UF IFAS Extension UNIVERSITY of FLORIDA

UF/IFAS PEER REVIEWED

AN379

https://doi.org/10.32473/edis-AN379-2021

Analysis of the USDA's 2017 Cow-Calf Management Practices Results: Part 2—Breeding Practices/ Reproductive Technologies[1]

Mario Binelli, João Bittar, and Angela Gonella[2]

Every ten years, the National Animal Health Monitoring System (NAHMS) of the United States Department of Agriculture (USDA) conducts a thorough survey to assess the management practices of the cow-calf operation throughout the country. In May of 2020, they released the results of the survey conducted in 2017: "Beef 2017: Beef Cow-Calf Management Practices in the United States, 2017" (NAHMS Beef 2017). Players in the beef industry are urged to analyze this information to measure progress and detect strengths and weaknesses in the system. Furthermore, the data reported give indication of what can be improved to ensure profitability, efficiency, and animal welfare. This series of EDIS publications aims to analyze these data, select the most relevant points, and present the big picture of the US cow-calf herd practices to stakeholders (producers, Extension agents, and the public). When data from previous surveys (1997 and 2007) were available, a comparison was conducted to evaluate technologies' adoption over time. The raw data used to write this series may be accessed through the USDA webpage. This series consists of three publications that specifically discuss the following themes: Calf crop and calving distribution; breeding practices/reproductive technologies; and bull practices and breeding soundness evaluation.

Introduction

The single most important objective of a cow-calf operation is to generate a live calf from every female in reproductive age every year. The NAHMS Beef 2017 nationwide study on cow-calf practices reported multiple variables associated with reproductive success, according to size of the operation (Small = 1–49 cows; Medium = 50–199 cows; Large = 200 or more cows). Overall, 83% of heifers and 93.5% of cows produced a calf in 2017. For both categories of animals, calving was greater in large (94.4%) than small (88.9%) or medium (91.6%) operations. The objective of this paper is to discuss the use of breeding practices and reproductive technologies in cow-calf operations, and the ways they affect calf crop.

Control of the Breeding Season

Having an established breeding season is the practice of introducing bulls to a group of females for a limited amount of time each year. The starting date and duration of the breeding season will determine the beginning and duration of the subsequent calving season and the calf age at weaning. Considerations about this practice were addressed extensively in a companion EDIS publication (Gonella-Diaza et al. 2021). Operations that have a set date to start the breeding season will time other breeding practices

1. This document is AN379, one of a series of the Department of Animal Sciences, UF/IFAS Extension. Original publication date December 2021. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. Mario Binelli, MSc., PhD, assistant professor of physiology, Department of Animal Sciences; João Bittar, DVM, MSc., PhD, assistant professor of beef cattle Extension, UF College of Veterinary Medicine; and Angela Gonella, DVM, MSc., PhD, assistant professor of beef cattle reproduction, UF/IFAS North Florida Research and Education Center; UF/IFAS Extension, Gainesville, FL 32611.

Reviewed: 08/2024

accordingly. For example, breeding soundness evaluation of bulls (addressed in a companion EDIS publication by Bittar et al. 2021), vaccination, and reproductive tract scoring of heifers are conducted prior to the beginning of the breeding season. If the operation uses an estrus synchronization program for natural breeding or artificial insemination (AI), it is usually timed so that breeding starts on the first day of the season. Finally, it is based on the timeframe of the breeding season that pregnancy tests will be conducted. The pregnancy diagnosis is usually conducted at least 30 days after the end of the breeding season or at weaning.

Estrus Synchronization

Estrus synchronization has the purpose of programming the estrous cycles of a group of females so that most of them will come in heat and ovulate within a short time frame. Estrus synchronization is mostly used in association with AI, but it can also be used in programs of timed-bull breeding, in which synchronized females are exposed to bulls for natural mating only (Ferreira et al. 2018). Synchronization is achieved through the strategic use of hormones that are administered in compliance with synchronization protocols (Lamb and Mercadante 2016). Several estrus synchronization protocols have been developed and tested scientifically (https://beefrepro.org/wp-content/uploads/2020/12/Protocols-for-Sire-Directories-2021-Final.pdf). There are protocols specific to heifers or cows, protocols for AI at observed estrus, and protocols for timed AI (TAI; i.e., AI at a time determined by the protocol, independent of estrus observation). County Extension agents and state Extension specialists can offer guidance for producers to choose among protocols and implement them in their operations. The two main outcomes of an estrus synchronization program are facilitated management of females for breeding and the induction of cyclicity. Regarding management, estrus synchronization allows the programming of activities such as administration of hormones, insertion and removal of intravaginal devices, observation of heat, and AI to fall on pre-specified days. Induction of cyclicity is a less obvious outcome of estrus synchronization. Most protocols include the administration of a progestin source, such as progesterone in intravaginal releasing devices, for a limited time (7–14 days). One of the effects of progestins is to induce cyclicity, both in cows that are in postpartum anestrus (Ferreira et al. 2018) and in prepubertal heifers (Lima et al. 2020). Overall, when well executed, estrus synchronization will prepare a group of females to breed early in the season, which is economically desirable. The NAHMS Beef 2017 report indicates that 7.3% of cow-calf operations in the US used estrus synchronization in that year. The technology was used in 4.8%, 12.2%, and 24.9% of small, medium, and large operations, respectively (Figure 1). Most operations that implement estrus synchronization programs do it in association with AI. Thus, the overall low adoption of estrus synchronization is related to the equally low adoption of AI.

Artificial Insemination

Artificial insemination involves collection, processing, and storage of semen from selected bulls and subsequent introduction of that semen into the female's reproductive tract to generate a gestation. The main advantage of AI is to bring superior genetics to the operation at a lower cost and greater accuracy than a breeding bull of high genetic merit. A recent advancement of that technology is the utilization of sexed semen (Vishwanath and Moreno 2018). Sexing is a selection process that enriches the sperm cells that will generate offspring of a single sex. According to the NAHMS Beef 2017 survey, most operations that use AI expose females to bulls after one round of AI. Additionally, while 18.5% of heifers in the US were bred by AI (alone or in combination with natural breeding), only 6.5% of cows received AI. Overall, only 11.6% of cow-calf operations in the US utilize AI. Adoption of this technology varied according with the size of the operation and was 8.7%, 17.7%, or 29.4% for small, medium, or large operations, respectively. Even though overall adoption was still low, the number of operations using AI nearly doubled from 1997 (6.1%) to 2017 (11.6%). When AI is associated with estrus synchronization, it is expected that most females will breed early in the season, which will consequently shorten the calving season and produce a more uniform calf crop. Finally, a consequence of using AI is that fewer bulls will be needed in the operation, decreasing costs associated with bull maintenance and the potential of venereal disease (e.g., trichomoniasis). The major perceived disadvantage of AI is the cost associated with the increased animal handling in activities related to the estrus synchronization, heat detection, and AI. Overall, AI remains a powerful breeding tool that remains underused in commercial beef cow-calf operations in the US.

Embryo Transfer

The purpose of using this technology is to increase the number of offspring from a female of superior genetic merit in a limited amount of time. This technology has two main components: a donor female with superior genetic merit and a recipient female of high fertility. Increased number of offspring from the donor female results from the production of multiple embryos by one of two means: (1) by superovulation of the donor female, followed by AI and collection of fertilized embryos, ready for transfer into synchronized recipients; and (2) through the collection of

oocytes by follicle aspiration, followed by in vitro fertilization and subsequent transfer of the in vitro-produced embryos to synchronized recipients. In the 2017 survey, only 3% of the operations used this technology. Moreover, utilization was distributed according to size and ranged from 2.5% to 5.5%, for small and large producers, respectively (Figure 1).

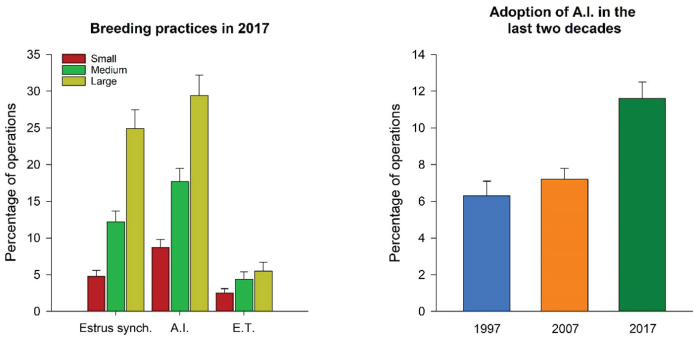

Figure 1. Left: Breeding practices in the US among small, medium, and large operations in 2017. Right: Adoption of artificial insemination in the last two decades. AI: Artificial Insemination; E.T.: Embryo Transfer. Data source: NAHMS Beef 1997, 2007, and 2017

Pregnancy Diagnosis

The pregnancy test is conducted at a point after breeding and before calving to measure the reproductive performance of individual animals and of the operation. Pregnancy tests can be performed by rectal palpation, transrectal ultrasonography, or blood test. Palpation and transrectal ultrasonography are conducted by a specialized technician. For a blood test, a sample is collected by the operation and usually shipped to a laboratory that will perform the test and send results back to the producer within a few days. Rectal palpation and ultrasonography tests provide a "real-time" result, and the female is referred to as "pregnant" or "open" (not pregnant). Starting 30 days after the expected date of conception, pregnancy tests exhibit high accuracy (Pohler et al. 2020). Thus, the pregnancy test should be conducted 30 days after the last expected opportunity of conception, which in most cases is the day of removal of bulls (in operations with a defined breeding season). For operations that utilize AI followed by bull breeding, it is common to have two pregnancy tests: one 30 days after the AI to measure conception to AI; and one 30 days after the end of the breeding season to measure overall reproductive performance in the operation. Pregnancy tests are a powerful tool for decision-making in cow-calf operations. Most commonly, operations rely on the pregnancy test to decide the fate of cows that are detected open at the end of the breeding season. Keeping an open cow until the subsequent breeding season constitutes a financial burden. In the beginning of this article, we mentioned that 83% of heifers and 93.5% of cows in the US produced a calf in 2017. Within the conditions of each individual operation, significant deviations from these numbers may be indicative of systemic issues in nutrition, management, herd health, and other aspects of the operation. Annually measuring the reproductive performance of the female herd should be a core activity of cow-calf operations. NAHMS Beef 2017 reported that 31.6% of cow-calf operations in the US used at least one of the three pregnancy tests mentioned. The most common method to test for pregnancy was rectal palpation, and it was adopted by 14.2%, 29.3%, and 53.6% of small, medium, and large operations, respectively. Overall adoption of ultrasound (4.7%, 16.0%, and 39.4% for small, medium, and large operations, respectively) and blood tests (2.87%, 5.6%, and 5.8% for small, medium, and large operations, respectively) was less prevalent. The use of rectal palpation remained similar between 2007 (18%) and 2017 (19.3% of operations) but use of ultrasound tests increased fourfold, from 2.2% to 8.8% during the same interval. Blood tests are relatively new to the market, which explains their lower adoption (Figure 2).

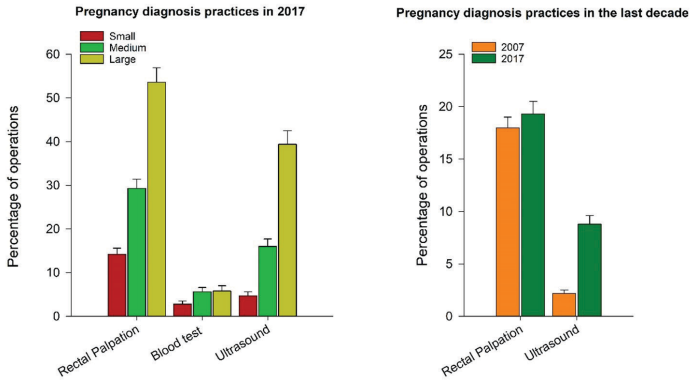

Figure 2. Left: Pregnancy diagnosis practices in 2017. Right: Adoption of pregnancy diagnosis practices in the last two decades. Data sources: NAHMS Beef 2007 and USDA-APHIS 2017

Additional Breeding Practices

The NAHMS Beef 2017 study also reported the adoption of pelvic measurement and body condition scores. Pelvic measurements of heifers provide an indicator for their development and capacity to deliver a calf. These measurements could be used to select heifers with greater chances of breeding successfully. In the 2017 report, this tool was used by 4.4%, 12.8%, and 15% of the small, medium, and large operations, respectively. Overall, adoption of this technology increased from 3.9% to 6.6% of operations from 2007 to 2017. Body condition scores (BCS) are attributed to animals after a visual inspection. BCS range from 1 to 9 and reflect the overall fat reserves of animals. They are also associated with the expected reproductive potential of females. Animals that are too thin (BCS 3 and lower) or too fat (BCS 8 and 9) are less fertile than animals presenting

intermediary scores. BCS use remained similar between 2007 (14.3%) and 2017 (13.6% of operations). In the 2017 report, 10.7%, 19.8%, and 30.6% of the small, medium, and large operations, respectively, used BCS.

In summary, there are two points that became apparent after the analysis of the NAHMS Beef 2017 report on the topic of breeding practices and reproductive technologies:

1. In general, utilization of reproductive technologies in cow-calf operations is low. When adding the proportion of operations that use at least one reproductive technology (estrus synchronization, artificial insemination, and pregnancy tests), the total is 50.5%.

2. Utilization of reproductive technologies increased with size of the operation.

Conclusions and Missed Opportunities

Reproductive performance measured as the number of calves in 2017 was very high (91.7%). This indicates that there was not a systemic issue of poor fertility in the US beef herd. However, what has been left on the table?

1. The opportunity to increase pounds of weaned calf/female. As indicated in this paper, strategies that favor breeding early in the season will allow calves to be weaned at an older age, consequently increasing calf weaning weights.

2. Greater genetic gains towards growth and carcass characteristics may be achieved by using superior sires through AI.

3. There is an opportunity to produce the same number of calves and beef with less land. Early detection of open females allows early culling and sparing of resources that would be needed to maintain them.

4. Late sexual maturity of heifers may also be addressed by using AI sires selected for early puberty.

5. Data reported by NAHMS Beef 2017 shows that there is a low adoption of reproductive technologies. Therefore, greater emphasis on producer education through targeted Extension programs in reproductive technologies and breeding practices is still greatly needed and could help to improve performance and profitability of cow-calf operations.

References

de Lima, R. S., T. Martins, K. M. Lemes, M. Binelli, and E. H. Madureira. 2020. "Effect of a Puberty Induction Protocol Based on Injectable Long-Acting Progesterone on Pregnancy Success of Beef Heifers Serviced by TAI." *Theriogenology* 154:128–134.

Ferreira, R. M., T. L. Conti, R. L. Goncalves, L. A. Souto, J. N. S. Sales, M. F. Sa Filho, et al. 2018. "Synchronization Treatments Previous to Natural Breeding Anticipate and Improve the Pregnancy Rate of Postpartum Primiparous Beef Cows." *Theriogenology* 114:206–11.

Gutierrez, K., R. Kasimanickam, A. Tibary, J. M. Gay, J. P. Kastelic, J. B. Hall, et al. 2014. "Effect of Reproductive Tract Scoring on Reproductive Efficiency in Beef Heifers Bred by Timed Insemination and Natural Service versus Only Natural Service." *Theriogenology* 81:918–24. doi:10.1016/j.theriogenology.2014.01.008.

Holm, D. E., P. N. Thompson, and P. C. Irons. 2009. "The Value of Reproductive Tract Scoring as a Predictor of Fertility and Production Outcomes in Beef Heifers." *J. Anim. Sci.* 87:1934–40. doi:10.2527/jas.2008-1579.

Lamb, G. C., and V. R. Mercadante. 2016. "Synchronization and Artificial Insemination Strategies in Beef Cattle." *Vet. Clin. North Am. Food Anim. Pract.* 32(2): 335–47. doi: 10.1016/j.cvfa.2016.01.006. Epub 2016 Apr 29. PMID: 27140297.

NAHMS. 1997. *Part II: Reference of 1997 Beef Cow-Calf Health & Health Management Practices: Beef '97*. Fort Collins: United States Department of Agriculture. https://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef97/Beef97_dr_PartII.pdf

NAHMS. 2008. *Beef 2007–08 Part III: Changes in the U.S. Beef Cow-Calf Industry, 1993–2008.* Accessed on April 8, 2013. https://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef0708/Beef0708_dr_PartIII_1.pdf

NAHMS. 2020. *Beef 2017: Beef Cow-Calf Management Practices in the United States, 2017*. Accessed on November 1, 2021. https://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef2017/Beef2017_dr_PartI.pdf

Pohler, K. G., S. T. Reese, G. A. Franco, R. V. Oliveira, R. Paiva, L. Fernandez, G. de Melo, J. L. M. Vasconcelos, R. Cooke, and R. K. Poole. 2020. "New Approaches to Diagnose and Target Reproductive Failure in Cattle." *Anim. Reprod.* 17(3):e20200057. doi:10.1590/1984-3143-AR2020-0057.

Vishwanath, R., and J. F. Moreno. 2018. "Review: Semen Sexing - Current State of the Art with Emphasis on Bovine Species." *Animal.* 12(s1): s85–s96. doi:10.1017/S1751731118000496. Epub 2018 Mar 19.