Alfalfa Bioenergy: Energy products and breeding strategies

JoAnn F. S. Lamb, Hans-Joachim G. Jung, Craig C. Sheaffer, A.A. Boateng and P.J. Weimer
USDA- ARS, St. Paul, MN, University of Minnesota, USDA-ARS, Wyndmoor, PA, and U.S. Dairy Forage Research Center, Madison, WI.

Alfalfa (*Medicago sativa*) has the potential to be a significant contributor to America's renewable energy future. In an alfalfa biomass energy production system, alfalfa forage would be separated into stem and leave fractions. The stems would be processed to produce energy, and the leaves would be sold to provide additional income as a livestock feed and/or a source of value-added products (e.g., genetically modified to produce specialty proteins, pharmaceuticals, or industrial chemicals). Other value-added components unique to an alfalfa biomass energy production system include a fertilizer N replacement value (for subsequent crops in rotation), increased soil N and C concentrations, and improved ground water quality. Both biochemical [saccharification and fermentation to liquid fuel (ethanol)] and thermochemical (combustion or gasification) conversion technologies can be used to produce energy or electricity from alfalfa biomass. Alfalfa stem cell wall sugar yields and lignin concentration impacted the efficiency of energy conversion depending on the technology used (Lamb et al., 2007; Boating et al., 2008 in press). Cell wall lignin concentration impacted the efficiency of biochemical conversion but showed little to no impact on thermochemical conversion. Choice of energy product will likely impact selection methods and breeding goals when modifying alfalfa for biomass energy production.

Referecnes:

Lamb, JF.S., H.G. Jung, C.C. Sheaffer, and D.A. Samac. 2007 Alfalfa leaf protein and stem cell wall polysaccharide yields under hay and biomass management systems. Crop Sci. 47:1407-1415.

Boateng, A.A., P.J Weimer, H.G. Jung, and J.F.S. Lamb. 2008. Response of thermochemical and biochemical conversion processes to lignin concentration in alfalfa stems. Energy & Fuels In press.