United States Department of Agriculture
Research, Education and Economics

Agricultural Research Service
Date: Oct. 26, 2010

Natural Resources Research Update

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Title: Determining Switchgrass Biomass Supplies for Cellulosic Biorefineries

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Switchgrass (*Panicum virgatum* L.) is being developed into a bioenergy crop for use in temperate regions of the USA. Information on spatial and temporial variation for stands and biomass yield among and within fields in large agroecoregions is not available. A reliable feedstock supply will be essential in maintaining stable biorefinery operational costs. Spatial and temporal variation information is needed to model feedstock availability for future cellulosic biorefineries. In a USDA-ARS on-farm study, spatial and temporal variation for biomass yield and stands was determined among and within 10 fields located in North Dakota, South Dakota, and Nebraska (1). Switchgrass fields were managed for bioenergy from 2000 to 2004 for the Nebraska locations and 2001 to 2005 for the South Dakota and North Dakota locations. A global positioning system (GPS) receiver was used to repeatedly measure within field quadrat sites for switchgrass stands using frequency grid measurements in June for five growing seasons. Sixteen quadrat yield samples were taken post-killing frost in the establishment year and in August in subsequent years at each location. Topographic within field effects on switchgrass stand frequency and biomass yields were largely insignificant. Stands tended to increase from establishment year to year 3 and then begin to plateau. Weather factors, which were the principal source of temporal variation, were more important in switchgrass yield variation than on switchgrass stand frequencies. Temporal standard deviations for yield were higher on quadrat sites with higher than average field means while temporal standard deviations were smaller in quadrat sites that had lower than average field means at six locations. In the Northern Great Plains agroecoregion, there is greater temporal and spatial variation for switchgrass biomass yields among fields than within fields. Results indicate that modeling feedstock availability for a cellulosic biorefinery can be based on field scale yields.

Cellulosic biorefineries will also need efficient and accurate methods to estimate switchgrass biomass feedstock supply within a production area. Another objective within the USDA-ARS on-farm study was to determine the effectiveness of indirect methods for estimating biomass yields and composition of switchgrass fields. Indirect or non-destructive measurements can rapidly measure

biomass at the field-scale with minimal labor requirements. Measurements were conducted in plot research located in Eastern Nebrarska and on fields across the Great Plains (2). A modified Robel pole was used to determine visual obstruction, elongated leaf height, and canopy height measurements. Prediction models from the study showed that elongated leaf height, visual obstruction, and canopy height measurements accounted for >91%, >90%, and >82% of the variation in switchgrass biomass, respectively. Visual obstruction was the best method for estimating yield on switchgrass fields with low to variable stand densities while elongated leaf height measurements would be recommended on switchgrass fields with high, uniform stand densities. Twenty to 30 elongated leaf height measurements in a field could predict switchgrass biomass yield within 10% with 95% confidence. These procedures developed by USDA-ARS can be used by biorefineries in estimation of feedstock supply in a production area and by government agencies in estimating national bioenergy supplies from switchgrass.

1. Schmer, M.R., Mitchell, R.B, Vogel, K.P., Schacht, W.H., Marx, D.B. 2010. Spatial and Temporal Effects on Switchgrass Stands and Yield in the Great Plains. BioEnergy Research. 3:159-171.

2. Schmer, M.R., Mitchell, R.B, Vogel, K.P., Schacht, W.H., Marx, D.B. 2010. Efficient Methods of Estimating Switchgrass Biomass Supplies. BioEnergy Research. 3(3):243-250.

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