Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada

Using cutting management and alfalfa-based mixtures as strategies to increase readily-available energy to protein ratio in forages

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Dairy Research Cluster

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Introduction

Cow's diet with a greater ratio of water soluble carbohydrates (**WSC**) to crude protein (**CP**) results in higher milk yield with higher protein content (Brito et al., 2008) and reduced N losses in urine (Edwards et al., 2007), likely due to more protein synthesis by ruminal bacteria (Brito et al., 2009; Berthiaume et al., 2010).

The WSC/CP ratio of 18 binary forage mixtures was previously shown to vary from 0.39 to 0.70 (Simili da Silva et al., 2013). Little information exists, however, on the effect of management practices on the WSC/CP ratio of forage crops.

Our **objective** was to assess the effects of 1) the choice of grass species, 2) the stage of development of alfalfa at cutting, 3) the proportion of grass, and 4) the regrowth period (spring *vs.* summer) in alfalfa-based binary mixtures on the forage WSC/CP ratio.

Materials & methods

Two experiments were conducted at 3 sites in Québec (Canada) during 2 production years (2015 and 2016).

Forage WSC and CP concentrations were chemically analyzed on a calibration set of samples (n=75) and then predicted by near infrared reflectance spectroscopy (NIRS) for all forage samples according to Simili da Silva et al. (2013).

Experiment 1 – grass species and stage of alfalfa at cutting

Split-plot factorial design with 3 replications:

- Main factor: 6 binary alfalfa (*Medicago sativa* L. cv. Calypso) – grass mixtures
  - Alfalfa – Festulolium (*Lolium* sp. × *Festuca* sp. cv. Spring Green)
  - Alfalfa – Perennial ryegrass (*Lolium perenne* L. cv. Remington)
  - Alfalfa – Meadow fescue (*Festuca pratensis* Huds.)
  - Alfalfa – Tall fescue (*Festuca arundinacea* Schreb. cv. Carnival)
  - Alfalfa – Timothy (*Phleum pratense* L. cv. AC Alliance)
  - Alfalfa – Meadow bromegrass (*Bromus biebersteinii* Roem. & Schult. cv. Fleet)
- Subfactor: 2 stages of development of alfalfa at cutting: early bud and early flowering.

Replications (3), years (2), sites (3), and cuts (3) were considered random effects, whereas mixtures (6) and stages (2) were considered fixed effects. In Fig. 2, representing interactions, the years and the first two cuts of each production year were considered fixed effects.

Experiment 2 – proportion of grass and regrowth period

Randomized complete block design with 2 replications:

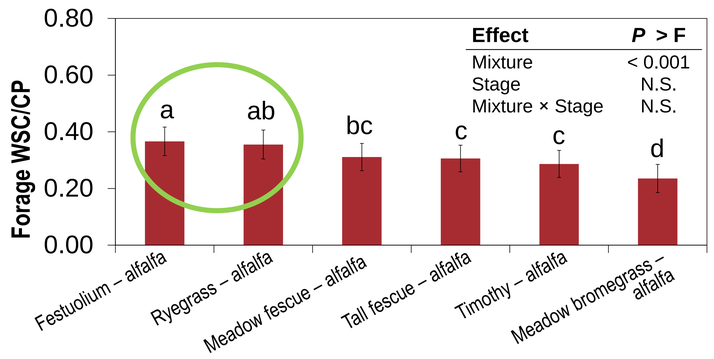
- Proportion of 0 – 20 – 40 – 60 – 80% of one of two grasses (tall fescue and timothy) in binary mixtures with alfalfa (9 treatments).
- Two regrowth periods: spring (cut 1) and summer (cut 2).

Replications (2), years (2), and sites (3) were considered random effects, whereas treatments (9) and cuts (2) were considered fixed effects. A logarithmic transformation was applied to the forage WSC/CP ratio in order to correct the normality, and untransformed data are presented.

Results & discussion

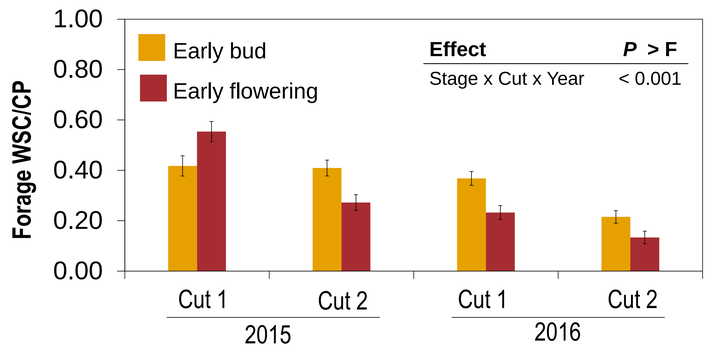
Experiment 1 – grass species and stage of development of alfalfa at cutting

Fig. 1. Effect of alfalfa-based binary mixtures with 6 grass species on the forage WSC/CP ratio (averaged across 3 cuts, 3 sites, and 2 years).



➢ The greatest forage WSC/CP ratio was observed in the alfalfa-festulolium and the alfalfa-ryegrass mixtures (0.36) and the lowest ratio in the alfalfa-meadow bromegrass mixture (0.24).

Fig. 2. Interaction between stage of development of alfalfa at cutting, cut, and year on the forage WSC/CP ratio (averaged across 6 mixtures and 3 sites).



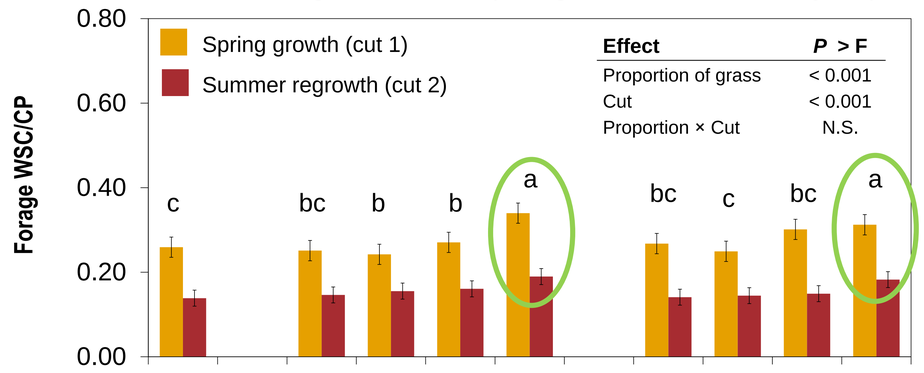
➢ Cutting mixtures at the early bud stage of alfalfa generally resulted in a greater forage WSC/CP ratio, except for the first cut in 2015.

Experiment 2 – proportion of grass and regrowth period

➢ At both regrowth periods (cuts 1 and 2), the forage WSC/CP ratio was the greatest when the proportion of grass in the seed mixture was of 80%, which was expected given that grasses usually have greater WSC and lower CP concentrations than legumes.

➢ With both tall fescue and timothy, the forage WSC/CP ratio was greater in spring (cut 1, 0.28) than in summer (cut 2, 0.16), probably due to the greater proportion of grasses in the mixture in spring growth than in summer regrowth.

Fig. 3. Effect of the proportion of grass (timothy or tall fescue) in the alfalfa-based binary mixture and of the cut on the forage WSC/CP ratio (averaged across 3 sites and 2 years).



Alfalfa (%)	100		80	60	40	20		80	60	40	20
Tall fescue (%)			20	40	60	80					
Timothy (%)								20	40	60	80

Conclusions

The four strategies that were tested affected the WSC/CP ratio of alfalfa-based forage mixtures. **A greater forage WSC/CP ratio was generally obtained:**

✓ With festulolium or ryegrass in mixture with alfalfa
✓ When mixtures were harvested at the early bud stage of alfalfa
✓ With 80% of grasses (timothy or tall fescue) in the seed mixture
✓ In spring (cut 1) rather than in summer (cut 2)

References

Berthiaume et al., 2010, J. Dairy Sci. 93:693; Brito et al., 2008, J. Dairy Sci. 91:3968; Brito et al., 2009, J. Dairy Sci. 92:1092; Edwards et al., 2007, Proceedings of the New Zealand Grassland Association 69, 161; Simili da Silva et al., 2013, Agron. J. 105:482.

Acknowledgements

This research is supported in main part by Agriculture and Agri-Food Canada, and by additional contributions from Dairy Farmers of Canada, the Canadian Dairy Network and the Canadian Dairy Commission under the Agri-Science Clusters Initiative.

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