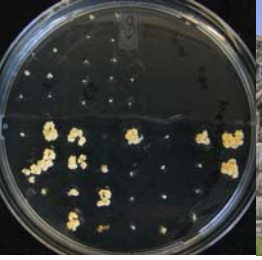

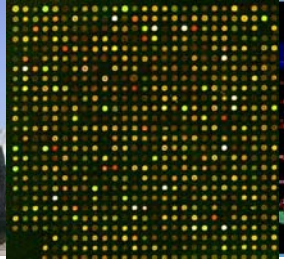
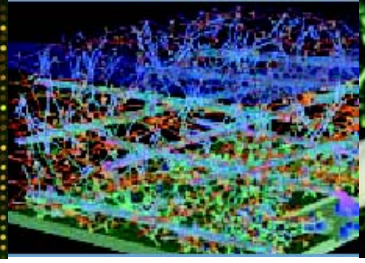

Ag BioEnergy (ABE) Program
USDA Agricultural Research Service
Albany, CA

A research program aimed at the more **efficient conversion of agricultural biomass into bioenergy and biobased coproducts** is underway at the USDA's Agricultural Research Service (ARS) in Albany, CA, in the San Francisco Bay Area. Research efforts are concentrated on feedstock improvement and development of flexible biorefineries.

Improvement of Agricultural Feedstocks

Employ modern molecular, genomic, and biotechnological strategies to **enhance the value of energy crops** and small grain cereals, including the model species *Brachypodium*, as well as of **industrial crops** such as the oilseed Castor, and the rubber-producing guayule. Study molecular genetic processes to develop germplasm with increased biomass and improved characteristics, including modification of the plant cell wall to improve availability and yield of energy-rich components, and biobased products.

Research Highlights

- Published **gene sequences for switchgrass** and led national efforts to sequence expressed genes in switchgrass; sequence data generated will accelerate efforts to breed better varieties of switchgrass
- Developed the new model bioenergy monocot species ***Brachypodium***
- Developed **transformation technology** for switchgrass and *Brachypodium*
- Led efforts to sequence the *Brachypodium* **genome**
- Produced first large-scale **wheat** EST collection (140,000)
- Constructed **GrainGenes database**, an internationally valued resource of molecular and phenotypic information on the small grain cereals
- Employed proteomics approach to study **starch biosynthesis** in wheat and response to environment
- Identified new **maize** lines with altered levels of lignin via EMS and transposon mutagenesis
- Developed new tools to **minimize risk** in genetically engineered crops — novel promoters and recombination tools
- Elucidated oil biosynthesis pathway in **castor** for safe feedstock production for biodiesel in the U.S.
- Used metabolic engineering to improved domestic **rubber-producing crops**

Flexible Biorefineries

Provide technical leadership in capturing the total value of agricultural resources for biofuels and biobased products. Develop **flexible, or 'athletic', biorefining** technologies**,** whereby cellulosic biomass from a variety of local feedstocks is converted to ethanol or other fuels and bioproducts, within a single processing facility, using new enzyme systems and novel separation technologies.

Research Highlights

- Pioneered the idea of **'cold' starch hydrolysis** — the industry standard for dry-grind ethanol plants.
- Identified novel biomass degrading **enzymes**
- Improved biomass degrading enzymes via microbial biotechnology and **directed enzyme evolution**
- Developed flexible township-scale **biorefineries** for straws, grasses, and processing wastes
- Produced novel membranes, solvent extraction/separation, and pervaporation for **ethanol separation**
- Developed **bioproducts,** including nanocomposite and biodegradable packaging
- Investigated **bagasse** from guayule as energy source after extraction of hypoallergenic latex and resin

Researchers and Resources at ARS, Albany, CA

Agricultural bioenergy research at the Albany, CA ARS Location is conducted by 35 Ph.D. level scientists, along with over 100 postdoctoral research associates, graduate students, and technicians, in two co-located ARS Centers, the Western Regional Research Center and the Plant Gene Expression Center.

Specialized Facilities and Equipment

- *Industrial Pilot Plant* — 30,000 ft^2 specialized facility that includes work on an 'athletic biorefinery'
- *Solid state NMR*, other techniques for characterization of cell wall components and biopolymers
- *Fermentation facilities* including an array of fermenters ranging in size to 20 liters
- *Sequencing* — ABI sequencers, robots, Genetix Q-bots, Affymetrix and other microarray equipment
- *Proteomics/mass spec facility* including nano-flow instruments, spot pickers and enzyme digesters
- *Bioinformatics facility* — 4-processor server, 32-node parallel cluster, disc storage, and workstations
- *Microscopy center*, including scanning electron microscope and fluorescent microscopes
- *State of the Art Greenhouses (38,000 ft^2)*, ~100 plant growth chambers, and adjacent 3 acre field plot
- *Access to fields* and researchers at field-oriented ARS locations

Collaborations

- Sixteen active Cooperative Research and Development Agreements (CRADAs) with private firms
- NSF, DOE, USDA-CSREES, NIH grants,over $5 Million, augmenting base funds for research
- Collaborations with UC Berkeley, UC Davis, University of Illinois, and other academic partners
- Lawrence Berkeley National Laboratory, DOE JGI, NREL and other national laboratory partnerships
- USDA-ARS scientists nationwide for resource exchange, plant breeding, and field studies
- International Cooperative Research in EU, Brazil, China, and other nations

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http://www.ars.usda.gov/Main/docs.htm?docid=5819