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“Beef Production Strategies” article

Sex-Sorted Semen for Commercial and Purebred Beef Producers

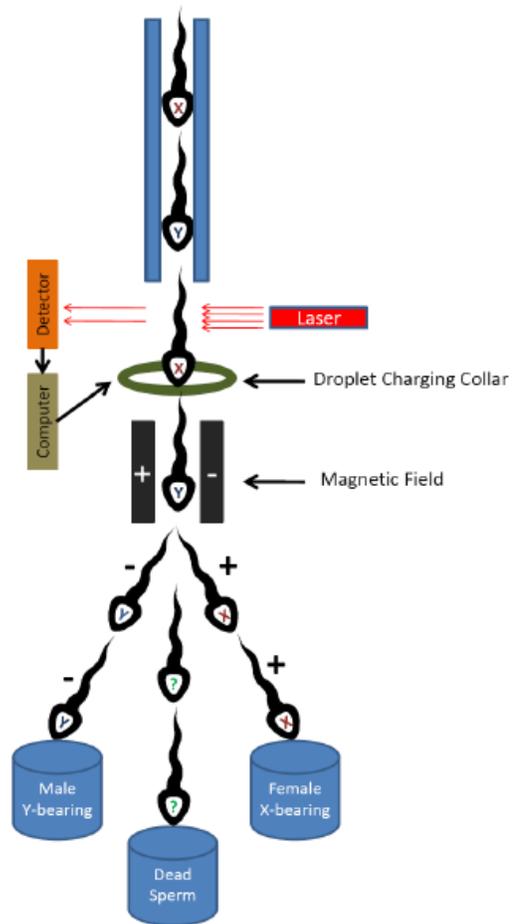
Justin Rhinehart, MSU Extension Beef Cattle Specialist

In the past few years, sex-sorted semen has made its way from the lab and field trials to use in beef cattle production. Shifting the sex ratio for a calf crop has been tried several different ways, but the idea of sorting or selecting semen to favor male or female offspring has been researched since the advent of artificial insemination. The fact that makes this concept possible is that the fertilizing sperm cell determines the gender of the calf. Due to the genetic makeup of the cells, sperm that produce female offspring are referred to as X-bearing sperm while those that produce male offspring are referred to as Y-bearing sperm.

Sex-Sorting Technology

There have been several attempts to develop a method that efficiently separates bovine semen into fractions containing higher concentrations X- or Y-bearing sperm. These technologies have utilized sex-specific antibodies, centrifugation, and flow cytometry. Of these attempts, the only one that has proven to be commercially viable is flow cytometry. This type of sorting was first researched in the 1980’s but yielded very low conception rates when the semen was used fresh after processing. Work in the laboratory and field has improved the results, and the first gender-selected calf using frozen semen was produced in 1999. Eventually, sexed semen became commercially available on a large scale in the U.S. in 2004.

The inefficiency of flow cytometry comes from its complexity and slow pace. The principle of this method relies on the fact that X-bearing (female) sperm contain 3.8% more DNA than Y-bearing (male) sperm. Before sorting, the sperm cells are stained with a florescent dye and then passed through the flow cytometer as drops of liquid containing a single sperm cell per droplet. Because of the difference in amount of DNA, the X-bearing sperm shine brighter than the Y-bearing sperm when exposed to light. This allows the cytometer’s laser and detector to determine the gender of the sperm cell based on the amount of light it emits. A positive



or negative charge is then applied to the droplet containing the single sperm cell. Positively charged drops are deflected one way, negatively charged drops deflected the other, and uncharged droplets pass straight through. The uncharged drops may contain multiple sperm, damaged material, or cells that were not aligned in the proper direction. This process is depicted in the illustration on the previous page.

Disadvantages

The sperm cells pass through the machine at about 60 miles per hour. This seems fast but, considering that they pass in single file and one ejaculate can contain more than 7 billion sperm, it takes about 3 to 4 times longer to process sex sorted semen than conventionally processed semen. Therefore, this technique yields fewer straws of frozen semen per ejaculate at an increased cost and results in lower conception rates. Current research shows that, in an ideal situation, pregnancy rates will be about 70 to 90% of that for cows or heifers bred with non-sorted semen. This sorting method is not perfect but it does shift the ratio to about 85 to 90% of the desired sex. As with any other market-driven technology, it is reasonable to consider that sex sorting will evolve to become more efficient and less costly. In the meantime, the benefit from shifting the sex ratio of a calf crop has to be weighed against the increased cost and lower fertility.

Advantages

In some regards, sex-sorted semen is more applicable to the dairy industry. Milking herds are almost always more interested in producing replacement heifers while bull calves are drastically less valuable. For purebred beef cattle producers, bull sales to commercial cattlemen are often the most significant source of revenue while heifers are also important for genetic improvement as replacements. For producers who rely on bull sales and require fewer replacement heifers (or purchase bred replacements), breeding with Y-bearing (male) sorted semen could be a practical management decision. For commercial cattlemen who sell feeder calves, steers are usually heavier at weaning and \$5.00 to \$10.00/Cwt. more valuable than their female counterparts (depending on the method of marketing). Therefore, using Y-bearing sorted semen in a commercial setting would lead to more steer calves which could defray increased semen cost. Furthermore, if heifers are retained as replacements, individual matings can be hand selected to produce heifers from more maternal dams and bull calves from terminal crosses.

Breeding Strategies

Use of sex-sorted semen should be reserved for herds where reproductive efficiency has been optimized through intense reproductive management. Pregnancy rates to sexed semen will be highest in virgin heifers that are bred 12 hours after the beginning of standing heat, and mass insemination or timed breeding is not an acceptable method. Semen handling is similar to traditionally processed semen even though it will likely be packaged in a ¼ cc straw as opposed the usual ½ cc straw. Keep in mind that semen handling during storage and just prior to insemination is equally critical for success as proper insemination technique. Most of the research to this point indicates

that the number of transferable embryos produced by using sex-sorted semen in superovulated cows will be half that of conventionally packaged semen.

With new technologies that have some potential for controversy, it is important to understand the underlying science before making a judgment on its ethical implications. Sex-sorted semen is not genetically engineered or modified. It is a natural product that is simply separated into fractions that contain a higher percentage of sperm cells that will produce either male or female offspring. Calves from these matings do not have an increased risk for death or abnormalities compared to calves from conventional artificial insemination or natural breeding. For more information on beef cattle reproduction or related topics, contact an office of the Mississippi State University Extension Service.