GENETIC SELECTION FOR HIGH ENERGY IN ALFALFA (*Medicago sativa* L.) STEMS

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INTRODUCTION

- A large proportion of alfalfa proteins escapes microbial digestion leading to urea excretion into the environment. An inflow of carbohydrates must be provided to ensure a more efficient use of nitrogen (N) by rumen microbes (Brito et al., 2009).
- The genetic selection of alfalfa for a high non-fiber carbohydrate (NFC; sum of soluble sugars, starch and pectin) concentration is a sustainable approach to reduce N losses and improve animal performance.
- As NFC concentration in alfalfa forage is strongly influenced by daily fluctuations while stem NFC is more stable, we developed a method of recurrent selection for high-NFC in alfalfa based on stem NFC concentration (Claessens et al., 2021).
- Our objective was to test in the field alfalfa populations obtained after 1 to 4 cycles of selection for high stem-NFC.

MATERIAL & METHODS

- Five alfalfa populations selected from cultivars 55V48, Akori, Genoa VR and Megan:
  - **NFC0** : 40 genotypes from the four initial cultivars randomly selected and intercrossed;
  - **NFC1** resulting from a 1st cycle of selection for winter survival, yield and high stem-NFC concentration;
  - **NFC2**, **NFC3,** and **NFC4** resulting from a 2nd, 3rd, and 4th cycle of recurrent selection for plant vigor and high stem-NFC concentration.
- Established in rows of 25 plants in five repetitions at two sites in Quebec, Canada (Saint-Augustin-de-Desmaures and Normandin).
- Samples of above-ground biomass from 1st and 2nd harvests were collected to ensure that selection based on stem NFC effectively translated into whole forage.
- Samples dried, ground and scanned by VNIRS to estimate nutritive attributes [acid and neutral detergent fibers, total nitrogen, and NFC concentrations].
- Statistical analysis using MIXED procedure of SAS in a model with selection cycle as fixed effect and site, cut and interaction as random effects.
- Results of the first post-seeding year are presented.

RESULTS & DISCUSSION

- NFC concentration increased linearly through the four cycles (P=0.001), the alfalfa forages from population NFC4 being 9% higher than NFC0 (Fig.1).
- The differences in NFC concentrations between the populations were mainly due to soluble sugars plus starch concentrations which increased at each cycle (+13%).
- Pectin represented up to 30% of the rapidly available energy of alfalfa forage and was not affected by recurrent selection.

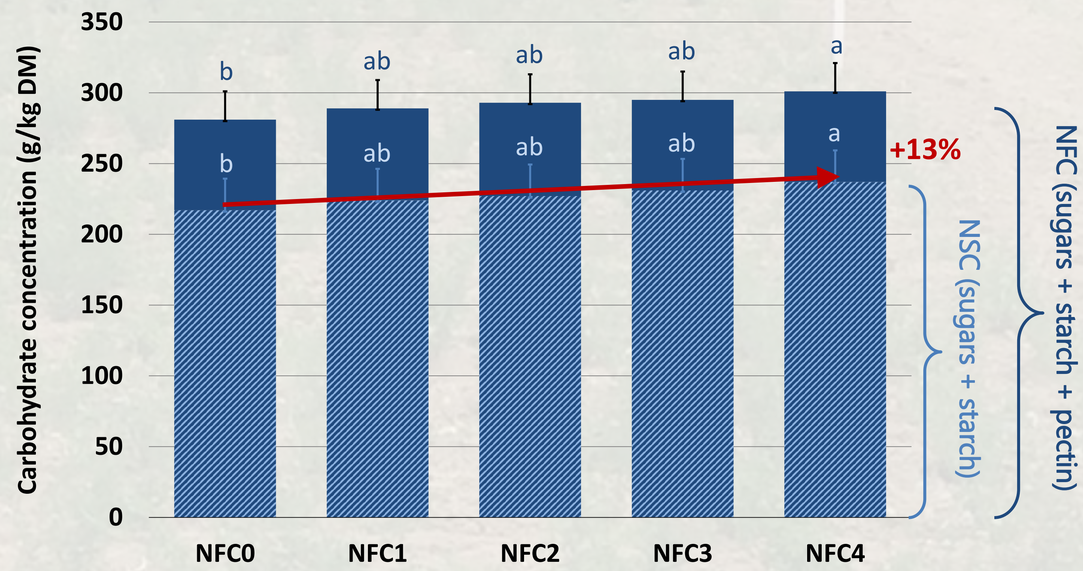

Fig. 1. Carbohydrate concentrations in forage of four populations of alfalfa recurrently selected (one to four cycles) for high-stem NFC along with control population (NFC0) grown in the field

- The gain in carbohydrates was made at the expense of acid detergent fibers (data not shown).
- Recurrent selection did not affect protein concentration (data not shown).

CONCLUSIONS

- As validated in the field, **the energy in alfalfa forage can be increased by genetic selection based on the concentration of stem NFC** which is a promising approach to improve the energy to protein balance in alfalfa.
- The field trials are being pursued for a second post-seeding year and at an additional site established in 2021 at Saskatoon to further validate the results under different environmental conditions.
- High-energy alfalfa could translate into both improved animal performance and reduced N loss to the environment.

REFERENCES

Claessens et al. 2021
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