Abstract

The relationship between residual feed intake (RFI) in heifers (n=451) and subsequent lifetime productivity as cows was measured over an 8-year period (2005-2013, mating opportunities=1081) at Lacombe, Alberta, Canada. Most probable producing ability for birth weight (MPPAbw) and weaning weight (MPPAww) were calculated to estimate cow productivity. RFI was negatively correlated (P=0.02) to MPPAbw, but was not significant when RFI was adjusted for backfat thickness (P=0.08) or backfat thickness and feeding activity (P=0.10). No significant correlations were found between RFI or adjusted RFI and MPPAww (P=0.64). Lifetime productivity (LTP) was calculated for cows culled from the herd (n=108) over the 8-year period. RFI and LTP were not correlated (P=0.10). Selection for feed efficient, low RFI replacement heifers does not have an impact on their productivity as cows.

Methods

Intake was measured in over 450 beef replacement heifers, either British breed cross (Angus and Hereford) or Continental-British cross (Charolais-Maine Anjou x Red Angus), using the GrowSafe™ System from 2006 to 2012. Growth, feeding behavior, live animal body composition, fertility and their calf productivity traits were recorded. Three measures of residual feed intake (RFI) were determined for each heifer.

Objective

•RFI=Standardized DMI-Expected Feed Intake (EFI)

•RFI1: Standardized DMI (SDMI) of each animal within contemporary group was regressed on ADG (kg/d) and metabolic MIDWT (kg^{0.75}) to estimate EFI1 using PROC GLM (SAS Institute, Inc. 2009), using the following model:

\[ Y_i = b_0 + b_1 \text{ADG} + b_2 \text{MIDWT}^{0.75} + e_i \]

•A second and third model were developed to estimate EFI that adjusted RFI for back fat thickness, BF, measured at the end of the feeding period (RFI2), and back fat thickness and average feeding event frequency during the test, FEF (RFI3) in addition to ADG and metabolic mid-weight.

•Heifers were classified into High [+] and Low [-] RFI groups for some of the analyses.

•Most probable producing ability (MPPA) for birth weight and weaning weight were calculated (Bourdon 2000) to study the relationship between RFI and cow productivity.

\[ Y_{ij} = \mu + \text{Year}_j + b_1 \text{Cowage}_{ij} + b_2 \text{Cowage}^2_{ij} + S_j + \text{Cow}_i + e_{ij} \]

•In addition, a lifetime productivity measure (LTP) was calculated for those cows culled from the herd. Lifetime productivity was calculated as the MPPAww multiplied by number of calves weaned in the lifetime of the cow.

•Determine the relationship between heifer RFI and various measures of cow productivity which include both calf growth traits as well as herd lifetime productivity.
Results

• A significant correlation was observed between RFI1 and MPPAbw, but not when RFI was adjusted for backfat thickness and feeding activity (Table 2).

• This correlation suggests that low RFI heifers/cows have slightly heavier calf birth weights.

• Correlations between all RFI measures and MPPAw or LTP were not significant (Table 2).

• Least squares means for MPPAbw, MPPAw and lifetime productivity for [-] and [+ ] RFI heifers were not significantly different (Table 3).

Conclusions

• A significant negative phenotypic correlation was found between RFI and MPPA for birth weight, but this relationship was no longer evident when RFI was adjusted for backfat thickness and feeding activity.

• Animals ranked as high or low RFI have no significant differences in MPPA values for birth weight and weaning.

• These results suggest that selection for feed efficient, low RFI replacement heifers will have no impact on their productivity as mature cows.

Table 1. Animal numbers in the herd over 8 years, with trait means for residual feed intake (RFI1) measured on heifers, as well as birth weight (BW) and weaning weight (WW) of calves.

<table>
<thead>
<tr>
<th>Year</th>
<th>Heifers RFI1 N</th>
<th>Cows Calving N</th>
<th>Calves Weaned N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>21</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2006</td>
<td>19</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>2007</td>
<td>61</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>2008</td>
<td>68</td>
<td>70</td>
<td>67</td>
</tr>
<tr>
<td>2009</td>
<td>61</td>
<td>114</td>
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</tr>
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<td>2010</td>
<td>40</td>
<td>139</td>
<td>119</td>
</tr>
<tr>
<td>2011</td>
<td>94</td>
<td>139</td>
<td>132</td>
</tr>
<tr>
<td>2012</td>
<td>87</td>
<td>156</td>
<td>153</td>
</tr>
<tr>
<td>2013</td>
<td>-</td>
<td>145</td>
<td>144</td>
</tr>
</tbody>
</table>

Trait Summary Across Years
Heifer RFI kg DM d⁻¹, Calf BW kg, Calf WW kg
N 451
Mean (SD) 806 (39.9) 759 (257.6) 759 (31.9)

Table 2. Phenotypic correlations between heifer RFI, MPPA for birth and weaning weights and cow lifetime productivity.

<table>
<thead>
<tr>
<th>Trait</th>
<th>RF12</th>
<th>RF13</th>
<th>MPPAbw</th>
<th>MPPAw</th>
<th>LTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFI1 N</td>
<td>0.98*</td>
<td>0.93*</td>
<td>-0.13*</td>
<td>-0.03</td>
<td>-0.15</td>
</tr>
<tr>
<td>RFI2 N</td>
<td>0.95*</td>
<td>-0.10</td>
<td>-0.04</td>
<td>-0.17</td>
<td></td>
</tr>
<tr>
<td>RFI3 N</td>
<td>-0.10</td>
<td>-0.02</td>
<td>-0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPPAbw N</td>
<td>0.24*</td>
<td>0.34*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPPAw N</td>
<td>0.92*</td>
<td>108</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P<.05

Table 3. LSMeans for heifers that were below average [-] and above average [+ ] in their RFI1, and their MPPA values for birth weight, weaning weight, and lifetime productivity as cows.

<table>
<thead>
<tr>
<th>Trait</th>
<th>LOW [-]</th>
<th>SE</th>
<th>HIGH [+ ]</th>
<th>SE</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFI1 kg DM d⁻¹</td>
<td>-0.29</td>
<td>-0.11</td>
<td>0.30</td>
<td>-0.11</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>MPPAbw kg</td>
<td>0.11</td>
<td>0.11</td>
<td>-0.11</td>
<td>0.10</td>
<td>0.120</td>
</tr>
<tr>
<td>MPPAw kg</td>
<td>0.33</td>
<td>0.98</td>
<td>-0.62</td>
<td>0.93</td>
<td>0.485</td>
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<tr>
<td>LTP kg</td>
<td>2.93</td>
<td>5.31</td>
<td>-6.12</td>
<td>5.03</td>
<td>0.219</td>
</tr>
</tbody>
</table>

References
Canadian Council on Animal Care 1993. Vol. 1. E. D. Olifer B. M. Cross, and A. A. McWilliams, eds. CCAC, Ottawa, ON.