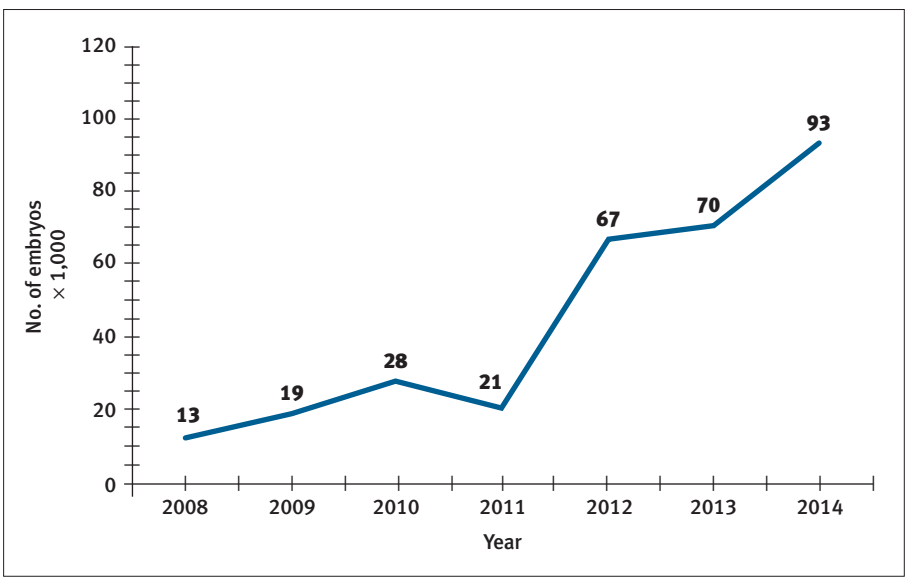
Repro Tracks

▶ by **Cliff Lamb,** *University of Florida*

Synchronization programs and reproductive technologies

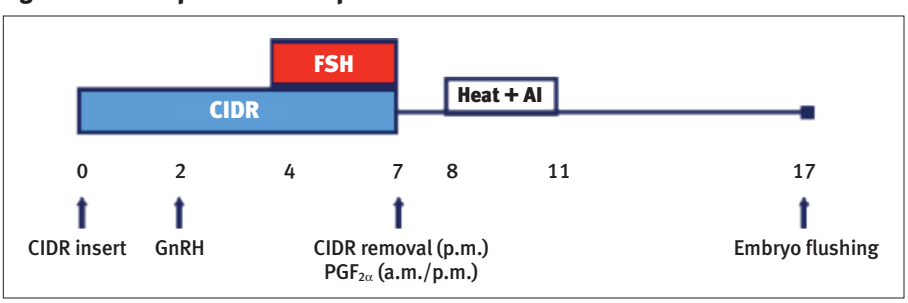
We are in the middle of winter, which often indicates that many producers have started calving or are about to start calving. This also means that the breeding season will be upon us before we know it. Many producers, particularly seedstock producers, are starting to consider breeding decisions for the new breeding season. Some may be considering which bulls to use, and others may be trying to decide whether to use artificial insemination (AI) or embryo transfer (ET). For those producers considering ET, keep in mind that there are many moving parts to having a successful ET experience. I have been asked many questions over the years related to embryo collection and/or transfer. Let me address some of those questions.

Fig. 1: Increase in use of *in vitro* fertilized embryos in North America since 2008



Source: International Embryo Transfer Association, 2016.

Fig. 2: Current superstimulation protocol for donors



A CIDR® is inserted on Day 0, followed by a 100-µg injection of GnRH two days later. The superovulatory treatment (eight injections every 12 hours of FSH) is initiated on Day 4. Donors receive two injections of prostaglandin $F_{2\alpha}$ (PGF) on Day 7, 12 hours apart (a.m./p.m.). At the time of the second PGF, the CIDR insert is removed. Heat detection starts 24 hours after CIDR removal and continues until Day 11. Donors detected in heat are artificially inseminated 12 and 24 hours after onset of estrus. Embryos are flushed seven days after AI.

Should I consider using *in vitro* fertilization (IVF) technologies rather than flushing donor females?

Beef producers should keep an eye on the advances in *in vitro* technologies. Currently, companies in the United States are offering this technology. Based on current data, this is the reproductive technology that is being adopted at the fastest rate and will see the largest growth in the next decade (see Fig.1).

While IVF technologies may not be procedures that you have used in the past, they offer tremendous opportunities for increased reproductive efficiency and overall production. In fact, some nuances that favor IVF over conventional embryo collection include that the donor does not need to be removed from production, since oocytes can be collected from a pregnant female. In addition, IVF offers opportunities for more total pregnancies per year than from a donor under conventional ET.

The current drawback with IVF technology is that the donor needs to be collected by a technician who is equipped with the proficiency, facilities and equipment required for oocyte recovery. In addition, pregnancy risk from IVF-derived embryos still remains slightly less than those derived from conventional *in vivo* embryo production.

Does feeding an expensive mineral to my donors increase embryo collection success?

I frequently find that producers who are flushing donor cows are always looking for a silver bullet that will alter embryo production; however, many factors may influence how donors respond to superstimulation and generate a high number of fertilized, good- to excellent-quality embryos.

Outside of genetics, nutrition is likely the single greatest factor that influences the response of donor females to superstimulation. It is important to ensure that cows are maintained on a positive plane of nutrition and are fed a diet that meets maintenance requirements.

Throughout the embryo transfer industry, the current dogma exists that feeding an organic source of mineral prior to superovulation of donors will enhance the total number and quality of transferable embryos. One previous unpublished study has demonstrated that donors receiving

organic mineral may yield a greater quantity of embryos, but this report failed to demonstrate that organic mineral enhanced the quality or quantity of embryos.

Therefore, we conducted a study to determine whether trace-mineral supplementation prior to embryo collection affected embryo production and quality. In this study (Lamb et al., 2008), among all heifers, the total number of recovered embryos was similar among treatments. We deduced that mineral source likely does not influence embryo quality or number when donors receive a well-balanced diet to meet their nutrient requirements.

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To date, no science-based experiment has been published to demonstrate an advantage of one mineral source to enhance embryo production over another mineral source. However, in cases in which donors do not receive a diet that is balanced for all nutrients, supplementation of those donors with a mineral fortified to address nutrients that are lacking may note an improvement in embryo production.

Have there been any recent advances in superovulation strategies?

Significant progress has been made in the understanding of cattle reproductive physiology. This knowledge has been used for the development of applied technologies that allow us to control reproductive events in the cow with the use of exogenous hormones. Within those technologies, the objective of superovulation protocols is to increase the number of follicles ovulated per cycle, allowing the fertilization of multiple oocytes and, consequently, the production of several embryos at once.

One relevant strategy is the use of hormonal treatments to synchronize the follicular wave in such a way that the beginning of a new follicular wave coincides with the beginning of FSH administration. This strategy has the convenience of initiating the superovulation protocol at a self-appointed time, regardless of the stage of the estrous cycle of the donor.

The commercial impact of synchronizing the new follicular wave is significant for the ET industry, since it allows embryologists to initiate superovulation of multiple donors at the same time. While there are many superovulation protocols recommended, the most frequently utilized protocol in the United States is the protocol depicted in Fig. 2.

How do I select an estrus synchronization system for recipients?

The most useful alternative to increasing the number of animals receiving embryos is to utilize protocols that allow for ET without the need for estrus detection, usually called fixed-time embryo transfer (FTET) protocols. However, much of the research related to the systems currently used in ET programs were developed for fixed-time artificial insemination (FTAI) rather than FTET. In fact, there is a misconception among producers that it is more complicated to transfer embryos into cows who receive embryos than for AI. However, this is not the case.

Synchronization of cattle for AI requires more precision than for ET. Transfer of embryos into estrus-synchronized cows is most effective when embryos are transferred six to eight days after detected estrus or GnRH injection.

Not until the discovery that growth of follicles in cattle occurs in distinct wave-like patterns were scientists able to embark on the development of estrus synchronization for FTAI or FTET. In a survey we conducted among American Embryo Transfer Association technicians, 72% of technicians indicated they prefer transferring embryos into cows that have been synchronized for FTET than into recipients in which estrus was detected. The primary reason for this is that FTET eliminates the error associated with heat detection and usually always results in more pregnancies per recipient synchronized than when estrus detection was used.

Are there methods in which to resynchronize nonpregnant recipients?

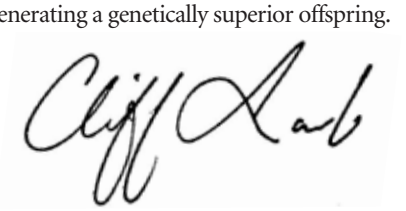
Effective management of a recipient herd requires getting the recipient ready to receive an embryo and identifying and preparing open cows to be resynchronized to receive an embryo or to be inseminated. In any group of synchronized recipients, a small percentage will not be detected in estrus, and not all detected in estrus will receive an embryo, either due to an asynchronous estrus or lack of a suitable *corpus luteum* (CL) at the time of transfer.

If 80% of the synchronized recipients are detected in estrus and 90% of those receive embryos, with 60% becoming pregnant, then less than 45% of any group of recipients will become pregnant. Therefore, it is important to devise a strategy to resynchronize recipients as soon as possible.

Resynchronization of nonpregnant cows at the first eligible estrus can be facilitated by resynchronization of the estrous cycle, which has a wide application in intense ET programs. Resynchronization strategies vary depending on the resources and capabilities of the ranch.

With the use of ultrasonography, nonpregnant recipients may be identified and resynchronized as early as three weeks after embryo transfer. However, to most efficiently condense the calving season, the second round of estrus synchronization should begin before the pregnancy status of the animals is known.

Likely the most desirable technique to resynchronize cows is the insertion of a CIDR for 14 days on the day of embryo transfer, seven days after estrus. This system has been shown to be effective in resychronizing estrus in nonpregnant cows. Hence, resynchronization of estrus is a strategy that increases the number of times a female can be exposed to biotechnologies such as embryo transfer; therefore, increasing its chances of resulting in pregnancy and generating a genetically superior offspring.



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