

Breeding for stem cell wall digestibility in alfalfa

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Alfalfa (*Medicago sativa* L.) is an open-pollinated autotetraploid species with extensive genetic variability for cell wall (CW) digestibility that can be exploited for genetic improvement. However, genetic gains for this trait are tributary to the availability of screening techniques for the precise identification of superior genotypes. We developed a screening approach using glucose released from CW following enzymatic hydrolysis and NIRS prediction to identify highly digestible genotypes. Enzyme-released glucose (ERG) is a function of both glucose concentration and the efficiency with which that glucose is released from CW. Our objectives were to evaluate the direct effect of a divergent phenotypic selection for stem ERG on alfalfa and the indirect effects of this selection on alfalfa plant biomass and water soluble carbohydrate concentration.

Alfalfa genotypes from two genetic backgrounds (54V54 and Orca) were subjected to two cycles of phenotypic selection based on their stem ERG concentrations. After each cycle, the lowest and highest ERG genotypes within each background were selected and intercrossed. Eight populations were generated and evaluated at three sites in 2014 and 2015 for their ERG concentrations, soluble carbohydrate concentrations and plant biomass. The direct divergent selection response was significant for both backgrounds. The low populations were significantly lower in stem ERG concentration than the high populations, e.g.: 54V54 ERG-2 population (140 mg glucose g⁻¹ CW) being 20% lower in stem ERG concentration than the 54V54 ERG+2 population (176 mg glucose g⁻¹ CW). Indirect responses for water soluble carbohydrates and plant biomass were not significant between divergently selected populations and their respective genetic backgrounds. Phenotypic selection based on stem ERG concentrations is a very promising approach to improve alfalfa stem cell wall digestibility without reducing plant biomass.