Replacement Female Strategies

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What is the right “equation” for creating the ideal replacement heifer?

\[ (\text{Selection}^3 \times \text{Nutrition}^2 \times \text{Health})^{\text{Management}} = \]

Return on Investment

Cumulative Profit

Assumptions:
- Heifer develop: $368
- $450 yr cow costs
- 550 lb @ $1.50/lb

\[ \text{Profit} = \{1133, 1561, -1192, -817, -442, -68, 682, 1017, 1442, 1807, 2052\} \]
Retain heifer or purchase replacement??

Develop or purchase?

- Complex decision, driven by multiple factors
- Should be evaluated yearly
  - Market fluctuations, feed supply, business model, etc.
- Specific for your operation

Develop or purchase?

- “Heifer Conundrum”
  - Don’t let 10% of herd dictate the decisions made for the other 90%
- Purchased replacement female does not have to be a heifer
  - Purchased cows = less calving issues, greater probability of breeding back
- Calving this year or next?
- Longevity in herd

Drivers of choice

Financial
Dollars and cents

Convenience
Management and fence
Financial evaluation tool

Comparing Purchasing vs Raising Beef Replacement Females
Created by Dr. Jack Whittier and Kevin Miller; Colorado State University

http://www.ansci.colostate.edu/beef/pdf_files/Buy-or-Raise-2011-Replacement-Decision-Aid.xls

Current analysis

Summary for the Retain vs Buy

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>Break-even for the Retained Heifer calf</th>
<th>Break-even for the Purchased Bred Heifer</th>
</tr>
</thead>
</table>

Breakeven for the Raised Heifer calf

$0.84/lb before it would cost less to raise replacements from within the herd than purchasing them at $1,750.00.

Breakeven for the Purchased Bred Heifer

$1,839.38/hd before it would be more costly to purchase than raise a replacement.

Breakeven annual additional weight change for Raised vs. Purchased

6 lbs of calf production per year to make an equal contribution to ranch net income.

When does selecting the replacement heifer begin?

- Replacement heifer selection begins at sire selection
  - 85% of genetic make-up of cow herd is contributed by sire selection
- Dam selection is also critical but often less managed on most farms
- What comprises phenotypic selection?

Phenotype = Genetics + Environment

*The look*

Weaning Wt

Milk production

1st service preg rate

Genetics

EPD

Nutrition

Vaccination

Management
Phenotype = Genetics + Environment

**EPDs**

- Expected Progeny Differences (EPDs)
  - EPD accuracies are as important as the EPD
  - Genomic selection and Molecular EPDs

<table>
<thead>
<tr>
<th>Trait</th>
<th>CED</th>
<th>BW</th>
<th>WW</th>
<th>YW</th>
<th>SC</th>
<th>CEM</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPD</td>
<td>-1</td>
<td>5.7</td>
<td>68</td>
<td>118</td>
<td>.5</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Acc</td>
<td>.86</td>
<td>.97</td>
<td>.96</td>
<td>.95</td>
<td>.95</td>
<td>.88</td>
<td>.93</td>
</tr>
</tbody>
</table>

**Recommendations when using EPDs**

1. Prioritize traits of economic importance
   - Heifer vs. Steer
   - BW, CEd, CEm, WW, YW, MA, SC, STAY, DOC,
     What is important to your herd, not your neighbors
2. Match select traits with environment
   - Don’t select high milk if don’t have enough feed
3. “Optimize” rather than “Maximize”
   - Don’t single trait select!
   - Well-rounded with multiple traits above average

**Calving？ What next?**
Reproductive goals for heifers

- Reach puberty by 12 to 13 months of age
  - Age at puberty influenced by genotype, nutrition, and environment
  - Conception rate after 3rd estrus is ~20% greater compared to conception rate at 1st estrus
- Conceive by 15 months of age
- Calve by 2 years of age
  - Most profitable

Reproductive goals for heifers

- Need minimal assistance calving
  - Selection for growth, BW, and pelvic area
- Rebreed as a 2-yr old cow
  - Difficult as cow must partition nutrients into lactation, growth, and reproduction
  - Breed heifers 2-3 weeks before mature cows to “buy insurance”

Heifers selection

- Select heifers born in the first half of the calving season
  - Easier to reach target weights at breeding
  - Indicative of dams fertility
- Retain heifers with heavy actual weaning weights
  - Cheapest to feed to target weight
  - You can’t adjust for day of age at breeding
- Retain 10 to 15% more heifers than replacement rate requires
  - ~5 to 10% of heifers will fail to conceive
  - ~30% of heifers born
- Do not retain heifers with structural defects
- Avoid freemartins
  - Female twin with a bull twin
  - Infertile

Antral follicle count – Future selection criteria?

- Antral follicle count is the assessment of the number of follicle visible on the ovary
- Greater numbers of antral follicles has been associated with greater fertility (Ireland et al., 2008; Cushman et al., 2012)
- Selection of heifers at early age with greater antral follicle count may yield benefits – research ongoing
**Pre-weaning growth and puberty**

- Many studies have demonstrated that pre-weaning growth rate has a greater impact on age at puberty than post-weaning growth rate.

![Graph showing the relationship between increasing weaning weight and the probability of heifers conceiving to the first AI.]

**Ways to increase WW:**

1) Implant – Bad idea
2) Mother Milk Production
3) Creep Feeding
4) Early Weaning

**Post-weaning nutrition**

- Most common strategy is feeding heifers to reach a “Target Weight” prior to the breeding season.

  - Typical: 65% mature body weight (MBW)
    - 1300 lb cow * 0.65 = 845 lb at breeding
    - This is not an average wt of the herd, but rather all heifers should meet or exceed this weight.
    - Must know mature body wt of cow herd

  - If I know the WW and 65% MBW target, how do I calculate how much I need to feed?

**How much do I feed??**

- Example:
  - WW = 550 lb
  - Target Wt = 845 lb
  - Age at weaning = 220
  - Age at breeding = 450

  \[ \text{Difference} = \frac{(845 - 550)}{(450 - 220)} = 1.28 \text{ lb/day} \]

**Table: Desired weight at start of breeding season [target weight]**

<table>
<thead>
<tr>
<th>Problem 1 et al., 1985</th>
<th>Desired weight at start of breeding season [target wt]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>600 lb (60% MBW)</td>
</tr>
<tr>
<td># of heifers</td>
<td>130</td>
</tr>
<tr>
<td>Corn fed (lb)</td>
<td>748</td>
</tr>
<tr>
<td>Cost ($, $0.11/lb corn)</td>
<td>82</td>
</tr>
<tr>
<td>Wt at breeding (lb)</td>
<td>617</td>
</tr>
<tr>
<td>Showing heat at:</td>
<td></td>
</tr>
<tr>
<td>20 d</td>
<td>23</td>
</tr>
<tr>
<td>40 d</td>
<td>56</td>
</tr>
<tr>
<td>60 d</td>
<td>71</td>
</tr>
<tr>
<td>Preg. after breeding</td>
<td></td>
</tr>
<tr>
<td>20 d</td>
<td>9</td>
</tr>
<tr>
<td>40 d</td>
<td>27</td>
</tr>
<tr>
<td>60 d</td>
<td>47</td>
</tr>
<tr>
<td>Calving %</td>
<td>82</td>
</tr>
<tr>
<td>Lbs of calves weaned</td>
<td>25310</td>
</tr>
<tr>
<td>Lbs/heifer exposed</td>
<td>210</td>
</tr>
<tr>
<td>S/heifer exposed ($1.10/lb)</td>
<td>231</td>
</tr>
<tr>
<td>$ return above feed</td>
<td>149</td>
</tr>
<tr>
<td>Preg. next year</td>
<td>86</td>
</tr>
</tbody>
</table>
Feeding strategies

- If there is a wide variation in WW between heifers, it may be beneficial to split the group
  - Prevent larger heifers from gaining to much weight
  - Reduce cost of developing larger heifers
  - Ensure smaller heifers achieve target weight
- Avoid getting heifers to fat
  - Impairs mammary development and reduces milk production
  - Calving difficulty
  - Reduced conception rates

Feeding strategies

<table>
<thead>
<tr>
<th>Variable</th>
<th>Light</th>
<th>Heavy</th>
<th>Fed Together</th>
<th>Light</th>
<th>Heavy</th>
<th>Fed Separately</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of heifers</td>
<td>10</td>
<td>10</td>
<td>19</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaning wt (lbs)</td>
<td>376</td>
<td>475</td>
<td>374</td>
<td>464</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily gains (lbs)</td>
<td>1.5</td>
<td>1.4</td>
<td>1.7</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected</td>
<td>1.3</td>
<td>1.5</td>
<td>1.8</td>
<td>1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breeding wt (lbs)</td>
<td>715</td>
<td>715</td>
<td>715</td>
<td>715</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Projected</td>
<td>620</td>
<td>719</td>
<td>669</td>
<td>722</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter feed cost/head/day</td>
<td>$0.75</td>
<td>$0.75</td>
<td>$0.89</td>
<td>$0.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>$0.75</td>
<td></td>
<td>Combined $0.78</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reproductive performance for light and heavy heifers when fed separately or as a group (Varner et al., 1977)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Fed together</th>
<th>Fed Separately</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of heifers</td>
<td>Light</td>
<td>Heavy</td>
</tr>
<tr>
<td>Age at puberty (days)</td>
<td>423</td>
<td>404</td>
</tr>
<tr>
<td>Cycling at start of breeding (%)</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Pregnant in 45-day breeding season (%)</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Combined 70%</td>
<td>Combined 85%</td>
<td></td>
</tr>
</tbody>
</table>

Why is achieving puberty prior to breeding so critical?

- Regardless of estrous synchronization and AI or natural service, pubertal heifers conceive earlier in breeding season!

Figure 1. Influence of calving date in first calving season on longevity within the USMARC heifers (P<0.01; n = 16,469).

Figure 2. Influence of first calving date in first calving season on longevity within the South Dakota heifers (P<0.01; n = 2,195).
Longevity in the Herd

- Of the heifers that calved with their first calf in the first 21 d period of the calving season at the USMARC:
  - 63.7% of them were still in the herd after 10 calving seasons
    - 54.7% of heifers in 2nd 21 d
  - 14.3% of South Dakota heifers remained after 10 calving seasons
    - 6.4% of heifers in 2nd 21 d
  - Positive relationship between early calving heifers and longevity in the herd.

Profitability of SD Herds

- Mean return per female:
  - 1st 21 d period $1,055.69
- Mean return per female:
  - 2nd 21 d period and after $705.45
- Mean return per female:
  - Whole herd $908.19

Heifers that calve in the 1st 21 d represent as much as 75% of future income.
Things we forget in the beef industry

Growth rate and puberty attainment

Figure 1. Average daily gains (kg/day) of heifers weaned and developed on range (Range) compared to heifers weaned and developed in a dry-lot (Dry-lot). All heifers were moved to a common pasture on May 18th. *P = 0.06, **P < 0.05

Table 1. AI and breeding season pregnancy rates in beef heifers fed to 120% (Gain), 100% (Maintain), and 80% (Lose) NEm following insemination.

<table>
<thead>
<tr>
<th>Treatment (Trt)</th>
<th>AI pregnancy rates</th>
<th>Breeding season pregnancy rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain 120% NEm</td>
<td>73.7% (86/118)</td>
<td>84.1% (111/118)</td>
</tr>
<tr>
<td>Maintain 100% NEm</td>
<td>62.3% (71/114)</td>
<td>77.7% (100/134)</td>
</tr>
<tr>
<td>Lose 80% NEm</td>
<td>64.3% (75/116)</td>
<td>88.8% (103/116)</td>
</tr>
</tbody>
</table>

Contrast: Gain vs Maintain + Lose
Contrast: Maintain vs Lose

Treatment x Replication, P = 0.39, thus replications combined for analyses.

Post-AI nutrition and embryo development

Similar results have been demonstrated in the laboratory of G. Perry (SDSU)
**Experimental design - UMN**

- Virgin heifers
- UMN: n = 41 (2 reps)
- SDSU: n = 41 (1 rep)

**Effect on day 6 embryo quality**

<table>
<thead>
<tr>
<th>TRT</th>
<th>TRT</th>
<th>Embryo Recovery (%)</th>
<th>Embryo Stage (n, %)</th>
<th>Embryo Quality (n, %)</th>
<th>Access. Sperm (n)</th>
<th>Dead Cells (n)</th>
<th>Total Cells (n)</th>
<th>Percent Live Cells (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAIN</td>
<td>46</td>
<td>70.8 (46/65)</td>
<td>4.6 ± 0.1</td>
<td>2.0 ± 0.2</td>
<td>22.7 ± 3.8</td>
<td>7.6 ± 0.9</td>
<td>70.6 ± 5.6</td>
<td>80.3 ± 5.1</td>
</tr>
<tr>
<td>LOSE</td>
<td>42</td>
<td>62.1 (42/66)</td>
<td>3.8 ± 0.2</td>
<td>2.8 ± 0.2</td>
<td>16.7 ± 3.8</td>
<td>9.7 ± 1.0</td>
<td>48.9 ± 3.3</td>
<td>71.1 ± 4.1</td>
</tr>
</tbody>
</table>

P-value: NS < 0.01 0.02 0.64 0.42 0.03 0.01

*Defined as embryo number; not heifer with the exception of recovery rate

*Stage of development (1-9; 1 = UFO; 9 = expanded hatched blastocyst; per IETS Standards)

*Quality of embryo (1-5; 1 = excellent; 5 = degenerate; per IETS Standards)

*No Treatment x Replication interaction for any variable analyzed so data pooled.

**Summary**

- Proper heifer selection is critical
- Improper development can result reduced longevity and performance
- Nutrition pre- and post-breeding critical
Thank you

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