REPRODUCTIVE MANAGEMENT IN CATTLE AND SHEEP

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Contents

Summary

Reproductive efficiency is very important for profitable and sustainable operation of a commercial livestock production. Management, including genetic selection and nutrition, is critical to good reproductive performance. Replacement females should be productive, and reach puberty early. Fertility is maximized when well-managed females are bred with high-quality semen delivered at the appropriate time and place. Since the genetic value and fertility of each male is typically much more important than that of each female, breeding males should have superior genetics and good reproductive performance. Pregnancy diagnosis should be done as early as possible after breeding, to

identify nonpregnant females and get them bred again as soon as possible. In beef cattle, is very important to establish a restricted calving season (~ 60 days) to optimize management and produce a uniform calf crop. Calving difficulty (dystocia) results in direct and indirect losses. Birth weight is the major factor affecting the incidence of dystocia in cattle; dystocia can be minimized by good heifer management and selection of calving-ease sires. Although bull to female ratios for natural service in beef cattle are habitually 1:20 to 1:25, ratios of 1:35-1:40 are often appropriate for reproductively sound bulls. In lactating dairy cows, reproductive efficiency has declined over the past 50 years, apparently due to management, as heifers are not similarly affected. Traditionally, sheep production has often involved intensive management, but there is a move towards more extensive, lower-input management systems. Since many breeds of sheep are seasonal breeders, numerous strategies have been developed to improve their reproductive performance, including extending the breeding season. In sheep and cattle, assisted reproductive technologies, including induction and synchronization of estrus, collection and long-term preservation of gametes and embryos, artificial insemination and transfer of embryos, semen sexing, *in vitro* fertilization, and cloning, have been used to hasten genetic progress, preserve and disseminate genetic material, and control disease.

1. Introduction

Reproductive efficiency has profound effects on production efficiency, profitability, and sustainability of commercial livestock production. For example, reproductive efficiency is 10 times more important than carcass quality and 5 times more important than calf growth rate in beef herds. Optimal reproductive efficiency requires excellent management, not only of reproduction, but of the environment, feed, etc. Since objectives for reproductive efficiency are species and even herd or flock specific, data to monitor progress should be frequently collected, analyzed, and reported. The objective of this manuscript is to briefly describe management practices to improve reproductive efficiency and productivity of cattle and sheep. In addition, there are several reproductive technologies available to improve reproductive efficiency in cattle and sheep. Some of these technologies will be described in this subchapter, whereas others will be reported elsewhere.

2. Reproductive Management of Beef Cattle

2.1. Management of Beef Cows

It is very important to establish a restricted calving season (~ 60 days). In a herd with a non-restricted calving season, this can be achieved by gradually reducing the length of the breeding season. A restricted calving season provides selection pressure for cow fertility; in addition, cows can be culled based on performance of their progeny. A restricted calving season simplifies feeding and management, as cattle with similar nutritional needs can be easily grouped, and routine treatments (e.g. vaccinations) can be done at optimal ages. Finally, it is easier to market calves of a uniform age and size. The goal is to have 60% of calves born in the first 21 days; those born during this interval can weigh 14 kg more at weaning than those born during the second 21-day interval.

Since forage is the primary feedstuff for cattle, the breeding season should be dictated by forage supply, which can vary according to local growing conditions. Females having their first calf (primiparous heifers) are the most challenging group in a cow-calf herd, as they are still growing and nursing a calf. Consequently, they often have prolonged anestrus, delayed conception, and a lower pregnancy rate. Therefore, it is recommended that replacement heifers have a short breeding season (e.g. 42 to 45 days), which starts 20 to 30 days before mature cows, resulting in more synchronous calving and a longer postpartum interval before breeding. However, as a consequence, heifers may calve before pastures are optimal. Therefore, primiparous females should be separated from older (multiparous) cows after calving, and if necessary, given supplemental feed to meet their nutrient requirements. This should reduce the duration of postpartum anestrus, improve reproductive performance, and reduce culling due to failure to become pregnant.

2.2. Management of Replacement Beef Heifers

Approximately 15-20% of the cow herd is replaced annually; therefore, development of replacement heifers is critical. Traditionally, the oldest and biggest heifers were selected as replacements, although this can gradually increase mature cow weight. Since fertility increases from the first to the third estrus in a heifer, ensuring that the majority have reached puberty before the breeding season will enhance reproductive performance.

As a general guideline, at the beginning of the breeding season, beef heifers should weigh approximately 60-65 percent of their expected mature body weight (so called 'target weight'). Heifers should be weighed at weaning to accurately determine the amount of weight gain needed to reach their target weight. At weaning, producers should select the oldest heifers that are heaviest, as age and body weight are key factors affecting age at puberty. It is prudent to select at least 30% more heifers for development than are needed for replacements, to enable subsequent selection and culling. Well fed and managed, British and continental breed heifers should reach their target weights at 14-15 months of age, whereas Brahman-influenced breeds may not reach their target weight and puberty before 24 months of age. Age at puberty is affected by genetics (puberty can be hastened by genetic selection or crossbreeding) as well as management (particularly nutrition).

There are many methods to determine whether heifers have reached puberty. The simplest approach is to observe heifers for mounting behavior. Measurement of blood progesterone concentrations (at least two samples, approximately 10 days apart) is often done in research studies to confirm cyclicity. Alternatively, heifers can be examined by transrectal palpation or ultrasonography.

The reproductive tract scoring (RTS) system is based on a transrectal examination to estimate heifer maturity. It can be used as a selection tool when approximately half of the heifers should have reached puberty or as a culling tool 1 month before breeding. The RTS ranges from 1 to 5, with 1 being an infantile reproductive tract, 2 and 3 indicate reproductive tract development, but heifers are not yet cycling (3 are on the verge of cycling), whereas heifers rated 4 or 5 are cycling. The RTS system is useful as an indicator of pregnancy rate to synchronized breeding and at the end of the breeding

season. Based on those results, heifers scoring 1 should be eliminated from the breeding group. Heifers with an RTS of 2 should be also eliminated, unless estrus synchronization including a progestin (e.g. melengesterol acetate or progesterone-releasing intravaginal inserts) is planned. Regarding pregnant heifers, on average, those with scores of 3, 4, or 5 conceived 10 days earlier than those with an RTS of 1 or 2.

To determine cyclicity and stage of the estrous cycle based on a single transrectal ultrasonographic examination, we developed the following criteria: anestrus/prepuberal = no corpus luteum (CL); metaestrus = CL ≤ 15 mm and follicles < 10 mm; diestrus = CL ≥ 16 mm; and proestrus CL ≤15 mm with follicles ≥10 mm. With these criteria, the day of the estrous cycle was determined erroneously in 8.2% (30/368) and 11.5% (46/400) of the examinations in 3-wave and 2-wave heifers, respectively. However, it was noteworthy that >95% of incorrect classifications were in the first 2 d of the cycle (designated non-cycling). Presumably, including assessment of the uterine diameter (which is much smaller in prepubertal than cycling heifers) would greatly increase the ability to determine if a heifer is prepubertal or metaestrus.

2.3. Calving Difficulty

Calving difficulty (dystocia) is directly associated with a decreased number of calves weaned, due to increased calf and cow mortality. Furthermore, dystocia also has an indirect role in many cases of calf mortality attributed to infectious disease, and in the dam, it suppresses reproductive performance (prolongs the postpartum interval and reduces the conception rate). Collectively, all of these factors decrease profitability.

Birth weight is the major factor affecting the incidence of dystocia. Other factors include the dam's pelvic area, calf's sex, gestation length, dam's breed, age, size, and parity, sire's breed, nutrition and body condition score (BCS), exercise, environment, hormonal influences, and season. Producers and managers should carefully consider all factors that influence birth weight to reduce calving difficulties, particularly for first-calf heifers. They should select bulls for low birth weight, calving ease, and gestation length (when these data are available). Fortunately, Expect Progeny Difference (EPD) for those traits are now available for many AI sires. In this regard, producers can select replacement heifers sired by bulls with low EPDs for birth weight and reduced calving difficulty. In the absence of EPD data, a bull's actual birth weight can be used as a selection criterion.

Male calves are heavier at birth than female calves; consequently, the rate of dystocia in dams carrying male calves is approximately twice that of those with female calves. Furthermore, since most of the fetal growth occurs at the end of gestation, length of gestation is likely to affect calving difficulty. Fortunately, selection can be made for this characteristic; it is noteworthy that bulls designated as 'calving ease sires' (i.e. their offspring are born with a low incidence of dystocia) typically sire offspring that are born following a shorter than average gestation period.

Dystocia has been inversely related to pelvic area (size of the birth canal); tables have been developed to relate size of heifer, pelvic area, and suggested maximal birth weight of an easily deliverable calf. However, in other reports, pelvic area appeared to be

highly correlated with heifer and mature cow size. Consequently, selecting for larger heifers resulted in a larger pelvic area and heavier calf birth weight. Therefore, a minimum pelvic area measurement should be used as a culling criterion, rather than as a selection criterion which favors heifers with greater pelvic areas.

Nutritional management during pregnancy may affect the incidence of dystocia. It is a fallacy that limiting nutrient intake prior to calving will reduce calf birth weight and subsequently reduce the incidence of dystocia. Several studies have shown that this slightly decreases birth weight, but dystocia increases as cows tend to be weaker. In addition, there are long-term consequences of maternal nutrient deprivation, with deleterious effects on calf growth, health, reproduction, and body composition. Conversely, supplemental dietary energy (moderate to high) for 90-100 days prior to calving increases birth weight, but decreases dystocia. On a cautionary note, over-conditioned cows have a 10-20% increase in dystocia compared to moderately conditioned and thin cows. Managers must ensure adequate nutrition (with special attention for nutrition of replacement heifers) as part of a comprehensive approach to reduce dystocia.

Sire breed affects calf birth weight. Although virgin heifers have been bred to bull breeds with a reputation for siring calves with low birth weights (e.g. Jersey or Longhorn), these calves have very limited economic value. Finally, warmer environments and forced exercise reduce the incidence of dystocia in confinement-raised heifers.

2.4. Reducing Calf Losses in Beef Herds

A more concentrated calving season with a low incidence of dystocia will reduce neonatal mortality, a major cause of economic loss in beef cattle herds. Cows calving during daylight hours are generally more closely monitored, thereby increasing calf survival. A Canadian farmer, Gus Konefal, observed that beef cows fed at night tended to calve during the daylight hours. The system involves feeding twice daily, once from 11:00 to 12:00 and again at 21:30 to 22:00. This practice should be started approximately 1 month before the first calf is born and continue for the duration of the calving season. Konefal reported that using this regime, 80% percent of his cows calved between 07:00 and 19:00. In subsequent scientific studies, the percentage of cows calving from 22:00 to 06:00 was consistently 10 to 20% lower for cows fed using Konefal's system compared with cows fed earlier in the day.

Management strategies should focus on reducing calving difficulties, improving passive transfer of colostral immunoglobulins (IgG), and reducing environmental contamination during calving. Dystocia can not only directly cause calf mortality, but also has an indirect role in many deaths attributed to infectious disease. In that regard, calves born unassisted are more likely to survive, because they will quickly stand and suckle. Antibody concentrations are highest during the first milking and the ability of a calf to absorb IgG decreases drastically by 12 hours after birth. Thus, delayed suckling appears to be the most common cause of inadequate colostrum intake and low serum IgG concentrations in calves. Although fresh colostrum could be obtained from the dam and

administered by bottle to calves which experienced dystocia, they are less able to absorb colostral IgG, highlighting the importance of reducing the incidence of dystocia.

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Biographical Sketches

Dr. Marcos G. Colazo is a dairy scientist at Alberta Agriculture and Rural Development in Edmonton, Alberta, Canada. He received a DVM degree (in 1990) at the University of La Pampa, Argentina. After 8 years of private practice and teaching at the University of La Pampa, he moved to Canada where he received his MSc (in 2001) and PhD (in 2005) in Theriogenology at the University of Saskatchewan. His research focuses on reproductive management in cattle and his work on developing timed artificial insemination protocols and nutritional strategies that improve reproductive efficiency. He has published 37 peer-reviewed papers, 19 papers in conference proceedings and 89 abstracts in national and international meetings. Dr. Colazo's achievements have been recognized by many awards, including the Pfizer Student Award in 2000, the Hope Haanen Memorial Scholarship in Dairy Science in 2001, the AAPEX award in 2007 and the Canadian Society of Animal Science (CSAS) Young Scientist Award in 2011.

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