

Plant Density and Maturity Stage Impacts on Stem Cell Wall Composition in High Quality and Non-lodging Alfalfa

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The concentration of stem cell wall constituents in alfalfa (*Medicago sativa* L.) can affect energy availability in livestock production systems and energy conversion efficiency when alfalfa is used to produce biofuels. Knowledge of the environmental variability of cell wall concentration and composition among different germplasms would be critical in a breeding program to improve the available energy in alfalfa stems for livestock production or conversion to bioenergy. We evaluated total stem cell wall concentration (g kg^{-1} dry matter), Klason lignin, cellulose (glucose), hemicellulose (xylose + mannose + fucose), and pectin (uronic acids + arabinose + galactose + rhamnose) (g kg^{-1} cell wall) in four germplasms (two high quality and two non-lodging populations) established at two plant densities (180 and 450 plants m^2) at two locations (Arlington, WI and Becker, MN) and harvested at two maturity stages, early bud (4 cuts per season), and full flower (3 cuts per season) for two years. Yield weighted annual averages for all stem cell wall traits were calculated and analyzed to identify the impacts of location, year, plant density, harvest maturity and germplasm sources on stem cell wall composition. Stem cell wall composition traits responded differently at the two locations, therefore results are presented separately for the MN and WI locations. Plant density had no effect on stem cell wall concentration or composition at either location. Total cell wall concentration and cellulose increased while pectin and hemicellulose decreased at the later maturity stage at both locations. Cell wall compositional changes between the two maturity stages differed between MN and WI. At MN the plants gained a greater proportion of cellulose compared to Klason lignin, at the later maturity stage, while the opposite was true at WI. The high quality alfalfa populations tended to have greater pectin concentrations than the non-lodging populations. All other stem cell wall traits showed inconsistent responses among the germplasms at the locations.