Alfalfa Leaf Protein and Stem Cell Wall Polysaccharide Yields under Hay and Biomass Management Systems

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Alfalfa (*Medicago sativa* L.) has been proposed as a biofuel feedstock, where the stems would be processed to produce ethanol and the leaves sold separately as a livestock feed. We propose a different management regime reducing population density, delaying harvest and cutting less frequently per growing season to maximize leaf and stem yield be implemented for biomass production. Our objectives were to evaluate the effects and interactions of environment, biomass management strategy compared to traditional hay production practices on leaf crude protein (CP), and stem carbohydrate concentrations and yields of alfalfa germplasms differing in fall dormancy and genetic origin. Four alfalfa germplasms, two hay-type alfalfas adapted to the upper Midwest region of the US and two biomass-type alfalfas of Flemish or Southern European origin were established at 450 plants m^{-2} and harvested at early bud (hay management system) and at 180 plants m^{-2} and harvested at green pod (biomass management system) in three environments. The biomass-type alfalfas under the biomass management treatment had lower leaf CP, higher stem cell wall polysaccharide, and higher stem lignin concentrations, comparable leaf CP yield and higher stem cell wall polysaccharide yields compared to the hay-type alfalfas under the hay management. No germplasms differences were found for lignin concentration under either management system. On average all alfalfa germplasms had a 78% increase in total stem cell wall polysaccharide yield under the biomass management system compared to the hay management system. The impact of altered stem cell wall composition and increased stem DM yield of a biomass-type alfalfa under biomass system compared to a hay-type alfalfa under hay system increased the theoretical potential ethanol yield by 128 %. Reduced harvesting costs, and potentially longer stand life under the less frequent harvesting biomass management system would contribute additional economic efficiencies.