Sustainable Production of Cellulosic Biomass with Attention to Natural Resource Conservation and Wildlife Stewardship

Legumes can be used as green manures for perennial and annual grass biofuel crops

This research project is a collaborative effort under the 2009 Texas AgriLife Research Bioenergy Initiatives Program. The following researchers are involved:

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Rationale

Much of Texas is dominated by grasslands, with natives such as switchgrass prominent among these. These grasses require nitrogen, an energy-consuming input that defeats the purpose of bio-energy and may preclude economical fuel cropping in marginal climates and soils. **Herbaceous legumes that enhance the multiple-uses (biofuel, grazing, and wildlife) of these grass monocultures can ensure their profitability and sustainability by reducing dependence on industrial-N sources**.

Many different plant species may eventually play a part in this industry but switchgrass (*Panicum virgatum* L.) and high biomass forage sorghums [*Sorghum bicolor*

(L.) Moench] have received the most attention as potential biomass feedstock crops for Texas , the Midwest and the US southern region. These warm-season grasses require N as a first-limiting plant nutrient for growth and biomass production. For example, sustainable production of switchgrass in central Texas requires the application of 150 kg N ha^{-1} yr^{-1}. Herbaceous legumes can provide these systems with inexpensive nitrogen as well as enhance the multiple-uses of these grass monocultures (biofuel feedstock, carbon sequestration, grazing and wildlife) that ensure profitability and sustainability in our unpredictable sub-humid and semi-arid Texas climates.

AgriLife Research has a long history of breeding and developing agronomic practices for maximizing forage legume production. Adapted cool-season and warm-season annual legumes have been identified at some locations as have perennial natives. Interaction between warm-season grasses and over- or inter-seeded legumes have also been measured with varying results in locations. **We now need to redirect our programs to breeding and managing legumes as primary bioenergy feedstocks.** The importance of nutritive value to ruminants must give way to maximized C yields and maximized N transfer to grass-based biofuel cultivation. Legumes have much to offer the biofuel industry, including N fixation and drought resistance because of deep tap roots. The challenge is to identify species that are well adapted to our climates, produce consistent yields that can compete with grasses, and have bioenergy characteristics that meet industry needs. Research needs include measuring biomass productivity, soil N and C sequestration, legume N transfer, and crop fermentation/combustion characteristics.

Objectives

1. Foster the use of legumes as green manures for perennial and annual grass biofuel crops.
2. Identify or breed cool (annual) and warm season (annual and perennial) legumes for dedicated biofuel feedstock production.

Projected Impact

We know how to grow legumes as forages and pulses; now **we must retool AgriLife's expertise to grow legumes as biofuel feedstocks**. Our goal is to 1) develop productive legumes as dedicated carbon (C) biofuel feedstock or 2) as nitrogen (N) sources for economical and sustainable grass-based bioenergy systems. Much of Texas has soil and climatic conditions that lend themselves to growing perennial cellulosic bioenergy crops whose main input will be nitrogen, a fossil fuel-consuming industrial fertilizer that detracts from the purpose of bioenergy and may preclude economical fuel cropping in marginal climates and soils. Our multi-location team will implement a statewide research effort to test legumes as both primary crops (feedstock) as well as providers of nitrogen to primary biofuel feedstock.

Funding Sources

Texas AgriLife Research

Forage System Program Homepage