Adding Value to Biofuels Production Systems Based on Perennial Forages

This Biofuel project is one of six main areas of research emphasis at the U.S. Dairy Forage Research Center

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Objectives:

1. Develop new germplasm of perennial forage species that display increased yield and bioconversion potential.
2. Develop new commercially-viable technologies for harvest, storage and/or on-farm pretreatment and biorefining of perennial bioenergy crops, and use modeling to assess the economic and environmental impacts of integrating these new technologies into sustainable farming systems.
3. Develop technologies based on mixed culture ruminal fermentation that enable commercially-viable processes for producing hydrocarbon and alcohol fuels from lignocellulosic biomass via volatile fatty acid intermediates.
4. Develop technologies to enable commercially-viable consolidated bioprocessing (CBP) of lignocellulosic biomass to fuel ethanol and adhesive co-products.

Approach:

1. Use conventional breeding methods and molecular analytical tools to develop and characterize new varieties of switchgrass adapted to growth in the northern United States.
2. Develop equipment and technology for harvesting perennial grasses and alfalfas at reduced cost or producing fractions having higher value and different end uses (e.g., stem fraction as biofuels feedstock and leaf fraction as animal feed). Evaluate practicality and economics of on-farm biomass pretreatment with acid, lime, ozone, and/or other reagents. Evaluate economics and environmental impact of biofuels production systems and assess opportunities for integration into dairy farming systems.
3. Modify cultivation methods and use selective pressure to improve mixed culture fermentations for converting cellulosic biomass to volatile fatty acids (VFA) mixtures. Economically prepare fermentation broths for further processing. Demonstrate and improve electrolytic conversion of VFA to hydrocarbons in aqueous systems using Kolbe and Hofer-Moest reactions.
4. Identify secondary plant cell wall structural factors that limit plant cell wall biodegradation. Improve fermentation of plant cell wall materials to ethanol and adhesive-containing fermentation residue. Improve bacterial strains and culture media to increase yield of adhesive material, and improve adhesive properties through further chemical modification.