Forever Green Initiative

Woody Perennials

FOR BIOMASS FEEDSTOCK AND ECOSYSTEM SERVICES

Overview

Woody perennial biomass crops, such as hybrid poplars, are an important component of a comprehensive strategy providing a range of high-quality feedstock, or raw materials, for bioindustrial applications while offering significant environmental and ecological benefits.

Woody biomass crops are fast-growing with short harvest cycles (typically three to five years) providing a continuous, productive living cover for up to 20 years. Moreover, woody biomass crops are adaptable to a wide range of soil and climate conditions, allowing them to be planted on marginal land where annual crops do not grow well.

The challenge with woody perennials is providing a consistent and economically viable source of biomass that meets productivity and quality benchmarks. An alternative approach is to establish dedicated woody biomass crops in agricultural areas of the state where high density plantings in monocrop or mixed-species agroforestry systems can be used to provide a consistent source of biomass with known productivity and quality parameters.

Our overarching goal is to provide farmers, land managers, policymakers, and other end-users with information needed to design and evaluate integrated strategies that use woody biomass cropping systems to meet unique economic and environmental goals. This work offers a viable crop that can fit into a strategy aimed at optimizing profitability and sustainability through the use of continuous living cover.

University of Minnesota | CFANS College of Food, Agricultural and Natural Resource Sciences

MORE INFORMATION:
DON WYSE | WYSEX001@UMN.EDU
FOREVERGREEN.UMN.EDU

Research Status and Goals

Investments made in faculty, staff, graduate students, Extension educators, farmers, and other program collaborators support field research, development of decision support systems, and education to ensure a profitable and consistent supply of biomass across a range of soils in a way that offers needed environmental/ecosystem services.

Activities:
We are evaluating yield and stability of 18 elite hybrid willow clones in southern Minnesota, as well as identifying any potential production risks from insects and disease that may reduce yield potential. We are evaluating the performance of willow varieties native to Minnesota when grown in high density biomass production systems. We are working with poplar to explore strategies for production of feedstock in support of bioproducts and bioenergy sectors. Our work has shown that integrating woody and perennial biomass crops in an alley cropping (agroforestry) strategy provides excellent total biomass yield potential, as well as nutrient scavenging capabilities that address water quality issues. Field research is also being conducted to evaluate the use of perennial woody and herbaceous biomass crops that support beneficial predator insects of soybean aphid to surrounding soybean crops while providing quality biomass feedstock. We are exploring the use of woody biomass crops as a living snow fence to keep snow off of roadways while providing added economic advantages through biomass production.

Goals include the assessment of woody perennial feedstock yield and quality across environments and systems. Although current work provides a basis for identifying the most efficient and productive willow and poplar cultivars, there is a critical need to expand this testing to include evaluation of the newest willow and poplar clones across the state. Specifically, we need detailed information about biomass productivity and quality across different environments, both regionally and locally, as well as across systems (e.g., monoculture versus alley cropping/ agroforestry). For example, growers need to provide industry partners with custom-grown feedstock that meets very specific productivity and quality requirements set by a given end use (e.g., lower lignin content to improve conversion efficiency, longer fiber length for composite materials). By providing a custom- grown product, farmers and industrial partners will both benefit.

We also want to quantify ecosystem services provided by woody biomass crop production. Data related to carbon sequestration, nutrient uptake, water use, habitat for beneficial insects, and other ecosystem services need to be obtained on marginal lands across the state to help growers meet their unique environmental and production goals. This information is also needed to assign tangible values to environmental benefits provided by woody biomass crops on a regional and local scale. Reducing establishment costs and improving harvest efficiency associated with woody biomass crop production is essential to improving overall profitability and adoption. Developing local infrastructure, value chains and employment and income opportunities around the production, harvest, processing and transport of biomass and the subsequent conversion to bioproducts is critical.

COMMERCIALIZATION PLAN

Our goal is to use the Madelia Model along with research-based information to guide expansion of the biomass industry and inform future research efforts across the state.

TIMELINE

2020–2024 AND BEYOND

- Assess biomass crop production impacts on ecosystem services
- Measure biomass quality across environments and cultivars
- Determine optimal cultivar across environments
- Evaluate mixed crop/species agroforestry options
- Evaluate strategies for reducing production costs
- Expand CE2T website

Outcomes:
Increase awareness and knowledge about woody perennial biomass crops as a potentially viable way to obtain multiple values on the landscape, including both economic and environmental.

We recently established a new web-based biomass crop enterprise and environmental budgeting tool for biomass, forage, agroforestry, and annual crops, CE2T: **ce2t. umn.edu**. This tool calculates the break-even price needed to cover the costs of producing biomass from conventional and alternative feedstocks. CE2T describes a variety of biomass crops, including shrub willow and hybrid poplar, and various agroforestry design options such as alley-cropping. It also provides an environmental report, comparing changes in soil carbon storage and soil erosion between current management practices and future scenarios comparing both conventional crops and herbaceous and woody perennials.

We have worked closely with Rural Advantage, an NGO dedicated to addressing water quality problems in the Minnesota River Basin and linked to initiatives in the Mississippi River Basin. Many of those efforts are built around the concept of continuous living cover and getting more perennial crops on the landscape to address both water quality and water storage problems. Rural Advantage, in collaboration with several NGOs, state and county agencies, and companies in the private sector, developed the Madelia Model. The Madelia Model is an integrated effort to identify locations in the Madelia fuelshed where perennial crops for biomass for energy can be produced while optimizing the potential positive environmental impacts by sourcing biomass from environmentally sensitive areas and creating corridors for wildlife while storing carbon. The background information is available to move ahead with a project in Madelia once the economic conditions and policy support are amenable to development of renewable energy options.

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