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Extension's Guide to Sexed Semen: A Dairy Case Study

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Abstract: *The dairy industry is constantly changing as new technologies requiring conscious management decisions are introduced. This case study analyzes the profitability of using sexed semen to attain a specific calf crop based on three scenarios. Market, management, and technology variables simulate changing conditions that affect the profitability of using sexed semen. The biggest impacts a producer can have on profitability using sexed semen is to manage their calf crop based on market prices and to employ strong management practices to achieve the best conception rates possible. With these guidelines, Extension can help managers achieve the best results.*

Introduction and Background

Sexed semen is semen that has been sorted by its X and Y chromosomes and allows a producer to limit offspring to a single sex as opposed to the near 50/50 natural selection. Sexed semen can achieve 90% accuracy of a desired sex (Seidel & Garner, 2002), suggesting profound implications for the dairy industry in terms of economic returns. Extension can help amplify returns by educating producers on sexed semen advantages, disadvantages, and use scenarios. This presents a case study that Extension can use to describe possible implementation of sexed semen on a dairy farm.

On-farm advantages and disadvantages have led to numerous debates about the value sexed semen can add to an operation's bottom line. The biggest advantages for using sexed semen are the certainty of replacement females, bio-security, and opportunities to create a more valuable calf crop (Seidel, 2003). Obtaining enough replacement females to maintain a productive herd is a problem for farms with reproductive problems. Using "female" sexed semen for insemination of top-producing cows can increase the number of genetically superior female calves from which replacement females can be chosen. Female calves or heifers can be produced more abundantly using sexed semen either for faster culling or expansion within the herd. Calf crops can be based on anticipated calf prices with a larger portion of the herd devoted to specific markets depending on the price advantage.

The biggest disadvantage to using sexed semen is the additional expense. Sexed semen sells for

$18-$22 more per straw than conventional semen (G. E. Seidel, personal communication, 2009). In addition to paying a premium, conception rates are lower with sexed semen because of the sorting process (Seidel & Garner, 2002). Sperm must be sorted using high pressure, thereby decreasing fertility (Dejarnette et al., 2008; Frijters et al., 2009). Because the process only uses one sex, the amount of viable sperm is decreased by more than half. The other half is of the undesired sex, while some are not sortable, resulting in overall less sperm available for sexed semen. Sexed semen is sold in smaller quantities than conventional semen, also adding to the risk of decreased pregnancy (Seidel, 2003). In essence, not only is the price per straw more, but also additional straws may be needed in order to achieve pregnancy.

Because of the additional expense and lower conception rates, there are only certain market and management environments in which sexed semen can thrive. Management techniques and protocols have been shown to affect profits in the dairy industry (Zimmerman, 2006). Dairies are a complex system in which management, technology, and the marketing environment interact. These interactions make it difficult to describe situations where sexed semen enhances profitability. The case study presented here uses Monte Carlo simulation to explore a broad spectrum of outcomes resulting from sexed semen use on a dairy farm. In order to create measurable outcomes certain assumptions had to be made about the dairy farm such as size, lactation groups, and cull decisions. Although the magnitude of outcomes may differ between assumptions, directionally the model soundly predicts outcomes for scenarios as they compare to the baseline.

Methodology

The case study was conducted for the purpose of evaluating sexed semen use on a dairy operation with the goal of capitalizing on specific calf crops. Thirteen key variables were used to analyze market, managerial, and technology possibilities. The baseline was a 2,500 head dairy herd with three lactation groups. Costs and returns were estimated using a baseline enterprise budget without sexed semen. Simulating the use of sexed semen changed costs and returns depending on the chosen calf crop scenario. The 13 key variables then simulated different market, management, and technological conditions across all sexed semen scenarios and the baseline. Each draw from the simulation was held constant for 5 years. The net present value (NPV) of each scenario and the baseline was then calculated using 5 years of profit data and a nominal interest rate of 8%.

After simulating each of the 13 key variables over a uniform distribution, the difference in NPV between the baseline and each scenario created a series of response surfaces. These response surfaces contained highs and lows that would indicate market, management, and technology conditions that would make using sexed semen profitable or not profitable under each calf crop scenario.

Variables

The 13 variables were chosen through a sensitivity analysis on profit and expert opinion. Market variables were input and output prices: feed, milk price, heifer replacement prices, bull calf prices, and beef steer prices. Management variables were number of inseminations with sexed semen and a reproduction factor. Technology variables were the additional genetic gain, price premium for sexed semen straws, sexed semen accuracy, and the effect of sexed semen on conception rates for cows and heifers. The effects sexed semen had on conception rates for heifers and cows were the technology variables that had the greatest impact on profit. However, the technology variables were the least detrimental to profit compared to the market environment and management variables. Because technology is exogenous of the farm itself, it is likely fixed when sexed semen is purchased, thus, the discussion that follows focuses mainly on management and market variables.

Scenarios

The three scenarios dealt with different breeding schemes related to possible calf crops. Scenario one used sexed semen to breed all replacement heifers to have female calves and used conventional dairy semen to breed all the adult cows. This scenario allowed sexed semen to be used with only the latest and best genetics to produce replacement heifers. The second

and third scenarios also used sexed semen on 100% of the replacement heifers. In addition, sexed semen was used on enough cows so that the replacement void would be filled completely by heifer calves conceived with sexed semen. In scenario two, the cows not bred with sexed semen would be given conventional dairy semen. In scenario three, the cows not bred with sexed semen would be given conventional beef semen. In scenarios two and three, a producer is maximizing genetic gain from sexed semen by only breeding the best cows to completely fill replacement needs. Increases in genetic gain applied to all replacement heifer calves produced from sexed semen. Extra heifers born through conventional dairy semen were sold as replacement dairy heifers. The use of conventional beef semen in scenario three produced crossbred calves that could bring significantly higher prices in the slaughter market channels than purebred dairy calves.

Results and Discussion

In addition to determining which scenario was more likely to produce higher profitability, the response surface also examined variables to determine which had the greatest impact. Overwhelmingly, dairy heifer prices had the largest impact on profitability in all three scenarios. In scenario one, the other variables with the greatest impacts were variables affecting conception rates on heifers in both management and technology variables, followed by dairy bull calf prices. In the second scenario, other variables impacting the profitability difference the most were conception rate variables, dairy bull calf prices, and the sexing accuracy. In scenario three, beef calf prices, the number of inseminations, and the dairy bull calf prices were the other variables that had the greatest impacts.

Calf prices are the market variables that make the single largest impact on positive or negative returns from using sexed semen. Because the dependent variable compares the absence and the use of sexed semen, negative values do not indicate poor prices of the calf crop chosen. It is in comparison to a relative value and could simply mean the baseline's calf crop had better prices with fewer expenses. In some respect, the baseline is measuring an opportunity cost. For example, the baseline calf crop is based on the natural sex ratio. Heifer and bull calves are born more or less equally. If bull calf prices are relatively high and heifer prices are relatively very low, that shrinks the premium for producing replacement heifers. If heifer calves are only worth $30 more than bull calves, then it is likely the baseline will achieve a higher profit. Although the sexed semen premium is lower than $30, the conception rate affect will mean longer days open, and overall fewer calves born in the year. The premium is paid for every service with sexed semen regardless of the outcome, creating large immediate upfront costs for sexed semen to overcome.

As discussed above, the market environment is the most influential factor in the decision to use sexed semen. Producers have no control over prices, but they can control their reaction to prices. Lagged time is an important calculation with the use of sexed semen. Replacements are 3 years away from entering the milking rotation, but the calf crop is only 9 months away from entering the market and impacting the operation. The time lag between the initial use of sexed semen and milking heifers attained from sexed semen creates a decision in which benefits should be thought of as an investment in genetics and thus measured by NPV. Short term, using sexed semen provides the opportunity for better cash flow from optimal calf sales. Anticipating relative calf prices is one key to achieving a higher profit level using sexed semen.

There are also variables producers can control. The single most important thing a manager can control is having better-than-average reproduction within the herd. It was assumed in our model that an average producer would have an average conception rate. Thus, if the conception rate management variable is above or below average in our model's stochastic draw, it is indicating how much better or worse the producer's ability is to impregnate cows. Reproductive struggles would affect any dairy negatively. However, sexed semen multiplicatively increases conception rate problems because of the decreased fertility using sexed semen straws.

Table 1 summarizes the results of positive outcomes by scenario based on dairy calf market prices and the management variable described above. Total positive outcomes, where sexed semen created a higher profit than the baseline, are listed for each scenario in the second column. Scenario one had the highest frequency of positive outcomes. Columns three and four list the frequency of the variable meeting the criteria described in the heading within only the

positive outcomes. The latter columns describe the occurrence of these two variables together within the positive outcomes. Because calf prices are relative to each other, dairy bull and heifer calf prices were combined in a ratio for ease of displaying results.

Table 1.
Summarized Results by Key Variables: Conception Rate Management (CR) and Dairy Bull and Heifer Calf Prices (Presented as Ratio)

Total Positive Outcomes		Percentage of Positive Outcomes				
		CR > Average	Bull/Heifer Price < .35	Both	Either	Neither
Scenario 1	80%	53%	89%	46%	96%	4%
Scenario 2	71%	54%	99%	53%	100%	0%
Scenario 3	28%	59%	74%	42%	91%	9%

Extension personnel can highlight Table 1 for dairy producers big and small with three guiding points for the use of sexed semen.

1. Because of the lag between deciding to invest in sexed semen and capitalizing on milk returns, sexed semen is best viewed as an investment in genetics.

2. Calf price based on the sex of the animal is critical to early cash flow in the sexed semen investment strategy. Relative price relationships can help decide which implementation scenario is right for the market environment.

3. Above-average reproductive management increases a producer's chances for sexed semen to be a positive investment.

Summary

The dairy industry is ever changing as technology alters management practices. Extension can help aide these transitions by focusing on practical implementation of technology. In this article, scenarios for using sexed semen have been critically evaluated. One of the most important outcomes of the study is showing how the application of sexed semen must be with a specific goal in mind. It may or may not be profitable on a particular operation in the short-term, and it is best to think of it as a long-term investment. It is important to recognize that many factors that make sexed semen unprofitable are exogenous. Producers can achieve the best implementation results with sexed semen by employing strong management practices to achieve high conception rates and actively managing calf crops based on market conditions.

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