SDSU Extension

BEEF

Chapter 26

Adding Value to Cowherds Using Reproductive Technology

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Introduction

It has previously been estimated that reproduction is the most important factor in the profitability of a cow-calf operation (Trenkle and Willham 1977). However, when annual cow costs are calculated the majority of the cost is associated with nutrition. Therefore, how can reproduction and reproductive technologies impact the value of the cow herd? Rogers et al., (2012) performed a partial budget analysis on utilizing fixed-time artificial insemination as a specific reproductive technology. They demonstrated that through heavier calves, imporved genetics, more calves, improved uniformity, fewer bulls, improved calving ease, and a more concentrated calving season while also considering fewer cull bulls, increased costs, increased labor, increased facilities and supplies needed commercial herds realized an almost $50 advantage over just turning out bulls and no synchronization. Furthermore, when we think about value and profitability in our cow-calf herd we need to evaluate what can increase the value of the calves we produce and what can lower the expenses it takes to produce those calves. When we think of increasing the value of the calves produced, we can increase the value through increased pounds weaned (or percent calf crop weaned), increased performance, and by producing cattle that are more highly valued in the marketplace. When we think of decreasing the cost of producing calves we need to consider our annual labor, number of bulls required, and the cost associated with heifer development (or the replacement of a mature cow in the herd).

Increasing the Value of the Calves Produced

Pounds Weaned

The value of the calves at weaning are based mostly on weight, and the producer is often subjected to prices based on those offered at a local market. Thus, weight of the calves at the time of marketing is the main factor impacting value of the calves and revenues generated. Age of calf at weaning is the single largest factor that affects weaning weight. Analysis of 3700 animals at the USDA-Meat Animal Research Center indicated that for each day of age

Key Points

- There are two methods to increase profitability:
  1) increasing the value of the calves we produce and
  2) lowering the expenses it takes to produce calves.
- Increasing the value of the calves produced, can be accomplished by increasing pounds weaned or percent calf crop weaned, increasing performance, and by producing cattle that are more highly valued in the marketplace.
- Decreasing the cost of producing calves can be accomplished by: decreasing annual labor costs, decreasing fixed costs, and by decreasing costs associated with heifer development.
- Several reproductive technologies exist that can help in the production of higher valued calves and allow for more focused utilization of labor.

after the beginning of the calving season that a calf is born 2.42 pounds of weaning weight is lost (personnel communication R. Cushman). This translates to a loss of $3.63 per day per calf or almost $25.41 per week per calf as the calving season progresses (assuming a market price of $150/cwt). Given such economic ramifications, there is a clear economic advantage to having calves born early in the calving season and minimizing the number of calves born late in the calving season.

Uniformity of Calf Crop

Calf values are affected by multiple factors: However, uniformity is one that statistics indicates plays a key role. Color, frame size, flesh, weight range and genetic similarity are factors included by potential buyers as they evaluate lot uniformity.

Researchers at South Dakota State University, North Dakota State University and Montana State University collected data that offered the economic benefits for uniformity in calves at marketing: Selling vaccinated calves in larger lot sizes was found to be economically beneficial.

Estrous synchronization protocols that document increased numbers of calves born early in the breeding season encourage uniformity within calf crops. That increased uniformity generally rewards them in terms of increased value for the producer at marketing time.

Estrous Synchronization

Estrous synchronization simply implies the manipulation of heifer's/cow's estrous cycles to cause them to exhibit standing estrus around the same time. This can greatly reduce the number of days needed to detect a group of animals in standing estrus. Furthermore, synchronized cows that exhibit estrus early in the breeding season will also have additional chances to conceive during a defined breeding season. The average estrous cycle is 21 days (range 18 to 23 days), allowing one chance every 21 days for a cow to conceive. During a 65-day breeding season, cows that cycle naturally have only three chances to conceive, but cows that are synchronized and show estrus the first few days of the breeding season have up to four chances to conceive. Additionally, estrous synchronization protocols capable of inducing puberty and shortening the anestrous postpartum period can result in an even greater percentage of cows having a chance to become pregnant during the first few days of the breeding season.

Artificial Insemination

Estrous synchronization makes artificial insemination (AI) more feasible due to the reduction in time and labor required for estrous detection. When AI is combined with estrous synchronization, the limitation on serving capacity of a single bull is removed, and a large number of females can be bred to a single sire or group of sires during the first few days of the breeding season. This can result in a more uniform calf crop that is older and heavier at weaning. Utilizing AI technology also allows cattlemen, regardless of cowherd size, access to almost any genetic bloodlines available in the industry.

Fixed-time Insemination

To expand the use of artificial insemination and increase the adoption rate of other emerging reproductive technologies, precise methods of controlling ovulation must be developed. Numerous studies have been conducted to induce ovulation in cattle at a specific time, thereby eliminating the time and labor required to detect estrus. Stevenson et al. (2000) reported higher pregnancy rates ($P < 0.05$) for cattle artificially inseminated following detection of standing estrus (44%; Select Synch - GnRH on day -9, PG on day -2 and detect estrus) compared to cattle bred by timed AI (33%; CO-Synch – Select Synch with timed insemination and a second injection of GnRH on day 0). However, Lemaster et al. (2001) reported higher ($P < 0.05$) pregnancy rates for timed AI following the CO-Synch protocol (31%) compared to AI following estrus detection with the Select Synch protocol (21%).

Performance and quality

There are several ways to think about improved performance and quality in cattle. Improved performance is usually thought of as increased weight at different time points, or in increased average daily gain or feed efficiency. Improved quality can be thought of in many different ways, and they depend on the marketing program through which you market your calves. Some people market bulls and the son of one sire could be worth more

Table 1: Factors influencing price of North Dakota, Montana and South Dakota calves during fall 2006.

Factor	Number of Lots	Lot Price	Price Premium[a]	*P -value*
Lot size				<0.001
≥ 21	911	114.74[a]	6.20	---
11–20	885	112.85[b]	4.31	---
6–10	1,113	112.76[b]	4.22	---
≤ 5	3,342	108.54[c]	0.00	---
Calf sex				<0.001
Steers	3,440	117.11[a]	9.78	---
Heifers	2,805	107.33[b]	0.00	---
Color				<0.001
Black, BWF[b]	3,831	114.40[a]	3.48	---
Mixed	968	112.15[b]	1.23	---
Red, RWF[c]	983	111.42[b]	0.50	---
White	450	110.92[b]	0.00	---
Vaccinations				<0.001
4-way viral	1,191	113.46[a]	2.50	---
741[d]	1,559	112.24[a]	1.28	---
No vaccinations[e]	3,502	110.96[b]	0.00	---
Natural				0.04
Yes	898	113.00[a]	1.55	---
No	5,354	111.45[b]	0.00	---
Implants				0.18
Yes	286	113.05	1.66	---
No	5,966	111.39	0.00	---
Base weight[f]	6,251	-0.09	<0.001	---
Base weight (quadractic)	6,251	0.00	<0.001	---

[a] Price in $/cwt
[b] BWF = black white face
[c] RWF = red white face
[d] 741 = 7-way clostridial plus 4-way viral plus Pasteurella
[e] No vaccination history, but may have 7-way clostridial
[f] Mean base weight of all lots (520 lbs.) – base weight of each lot

Estrous synchronization protocols that document increased numbers of calves born early in the breeding season encourage uniformity within calf crops. That increased uniformity generally rewards them in terms of increased value for the producer at marketing time.

than the son of a different sire. However, the most objective way to measure quality in the beef industry is through the beef that is produced. Traits associated with both growth and quality are considered moderately to highly heritable (Table 2). The most efficient and economical method for genetic change in cattle is through the use of genetically proven sires by artificial insemination (AI).

Table 2: Estimates of heritability of growth and carcass traits in beef cattle. *Data adapted from [a]Minyard and Dinkel, 1965; [b]Herring and Bertrand, 2002; [c]Koots et al., 1994; [d]Utrera and Van Vleck, 2004.*

Trait	Heritability
Weaning weight[a]	0.32
Average daily gain[b]	0.28-0.38
Feed conversion (f/g)[c]	0.36
Feed efficiency (g/f)[c]	0.42
Carcass weight[d]	0.40
Dressing percent[d]	0.32
Back fat[d]	0.36
Rib eye area[d]	0.40
Marbling[d]	0.37
Yield grade[d]	0.64
Retail product percentage[d]	0.52

Sexed Semen

In the late 1980s, bovine reproductive scientists developed a process for sorting semen by gender and that process, while extremely slow, inefficient and costly early-on, has improved immensely since then. While the dairy industry recognized the benefits of this technology in its early stages, application for adoption in beef reproductive practices rapidly became apparent.

The sexed semen application for use in dairy herds has like benefits for at least two significant production areas in the beef cowherd: (1) Heifer calves are easier to deliver than bulls so calving ease has merit from this process; (2) Heifer calves with genetic superiority always have increased value especially for seedstock operations and in times when industry expansion is a priority.

Contrarily, seedstock operations that generate a significant portion of their sales by marketing calves as next generation herd sires can be financially rewarded through the use of sexed bull semen. This practice would have little, or no, benefit to the dairy industry, especially in the Jersey breed where bull calves are virtually worthless.

Economically, sexed semen technologies have been greatly perfected to where sorting of bull and heifer sperm is over 90 percent accurate. Additionally, its cost to cattlemen has moderated to where it is becoming more equitable to use; offering a greater return on the producer investment.

Decreasing the Cost of Producing Calves

Decreasing Annual Labor

Calving Season: The longer the calving season the greater the labor demands on the producer. A recent survey of over 4000 producers from 23 states indicated that the number of times heifers and cows were observed within a 24 hour period during the calving season ranged from 1.6 to 5.8 (Dargatz et al., 2004). If only 30 minutes were spent at each observation, this translates to 48 minutes to almost 3 hours spent each day observing calving. Therefore, labor costs ($15 per hour) per day of calving season can range from $12 to $45. Thus, as the calving season is extended, labor costs increase dramatically. When the cost of an extended or multiple calving seasons is evaluated, each additional week of the calving season cost producer between $84 and $315 per week. Given these scenarios, to improve the efficiency of production it is important to: 1) have as many cows and heifers as possible bred at the beginning of the breeding season and 2) have a condensed calving interval. This will increase the proportion of calves born early in the calving season and decrease the time and labor (observing calving over 45 days instead of 90 days) required for calving observation.

Breeding Season: Estrous synchronization and AI remain the most important and widely applicable reproductive biotechnology available for cattle (Seidel, 1995). Although estrous synchronization of heifers and cows has been commercially available for over 30 years, beef producers have been slow to adopt this management practice (Fewer than 10% of beef animals in the United States are bred by AI). The time and labor required to detect spontaneous estrus in beef cattle has been a deterrent to the widespread utilization of AI (Britt, 1987). To rectify

this drawback, estrous synchronization methods that reduce or eliminate the time and labor required for estrus detection have been developed to encourage producers to use AI. Unfortunately, only half of the producers that practice AI use any form of estrous synchronization to facilitate their AI programs (Corah and Kiracofe, 1989; NAHMS, 1994). Although producers that use AI without estrous synchronization receive the benefit of improved genetics, the additional benefit of more calves born early in the breeding season is not realized.

Heifer Development to Increase Longevity

Research has indicated it takes the net revenue from approximately six calves to cover the development and production costs of each replacement heifer (E. M. Mousel Unpublished data). In addition, any cow that misses a single calving is not likely to recover the lost revenue of that missed calf (Mathews and Short, 2001). Therefore, longevity of a beef female is important to the sustainability and profitability of any beef operation. Considering the importance of longevity, an important question is as follows: Why are females culled from a beef herd? According to the 2007-08 NAHMS survey the greatest percentage of cows culled from the herd were for pregnancy status (33.0%); other reasons for culling included age or bad teeth (32.1%), economic reasons (14.6%), other reproductive problems (3.9%), producing poor calves (3.6%), temperament (3.6%), injury (2.9%), udder problems (2.7%), bad eyes (1.8%), and other problems (1.8%). Furthermore, 15.6% of animals culled were less than 5 years of age and 31.8% were 5 to 9 years of age. These females that are culled from a herd prior to producing 6 calves increase the developmental cost of other heifers and do not contribute to the profitability and sustainability of the farm. Therefore, understanding how management decisions impact pregnancy success and longevity will have an effect on the profitability and sustainability of an operation.

Heifers need to calve by 24 months of age to achieve maximum life-time productivity (Patterson et al., 1992), and heifers that lose a pregnancy or conceive late in the breeding season are not likely to have enough time in the subsequent breeding season to conceive. Conversely, heifers that calve early with their first calf have a longer post-partum interval and are more likely to breed back as two year olds and continue to calve early in the calving season. Research has indicated that animals that conceive earlier in the breeding season are more likely to conceive in the subsequent breeding season compared to cows that conceive late in the breeding season (Burris and Priode, 1958). In a more recent study by Cushman et al., (2013), longevity data were collected on 2,195 heifers from producers in South Dakota, and longevity and weaning weight data were collected on 16,549 heifers at the USMARC. Data were limited to heifers that conceived during their 1st breeding season. Heifers that calved with their first calf during the first 21 day period of the calving season had increased ($P < 0.01$) longevity compared to heifers that calved in the second 21 day period, or later. Average longevity for South Dakota heifers that calved in the 1st or later period was 5.1 ± 0.1 and 3.9 ± 0.1 yr, respectively. Average longevity for USMARC heifers that calved in the 1st, 2nd, and later period was 8.2 ± 0.3, 7.6 ± 0.5, and 7.2 ± 0.1 yr, respectively. Calving period also influenced ($P \leq 0.03$) weaning weight of the 1st, 2nd, 3rd, 4th, 5th, and 6th calf born from these heifers. In addition, calving period influenced total pounds weaned and average weaning weight ($P < 0.01$), with heifers that calved during the 1st period having increased weaning weights, total pounds weaned, and average weaning weight compared to heifers calving in the 2nd period or later, and heifers calving during the 2nd period had increased weaning weight, total pounds weaned, and average weaning weight compared to heifers calving later. Therefore, heifers that calved early in the calving season with their first calf had increased longevity and pounds weaned compared to heifers that calved later in the calving season.

Summary

The costs associated with reproduction are often only thought about when reproduction fails in cow-calf operations. However, reproductive technologies can be used to increase the percentage of cows that calve during the first 21 days of the calving season. This can increase weaning weights and decrease labor associated with calving. Reproductive technologies can also facilitate genetic improvement for both carcass and growth traits in an operation.

Furthermore, understanding the importance of reproduction can have a tremendous impact on the longevity of animals within your herd. Therefore, reproduction and reproductive technologies can greatly impact the value of your calves and the overall profitability of you operation.

References

Beal, W. E. 1983. A note on synchronization of oestrous in post-partum cows with a prostaglandin f2a and progesterone-releasing device. Anim Prod 37:305-308.

Britt, J. H. 1987. Induction and synchronization. In: E. S. E. Hafez (ed.) Reproduction in farm animals. Lea and Febiger, Philadelphia, PA.

Cushman R. A., L. K. Kill, R. N. Funston, E. M. Mousel, and G. A. Perry. 2013. Heifer calving date positively influences calf weaning weights through six parturitions. J. Anim. Sci. (9): 4486-91.

Downing, E. R., D. Schutz, D. Couch, D. G. LeFever, J. C. Whittier, and T. W. Geary. 1998. Methods of estrous detection to increase pregnancies using the select synch protocol., Colorado State University Beef Program Report.

Hall, J. G., C. Branton, and E. J. Stone. 1959. Estrus, estrous cycles, ovulation time, time of service, and fertility of dairy cattle in louisana. J. Dairy Sci. 42:1086-1094.

Herring, W. O. and J. K. Bertrand. 2002. Multi-trait prediction of feed conversion in feedlot cattle. In the Proceedings of the Beef Improvement Federations.

Healy, V. M., G. W. Boyd, P. H. Gutierrez, R. G. Mortimer, and J. R. Piotrowski. 1993. Investigating optimal bull:Heifer ratios required for estrus-synchronized heifers. J Anim Sci 71:291-297.

Koots, K. R., J. P. Gibson, C. Smith and J. W. Wilton. 1994a. Analyses of published genetic parameter estimates for beef production traits. 1. Heritability. Anim. Breed. Abstr. 62: 309-338.

Landivar, C., C. S. Galina, A. Duchateau, and R. Navarro-Fierro. 1985. Fertility trial in zebu cattle after a natural or controlled estrus with prostaglandin f2 alpha, comparing natural mating with artificial insemination. Theriogenology 23:421-429.

Lemaster, J. W., J. V. Yelich, J. R. Kempfer, J. K. Fullenwider, C. L. Barnett, M. D. Fanning, and J. F. Selph. 2001. Effectiveness of gnrh plus prostaglandin f2alpha for estrus synchronization in cattle of bos indicus breeding. J Anim Sci 79:309-316.

Lucy, M. C., H. J. Billings, W. R. Butler, L. R. Ehnis, M. J. Fields, D. J. Kesler, J. E. Kinder, R. C. Mattos, R. E. Short, W. W. Thatcher, R. P. Wettemann, J. V. Yelich, and H. D. Hafs. 2001. Efficacy of an intravaginal progesterone insert and an injection of pgf2a for synchronizing estrus and shortening the interval to pregnancy in postpartum beef cows, peripubertal beef heifers, and dairy heifers. J Anim Sci 79:982-995.

Miksch, E. D., D. G. LeFever, G. Mukembo, J. C. Spitzer, and J. N. Wiltbank. 1978. Synchronization of estrusin beef cattle ii. Effect of an injection of norgestomet and an estrogen in conjuction with a norgestomet implant in heifers and cows. Theriogenology 10:201-221.

Minyard, J. A. and C. A. Dinkel. 1965. Heritability and repeatability of weaning weight in beef cattle. J. Anim. Sci. 24:1072-1074.

Patterson, D. J., R. C. Perry, G. H. Kiracofe, R. A. Bellows, R. B. Staigmiller, and L. R. Corah. 1992. Management considerations in heifer development and puberty. J Anim Sci 70:4018-4035.

Perry, G. A., M. F. Smith, and T. W. Geary. 2004. Ability of intravaginal progesterone inserts and melengestrol acetate to induce estrous cycles in postpartum beef cows. J Anim Sci 82:695-704.

Rodgers, J. C., S. L. Bird, J. E. Larson, N. DiLorenzo, C. R. Dahlen, A. DiConstanzo, and G. C. Lamb. 2012. An economic evaluation of estrous synchronization and timed artificial insemination in suckled beef cows. J. Anim. Sci. 90:4055-4062.

Rupp, G. P., L. Ball, M. C. Shoop, and P. J. Chenoweth. 1977. Reproductive efficiency of bulls in natural service: Effects of male to female ratio and single- vs multiple-sire breeding groups. J Am Vet Med Assoc 171:639-642.

Schafer, D. W., J. S. Brinks, and D. G. LeFever. 1990. Increased calf weaning weight and weight via estrus synchronization. Beef program report. Colorado state university. p 115-124.

Stevenson, J. S., K. E. Thompson, W. L. Forbes, G. C. Lamb, D. M. Grieger, and L. R. Corah. 2000. Synchronizing estrus and(or) ovulation in beef cows after combinations of gnrh, norgestomet, and prostaglandin f2alpha with or without timed insemination. J Anim Sci 78:1747-1758.

Trenkle, A. and R. L. Willham. 1977. Beef production efficiency: The efficiency of beef production can be improved by applying knowledge of nutrition and breeding. Science 198:1009-1015.

Utrera, A. R. and L. D. Van Vleck. 2004. Heritability estimates for carcass traits of cattle: a review. Genetics and Mol. Res. 3:380-394.

Whittier, J. C., R. W. Caldwell, R. V. Anthony, M. F. Smith, and R. E. Morrow. 1991. Effect of a prostaglandin f2 alpha injection 96 hours after introduction of intact bulls on estrus and calving distribution of beef cows. J Anim Sci 69:4670-4677.

Yavas, Y., and J. S. Walton. 2000. Induction of ovulation in postpartum suckled beef cows: A review. Theriogenology 54:1-23.