Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Binary and complex legume-grass mixtures affect the forage energy to protein ratio

Tremblay G.F.[1], Bélanger G.[1], Simili Da Silva M.[3], Lajeunesse J.[1], Papadopoulos Y.A.[2], Fillmore S.A.E.[2] and Jobim C.C.[3]

[1,2]Agriculture and Agri-Food Canada, [1]Québec, QC, Canada, G1V 2J3, [2]Kentville, NS, Canada, B4N 1J5;

[3]Universidade Estadual de Maringá, Maringá, PR, Brazil 87020–900

Introduction

- A dietary combination of high energy availability and reduced total N concentration, or reduced N solubility, has been suggested for better microbial protein synthesis in the rumen (Bryant *et al.*, 2012) and enhanced N utilization by dairy cows (Brito *et al.*, 2009).
- Greater concentrations of water soluble carbohydrates (**WSC**) or non-structural carbohydrates (**NSC)** along with low concentrations of crude proteins (**CP**) or non-protein N (**NPN**) and rapidly degradable proteins (**RDP**) in herbage should improve N utilization by dairy cows.
- Two ratios of energy to protein can be considered: **WSC/CP** and **NSC/(NPN+RDP)**.
- **Objective :** To determine the variation in two ratios of energy to protein in binary and complex legume-grass mixtures.

Materials & methods

Experiment 1. 18 binary mixtures of
one of 3 legumes:
Birdsfoot trefoil, **B** (*Lotus corniculatus* L.)
Lucerne, **L** (*Medicago sativa* L.), grazing type
White clover, **C** (*Trifolium repens* L.)
plus one of 6 grass species:
Cocksfoot, **Co** (*Dactylis glomerata* L.)
Kentucky bluegrass, **Kb** (*Poa pratensis* L.),
Meadow bromegrass, **Mb** (*Bromus biebersteinii*)
Meadow fescue, **Mf** (*Festuca pratensis* L.)
Tall fescue, **Tf** (*Schedonorus phoenix*)
Timothy, **Ti** (*Phleum pratense* L.)

Experiment 2. 8 complex mixtures of
one of 2 legumes:
Birdsfoot trefoil, **B**
Lucerne, **L**, grazing type
plus one of four grass mixes (GM):
GM1, Ti + Mf + Kb
GM2, Ti + Mf + Rc + Kb
GM3, Tf + Mb + Co + Kb
GM4, Tf + Mb + Rc + Kb
Rc = Reed canarygrass (*Phalaris arundinacea* L.)

- Two sites: Lévis and Normandin, QC, Canada.
- Split-plot with legume species as main plots and grass species or grass mixes as subplots; 3 or 4 replications.
- In the first post-seeding year, first and second clippings were harvested when timothy reached 25 cm in height to simulate grazing.
- A subset of herbage samples were analysed for WSC, CP, ether extract (EE), ash, NDF, NPN, and RPD. Concentration of NSC was calculated (NSC=100-CP-EE-Ash-NDF). Nutritive attributes were then estimated by near infrared reflectance spectroscopy in all herbage samples (Simili da Silva *et al.*, 2013; 2014).

Results & discussion

A) $\frac{\text{Water Soluble Carbohydrates}}{\text{Crude Proteins}}\left(\frac{\text{WSC}}{\text{CP}}\right)$ **B)** $\frac{\text{Non Structural Carbohydrates}}{\text{Non-Protein N + Rapidly Degradable Proteins}}\left(\frac{\text{NSC}}{\text{NPN+RPD}}\right)$

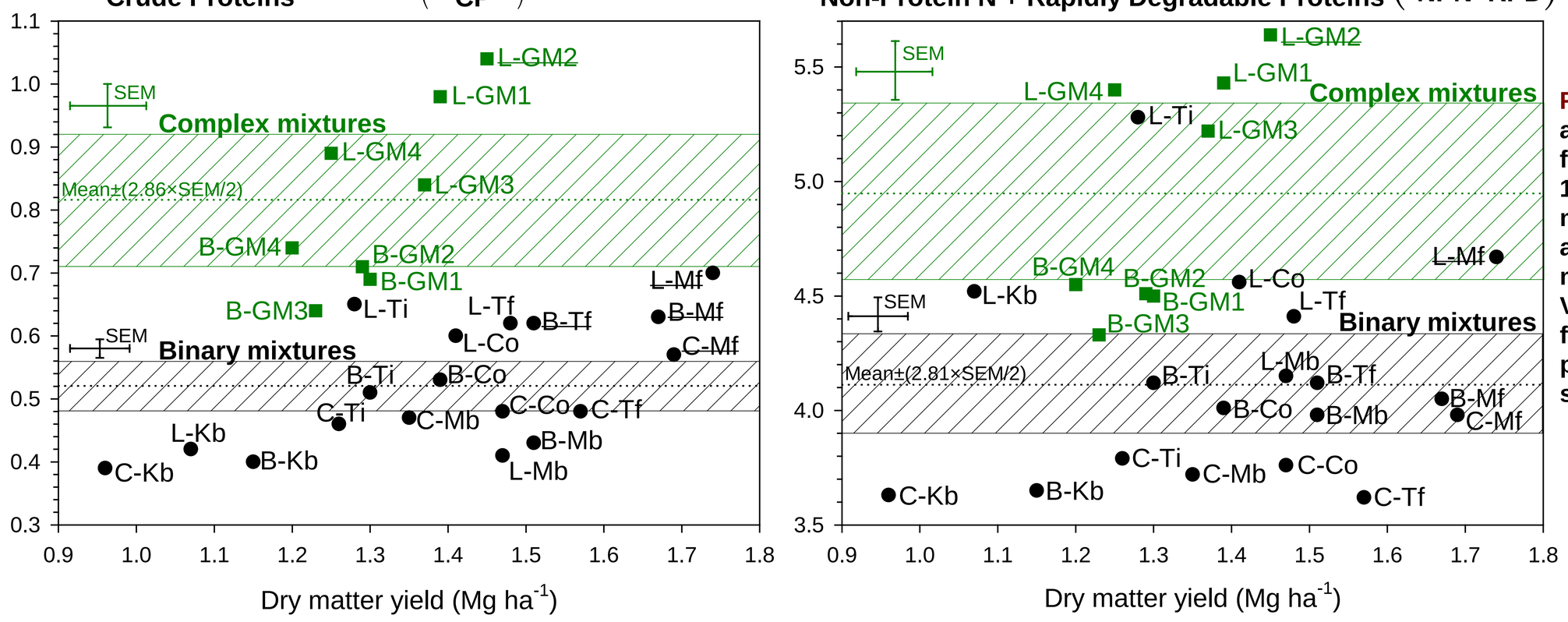

Figure 1. Ratios of WSC/CP and of NSC/(NPN+RDP) as a function of dry matter yield of 18 legume-grass binary mixtures (●, Experiment 1) and 8 legume-grass complex mixtures (■, Experiment 2). Values are averages of the first two clippings of the first post-seeding year at two sites.

- Complex mixtures (in green) had greater energy to protein ratios than binary mixtures (in black).
- Both energy to protein ratios varied significantly among the 8 complex mixtures (green square symbols) and the 18 binary mixtures (black circle symbols); these variations were due to both legume species and grass species or mixes.
- Among the 18 binary mixtures, the lucerne and meadow fescue mixture (L-Mf) provided the best combination of high energy to protein ratios and high DM yield.
- Among the 8 complex mixtures, the mixture of lucerne and the grass mix 2 [L-GM2: Lucerne + (Timothy, Meadow fescue, Reed canarygrass, and Kentucky bluegrass)] provided the best combination of high energy to protein ratios and high DM yield.
- Lucerne-based complex mixtures had greater WSC/CP (green square symbols, Figure 1A) and NSC/(NPN+RDP) (green square symbols, Figure 1B) ratios than birdsfoot trefoil-based complex mixtures.

Conclusion

- The results confirm the possibility of improving the balance between herbage readily-available energy and proteins through the choice of species.
- Research is ongoing to determine the feasibility of maintaining the desired composition throughout the growing season and over several cropping years.

References

Brito *et al.* 2009. J. Dairy Sci. 92:1092; Bryant *et al.* 2012. Anim. Feed Sci. Technol. 173:210; Simili da Silva *et al.* 2013. Agron. J. 105:482; Simili da Silva *et al.* 2014. Anim. Feed Sci. Technol. 188:17.

Acknowledgements

This study was funded by the Beef Cattle Research Council, a division of the Canadian Cattlemen's Association, and by Agriculture and Agri–Food Canada.

Canada