1) moderate gain (0.98 lb/d) or 2) high gain (1.98 lb/d). Animals in the high treatment had a greater percent in estrus at 20, 40 and 60 days

of the breeding season and their calves had heavier weaning weights compared to the moderate gain (Spitzer et al., 1995). Furthermore, Ciccioli et al. (2003) reported similar results with birth weights not affected by BCS at calving, but calves that suckled high treatment cows were heavier at the end of nutritional treatment, and the interval from calving to first estrus (normal luteal phase) was shorter for high than for moderate cows. Only 24% of moderate cows had ovulated and initiated a normal luteal phase before 80 days postpartum compared with 41% of high cows.

GLUCOGENIC PRECURSORS

Research conducted over the past several years at New Mexico State University has looked at thin cows < 5 BCS that have maintained a 90% plus fall pregnancy rate within a 60 day or less breeding season. Typically their feed cost are less than $30 per year per cow but does not include cost of range forage. They are using glucogenic precursors to encourage nutrient repartitioning from lactation to synthesis of maternal tissues for maintenance, growth and reproduction by way of improved nutrient use.

Endecott et al. (2007) fed 2, 3 and 4 year-old cows for 65 days postpartum one of 3 treatments RUP0 – no glucogenic potential, RUP80 – 80 g of propionate salt and RUP160 – 160 g of propionate salt. All treatments had similar levels of crude protein and ruminally undegradable protein. Supplementation ended at the start of the breeding season. Two-year-old cows fed RUP0 took longer to initiate estrous cycles than the other groups; however, as RUP0 cows age increased it took fewer days to return to estrus (Table 4). Increasing glucogenic precursor was beneficial on return to estrus for 2-yr-old cows. However, all treatment groups had above 95% pregnancy rates. Milk production showed a quadratic response to increasing supplemental glucogenic precursor; RUP80 produced the least amount of milk at 55 days postpartum (Table 5). Endecott et al, (2007) did not see any affect on weight loss or gain between groups.

When Endecott evaluated the data by age of cows; all age groups had > 95% pregnancy rates with 2-yr-old cows having a 100%. Two-yr-old cows returned to estrus about 1 month after reaching nadir (time from parturition to lowest body weight postpartum); 3-yr-old cows returned in approximately 3 weeks. The 4-yr-old cows returned to estrus at 1 day after reaching nadir, suggesting that body weight loss had less of an impact on reproductive performance in mature cows. The average BCS of the cows were 4.0, 4.0, and 4.5 at beginning of supplementation for 2-, 3, and 4-yr old cows, respectively. Thorough personnel communication with Mark Petersen, if the average BCS score was 4, some cows would have been in 3 to 3.5 BCS. Mature cows returned to estrus when they reached the bottom of losing weight; however, younger cows need to regain weight to return to estrus.

Table 4. Days to First Estrus for 2, 3, and 4 Year Old Postpartum Cows.

	Supplement		
Cow Age	RUP0	RUP80	RUP160
2	90^{ax}	68^{bx}	70^{bxy}
3	70^{ay}	63^{ax}	74^{ax}
4	46^{az}	50^{ay}	55^{ay}

^{a,b} Within row, values with different superscripts differ (P≤ 0.10)
^{x,y} Within column, values with different superscripts differ (P≤ 0.10)
Endecott, et al. (2007)

Table 5. Effect of Supplements Containing Increasing Amounts of Glucogenic Potential on Reproduction, Milk Production, Calf Weight, Cow Weight and Body Condition Score.

	Supplement		
Response	RUP0	RUP80	RUP160
Pregnancy Rate, %	96	100	96
Milk, lb/d	22	18.6	21.2
Calf Weaning Wt, lb	554	550	550
Days from nadir to estrus	24	14	18
Cow BCS			
Begin supplementation	4.2	4.2	4.1
End supplementation	4.4	4.5	4.4
End Breeding	4.6	4.9	4.5

Endecott et al. (2007)

CHANGING BCS

What are the opportunities to change BCS to improve the probability of cows becoming pregnant? Houghton et al. (1990) found that thin cows gaining condition increased the probability of cows becoming pregnant, however, fleshy (fat) cows losing condition improved pregnancy rates (Table 6). The key to maintaining BCS for optimum reproductive performance is evaluating cows early. Wiltbank, (1982) illustrates the concept of weight gain necessary for cows of varying BCS prior to calving (Table 7).

Evaluating body condition at various stage of production may help to eliminate situations of high-energy density rations for pregnant cows. Blasi et al. suggest evaluating body condition at various stages of production and potential management strategies to ensure cows are in optimum BCS for reproduction (Table 8). Assessing BCS earlier allows for a slow rate of gain and potentially less expense. Changing a 1100 lb pregnant cow from BCS of 4 to 5 would require ADG of 0.62 lb/d over 120 days or 1.62 lb/d over 45 days (Buskirk et al., 1992). A BCS change from 3 to 5 would require 1.24, 1.63 or 3.31 lb/d over 120, 90 or 45 days, respectively.

Table 6. Effect of Postpartum Condition Score Change on Pregnancy Rate

BCS status	Pregnancy (%)
Thin (<5) & increasing CS	100
Fleshy (>5) & increasing CS	75
Thin (<5) & decreasing CS	69
Fleshy (>5) & decreasing CS	94
Moderate (4.5 – 5.5) & maintaining	100

Adapted from Houghton et al (1990)

Table 7. Necessary Weight Gains in Pregnant Cows in Different Body Conditions.

Body Condition		Weight Gain Needed to Calving, lb				
At Weaning	Needed @ Calving	Calf Growth*	Body Weight	Total	Days to Calving	ADG, lbs
Thin (< 4)	Moderate	100	160	260	120	2.2
Borderline (4)	Moderate	100	80	180	120	1.5
Moderate (5-6)	Moderate	100	0	100	120	0.8
Thin (< 4)	Moderate	100	160	260	200	1.3
Thin (< 4)	Moderate	100	160	260	100	2.6

* Calf Growth includes calf, fluid and membranes

Wiltbank, 1982

Table 8. How to Utilize Body Condition Scores at Various Stages of Production.

Production period	Management
Late Lactation (2 month prior to weaning)	Depending upon current forage availability, supplementations and/or a modified weaning strategy may be necessary. Wean thin cows, especially young and older
Weaning	Pay particular attention to young cows weaning their first calf and cows beyond their prime age: they are most likely to be thin at this time.
100 days before calving	Last opportunity to gain body condition. This would be a good time to separate thin cows from cows in good condition and increase feed to thin cows.
Calving	If cows are thin, a change in the feeding program is needed. It is expensive to increase condition on thin cows after calving.
Breeding season	If cows are thin at this time, additional supplementation and/or implementation of an early weaning strategy may be necessary.

Blasi et al.

ECONOMICS

In addition to getting cows bred within the desired breeding season. Research has shown that having cows calve early results in larger calves, more time to cycle and therefore more chances to breed during a defined breeding season. Pruitt and Momont, (1988) grouped cows as early calvers (first 21 day of calving season) or late calvers, the calves from early calving cows average 45 lbs heavier in September than the calves from the late calving cows (Table 9). Since most producers sell feeder calves in one lot on a given date, the calves born early in the calving season have the potential to be larger and generate more income. Let's say the price of 550 pound calves are $110/cwt and 500 pound calves are $115/cwt, you are looking at $606.10 for heavier (551 lbs) calves and $581.90 for lighter (501 lbs) calves. The price spread for heavier calves may change due to increasing amounts of corn going into the ethanol industry.

Kunkle et al. (1994) looked at the relationship of BCS, cow performance and income (Table 10). Lower BCS had lower pregnancy rate which translated into less income per cow exposed.

Table 9. Effects of Calving Date on Calf Performance

	Early Calvers	Late Calvers
Average Calving Date	March 24	April 15
Calf Weight, lb		
May	167[a]	138[b]
June	235[a]	199[b]
July	306[a]	267[b]
September	551[a]	506[b]
205-day adjusted weight, lb	600	593

Pruitt and Momont, 1988

Table 10. Relationship of Body Condition Score (BCS) to Beef Cow Performance and Income.

BCS	Pregnancy rate, %	Calving interval, d	Calf ADG, lb	Calf WW, lb	Calf Price, $/100 lb	$/cow Exposed[a]
3	43	414	1.60	374	96	154
4	61	381	1.75	460	86	241
5	86	364	1.85	514	81	358
6	93	364	1.85	514	81	387

[a] Income per calf x pregnancy rate.

Kunkle et al., 1994

CONCLUSION

Body condition scores are an excellent indicator of reproductive performance. Evaluating cows/heifers early allows producers to change BCS as needed. Cows calving earlier in the calving season allows cows more time to cycle prior to breeding season, breed earlier and heavier calves at weaning. Glucogenic precursor in addition to protein supplements decreased the number of days to first estrus in 2-yr-old cows and may be a method to help cows in lower than optimum BCS.

LITERATURE CITED

Blasi, D.A., R.J. Rasby, I.G. Rush and C.R Quinn. Cow Body Condition Scoring Management Tool for Monitoring Nutritional Status of Beef Cows. Beef Cattle Handbook BCH-5405.

Buskirk, D.D., R.P. Lemenager, and L.A. Horstman. 1992. Estimation of Net Energy Requirements (NE_m and NE_Δ) of Lactating Beef Cows. J. Anim. Sci. 70:3867-3876.

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. 81:3107-3120.

Dziuk, P.J. and R.A. Bellows. 1983. Management of Reproduction of Beef Cattle, Sheep and Pigs. J. Anim. Sci. 57 (Suppl. 2): 355-379.

Endecott, R.L., S.H. Cox, and M.K. Petersen. 2007. Impacts of Supplemental Glucogenic Precursors and Cow Age on Postpartum Range Cow Performance. Western Section, American Society of Animal Science 58:352-357.

Goehring, T., L. Corah and J. Higgins. 1987. Factors Predicting the Probability of Estrus and Pregnancy. Rpt. of Prog. 514, Kansas State Univ., Manhattan, KS, p55.

Herd. D.B. and L.R. Sprott. 1986. Body Condition, Nutrition and Reproduction of Beef Cows. Texas Agricultural Extension Service. B-1526.

Houghton, P.L., R.P. Lemenager, L.A. Horstman, K.S. Hendrix, and G.E. Moss. 1990. Effects of Body Composition, Pre- and Postpartum Energy Level and Early Weaning on Reproductive Performance of Beef Cows and Preweaning Calf Gain. J. Anim. Sci. 68:1438-1446.

Kunkle, W.E., R.S. Sands and D.O. Rae. 1994. Effect of Body Condition on Productivity in Beef Cattle. M. Fields and R. Sands (ed.) Factors Affecting Calf Crop. Pp. 167-178. CRC Press.

Lamond, D.R. 1970. The Influence of Undernutrition on Reproduction in the Cow. Anim. Breed. Abstr. 38:359-372.

Momont, P.A. and R.J. Pruitt. 1988. Effects of Cow Body Condition and Calving Date on Calf Performance. SD Beef Rpt. CATTLE 88-12.

Morrison, D.G., J.C. Spitzer, and J.L. Perkins. 1999. Influence of Prepartum Body Condition Score Change on Reproduction in Multiparous Beef Cows Calving in Moderate Body Condition. J. Anim. Sci. 77:1048-1054.

Murphy M.G., M.P. Boland, and J.F. Roche. 1990. Pattern of Follicular Growth and Resumption of Ovarian Activity in Post-partum Beef Suckler Cows. J. Reprod Fertil. 90: 523-533.

Odde, K.G., H. S. Ward, G. H. Kiracofe, R. M. McKee, and R. J. Kittok. 1980. Short Estrous Cycles and Associated Serum Progesterone Levels in Beef Cows. Theriogenology 14:105.

Pruitt, R.J. and P.A. Momont. 1988. Effects of Body Condition on Reproductive Performance of Range Beef Cows. SD Beef Rpt. CATTLE 88-11.

Richards, M.W., J.C. Spitzer and M.B. Warner. 1986. Effect of Varying Levels of Postpartum Nutrition and Body Condition at Calving on Subsequent Reproductive Performance in Beef Cattle. J. Anim. Sci. 62:300-306.

Short, R.E., R.A. Bellows, R.B. Staigmiller, J.G. Berardinelli, and E.E. Custer. 1990. Physiological Mechanisms Controlling Anestrus and Infertility in Postpartum Beef Cattle. J. Anim. Sci. 68:799-816.

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. 73:1251-1257.

Whitman, R.W. 1975. Weight Change, Body Condition and Beef-cow Reproduction. Ph.D. Dissertation Colorado State University. Fort Collins.

Wiltbank, J. N., E. J. Warwick, E. H. Vernon, and B. M. Priode. 1961. Factors Affecting Net Calf Crop in Beef Cattle. J. Anim. Sci. 20:409-415.

Wiltbank, J.N. 1982. Nutrition and Reproduction in the Beef Female. In:Proc. Symposium on Management of Food Producing Animals. Pp. 770-787.