Increasing the energy of Canadian forages fed to high producing dairy cows

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National and multidisciplinary project

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  Forage breeding
  Nutritive value of feedstuffs
  Plant physiology and biochemistry
  Agronomy and crop physiology
  Molecular genetics
  Agro-ecosystem modelling
  Agricultural meteorology

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  Shabtai Bittman, Derek Hunt
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  Agronomy and crop physiology

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  Robert Berthiaume

  Ruminant nutrition

* AAFC, Normandin, QC
  Julie Lajeunesse

  Resource and crop management
Why and how can we improve the E:P ratio in alfalfa-based forages? Pourquoi et comment pouvons-nous améliorer le rapport E:P dans les fourrages?
Rationale for the research project

N losses to the environment

Proteins

Musquie Iatola Martha

Energy

Protein

Proteins
Research Objectives

To increase the energy in alfalfa through a multidisciplinary approach:

- Genetic selection for higher sugar concentration in alfalfa
- Crop management practices to improve the sugar/protein ratio in alfalfa-grass mixtures
- Web-based decision tool to determine the cutting time for optimum forage digestibility and yield
Results
Two cycles of selection for sugar concentration in stems were performed in a high yielding and persistent alfalfa population.

<table>
<thead>
<tr>
<th>Population</th>
<th>Sugar mg/g DM</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>77</td>
<td>115</td>
</tr>
<tr>
<td>After 1 cycle of selection</td>
<td>90</td>
<td>130</td>
</tr>
<tr>
<td>Improvement</td>
<td>+ 17%</td>
<td>+ 13%</td>
</tr>
</tbody>
</table>

Promising results
26 genes differentially expressed between the low and the high sugar groups were identified.

The identification of these genes will accelerate and simplify the selection process.
The forage sugar/protein ratio was greatest:

- at the first harvest;
The forage sugar/protein ratio was greatest
- at the first harvest;
- in mixtures that include grasses.

Management practices that promote the grass proportion in alfalfa-based mixtures will improve the sugar/protein ratio.
A way to improve the energy content of forages is to harvest them at the right time.

A web-based decision tool was developed to simulate with good accuracy timothy growth and NDF content.

The user will select the closest weather station near his/her farm and the change in yield and NDF content for the past period and a trend for the next 7 days will be provided.

A prototype will be tested this year.
Is it worth increasing your production and utilization of forage? / Est-ce bénéfique d'accroître votre production et utilisation de fourrages?
Agri-environmental assessment of Canadian dairy farms: Towards eco-efficient management of forage crops and manure (PI: Martin Chantigny)

* Obj. 1: Determine the best cutting management for alfalfa-based mixtures using field experiments.

Cutting alfalfa-based mixtures at the early bloom stage is the best option for maximizing the net farm income.

<table>
<thead>
<tr>
<th>Cutting Stage</th>
<th># cuts per year</th>
<th>Yield</th>
<th>Alfalfa persistence</th>
<th>Milk/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early bloom vs. bud</td>
<td>↓</td>
<td>↓</td>
<td>↑</td>
<td>↑</td>
</tr>
</tbody>
</table>
Agri-environmental assessment of Canadian dairy farms: Towards eco-efficient management of forage crops and manure (PI: Martin Chantigny)

* Obj. 2: Determining long-term capacity of dairy farm soils to sequester C and N

* Soil sequesters more C and N when:
  * fertilized with manure;
  * manure is applied in systems with perennial forages.

Apply manure preferentially in field with perennial forages and save fertilizers for annual crops.
Mitigation of enteric methane production from dairy cows and impact on manure emissions (PI: Chaouki Benchaar)

Other dairy projects involving forages

- The type of silage used in the dairy ration affects CH$_4$ emissions.
- Need a whole farm evaluation of the GHG emissions from all operations.

<table>
<thead>
<tr>
<th>Silages</th>
<th>Potential CH$_4$ reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn vs Timothy</td>
<td>10%</td>
</tr>
<tr>
<td>Corn vs Barley</td>
<td>14%</td>
</tr>
<tr>
<td>Corn vs Red clover</td>
<td>13%</td>
</tr>
<tr>
<td>Alfalfa vs Timothy</td>
<td>5%</td>
</tr>
<tr>
<td>Brown midrib vs Conventional corn</td>
<td>7%</td>
</tr>
</tbody>
</table>
New knowledge, tools or technology to be transferred to dairy farmers or the dairy sector? Other intervenors?

1. Promising selection strategy to increase alfalfa sugar content that will be used to develop improved cultivars.
2. Field-based management practices that improve the sugar to protein ratio and the on-farm profitability of alfalfa-based mixtures.
3. Web-based decision tool to provide optimum time for cutting forages.
4. New knowledge on the environmental impact of forage production and utilization in dairy production; essential to develop a sustainable dairy production system.
Key Takeaways

Increasing the production and utilization of alfalfa-based mixtures is a sustainable strategy to improve on-farm profitability and to reduce the environmental footprint of the Canadian Dairy Industry.
Acknowledgements