The Snowball Effect: Combining Genomic Selection with Advanced Reproductive Technologies

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Most of the articles I write focus on technologies that apply to a wide scope of cattle producers. I usually have the commercial cow-calf sector in mind even when I write about technologies that are used predominantly in seedstock production. This article is a bit different as I aim to describe how the combination of two technology categories are being used together to make the metaphorical snowball of genetic advancement grow and roll faster. A handful of progressive seedstock producers are testing DNA collected from embryos to determine which embryos they will transfer to recipient cows. Culling through the embryos allows them to only transfer those that have the best opportunity to produce a very specific type of calf without wasting their limited resources on less valuable calves.

Here is how it works using embryo transfer as an example (this approach can also be incorporated into IVF procedures). First, the donor cow is set up for normal superovulation and embryo transfer and the embryos are collected. The genomic analysis technology is started prior to the embryos being frozen by taking a few cells from a specific part of the embryo with a small needle guided under a microscope. After the biopsy is taken, the embryos are frozen while the genomic analysis is completed. There are a few additional steps that have to be done to get enough DNA from the smaller sample. After that, the process is the same as normal genomic analysis; the same group of genes are analyzed and that analysis reported to the breed association to enhance the accuracy of specific EPDs.

When the genomic analysis is completed, the actual data and/or the genomically-enhanced EPDs are used to decide which embryos will be thawed and transferred into recipient cows. Additionally, the gender of each embryo can be identified so that only bulls or heifers are transferred to meet the objectives of that specific mating. For some breeds, testing for genetic abnormalities could reduce or completely eliminate the production of carriers of that abnormality. Although I am not aware of producers that are doing it, this process could also allow for multi-sire AI to a single flush by incorporating parentage testing with the genomic analysis. To make the technology snowball even larger, the possibility exists to use gender-sorted semen from two different sires, one sorted for heifers and the other for bulls, and each embryo genetically tested for sire and gender to generate replacement heifers and herd bull prospects from two different sires in the same embryo collection. This is already done in IVF procedures.

The reason a seedstock producer would want to go through all this trouble might not seem obvious. But, consider how many resources (land, time, and money) are dedicated to each recipient cow that carries an embryo to term and then weaning. Identifying embryos that do not meet the criteria before they are transferred dramatically reduces that investment. Also, embryos from the same flush or IVF cycle produce calves that perform very differently. In fact, if you have seen many flush mates in a contemporary group, you will know that there can be quite a bit of variation in phenotype and performance. Combining these modern technologies can reduce the resources needed to produce a calf crop with genetic value well beyond the average incremental advance of using them separately. Or, looking at the same scenario from the other direction, more calves that meet specific genetic criteria can be produced on a limited amount of resources by using these technologies together.

How does this relatively new approach to advancing the genetic capabilities of seedstock affect commercial cow-calf producers and the rest of the beef production chain? Since embryo transfer has

not been adopted in commercial production at a significant rate, the impact might simply be through the availability of better bulls from seedstock herds a couple of steps downstream from the cattlemen using this approach. But, the case could also be made for targeted use of this method in large commercial herds to produce custom-made F1 replacement females. Regardless of where market forces take this approach, knowing about how genetics are being advanced more rapidly at the top of the hill will let you see the snowball coming so you can decide to either be part of it or, at least, not get buried by it.