CHARACTERISTICS OF SUCCESSFUL REPRODUCTIVE MANAGEMENT PROGRAMS

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Introduction

The economic success of cow-calf beef operations relies on the ability to produce one live calf per cow per year. To achieve this goal, cow-calf producers need to overcome several obstacles related to the cow, bull and the offspring including, ovulation and fertilization rates and embryonic, fetal and postnatal survivals (Inskeep and Dailey, 2005). Over the last four decades several advances in reproductive biotechnologies such as, breeding soundness exams (BSE), pregnancy diagnosis, ultrasonography, artificial insemination (AI), estrus-synchronization, and fixed-time AI (FTAI) have helped producers improve genetic traits of their cattle, tighten the breeding season and shorten the calving season leading to an increase in overall profitability of cow-calf production systems (Lamb et al., 2010; Rodgers et al., 2012). However, even with these advancements, infertility and reproductive failure are still a major cause for economic loss in beef production. Recently, we projected a loss of $6.25 per exposed cow for every 1% decrease in pregnancy rate, with an estimated gross loss of $2.8 billion annually in the United States due to infertility of beef females (Lamb et al., 2011).

Rising feed costs, global competition, and societal concerns about energy policy and the environment have created new economic challenges for the beef industry. In order to sustain adequate supply for the growing protein demands all efforts should focus on increasing efficiency of beef production through implementation of best management practices and adoption of technology. Here we will explore the major characteristics of successful beef cow-calf reproductive management programs and highlight factors that can directly affect the reproductive efficiency of beef operations.

Setting Goals

Before making any decisions and changes on a current reproductive program, it is important to set goals and determine clear steps to achieve those goals. To achieve maximum reproductive efficiency, a beef cow-calf operation goal could be set as: producing one healthy and heavy calf for every exposed female in the operation, and achieving the greatest pregnancy rate as early as possible in the breeding season and, therefore, achieving the greatest calving rate early in the calving season. Furthermore, this goal needs to be achieved in the most economical manner possible to ensure profitability of the operation.

To achieve the goal a variety of factors will need to be considered and several management practices will need to implemented. A breeding season will need to be defined, keeping a short breeding season with 70 days or less is crucial to maintain increased selection pressure in the herd. Establishing an animal health and nutrition programs are essential to guarantee cattle performance. Implement aggressive culling guidelines that will eliminate females of poor fertility, disposition and performance. In addition, keeping accurate records on all cattle allows us to evaluate each animal and determine whether our steps towards our goals are being effective. Lastly, reproductive technologies should be used as tools to ensure maximum

pregnancy rates early in the breeding season can be achieved, as well as tools to increase the genetic potential of the herd.

Whatever your goal might be, make sure to be specific, separate it into short- and long-term steps and objectives, and to set measureable outcomes that can be achieved during the process. Achieving the short-term objectives will help you stay on track and progress through the long-term goal. A few examples of reproductive management goals and steps include:

1) Shortening breeding season from 100 to 70 days
    a. Cut 7 days per year for the next 4 years
    b. Cull all open females at the end of breeding season
2) Establish an estrous synchronization and FTAI program
    a. Update facilities to ensure adequate animal handling
    b. Evaluate and improve nutritional program to guarantee a BCS of 5 at the beginning of breeding season
    c. Identify an AI service provider
    d. Enroll all replacement heifers
    e. Enroll multiparous cows with at least 35 days post-partum by the beginning of the protocol, create multiple synchronization groups during the breeding season
3) Achieve 75% pregnancy rate within 21 days of breeding season
4) Achieve 95% of pregnancy rate at end of breeding season
    a. Make sure all females are exposed to FTAI
    b. Perform annual BSE in all bulls
    c. Perform pregnancy diagnosis as early as possible – 30 days into the breeding season and 30 days after removing the bulls to identify early pregnant cows
5) Achieve 90% calving rate and weaning rate
    a. Cull females with dystocia history
    b. Select sires of low/moderate birth weight
    c. Establish sound animal health program
6) Only retain replacement heifers born within the first 21 days of the calving season
    a. Perform early pregnancy diagnosis to identify pregnant heifers
    b. Maintain an accurate record system

Data Collection and Interpretation

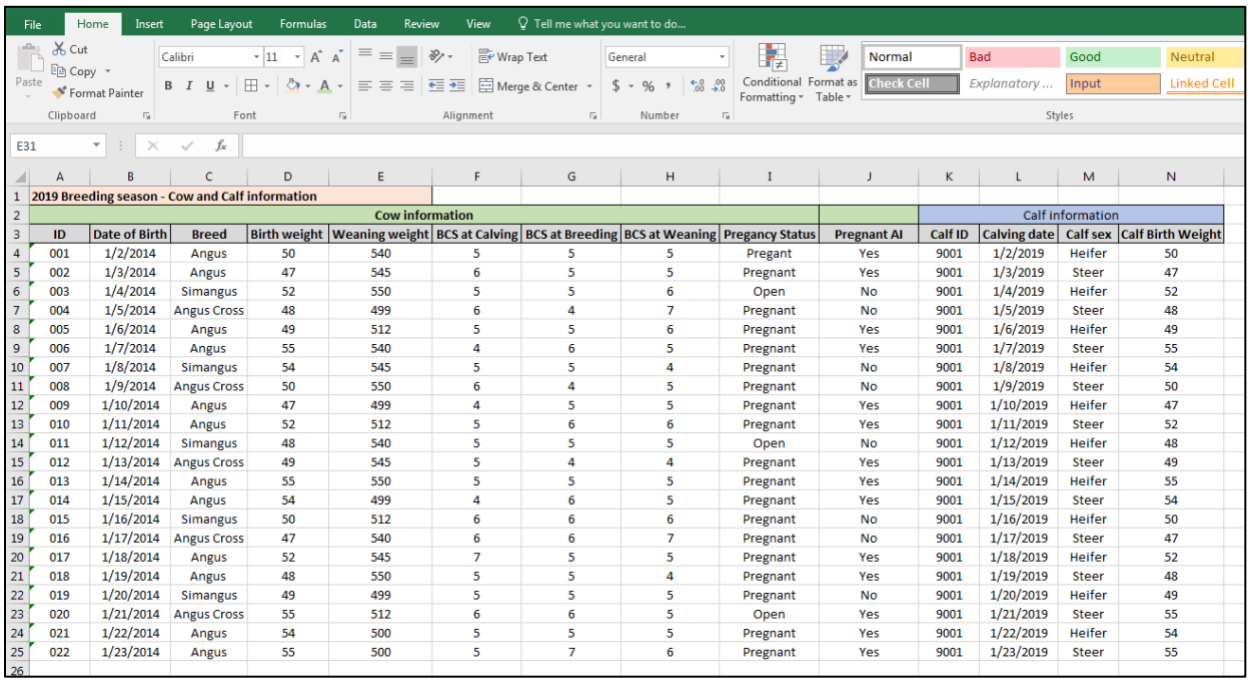
Collecting data on your herd and taking the time to look and interpret your results are extremely important to ensure your management decisions are adequate, your steps are being complete and the operation is moving towards achieving the goals previously set. Data interpretation also allows for changes in management when the strategies implemented are not being successful. Being able to determine the progression and success of all management changes implemented is critical to achieve your goals.

In order to collect data an individual animal identification system needs to be in place. The most common systems used are ear tags and branding (either hot or freeze), both systems are often used together to ensure proper animal identification. Electronic identification systems are also available and allow for automatic data logging and ease of access; however, such systems require a larger initial investment and might not be ideal for all producers. Several management software are available to aid on tracking individual animal health, production, performance and marketing records. As well as, whole herd and operation performance, costs and profitability.

Before purchasing a software, consider what your specific needs are. For example, some programs limit the number of animals that can be added and might require specific data that you do not collect in your herd. In addition, some programs require the animals to be numbered in a certain way, which might not be compatible with your numbering systems. Furthermore, consider what reports do you want to generate and make sure the software can deliver those. An example is the ability to track performance data on a cow's previous calves, creating a history of calf performance. Lastly, ease of use and access to helpdesk are important factors to consider. A program will only be helpful if you can actually enter the data and create reports of interest.

For most small and medium-size cow-calf operations, using Microsoft Office Excel spreadsheets is a simple way of collecting data and tracking individual animal performance. Most computers come equipped with Excel, reducing costs of purchasing a software, and it provides freedom to collect all the relevant data for your operation. In addition, it has the flexibility to add or remove data points with ease. Figure 1 shows an example of Excel spreadsheet for individual animal data collection. Each column represents data of interest and individual animals are listed as lines. Examples of data collection include:

1) Animal ID
2) Date of birth
3) Breed
4) Damn ID
5) Sire ID
6) Birth weight
7) Weaning weight
8) Temperament/disposition
9) BCS and/or BW at different time points
    a. At calving
    b. Beginning of breeding season
    c. At weaning
10) Pregnancy status
    a. AI or bull pregnancy, sire information
    b. Approximate date of pregnancy
11) Calving date
12) Dystocia incidence
13) Calf ID
14) Calf birth weight
15) Calf sex
16) Calf weaning weight



2019 Breeding season - Cow and Calf information													
Cow information										Calf information			
ID	Date of Birth	Breed	Birth weight	Weaning weight	BCS at Calving	BCS at Breeding	BCS at Weaning	Pregancy Status	Pregnant AI	Calf ID	Calving date	Calf sex	Calf Birth Weight
001	1/2/2014	Angus	50	540	5	5	5	Pregant	Yes	9001	1/2/2019	Heifer	50
002	1/3/2014	Angus	47	545	6	5	5	Pregnant	Yes	9001	1/3/2019	Steer	47
003	1/4/2014	Simangus	52	550	5	5	6	Open	No	9001	1/4/2019	Heifer	52
004	1/5/2014	Angus Cross	48	499	6	4	7	Pregnant	No	9001	1/5/2019	Steer	48
005	1/6/2014	Angus	49	512	5	5	6	Pregnant	Yes	9001	1/6/2019	Heifer	49
006	1/7/2014	Angus	55	540	4	6	5	Pregnant	Yes	9001	1/7/2019	Steer	55
007	1/8/2014	Simangus	54	545	5	5	4	Pregnant	No	9001	1/8/2019	Heifer	54
008	1/9/2014	Angus Cross	50	550	6	4	5	Pregnant	No	9001	1/9/2019	Steer	50
009	1/10/2014	Angus	47	499	4	5	5	Pregnant	Yes	9001	1/10/2019	Heifer	47
010	1/11/2014	Angus	52	512	5	6	6	Pregnant	Yes	9001	1/11/2019	Steer	52
011	1/12/2014	Simangus	48	540	5	5	5	Open	No	9001	1/12/2019	Heifer	48
012	1/13/2014	Angus Cross	49	545	5	4	4	Pregnant	Yes	9001	1/13/2019	Steer	49
013	1/14/2014	Angus	55	550	5	5	5	Pregnant	Yes	9001	1/14/2019	Heifer	55
014	1/15/2014	Angus	54	499	4	6	5	Pregnant	Yes	9001	1/15/2019	Steer	54
015	1/16/2014	Simangus	50	512	6	6	6	Pregnant	No	9001	1/16/2019	Heifer	50
016	1/17/2014	Angus Cross	47	540	6	6	7	Pregnant	No	9001	1/17/2019	Steer	47
017	1/18/2014	Angus	52	545	7	5	5	Pregnant	Yes	9001	1/18/2019	Heifer	52
018	1/19/2014	Angus	48	550	5	5	4	Pregnant	Yes	9001	1/19/2019	Steer	48
019	1/20/2014	Simangus	49	499	5	5	5	Pregnant	No	9001	1/20/2019	Heifer	49
020	1/21/2014	Angus Cross	55	512	6	6	5	Open	Yes	9001	1/21/2019	Steer	55
021	1/22/2014	Angus	54	500	5	5	5	Pregnant	Yes	9001	1/22/2019	Heifer	54
022	1/23/2014	Angus	55	500	5	7	6	Pregnant	Yes	9001	1/23/2019	Steer	55

Figure 1. Example of a Microsoft Excel spreadsheet for individual animal data collection.

Increasing Selection Pressure

Increasing the selection pressure on your herd can help you make sure that only your best cattle, the ones who perform well within your management and environment, stay in the herd. There are several strategies to help increase the selection pressure on your herd. These include, establishing a breeding season, defining clear animal performance parameters that need to be met, and create an aggressive culling criteria for animals that do not meet your performance parameters.

Breeding Season. Having a defined breeding season of 70 days or less is perhaps the most simple, economical and effective strategy to improve selection pressure on your herd. In addition, a short breeding season allows for concentrated management with improved management of time and labor, and it creates a more uniform and valuable calf crop. It has been previously shown that heifers that become pregnant early in the breeding season will consequently calve early in the calving season, wean heavier calves and have improved longevity (Cushman et al., 2013). However, according to the last NAHMS census published (Figure 2, NAHMS, 2009) only 38% of all beef cows in the U.S. are managed under a breeding season of approximately 70 days. Establishing a breeding season is best accomplished by a systematic approach, reducing only between 7 to 10 days a year, over several years until reaching the desired breeding season length.

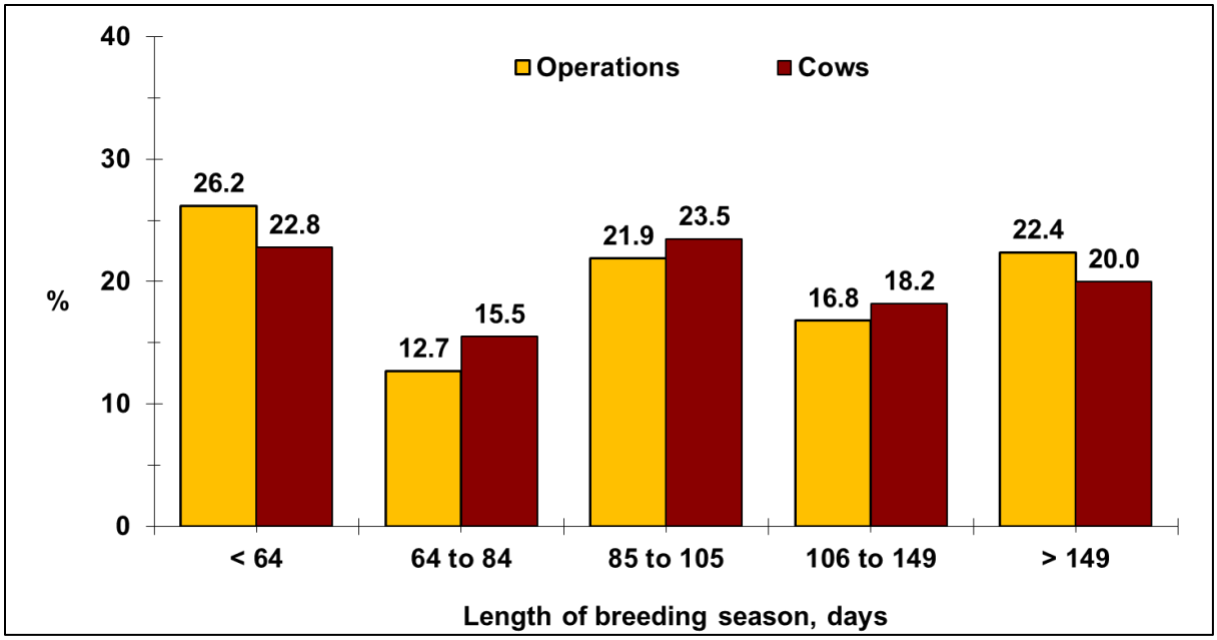


Figure 2. Percentage of cows and operations in the U.S. that are exposed to different length breeding seasons. Adapted from NAHMS, 2009.

Defining performance parameters. By increasing the selection pressure in your herd, you will ultimately select and maintain your best, most productive and efficient cows. One way to approach this is by creating a "job description" for your cows and heifers. For example:

1) Replacement heifers must become pregnant during the first 25 d of the breeding season.
2) Every cow will be exposed to estrous synchronization and FTAI.
3) Each cow must produce a live calf every year and calve without assistance or they will be culled.
4) Every cow must provide the resources for the genetic potential of the calves and each calf she produces must be genetically capable of performing.
5) No additional supplemental feed will be offered to cows that failed to maintain body condition.
6) Females with an undesirable temperament or disposition will be culled.
7) Bulls that fail the annual breeding soundness exam will be culled.

Following strict culling criteria. Once you have clear and defined production parameters that every female needs to achieve, any female that does not perform to those standards will need to be culled. Females that do not satisfy your parameters should not be given a second chance. Otherwise, the selection pressure will not be applied and undesirable females will continue in the herd, with an overall decrease in herd productivity. It is also important to hold your bulls to the same high standards of you females. Bulls with undesirable temperament, structural issues and that fail a breeding soundness exam should be culled.

Taking Advantage of Reproductive Technologies

There are several reproductive technologies available to ensure maximum reproductive efficiency and profitability of cow-calf production systems. We will focus on two reproductive technologies that when used in combination can have the greatest positive impact on reproductive efficiency. Those reproductive technologies are: estrous synchronization and FTAI.

Fixed-time Artificial Insemination. Advances in reproductive biotechnologies and enhanced understanding of the dynamics of the bovine estrous cycle have made possible the development of protocols to manipulate the estrous cycle and control ovulation utilizing natural and/or artificially synthesized hormones. Utilization of estrus or ovulation synchronization and FTAI has facilitated the widespread utilization of artificial insemination and can greatly impact the economic viability of cow-calf systems by enhancing weaning weights (Rodgers et al., 2012). Implementation of FTAI programs by beef producers, however, depends largely on 2 key factors:

1) Limited frequency of handling cattle; and
2) Elimination of detection of estrus by employing FTAI.

Currently only 7.6% of beef operations in the United Sates utilize AI as a reproductive management tool (NAHMS, 2009a), whereas 72.5% of all pregnancies in dairy females are the result of AI (NAHMS, 2009b). When queried as to their reluctance to utilize AI, over 53% of operations cited labor concerns or complicated estrous synchronization protocols as primary reasons for not implementing this reproductive technology (NAHMS, 2009a). During the past decade, FTAI protocols have been developed that eliminate detecting estrus and yield satisfactory pregnancy rates. The majority of these TAI protocols depend largely on the use of exogenous progesterone, gonadotropin release hormone (GnRH) to induce ovulation, and luteolysis via administration of prostaglandin $F_{2\alpha}$ (Lamb et al., 2010).

Among other factors, body condition score (BCS) and days post-partum (DPP) are two major factors that can negatively impact pregnancy success of FTAI protocols. A single unit increase in BCS, especially from poor BCS to adequate BCS, resulted in a 23 percentage point increase in the proportion of cows pregnant to FTAI (Lamb et al., 2001). Cows calving in poor BCS experience longer postpartum intervals to first estrus than those cows calving in moderate to good BCS. The effects of days postpartum on pregnancy rate to FTAI in suckled beef cows have also been previously shown, with improved fertility in multiparous cows and when DPP were greater than 50 days (Lamb et al., 2001). In a review (Stevenson et al., 2015) combining data from 3,269 suckled cows exposed to estrous synchronization protocols, as BCS increased from ≤ 3.5 to ≥ 6.0, the percentage of cows cycling increased linearly by 18% ± 2% for each unit increase in BCS, and pregnancy rates were greater in cows that calved during the first 7 weeks of the calving season, even though they had a lower overall BCS than later calving cows. In addition, cyclicity activity increased curvilinearly from 9% at ≤ 30 days to a peak of 70% at 81 to 90 d postpartum. The maximum pregnancy success of FTAI for multiparous cows was achieve when cows were at least 72 DPP and with a BCS greater than 5 (Table 1).

Possible outcomes from the use of FTAI include shortened calving season, increased calf uniformity, and concentrated births during the beginning of the calving season. In an analysis which investigated the incorporation of FTAI compared to natural mating in a cow/calf production setting, 84% of cows exposed to FTAI subsequently weaned a calf compared to 78% of cows in the natural mating group (Rodgers et al., 2012). Calving distribution also differed, resulting in the mean calving day from initiation of the calving season to be 26.8 d for cows exposed to FTAI and 31.3 d for cows exposed to natural mating (Rodgers et al., 2012).

According to these data, not only are more calves weaned per cow exposed to estrous synchronization and FTAI, but calves may be older at weaning and have had the opportunity to gain more weight.

This increase in weaning weight may have the greatest potential to offset the cost of estrous synchronization and FTAI systems. Although the improvement in genetics is a significant and long-term improvement, many producers have a desire for an immediate recovery of costs. Such costs can be recovered with the increase in total pounds of calf produced. The increase in total pounds produced was due to cows producing more weaned calves which tend to be older and heavier. It is clear that the benefits of estrous synchronization in combination with AI will continue to be realized and incorporated into beef production systems, with a subsequent improvement in efficiency of beef cattle operations.

Table 1. Impacts of body condition score and days post-partum on FTAI pregnancy rate of beef cows. Adapted from Stevenson et al., 2015.

Parity	Days postpartum	Body condition score	n	Pregnancy rate
Multiparous	> 72	> 5	2,154	51.7^{x}
	> 72	≤ 5	2,054	43.8^{y}
	≤ 72	> 5	1,056	44.2^{y}
	≤ 72	≤ 5	1,676	41.8^{y}
Primiparous	> 72	> 5	496	43.8^{x}
	> 72	≤ 5	623	43.5^{x}
	≤ 72	> 5	166	40.7^{xy}
	≤ 72	≤ 5	284	33.3^{y}

^{xy} Within parity, means without a common superscript differ ($P < 0.05$)

Summary

The main characteristics of a successful reproductive management program include the elaboration of a clear goal with steps to achieve this goal. A special focus on data collection and interpretation to identify the greatest performing animals in the herd and guide the decision making process for selecting management changes and strategies to achieve reproductive efficiency. Finally, the use of reproductive technologies, especially FTAI, are a great tool to improve selection pressure and genetic potential of the herd.

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