Implications of Sexed Semen on the Beef Industry[1]

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INTRODUCTION

The hunt has been on for several decades to find the scientific breakthrough that will allow one to use spermatozoa which will produce offspring of the desired sex (commonly called sexed semen). Several reviews have been written on this subject (Kiddy and Hafs, 1971; Garner, 1984; Amann 1989; Bradley 1989).

The general conclusions coming from these reviews is that many different technologies have been attempted in this area with no major breakthroughs occurring. Once the promising technique has been evaluated using enough inseminations, the results indicate no skewing of the sex ratio. This is not to say that the breakthrough will not occur. In fact, promising new developments in our understanding of the spermatozoa have been made. The recent work of Johnson et al. (1989), where spermatozoa carrying the X chromosome were separated from the spermatozoa carrying the Y chromosome give new hope that sex preselected semen can be accomplished.

It is not the intent of this paper to make another review of the biological possibilities for sexing spermatozoa but rather to focus on how cattlemen will use technology once the breakthrough has been made.

Basic Physiology

Spermatogenesis in cattle is a complex process consisting of several cell divisions which eventually separates the X and Y chromosomes into different spermatozoa. Each spermatozoan has an equal chance of carrying the X chromosome which will produce females or the Y chromosome which will produce males. Therefore, in cattle the sex of a calf is determined at the time the spermatozoan enters the ovum.

Attempts to skew the sex ratio of the offspring try either to physically separate spermatozoa with the X or Y chromosome, or they try to render one or the other incapable of fertilization. It is well known that it is necessary to have a certain number of viable spermatozoa in order to achieve optimum fertility (Salisbury and VanDemark, 1961; Pace et al., 1981). Any technique that removes or destroys either the X or Y

bearing spermatozoa reduces the potential number of offspring that a bull can sire by one-half. This is because the number of viable spermatozoa needed to give optimum fertility still remains the same with sexed semen.

During each step in the processing procedure for preservation of spermatozoa, some spermatozoa are lost. With the additional steps that will be required to process sexed semen, it is reasonable to presume that some additional sperm loss will occur which will also reduce the production potential of a bull.

It is likely that no method will be capable of being 100% accurate in selection because of the large number of spermatozoa produced in each ejaculate, and the fact that only one spermatozoa results in fertilization. Therefore, once a selection technique becomes available it will probably skew the sex ratio of calves born by some percentage rather than being 100% predictable.

With all of the above factors considered, it is reasonable to assume that the sexing of semen will decrease the production potential of a bull by greater than one-half.

Economic Benefits of Sexed Semen

The reasons for wanting to use sexed semen will vary widely depending upon the operation. Some of the reasons will include:

1. Production of higher number of males for bulls for a seed stock producer or steers for a commercial unit.

2. Production of replacement females from a select population of your herd.

3. Production of females from virgin heifers to reduce calving difficulties.

Each of the above reasons has a perceived value for using sexed semen. In a commercial situation where the sex ratio is skewed toward males, the value is in the difference between the weaning weight of the steers vs heifers plus the higher selling price for steers.

When a higher ratio of females is desired for replacements, the increased value of the maternal characteristics should be considered. When the females are desired to reduce calving difficulties the value lies in the reduced losses in calves and virgin heifers during calving.

The perceived value of sexed semen to a seed stock producer will focus on being able to use greater selection pressure on the animal to be sold for breeding stock or to be able to sell additional animals of the desired sex.

Increased Costs of Sexed Semen

Can the benefits of sexed semen be justified economically? Several factors must be considered in this evaluation. If reproductive potential of a bull is being maximized with unsexed semen, sexing semen will reduce the number of units of semen by at least one-half.

However, in the A.I. business today most of the reproductive potential of the beef bull is not being maximized. This would allow the possibility of sexing semen from these bulls without reducing the number of units of semen sold. Two other factors that will be considered in establishing costs for producing sexed semen are additional losses of spermatozoa during processing and the costs to implement the technology.

Therefore, if semen sexing technology were here today, the cost of a unit of sexed semen would probably range from 1.5 to 2.25 times the present value of semen depending upon the genetic worth of the bull. Based upon these costs there will be situations where the value of sexed semen will be economically justified, however, every operation will have a different set of factors that will need to be considered.

Who is Likely to Use Sexed Semen?

The history of modern Artificial Insemination (AI) is not old, with the first cows being bred by AI in this country in the late 1930s. However, several significant advances have occurred which will probably allow the prediction of who will use the sexing technology once the breakthrough has been made. From the early days of AI it became clear that success depended upon good management as well as an understanding of the reproductive processes of the cow.

With the development of frozen semen in the 1950s came the opportunity to have the owner/operator inseminate their own cows. However, to be successful at inseminating their own animals required additional management skills. Those that were already using AI understood the basic principles and were able to adapt to the new technology first.

With the development of synchronization of estrus in the late 1970s and early 1980s came the opportunity to inseminate a high percentage of a herd during a short period of time. Again, in general those that were able to take advantage of this new technology were those that had on-going programs and understood the reproductive management of the cow.

Now when the sexed semen technology breakthrough occurs, it will be the operators that have solid AI programs in place who will be the first to capitalize on this new technology. Not only will they be able to take advantage of the benefits mentioned earlier, but they will also be in a position to market breeding stock as a result of years of superior genetic development using conventional AI techniques.

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