REPRODUCTION AND BREEDING

# Effects of Body Condition and Energy Intake on Reproduction of Beef Cows

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Several factors influence profitability in commercial cow calf herds including: percentage of calf crop weaned, weaning (sale) weight, sale price, cull cow salvage value and annual carrying cost per cow-calf unit. Of these, the factor that contributes the most to determining profit or loss is calf crop percentage. Weaning rate is properly defined as the number of calves weaned, divided by the number of cows that were intended for breeding during the previous season. The national average weaning rate has been estimated at 71%, thus 29% of those cows that were intended for breeding fail to wean a calf the following season. Failure of cows to become pregnant is by far the largest factor (table 1), accounting for 60% of all losses. Calf death within 24 hours of birth, the second largest factor accounts for only about 1/3 as many losses as failure to become pregnant.

Proper nutrition is critical to reproductive success. In Minnesota, cows cannot graze throughout winter, supplemental feed is required for adequate reproductive performance. However, because feed represents the largest cost in any livestock enterprise, minimizing feed cost and avoiding overfeeding should be a goal of producers. Just as underfeeding cows can reduce profits due to too many open cows, offering feed unnecessarily can reduce profits due to excess cost. Proper timing of feed supplementation can balance cost reduction with optimum performance. To best describe cow nutrient requirements, divide the beef cow year, based on production and nutrient needs. Following is a description of the cow year, with the day of calving as the first of the year:

| Period (days) | Physiological state | Relative nutrient needs |
|---|---|---|
| **Period 1 = days 1 – 80** | Post-calving an rebreeding | High |
| **Period 2 = days 81 - 205** | Pregnant and lactating | Moderate to high |
| **Period 3 = days 206 – 315** | Mid-gestation | Low |
| **Period 4 = days 316 – 365** | Pre-calving | Moderate |

There are three critical considerations for:

- Pre-calving nutrition
- Condition at calving
- Post-calving nutrition

These factors are interrelated, but each affects reproductive rate in different ways. Understanding the contribution of each is important to proper reproductive management. This document will focus on energy as a nutrient. Keep in mind that proper protein, vitamins and minerals are also required for optimum reproductive success.

## PRE-CALVING NUTRITION

Table 2 illustrates the effect of pre-calving energy levels on reproduction. Too little energy during Period 4 (50 days prior to calving) will reduce the percentage of cows cycling by the start of the breeding season. Cows will cycle and become pregnant eventually even if pre-calving energy levels are low. However, calves will be born late and an annual calving cycle will not be maintained, because cows must become pregnant within 80 days of calving in order to have an annual calving cycle.

Many producers feel that it is beneficial for cows to be gaining weight (in excess of fetal growth) at calving time. Research at the University of Nebraska has shown that as long as the recommended weight gain is achieved during late gestation, the timing of that weight gain is not critical.

## COW CONDITION AT CALVING

Body fat and protein reserves of the cow can be mobilized to meet nutritional needs under some circumstances. In addition, biochemical precursors of reproductive hormones are generated during the breakdown of stored fat, indicating that some level of fat degradation is required for adequate synthesis of reproductive hormones such as progesterone and estrogen. Fortunately, the cow does not need to be losing weight to assure fat degradation. Most body tissues are continually replenished through constant synthesis and degradation; indeed, these processes accelerate during weight gain. Therefore, existence of adequate body fat reserves will ensure sufficient fat degradation for production of these hormones, even if the cow is gaining weight and depositing body fat.

A key to profitability is properly managing body fat (condition) reserves. Research at the University of Minnesota, and other universities, has shown that visual evaluation of condition can be an accurate assessment of body fat reserves. With training, a producer can evaluate condition of his/her cow herd in order to sort cows into groups that need to gain, maintain or lose weight.

A nine point visual condition score (CS) system has been devised and is a useful tool. Following are descriptions of condition scores 1-9:

**Condition score 1.** Emaciated. No visible fat over shoulder, ribs, back, hooks or pins, tail head and ribs project quite prominently, little evidence of muscling.

**Condition score 2.** Poor. Little evidence of fat deposition but some muscling in hindquarters, some tissue cover along spine, but spinous processes are easily seen with space between them.

**Condition score 3.** Thin. Backbone highly visible but some fat cover over loin back and foreribs. Spaces between spinous processes still visible but less pronounced.

**Condition score 4.** Borderline. Foreribs are not noticeable but 12th and 13th are. Transverse spinous processes can be identified only by palpation and is rounded, rather than sharp. Muscling only slightly inhibited. Some fat cover over hooks.

**Condition score 5.** Moderate. 12th and 13th ribs not visible if cow has normal fill. Transverse spinous processes can only be felt with firm pressure. Normal muscling.

**Condition score 6.** High moderate. Ribs fully covered, not visible. Firm pressure now required to feel transverse processes. Obvious fat cover over foreribs and on each side of tailhead.

**Condition score 7.** Good. Cow appears fleshy and obviously has considerable quantity of fat. Abundant fat cover over ribs and patchiness apparent around pins. Some fat around vulva and in crotch.

**Condition score 8.** Fat. Most bone structure has disappeared from sight, spinous processes almost impossible to palpate. Thick fat cover and substantial patchiness.

**Condition score 9.** Extremely fat. Bone structure no longer visible and barely palpable. Tail head buried in fat. Mobility may even be impaired by large fatty deposits.

Cattlemen should become familiar with CS descriptions, especially description of CS 4 through 8, which will describe most cows. CS of cows should be appraised routinely and cows sorted into groups that need to gain (CS 5 or less), lose (CS 8 or 9) or maintain condition.

CS is a function of energy requirements and energy intake. Cows must be in proper condition (CS 5-7 is best) at calving. CS at calving has the greatest effect on the percentage of cows in heat (Table 3). Tables 4-6 provide further description of the effects of CS on reproductive performance.

An interesting aspect of this area of research is the effect of CS on strength and immune status of the calf (Table 7). As CS increased in first-calf heifers, colostrum production increased, time required for the calf to stand decreased and antibody levels of the calves increased.

## POST-CALVING NUTRITION

Post-calving energy levels have little influence on the percentage of cows in heat, but can dramatically influence conception rate in some situations (Table 8). This indicates that heats of cows fed too little after calving were sub-fertile or that cows were unable to maintain pregnancy. The extreme example in Table 8 makes a point but is applicable only to a few situations. Keep in mind that CS and post-calving energy are interrelated. For instance, as Table 5 indicates, cows that were in good condition at calving cycled well at 60 days post-calving whether they gained or lost weight post-calving . On the other hand, cows that calved in moderate or thin condition, and lost weight post-calving, cycled poorly, especially if they had not gained weight prior to calving.

In Minnesota, grazing is usually not possible until 30-60 days after calving, so supplemental feed must be offered during a portion of the post-calving period. A reasonable question is whether feed offered should be greatest immediately after calving, constant throughout the post-calving period, or increased when milk production peaks. Researchers at the University of Nebraska have shown that as long as nutrient intake by first-calf heifers was adequate during the first 90 days after calving, the timing of nutrient intake was not critical to reproductive rate, milk production or calf growth. These workers concluded that latitude exists in the way that heifers can be fed early in their first lactation, without adversely affecting production. Apparently these heifers were able to deposit energy reserves when possible and mobilize energy as needed.

## WHAT IF THIN COWS ARE UNAVOIDABLE?

Early weaning, once-daily suckling (ODS), and temporary calf removal (TCR) are suckling manipulation techniques that have been shown to improve rebreeding performance in some situations. While early weaning is impractical as a tool to shorten the postpartum interval, ODS and TCR merit consideration. Table 9 includes data from a study in which ODS shortened the postpartum interval of first calf Brahman x Hereford heifers, without decreasing milk production or calf gains. Other studies have generated less promising data. The difference in results between studies may lie in the cattle used. In general, ODS is successful in females that are in thin condition or under nutritional stress, especially first-calf heifers, but has little effect on females that are in moderate or higher condition, and are fed to meet requirements. TCR produces similar results. Research conducted at Clemson University has shown no advantage of TCR in cows that are CS 5 or higher. In studies involving first-calf heifers and thin cows, TCR has proved beneficial. ODS and TCR probably have little value for mature, well fed cows. These practices may not fit most programs to their high labor requirement, but could improve a poor situation.

## DEVELOPMENT OF REPLACEMENT HEIFERS

Replacement heifers must be fed to grow and develop rapidly enough so that they cycle and become pregnant early enough to calve at 24 months of age. Table 10 shows the effect of initial calving group on lifetime production. Heifers that calved in the earliest group raised an average of 68 pounds of calf per year more than those in the latest group.

Proper condition at breeding and again at first calving is essential to reproductive performance of replacement heifers. Heifers should be weighed and CS recorded at weaning time, and again at yearling and their diets adjusted so that they attain 65 to 70% of their mature weight by the start of the breeding season and 85% of mature weight at first calving (Table 11). Table 12 describes a study in which yearling Angus heifers were fed to weigh either 600 or 700 lb at breeding. In this study, investing $22 more in feed during the first winter paid substantial dividends in subsequent productivity.

Failure to meet nutrient requirements of the cow will result in cows that are not cycling soon enough to maintain an annual calving pattern, or are cycling but fail to become pregnant when bred. Failure to meet the needs of replacement heifers can cause similar problems and can also result in heifers that are too small at calving time, which will lead to calving difficulty, poor calves, and rebreeding problems.

## SPECIAL CONSIDERATIONS

Management recommendations will not apply to all situations. Those contained in this document are most applicable to commercial situations, with typical feed and calf prices. In a drought situation, or when feed prices are abnormally high in relation to calf prices, the optimum reproductive rate may decline. In this case, the added cost of feed may not be justified, despite improved performance. Researchers at Colorado State University have shown that the optimum reproductive rate can be as low as 78%, depending on the production environment, feed cost and calf prices. In general, when feed is cheap and calf prices high, it pays to feed cows, in the opposite situation feed supplementation probably would not pay.

Considerations may be substantially different in purebred herds where the individual value of calves (or pregnancies) may be much greater than market price. In this case, the ideal reproductive rate could be quite high, justifying supplemental feed, even if cost is great. The increased size (nutrient requirements) of many purebred cattle could dictate that they cannot meet their needs from forages during some times of the year and require supplemental grain. This could be especially evident in first-calf heifers.

## MANAGEMENT SUGGESTIONS

- Learn to assess condition score of cows and heifers. Practice.
- Condition scores are most valuable when assessed by a trained evaluator. The same person should evaluate condition scores each year.
- Assess condition score of cows and replacement heifers at least twice each year. Suggested times would be at least 60-90 days prior to calving (weaning would be okay), and again at or near calving.
- Sort cows into feeding groups based on condition score and ability to compete for feed (young, very old, injured or timid cows may need to be included with thin cows, even if in adequate condition).
- Feed mature cows to achieve condition score of 5 or greater at calving. Feeding to condition score 6 would further increase performance but would also increase cost. Performance of cows that calve in condition score 7 or greater probably will not be superior to those that calve as 6's.
- Feed first-calf heifers to achieve condition score of 6 or greater at calving.
- Due to lower maintenance requirements, weight can be gained more cheaply during the middle third of gestation. On the other hand, this is an excellent time to reduce supplemental feed costs. If substantial weight gain is required during the final third of gestation, grain or silage will probably be required.
- Record condition scores in order to assess effectiveness of feeding programs designed to add, maintain or subtract weight from cows. A further benefit would be year to year comparison if genetics, feed production or management change considerably.
- Once-daily suckling or temporary calf removal may improve reproductive performance of thin cows and/or first-calf heifers.
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- If the cow herd varies and cannot be sorted, feed will likely be provided to meet the needs of those cows that have the greatest nutrient requirements, resulting in overfeeding of many cows.

Table 1. Factors affecting calf crop percentage

| Factor | Percentage |
|---|---|
| Cows fail to become pregnant | 17.4 |
| Calves lost during gestation | 2.3 |
| Calves lost at birth | 6.4 |
| Calves lost birth to weaning | 2.9 |
| Total losses | 28.9 |
| Net calf crop percentage | 71.1 |

Table 2. Effect of pre-calving energy levels on reproduction

| | Energy Level | |
|---|---|---|
| Item | Low | High |
| TDN/day, lb | 4.5 | 9.0 |
| 120-day gain before calving, lb | -118 | +67 |
| In heat by 60 days, % | 45 | 80 |
| Pregnant after 20 days breeding, % | 46 | 60 |
| Pregnant after 90 days breeding, % | 95 | 95 |

Witbank et al.
Both groups fed 16 lb TDN/d after calving.

Table 3. Effect of body condition at calving on % of cows in heat

| | Cow's condition at calving | | |
|---|---|---|---|
| | Thin | Moderate | Good |
| Post-calving, days | ----% of cows in heat---- | | |
| 30 | 3 | 7 | 13 |
| 60 | 46 | 61 | 91 |
| 90 | 66 | 92 | 100 |

Whitman (1975).

Table 4. Effect of condition score at calving on % cycling 60 days postpartum

| Condition score | Number | % cycling |
|---|---|---|
| 2 | 1 | 0.0 |
| 5 | 97 | 19.6 |
| 6 | 55 | 58.2 |
| 7 | 21 | 57.1 |

Table 5. Relationship of body condition and percentage of cows cycling 60 days postpartum

| Condition at calving | Weight change pre-calving | Weight change post-calving | % cycling 60 days post-calving |
|---|---|---|---|
| Good | Lost | Gained | 90+ |
| Good | Lost | Lost | 90+ |
| Moderate | Gained | Lost | 74 |
| Moderate | Lost | Lost | 48 |
| Thin | Lost | Gained | 46 |
| Thin | Lost | Lost | 25 |

Table 6. Effect of condition score change on pregnancy rate

| Condition score change[a] | Number of cows | Pregnancy rate, % |
|---|---|---|
| +3 or +2 | 12 | 91.7 |
| +1 | 43 | 97.7 |
| 0 | 135 | 94.8 |
| -1 | 146 | 90.4 |
| -2 | 75 | 77.3 |
| -3 or -4 | 19 | 68.7 |

[a]Spring calving cows, condition score change reported is from fall to the next fall, pregnancy rates are second fall pregnancy check.
Odde and Field, 1987.

Table 7. Effect of heifers condition scores at calving on interval from calving to standing or the calf, colostrum production and immunoglobulin concentration

| | Heifer's condition score | | | | | |
|---|---|---|---|---|---|---|
| Item | 2 | 3 | 4 | 5 | 6 | 7 |
| Interval from calving to standing for the calf, min | --- | 60 | 64 | 43 | 65 | --- |
| Colostrum production L | 0.75 | 1.53 | 1.11 | 1.41 | --- | -- |
| Study 1 | | | | | | |
| Calf serum IgG, g/dl | 1.79 | 1.99 | 2.18 | 2.31 | 2.35 | --- |
| Calf serum IgM, g/dl | 0.16 | 0.15 | 0.16 | 0.19 | 0.30 | --- |
| Study 2 | | | | | | |
| Calf serum IgG, g/dl | --- | 0.70 | 0.60 | 0.85 | 1.38 | 1.12 |
| Calf serum IgM, g/dl | --- | 0.07 | 0.05 | 0.08 | 0.14 | 0.08 |

Odde, 1989.

Table 8. Effect of post-calving energy levels on reproduction

| | Energy Level | |
|---|---|---|
| Item | Low | High |
| TDN/day, lb | 8 | 16 |
| Gain, calving to 90 days, lb | -90 | -14 |
| In heat by 60 days, % | 81 | 80 |
| Pregnant after 20 days breeding, % | 34 | 60 |
| Pregnant after 90 days breeding, % | 77 | 95 |

Wiltbank et al.
Both groups fed 9 lb TDN before calving.

Table 9. Effects of once-daily suckling on rebreeding performance and milk production of first-calf heifer and growth performance of their calves, Texas

| Period | Normal | Suckling, once-daily |
|---|---|---|
| | -----Weight of heifers, lb---- | |
| 60 days post-partum | 732 | 741 |
| First estrus | 742 | 150 |
| Weaning | 738 | 794 |
| | -----4-hr milk production, lb---- | |
| 30 days post-oartum | 2.7 | 3.2 |
| First estrus | 1.8 | 1.5 |
| | ----Calf wt, lb----- | |
| Birth | 75 | 77 |
| 30 days of age | 123 | 129 |
| Weaning | 323 | 324 |
| | ----Post-partum interval, days----- | |
| | 168 | 69 |

Randel, 1981.

Table 10. Effect of initial calving group on lifetime production

| Initial calving group | Avg weaning wt, lb | Avg wean age, das | Lb below initial group |
|---|---|---|---|
| 1 | 443 | 211 | --- |
| 2 | 432 | 206 | 11 |
| 3 | 416 | 201 | 27 |
| 4 | 409 | 195 | 34 |
| 5 | 375 | 190 | 68 |

Table 11. Recommended weight of replacement heifers at breeding and first calving, by expected mature weight

| Expected mature weight, lb | Weight at breeding, lb | Weight at first calving, lb |
|---|---|---|
| 900 | 585 | 765 |
| 1000 | 650 | 850 |
| 1100 | 715 | 935 |
| 1200 | 780 | 1020 |
| 1300 | 845 | 1105 |
| 1400 | 910 | 1190 |

Table 12. Heifer weight at breeding and productivity

| | Weight at breeding, lb | | |
|---|---|---|---|
| Item | 600 | 700 | Difference |
| First winter feed cost, $ | 100 | 122 | +22 |
| Pregnant as yearlings,% | 58 | 79 | +21 |
| Calving in 60 days, % | 63 | 87 | +24 |
| Calf wean wt, lb | 360 | 388 | +28 |
| Pregnant as wet 2's, % | 72 | 92 | +20 |

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