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Time of Cutting and Genetic Selection Affect Non Structural Carbohydrates and Other Attributes of Nutritive Value in Alfalfa

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Introduction

- Increasing concentration of non structural carbohydrates (**NSC**) in forages improves ruminant N utilization (Brito *et al.,* 2009) and performance (Brito *et al*., 2008).
- Forage NSC concentration increases during the day (Burns *et al.,* 2005) and may be improved by genetic selection (Humphreys, 1989) but the extent of these effects is not well known.

Objective: To determine, under field conditions, the effect of selected populations of alfalfa for high and low NSC concentrations cut in the morning or the afternoon on NSC concentration and other attributes of nutritive value.

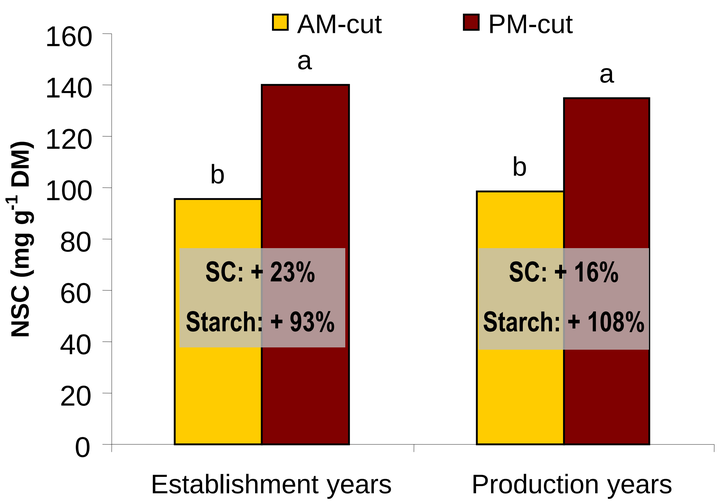
Materials & Methods

- Genotypes were selected for contrasted NSC concentration from 500 AC Caribou genotypes. Three alfalfa populations were obtained by intercrossing 10 genotypes/population;

  NSC+ (high NSC concentration)
  NSC- (low NSC concentration)
  NSC0 (randomly selected).

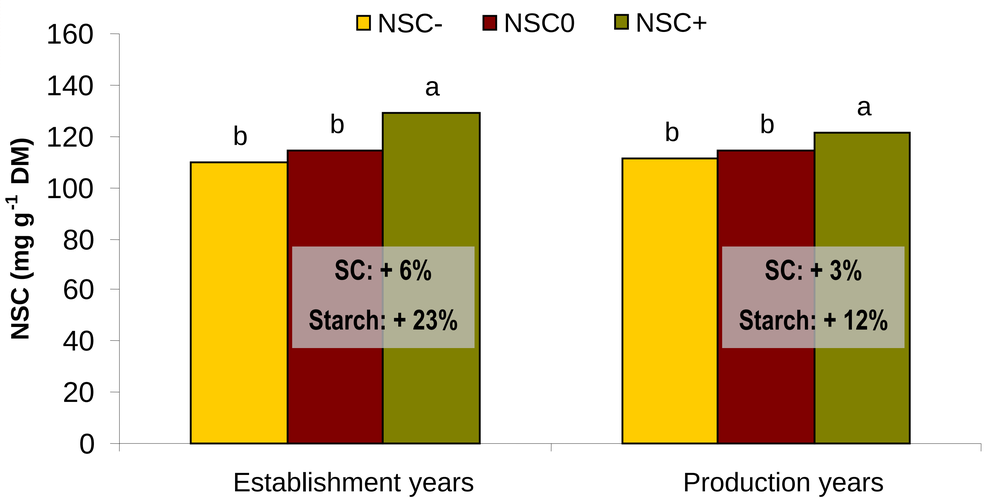
- Populations were established near Quebec City, Canada (46°48´N; 71°23´W) in **2006** and **2008**.
- Populations were harvested in **AM (9h00)** and **PM (15h00)** at early flowering once during the establishment years (n=96) and three times during the production years (n=432).
- Forage samples were dried at 55°C immediately after each harvest, ground using a Wiley mill to pass through a 1-mm screen.
- Forage samples were evaluated for **NSC**, crude protein **(CP)**, acid detergent fibre **(ADF)**, neutral detergent fibre **(NDF)**, *in vitro* true digestibility **(IVTD),** and *in vitro* NDF digestibility **(NDFd)** using NIR spectroscopy.
- **NSC** = sucrose + glucose + fructose + pinitol + starch.
- Soluble carbohydrates (SC) measured by HPLC; starch by colorimetry (Bertrand *et al*., 2008); CP (AOAC, 1995); ADF, NDF, IVTD, and NDFd according to Goering and Van Soest (1970).
- An ANOVA was performed using the MIXED procedure of SAS with field trials and years as random effects and cuts as repeated measures. LSMEANS were compared using the Tukey-Kramer test.
- **Establishment years:**
  means of two years with one cut/year.
- **Production years:**
  means of three years with three cuts/year.

Results & Discussion



NSC concentration of AM- and PM-cut alfalfa in establishment and production years (means of three populations).

- NSC concentration increased by 46% with PM-cutting during the establishment years and by 37% during the production years.



NSC concentration of three populations harvested in establishment and production years (means of two times of cutting/harvest).

- NSC concentration increased by 13% with NSC+ in the establishment years and by 6% during the production years compared to NSC0.

Other attributes of nutritive value and DM yield of three alfalfa populations cut in AM and PM.

		Establishment years						Production years					
		ADF	NDF	CP	IVTD	NDFd	Yield	ADF	NDF	CP	IVTD	NDFd	Yield
		---------- mg g^{-1} DM ----------				mg g^{-1} NDF	g DM m^{-2}	---------- mg g^{-1} DM ----------				mg g^{-1} NDF	g DM m^{-2}
Time of cutting	**AM**	251 *a*[1]	308 *a*	210 *a*	844 *b*	501	182	288 *a*	341 *a*	172 *a*	813 *b*	464 *b*	397
	PM	222 *b*	*289 b*	197 *b*	858 *a*	512	180	265 *b*	325 *b*	166 *b*	825 *a*	476 *a*	387
Alfalfa population	**NSC-**	245 *a*	310 *a*	205 *a*	841 *b*	493 *b*	188	280	338 *a*	170 *a*	813 *b*	461 *b*	396
	NSC+	233 *b*	298 *ab*	197 *b*	852 *a*	509 *a*	185	278	335 *ab*	164 *b*	818 *ab*	470 *ab*	404
	NSC0	230 *b*	288 *b*	209 *a*	859 *a*	518 *a*	170	270	326 *b*	173 *a*	825 *a*	479 *a*	377

[1]*Within a column and a main treatment effect, means followed by different letters are significantly different at P < 0.05.*

- In general, PM-cutting decreased ADF, NDF, and CP concentrations, and improved IVTD and NDFd.
- The NSC+ and NSC- populations did not differ for ADF, NDF, IVTD, and NDFd in production years.
- Greater NSC concentration with either PM-cutting or the NSC+ population was mainly due to greater starch concentration.
- There was no interaction between time of cutting and populations.

Conclusions

- Alfalfa NSC concentration can be increased by cutting in the afternoon (+ 42%) and via phenotypic selection (+ 10%).
- The increase in NSC concentration with PM-cutting was associated with a decrease in ADF, NDF, and CP concentrations, and an increase in IVTD and NDFd.
- Additional cycles of selection may further increase NSC concentration and affect other attributes of nutritive value.

Acknowledgements

This research was funded by the *"Action concertée AAC – FQRNT – MAPAQ – Novalait inc. (2007-2011)".*

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