

Field validation of the improvement of alfalfa stem cell wall digestibility by recurrent selection

Annick Bertrand, Agriculture and Agri-Food Canada

Annie Claessens, Agriculture and Agri-Food Canada

Marie-No Thivierge, Agriculture and Agri-Food Canada

Solen Rocher, Agriculture and Agri-Food Canada

Julie Lajeunesse, Agriculture and Agri-Food Canada

Philippe Seguin, McGill University

Phenotypic variability of alfalfa cell wall (CW) digestibility could be exploited for the improvement of that trait through recurrent selection to improve rumen-fermentable energy in forage. However, little is known on the stability of that trait or its inheritance in the field. We evaluated phenotypic progress obtained in alfalfa populations after two cycles of recurrent selection targeting stem CW digestibility under field conditions. Digestibility was assessed as the concentration of glucose released following enzymatic hydrolysis of fiber (enzyme-released glucose, ERG) in stems. We also wanted to know if recurrent selection for CW digestibility has an impact on other important traits such as biomass yield, winter survival, as well as water-soluble carbohydrates (WSC) concentration. Two initial cultivars, 54V54 and Orca, and populations obtained after successive cycles of divergent selection for stem CW Digestibility (D-1, D-2, D+1, and D+2) were established at three field sites in the North, Central, and South of the province of Québec. Field trials conducted over two growing seasons showed a significant improvement of stem CW digestibility in populations obtained after two selection cycles (D+2) (+20.7 mg ERG g⁻¹ CW) compared to the initial cultivars (average of 13% improvement in digestibility). The D+2 populations did not differ from the initial cultivars with regard to biomass yield, winter survival, and stem WSC concentration. Broad sense heritability of stem CW digestibility was evaluated based on three cycles of positive selection in each of the two initial genetic backgrounds. Increases of stem ERG concentrations were observed in response to recurrent selection and broad sense heritability highlights a moderate control of genetic factors over environmental factors for CW digestibility. This study demonstrated that recurrent phenotypic selection for higher stem ERG concentration in mature alfalfa can improve CW digestibility without affecting alfalfa dry matter yield, winter survival, and WSC concentration. Stem ERG concentration has a good potential as a selection trait for CW digestibility improvement with a high digestibility gain per selection cycle and a moderate heritability. The populations developed in this project are currently undergoing further cycles of recurrent selection. The molecular characterization of this unique genetic material will help uncovering molecular basis of that trait, and accelerate the development of germplasm with superior stem fiber digestibility.