

# Decision support tool for optimizing semen strategy given various target replacement rates

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## Introduction

Breeding and replacement decisions are increasingly complex considering recent advances in technology, management and market opportunities. Our objective was to create a tool to help identify the optimal semen strategy to capitalize on crossbred beef markets while maintaining the replacement supply to support lactating herd turnover.

## Materials and methods

We designed a model that identifies the semen mix to maximize crossbred calves while producing adequate replacements for a herd's turnover rate and system inputs and can be used to explore the impacts of varying inputs and assumptions. The tool is a deterministic model that estimates the number of replacements (dairy heifer calves) needed to be born per year to maintain herd turnover, and the resulting youngstock inventory. Given the set of inputs, it returns the percent of cow inseminations (AIs) to sexed semen needed to support the replacement rate (with the remainder to beef semen). We evaluated a baseline scenario of a herd with 35% annual turnover and desired buffer of 5% extra springers. Inputs included cull/loss rates at each stage (3% by day-old, 5% on milk, 1% between weaning-breeding, 2% at breeding stage, 0.5% pregnant heifers) and cow reproductive parameters (voluntary waiting period 60 days, 10% of breeding-eligible cows do not conceive, 10% pregnancy loss rate over whole gestation, 45% conception risk [CR] for sexed semen, 50% CR for beef semen), and the assumption that 90% of heifer pregnancies carry dairy females. Using the baseline inputs, we calculated results for varying turnover rates (25, 35 and 45%) and inventory cushions (5 and 10% surplus replacements). We then examined sensitivity to inputs set at +/- 20% of baseline value.

## Results

The results showed that a herd with a 35% turnover rate and 5% (10%) inventory cushion should use sexed semen for 13% (13%) of cow AIs. At 25% and 45% turnover, sexed semen comprised 9% (9%) and 16% (17%) respectively. For a 1,000-cow herd, the number of day-old crossbred calves annually available for market in each scenario ranged from 645 (45% turnover/10% buffer) to 729 (25% turnover/5% buffer). At 35% turnover with 5% cushion, the most influential variables were cow CR to sexed and beef semen and percent females born from heifer pregnancies. Increasing the sexed CR resulted in a lower percent of sexed semen usage (11% to sexed at a 54% CR: fewer AIs were needed to produce the same number of pregnancies carrying dairy females). Conversely, increasing beef CR with all else held equal corresponded to an increased percent of AIs to sexed semen (14% to sexed at 60% beef CR: there was no change to

the absolute number of AIs to sexed semen, only a decrease in the number of AIs to beef even while increasing the number of conceptions). Changing the percent females resulting from heifer AIs was also influential; a lower proportion of replacements born to first calf heifers increased the number of adult cow pregnancies expected to carry dairy females (22% of adult cow AIs to sexed if percent of females from heifers decreased to 72%). As youngstock losses increased, a modest rise in sexed semen use was needed to support the target replacements. When losses were 20% higher than baseline at all stages simultaneously (e.g., 3.6% by day-old, 6% on milk, etc.), sexed semen need increased to 14%. The Excel spreadsheet is available for download and use at <https://hdl.handle.net/1813/115530>.

## Significance

This model assumes that the user has already identified the optimal replacement rate for production and profitability. The value of this tool is to explore which semen mix will support that already-identified herd size and turnover rate (and thus not constrain efficient lactating cow decisions) while maximizing revenue from additional calves born, for a given youngstock system. The next important direction for this work is to link these choices with lactating herd performance, enabling study of the interdependent influences of semen choice, youngstock system, and replacement rate (no longer fixed) on whole-herd cash flow.

