Relationship of Cow Size to Nutrient Requirements and Production Management Issues[1]

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Introduction

Proper nutritional status is critical for optimal production efficiency in the beef cow herd. Meeting the nutrient requirements of the productive cow is a prime factor in reproductive success and overall herd profitability. However, beef producers often take a "one size fits all" approach when feeding the cow herd. This singular approach to nutrient supply can have nutritional and economic ramifications. Nutritional requirements vary with age, breed, sex, body condition, environment, physiologic status, and weight. By acknowledging these differences in nutrient requirements, management strategies can be implemented to optimize pasture forages, feed resources, and overall production.

While there are many factors that affect nutrient requirements, body size (weight) and milk production are the two primary factors impacting on nutritional requirements. Therefore, this report will focus on cow weight, acknowledging that milk production is an additional driving factor for nutritional requirements of beef cows.

Cow Body Weight Implications

Cow weight drives the intake of forages and feedstuffs. Heavier cows have greater dry matter intake potential to consume feed; therefore, conversely, lighter cows consume less. Through feed intake cows consume the required energy, protein, fats, vitamins, and minerals required for maintenance and production. EDIS document AN190: *Basic Nutrient Requirements of Beef Cows* http://edis.ifas.ufl.edu/an190 indicated the intake potential, total digestible nutrients, and crude protein requirement differences between cows of different weight during a production cycle. Regardless of the time of year, differences in BW are manifested through differences in feed intake.

So why are differences in feed intake so important for the cow herd? The cow herd's feed requirements amount to 50-75% of the annual maintenance costs for the herd. Grazed forages comprise the largest and most important feedstuff for the cow. So, utilization of forage through grazing is the most economical feed available. Thus the stocking density of the pastures for the cow herd becomes an increasingly important management control point. Stocking density is often thought of as number of cows or cow-calf pairs per unit of land area (head/acre). In addition, stocking density for many government agencies (USDA, NRCS, BLM) is described by animal units (AU). An animal unit is defined as one mature, non-lactating bovine weighing 1,000 lb and fed at maintenance. However, as previously stated, not every cow will consume the same amount of feed based upon differences in weight. Therefore, if our assumptions about stocking density are based on poor information or absent cow weight information, then the stocking density and pasture carrying capacity will be wrong.

Cow-calf producers that don't routinely collect weight data on their cow herd often under-estimate the actual weight

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of cows in the herd. It seems to be a pervasive assessment about cow herd weight that most cows or at least the herd average is 1,000 lb. A more correct assessment of the herd cow weight would reveal a much smaller proportion of the cows at or near the 1,000 lb benchmark and a greater proportion of the cow herd with weight greater than 1,000 lb. An increase in average cow weight over multiple years is most likely an effect of cow-calf producers placing greater emphasis on calf weaning weight, yearling weight, and the necessary increase in cow milk production required to support desired calf growth performance. The desire for larger calves with more growth potential most likely conspires to increase actual cow weight over time.

Three University of Florida research cow herds can be utilized as an example for cow weight. An assessment of cow weight at weaning of these three cow herds demonstrates the fallacy of assuming that the herd average cow weight is 1,000 lb (Table 1). None of the three herds' average cow weight was 1,000 lb; one herd average cow weight was 1,053 lb, but the other two herds have average cow weight over 1,200 lbs. Figure 1 demonstrates the distribution of cow weight in the three herds. Not only is the average cow weight not 1,000 lb, but only 17, 16, and 21% (for the three herds, respectively) of the cows were within ± 50 lb of 1,000 lb and the range of cow weight was over 500 lb or more in all three herds. Therefore, if total cow herd nutrition and stocking density decisions were made on the basis of 1,000 lb cows, those decisions would be incorrect.

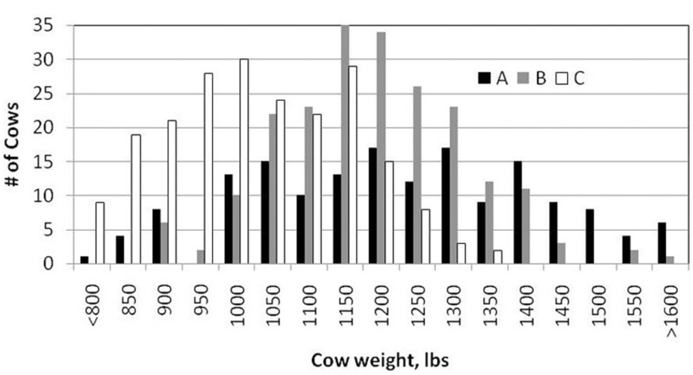

Figure 1. Distribution of cow weight in three example cow herds.

Nutritional Implications

It is prudent to consider examining the difference in feed requirements for the mythical 1,000 lb cow and the more realistic 1,200 lb cow. Table 2 outlines the intake, total digestible nutrients, and crude protein requirements for a single cow on a single day in three distinct periods: early lactation (three month after calving), at weaning (seven months after calving), and late gestation (one month before calving). For this comparison, lactation potential (moderate milk, 20 lbs at peak) is considered the same for both BW. The difference in DMI, TDN and CP amounts are quite evident during any of the three periods. The question arises: how to feed these two different cows when they are in the same herd. Obviously, the amounts of feed required are different, but with only minimal managerial input; how then are these cows effectively fed; which cow is utilized as the reference to feed to; and which cow suffers or which is overfed? If pasture is utilized to meet nutrient requirements the issue becomes one of stocking density. However, if supplements or stored forages are provided, then an accurate feeding program is necessary because of the increased financial cost associated with providing stored and supplemental feeds.

Table 2 illustrates the difference in intake, total digestible nutrients, or crude protein between a 1,000 and 1,200 lb cow, which will vary from 7 to 16%. The percent difference between cow weight for feed intake of 11.8, 14.7, and 15.0% can be directly translated into increased pasture stocking density. Alterations in stocking density directly affect the total number of cows an enterprise can carry, the amount of pasture needed to maintain cows, and the amount of supplemental feed that may have to be purchased to sustain the cow herd. The interaction of the number of cows and the fixed cost of land can have significant effects on the bottom line of the beef cattle enterprise. Likewise, if the stocking density can be positively adjusted purely based upon cow weight and more forage is available for consumption, then implicitly the nutritional environment of the cow herd will improve. Improving the cow nutritional environment most likely will result in an increase in the overall cow herd body condition. Cow body condition is directly related to the reproductive success of the cow, which in turn results in calves on the ground and salable product at weaning.

The preceding discussion could be interpreted as advocating for a smaller cow. A smaller cow has less nutrient requirements than larger cows. Thus, smaller cows generally are easier to maintain in any given nutritional environment. There are objections associated with a smaller cow; one issue is the potential for lighter weaning weights. True enough, if weaning weight as a percentage of cow weight remains constant between heavy and lighter weight cows, the total calf weaning weight can't be compensated by realistic increases in stocking density (number of cows in the herd). So the first response to the smaller cow objection and lighter calf weaning weights would be to increase the quality of the bull utilized with greater weaning weight potential. However, in actuality, cow weight and calf weaning weight do not track positively. The data from the three herds shows that as cow weight increase the calf weaning weight as a percentage of cow weight decrease. This trend was consistent across the three herds even though the herds have different breed composition, sires, sire types, and overall breeding programs. Table 1 illustrates the calf weaning weight (percentage of cow weight). The heaviest, largest cows never come close to weaning 50% of their weight, which is a general industry bench mark, whereas the lightest, smaller cows wean calves close to or over 50% of the cow's weight. In the example, the two herds with average cow weight in the range of 1,200 lb had a mean cow weight of 1,224 lb and weaned 48.5% of the cow weight. In that situation, a 15% increase in cow numbers associated with 1,000 lb cows that wean 50% of the cow weight would not result in the same amount of calf weight weaned. In order for the 1,000 lb cows to wean the same amount of calf weight, the 15% increase in cow herd number would have to be coupled with a 3% increase (53% of the cow weight) in weaning weight. Certainly, a 3% increase in calf weaning weight is achievable; in fact, one of the example cow herds has a mean calf weaning weight (percentage of cow weight) of 55% that surpasses that benchmark.

Production Implications

Cow size also has important effects on cow herd productivity. Starting with the developing heifer, projected mature weight affects the rate of maturation associated with reproduction in developing heifers. As mature BW increases, age at puberty increases, and this effect is greater for late- vs. early-maturing breed types. Similarly, as weight increases the percent of heifers cycling and conception rate decreases, again the effect is greater in late-maturing than early-maturing breed types. Florida based research (Table 3) by Vargas et al. (1999) support these generalizations, as Brahman cow frame size (i.e. cow weight) increased from small to medium to large, age at puberty increased from 633 to 672 days of age.

This research also demonstrates the effect of cow size on cow productive traits across first, second, and third or greater parity. As cow size increased and cows aged, calving rate decreased. The calving rate difference specifically led to differences in the ability of cows to remain in the herd (survival rate) after the first parity. Large cows had a 48% survival rate compared to 81% survival rate for small cows. Calving date within the calving season was similar among cow size; however, the change in calving date from first to third parity was two-times larger for large cows compared to small cows. Weaning rates during the first and second parity was greater for small and medium sized cows compared to large cows that had weaning rates of less than 50%. Weaning weights and pre-weaning daily gain of calves was greater for calves from large cows compared to small and medium cows. This is likely a function of milk production capacity as large cows likely produce proportionally more milk, which also increased cow nutrient requirements on top of the greater nutrient requirements based on weight. Despite smaller calves, cows of small and medium size produced more pounds of calf weaned relative to the total number of cows exposed for breeding during the first and second parity.

Cow mature weight has important implications for many of the production parameters associated with the overall cow herd. Heifer development, cow reproduction, and calf performance can be affected by cow weight. However, subsequent post-weaning performance of calves can be similar between small and large sized cows.

Conclusion

As beef cattle production costs increase, particularly those associated with feeding the cow herd, the size and nutritional requirements of the cow herd have to be addressed. The challenge for every beef cattle enterprise is to produce calves that meet market requirements as efficiently as possible. A key component to efficient calf production is the appropriate cow size. Cows with moderate size (weight) with good maternal traits and genetics for calf growth are the cows to target and retain in the cow herd. Certainly a good set of scales to assess cow weight might be one of the most important tools a beef cattle producer could have. Indeed, if you can't measure it, you can't manage it, and cow weight certainly falls in that important category. Better identification of efficient, low-weight cows is one management strategy to employ as production economics tighten and total enterprise efficiency becomes an important and measurable property of profitable beef cattle enterprises.

References

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Table 1. Relationship of calf weaning weight (% of cow weight) to cow weight of three example herds[1].

	Calf weaning weight (% of cow weight)				
Location	Avg. Cow (cow weight, lb)	Lightest Cow (cow weight, lb)	Heaviest Cow (cow weight, lb)	Greatest % (cow weight, lb)	Lowest % (cow weight, lb)
A	46 (1,233)	51 (808)	33 (1,750)	72 (901)	18 (1,518)
B	51 (1,215)	48 (902)	27 (1,650)	65 (1,110)	27 (1,650)
C	55 (1,053)	56 (806)	45 (1,380)	64 (892)	27 (964)

[1]Cow weights were taken weaning for each location.

Table 2. Relationship of cow weight to dry matter intake, total digestible nutrients, and crude protein requirements during lactation, at weaning, and mid-late gestation.

	Nutrient requirement		
Cow weight, lb	Dry matter intake, lb/d	Total digestible nutrients, lb/d	Crude protein, lb/d
Early lactation			
1,000	25.4	14.9	2.6
1,200	28.4	16.4	2.8
% difference	11.8	10.1	7.7
After weaning			
1,000	21.1	9.5	1.3
1,200	24.2	10.9	1.5
% difference	14.7	14.7	15.4
Late gestation			
1,000	21.4	11.9	1.9
1,200	24.6	13.8	2.2
% difference	15.0	16.0	15.8

Table 3. Relationship of body size and parity on production traits of Brahman cows in Florida[1].

	Cow body size		
Item	Small	Medium	Large
Calving rate, %			
1st parity	93.5	88.8	97.3
2nd parity	65.8[a]	69.0[a]	41.0[b]
≥3rd parity	93.5[a]	78.5[b]	79.8[b]
Calving date in the calving season			
1st parity	33.9	33.8	36.9
2nd parity	55.0	65.0	82.0
≥3rd parity	59.3	65.0	64.0
Cow survival rate, %[2]			
1st parity	80.7[a]	83.4[a]	47.9[b]
2nd parity	97.5	88.1	93.9
≥ 3rd parity	77.6	86.9	95.7
Weaning rate, %			
1st parity	75.0[a]	74.3[a]	46.2[b]
2nd parity	64.9[a]	59.8[a]	38.3[b]
≥3rd parity	71.8	68.5	75.8
Weaning weight, lb			
1st parity	424[a]	476[b]	498[b]
2nd parity	420	420	427
≥3rd parity	438[a]	447[a]	509[b]
Pre-wean calf gain, lb/d			
1st parity	1.65[a]	1.84[b]	1.98[b]
2nd parity	1.80[a]	1.80[a]	2.03[b]
≥3rd parity	1.83[a]	1.89[a]	2.11[b]
Production per cow, lb			
1st parity	315[a]	357[a]	227[b]
2nd parity	268[a]	254[a]	177[b]
≥3rd parity	310	331	389

[1] Adapted from Vargas et al. 1999.
[2] Likelihood of a cow to remain in the herd after each parity.
[a, b] Means with different superscripts are different $P < 0.05$.