Relationship of Cow Size, Cow Requirements, and Production Issues

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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 the cow's reproductive success and overall herd profitability. However, beef producers often take a "one size fits all" approach to feeding the cows in the cow herd. This singular approach to nutrient supply for the cow herd can have nutritional and economic ramifications. Nutritional requirements vary with age, breed, sex, body condition, environment, physiologic status, and body weight (BW). It should be obvious that not all cows have the same nutrient requirements. By acknowledging differences in nutrient requirements that exist in the beef cow herd, management strategies can be implemented to feed beef herds 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 factors with the greatest impact on requirements. This discussion will focus on cow BW, acknowledging that milk production is an additional driving factor for the following discussion.

Cow Body Weight Implications

Simply put, BW drives the intake of forages and feedstuffs. Heavier cows have greater dry matter intake (DMI) potential to consume feed, likewise lighter cows consume less. Through DMI cows consume the required energy, protein, fats, vitamins, and minerals required for maintenance and production. Figure 1 demonstrates the DMI potential, total digestible nutrients (TDN), and crude protein (CP) requirement differences between cows of different BW during a production cycle estimated by the NRC (1996). Regardless of the time of year, differences in BW are manifest in differences in DMI.

So why are differences in DMI 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 that is available to the cow herd. That said, 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). Additionally, stocking density for many of government agencies (USDA, NRCS, BLM) is described by animal units (AU). An AU 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 DMI based upon differences in BW. Therefore, if our assumptions about stocking density are based on poor information or absent BW information, then the stocking density and pasture carrying capacity will be wrong.

Cow-calf producers that don't routinely collect BW data on their cow herd often under-estimate the actual BW of cows in the herd. It seems a pervasive assessment about cow herd BW that most cows, or at least the herd average is 1,000 lb. This is what I call the "mythical" 1,000 lb cow. Likely, a more correct assessment of the herd cow BW 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 BW greater than 1,000 lb. The increase in cow BW over the years is 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, growthy calves likely conspires to increase actual cow BW over time.

An assessment of cow BW at weaning of three University of Florida cow research herds demonstrates the fallacy of assuming that the herd average cow BW is 1,000 lb. None of the three UF herds' average cow BW is 1,000 lb; one herd average cow BW is 1,053 lb, but the other two herds have average cow BW over 1,200 lbs. Figure 2 demonstrates the distribution of cow BW in the three UF herds. Not only is the average cow BW not 1,000 lb, but only 17, 16, and 21% of the cows are within ± 50 lb of 1,000 lb and the range of cow BW is 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 wrong.

Nutritional Implications

Let's examine the difference in feed requirements for the mythical 1,000 lb cow and the more realistic 1,200 lb cow. In Table 1 is outlined the DMI, TDN, and CP 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). Remember 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 are these cows effectively fed; which cow is utilized as the reference to feed to; and which cow suffers or which cow is overfed? If pasture is utilized to meet nutrient requirements the issue becomes one of stocking density, which will be addressed later. However, if supplements or stored forages are provided, accurate feeding programs are a must because of the increased financial cost associated with providing stored and supplemental feeds.

Upon close examination of Table 1, you would discover that the difference for DMI, TDN, or CP between a 1,000 and 1,200 lb cow vary from 7 to 16% increase for the heavier cow. The percent difference between cow BW for DMI of 11.8, 14.7, and 15.0% can be directly translated into increases in stocking density of pastures. Alterations in stocking density directly affects: 1) the total number of cows an enterprise can carry, 2) the amount of pasture the cattle enterprise needs to maintain cows, and 3) 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 beef cattle enterprise bottom line. Likewise, if the stocking density can be positively adjusted purely based upon cow BW and more forage is available for consumption, then implicitly the nutritional environment of the cow herd will improve. Improving the cow nutritional environment will likely lead to an increase in the overall cow herd body condition. Cow body condition score 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 nutrient requirements that are less 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 for the calves produced from lighter BW cows. True enough, if weaning weight as a % of cow BW remains constant between heavy and lighter BW cows, the total calf weaning weight can't be compensated by realistic increases in stocking density (# 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 BW and calf weaning weight do not track positively. In examining the data from the three UF research herds there is a trend that as cow BW increased the calf weaning weight as a % of cow BW decreases. This trend was consistent across the three herds even though the herds have different breed composition, sires, sire types, and overall breeding programs. Table 2 illustrates the calf weaning weight as a percent of cow BW. The heaviest, largest cows never come close to weaning 50% of their BW, which is a general industry bench mark. Whereas, the lightest, smaller cows wean calves close to, or over 50% of the cow's BW. In our UF examples, the two herds with average cow BW in the 1,200's lb had a mean cow BW of 1,224 lb and weaned 48.5% of the cow BW. In that situation, a 15% increase in cow numbers associated with 1,000 lb cows that wean 50% of the cow BW 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 BW) in weaning weight. Certainly, a 3% increase in calf weaning weight is achievable; in fact the Santa Fe cow herd with a mean calf weaning weight as a % of cow BW of 55% surpasses that benchmark.

Production Implications

Cow size or BW also has some important effects on cow herd productivity. Starting at the developing heifer, projected mature BW effects the rate of maturation associated with reproduction in developing heifers. Table 3 presents a simulation of the effect of projected mature BW on heifer production parameters for early and late-maturing breed types. As mature BW increases, age at puberty increases and this effect is greater for late-maturing breed types compared to early maturing breed types. Likewise, as BW 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 by Vargas et al. (1999) supports the simulation data. As Brahman cow frame size (*i.e.* BW) increased from small to medium to large, age at puberty increased from 633 to 672 days of age.

Vargas et al. (1999) also is a great demonstration of the effect of cow size on cow productive traits across first, second, and third or greater parity. As cow frame size increased and cows aged, calving rate decreased. Calving rate difference specifically led to differences in survival rate during 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 ADG 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 BW. 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.

Work in Hereford cows (Olson et al., 1982) demonstrated that differences in cow BW did not result in differences in calf weaning weight and pre-weaning ADG. Likewise, there was no difference in calf performance or carcass characteristics between when calves from cows of different size were finished to a common final BW. The lone exception was that calves from small, medium, and large cows had larger ribeye area compared to calves from very large (1,425 lb BW) cows. An important consideration regarding interpretation of the Olson et al. (1982) work is that the level of nutrition for all cows regardless of BW was more than adequate and was never limiting production.

Cow mature BW has important implications for many of the production parameters associated with the overall cow herd.

Table 1. Relationship of cow bodyweight (BW) to dry matter intake (DMI), total digestible nutrients (TDN), and crude protein (CP) requirements during lactation, at weaning, and mid-late gestation

	Nutrient Requirement		
Cow BW	DMI, lb/d	TDN, lb/d	CP, 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 2. Relationship of cow bodyweight (BW) to calf weaning weight as a % of cow BW of three UF research herds

	Calf Weaning Weight as % of Cow BW				
Location	Heaviest Cow (cow BW)	Lightest Cow (cow BW)	Avg. Cow (cow BW)	Greatest % (cow BW)	Lowest % (cow BW)
NFREC	33	51	46	72	18
	(1,750)	(808)	(1,233)	(901)	(1,518)
BRU	27	48	51	65	27
	(1,650)	(902)	(1,215)	(1,110)	(1,650)
Santa Fe	35	56	55	64	27
	(1,380)	(806)	(1,053)	(892)	(964)

Table 3. Simulation of the effect of mature BW on heifer development in early and late-maturing breed types[1]

	Age at Puberty (days)		Percent Cycling		Percent Conception	
Mature BW, lb	Early mature	Late mature	Early mature	Late mature	Early mature	Late mature
881	345	428	99	67	92	86
1,100	366	452	97	45	92	77
1,322	382	474	92	27	92	95
1,542	399	491	84	12	91	80
1,762	412	506	65	5	89	38

[1] Adapted from Notter et al. 1979.

Table 4. Effect 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			
1st parity	33.9	33.8	36.9
2nd parity	55.0	65.0	82.0
≥3rd parity	59.3	65.0	64.0
Survival rate, %			
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 ADG, 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.

[a, b] Means with different superscripts are different $P < 0.05$.

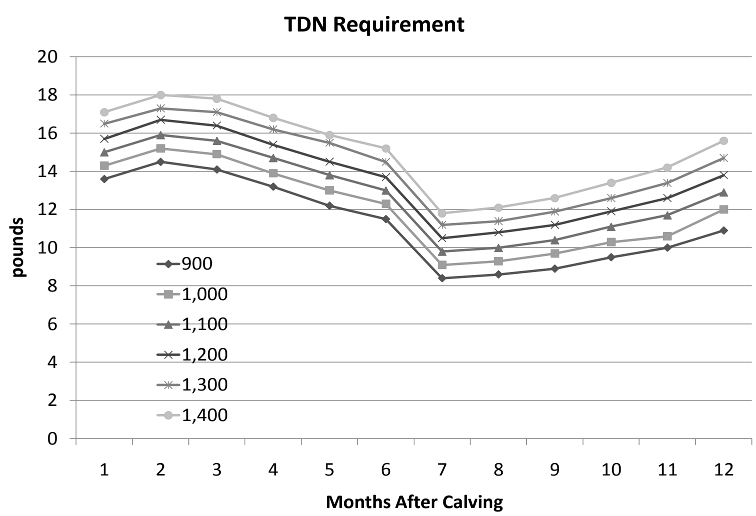
Table 5. Effect of cow body weight on production parameters and offspring performance[1]

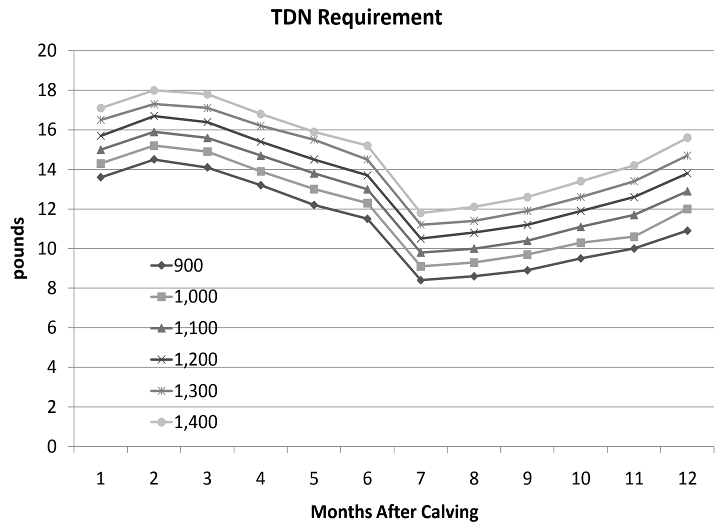
	Cow Body Size			
Item	Small	Medium	Large	Very Large
Cow body weight, lb	993	1,139	1,249	1,425
% Pregnant	87.2	89.5	92.1	87.5
% Weaned	85.0	76.8	86.7	76.7
Weaning weight, lb *	391	443	442	413
Pre-wean ADG, lb/d *	1.54	1.70	1.74	1.67
Post-wean ADG, lb/d	313	3.13	3.13	3.08
Hot carcass weight, lb	655	657	655	652
Dressing percent	61.2	61.4	61.1	60.9
Ribeye area, in^2 *	12.5	12.4	12.5	11.6
% Choice	86.3	85.9	85.7	83.9

[1] Adapted from Olson et al. 1982.

* Effect of cow size.

Figure 1. Effect of cow BW on dry matter intake, TDN, and crude protein requirements during the annual productive cycle




TDN Requirement
20
18
16
14
12
10
8
6
4
2
0
pounds
900
1,000
1,100
1,200
1,300
1,400
1
2
3
4
5
6
7
8
9
10
11
12
Months After Calving

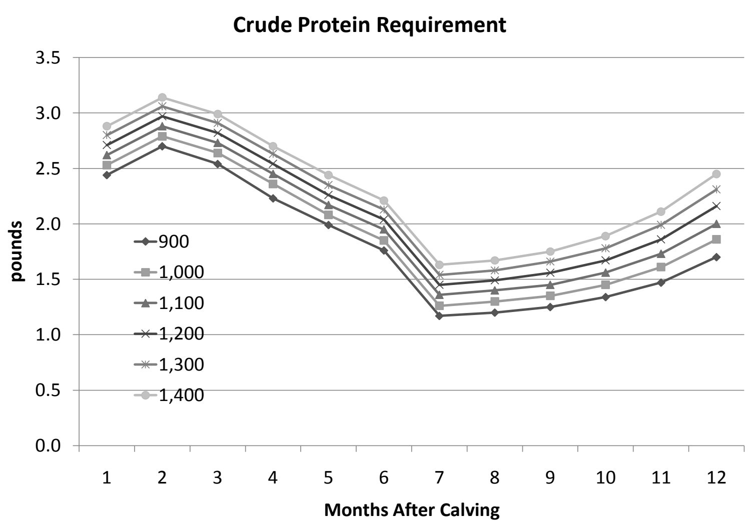
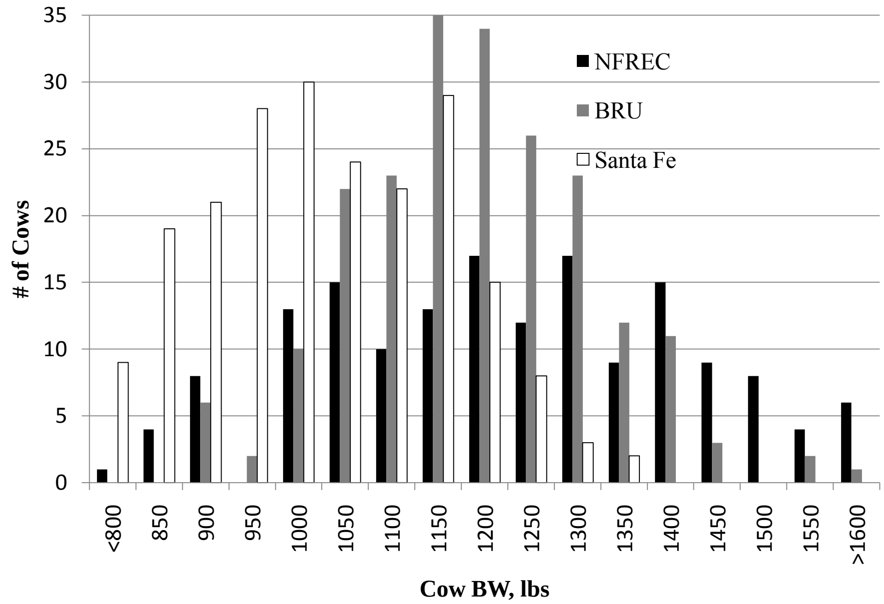

Crude Protein Requirement
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
pounds
900
1,000
1,100
1,200
1,300
1,400
1
2
3
4
5
6
7
8
9
10
11
12
Months After Calving

Figure 2. Distribution of cow bodyweight at three UF research facilities



Heifer development, cow reproduction, and calf performance can be affected by cow BW. However, subsequent post-weaning performance of calves can be similar between small and large sized cows.

Conclusion

As production costs associated with beef cattle production 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. Like much in life, moderation is the key to success. Cows with moderate size (BW) 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 asses cow BW 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 BW certainly falls in that important category. Better identification of efficient, low-BW 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

Notter, D. R., J. O. Sanders, G. E. Dickerson, Gerald M. Smith, and T. C. Cartwright. 1979. Simulated efficiency of beef production for a midwestern cow-calf-feedlot management system. II. Mature body size. J. Anim. Sci.49: 83-91.

NRC. 1996. Nutrient Requirements of Beef Cattle. 7th Ed. Natl. Acad. Press, Washington, DC.

Olson, L. W., D. E. Peschel, W. H. Paulson, J. J. Rutledge. 1982. Effects of cow size on cow productivity and on calf growth, postweaning growth efficiency and carcass traits. J. Anim. Sci. 54:704-712.

Vargas, C. A., T. A. Olson, C. C. Chase, Jr, A. C. Hammond, and M. A. Elzo. 1999. Influence of frame size and body condition score on performance of Brahman cattle. J. Anim. Sci. 77:3140-3149.