Growing the Right Plants: CABBI's Feedstock Theme

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https://cabbi.bio/research/feedstocks-theme/

Project Goals:

As DOE's newest Bioenergy Research Center, CABBI seeks to provide sustainable sources of energy for societal needs as the population continues to grow and global change accelerates. Looking at the most efficient ways to grow, transform, and market biofuels, CABBI's holistic approach will generate new products directly from biomass, reducing our nation's dependence on fossil fuels and making us more secure.

In support of that overall mission, research from the Feedstock Development Theme of the Center has two broad focuses: 1) engineering best-yielding grasses capable of synthesizing high levels of value-added products directly within their stems; and 2) increasing yield efficiency and resiliency in sorghum, energycane and Miscanthus.

Abstract Text:

The University of Illinois at Urbana-Champaign and 17 partner institutions are establishing the Center for Advanced Bioenergy and Bioproducts Innovation (CABBI) for the development of transformative technologies for the economic and sustainable production of fuels and chemicals from plants. This major interdisciplinary research effort is designed to accelerate biofuel and bioproduct development while retaining the flexibility to assimilate new disruptive technologies whatever their source. CABBI is founded on the "plants as factories" paradigm, in which biofuels, bioproducts, and foundation molecules for conversion are synthesized directly in plant stems. It will be built around three highly interconnected DOE priority research areas: Feedstock Development, Conversion, and Sustainability. These three themes each play an essential interconnected role into developing an overall solution to providing sustainable energy solutions for our future.

The growth of a strong bioeconomy requires cropping systems able to produce biomass at sufficient scale, at low cost, and with limited environmental impacts. Currently, biomass value must be created through deconstruction and conversion, which has proven difficult to achieve at a cost competitive with either fossil fuels, corn starch or sugarcane sucrose. In addition, dedicated biomass crops typically have only one major end use (bioenergy), which decreases

market flexibility. The CABBI Feedstock Development theme will directly address these challenges by increasing the value of biomass from best-yielding grasses and the diversity of compounds that can be produced in their stems.

Our targeted research crops are sorghum, energycane, and Miscanthus, which are high-yielding throughout the rain-fed eastern U.S., including on marginal soils. The shared core genome among these crops will facilitate accelerated genetic engineering for trait improvement. A primary objective is to employ an integrated functional genomics approach to increase our knowledge of stem biology in high yielding grasses, which is currently poorly understood, yet critical to the efficient accumulation of favored carbon forms. A discovery engine will be created that integrates comparative genomics, in silico modeling and genetics to efficiently link variation in genes and their expression with improved phenotypic traits.

The Feedstock Theme will harness the power of actionable genomics and systems modeling to develop plants capable of making bioproducts and high-value molecules directly in their stems, including specialized fatty acids for facile conversion to drop-in fuels and a wide variety of bioproducts. We will integrate developmental, metabolic, and cellular knowledge to shift stem carbon away from its default path of deposition as cell walls to the accumulation of other forms that either directly, or through further conversion, add value to biomass.

Carbon redirection lies at the heart of the plants-as-factories approach, and will circumvent the challenges of developing efficient lignocellulose deconstruction methods while still retaining residual biomass for deconstruction by traditional or emerging methods.

Finally, The Feedstock Theme seeks to increase yield efficiency and resiliency through research aimed at discovery and testing of strategies to modulate perenniality, photosynthesis, and efficiencies of nitrogen and water use. Each of these traits is an important contributor to the productivity and sustainability of cropping systems, particularly on marginal land.