ON-FARM PRETREATMENT TECHNOLOGIES FOR IMPROVING ENZYMATIC DIGESTIBILITY OF CELLULOSIC FEEDSTOCK

M. Digman

U.S. Dairy Forage Research Center, ARS-USDA, 1925 Linden Dr. West, Madison, WI 53706, USA

There is considerable interest in developing agricultural residues and herbaceous perennials as feedstocks for bioethanol production as supplements to grains. However, the logistics of harvesting, storing, and transporting the large quantities of biomass needed to supply cost-competitive biorefineries is an immense challenge – and a missing link in terms of the research attention it has received.

While most of the research on biomass conversion assumes that crops will be harvested and stored dry (like hay), wet storage methods (like silage) are being proposed for feedstock preservation and on-farm storage of perennial grass and corn stover biomass. On the farm, the advantages of a wet storage system over a dry system include: low risk of fire, reduced harvesting costs, less weather risk at harvest, and lower dry matter losses during storage. At the biorefinery the advantages of a wet system include: increased product uniformity and improved feedstock susceptibility to enzymatic hydrolysis.

A wet system of harvest and storage opens the door to pretreating the biomass on the farm. This is the main focus of our research. Unlike grain, cellulosic feedstock must be pretreated prior to further processing because the carbohydrates are largely contained in complex cell wall structures that impede their enzymatic conversion into fermentable sugars. At the biorefinery, this process would require substantial energy (high temperatures and/or pressures) to quicken the pretreatment process. On-farm pretreatment, however, would require little energy and would significantly increase the degradability of the biomass while in storage, thereby reducing (or possibly eliminating) the need for pretreatment at the biorefinery. A pretreated biomass product should also add value at the farm level, thereby providing a better return for farmers.

Our initial research looked at three different pretreatments on two different grasses and realized conversion efficiencies of nearly 80 percent for cellulose and hemicellulose. Research partners with sufficient capacity to optimize fermentation of pretreated material at pilot and/or full scale would allow us to further investigate various pretreatment methods, on-farm scale-up issues and economics.

Contact: Matthew Digman, U.S. Dairy Forage Research Center, ARS-USDA, 1925 Linden Dr. W., Madison, WI 53706, USA. Tel: 608-890-1320. E-mail: Matthew.Digman@ars.usda.gov.