

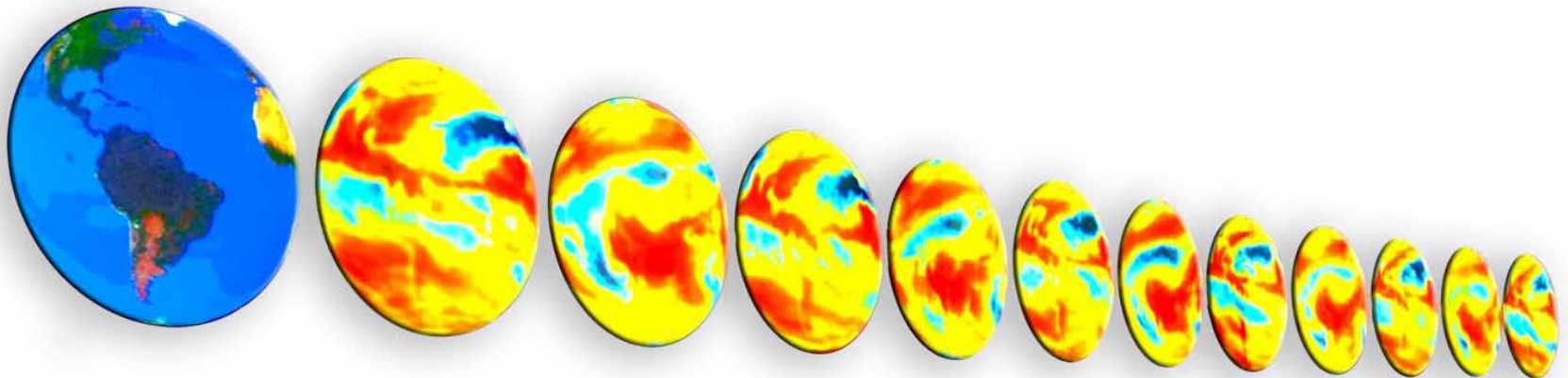
# ***Advanced Feedstock Opportunities***

Biomass Research and Development  
Technical Advisory Committee Meeting  
18 November 2016

Catherine M. Ronning, Ph.D., Program Manager  
DOE Office of Biological and Environmental Research  
Biological Systems Science Division

# DOE Office of Biological and Environmental Research (BER) Approach

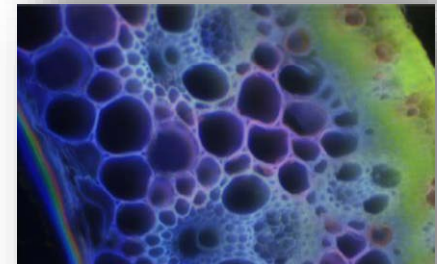
- Understanding complex biological and environmental systems across many spatial and temporal scales:
  - From the sub-micron to the global
  - From individual molecules to ecosystems
  - From nanoseconds to millennia
- Integrating science by tightly coupling theory, observations, experiments, models, and simulations
- Supporting interdisciplinary research to address critical national needs
- Engaging national laboratories, universities, and the private sector to generate the best possible science



# DOE Genomic Science Program Research: Sustainable Bioenergy Production

DOE mission driven fundamental biological research aimed at accelerating the development of clean and sustainable energy solutions:

- Bioenergy Research Centers (BRCs)
- Systems Biology for Bioenergy
- Plant Feedstocks Genomics
- Biosystems Design
- Carbon Cycle/Environmental Microbiology
- Computational Biosciences
- Sustainability Research for Bioenergy



# Research Support Mechanisms

- Bioenergy Research Centers
  - Three large scale, multidisciplinary research centers focused on development of biomass feedstocks, deconstruction of plant material, and synthesis of next generation biofuels
- Genomic Science Program Research Grants
  - Funding opportunities targeting academic institutions for DOE mission driven basic research performed by individual investigators or multidisciplinary teams
- *DOE National Laboratory Science Focus Areas*
  - *Team-oriented, collaborative research programs that take advantage of the unique scientific capabilities and resources of the National Laboratories*

# Bioenergy Research Centers (BRCs) Open Competition (DE-FOA-0001540)



*Sustainability*



*Feedstock  
Development*

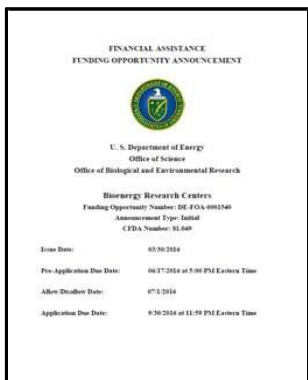


*Biomass  
Deconstruction*

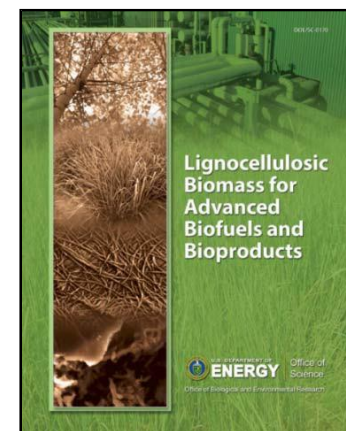


*Conversion  
biofuels & bioproducts*

- Team-based, multi-institutional, cross-disciplinary, integrated systems research centers.
- Total requested budget of \$89 million per year.
- Center annual budgets may range from \$12.5M to \$30M for up to 5 years.
- Open competition for domestic organizations as prime applicant; open to any organization as subawardee.



FOA posted March 30, 2016  
Applications received September 30, 2016





# USDA DOE Plant Feedstock Genomics for Bioenergy

Joint competitive grants program initiated in 2006

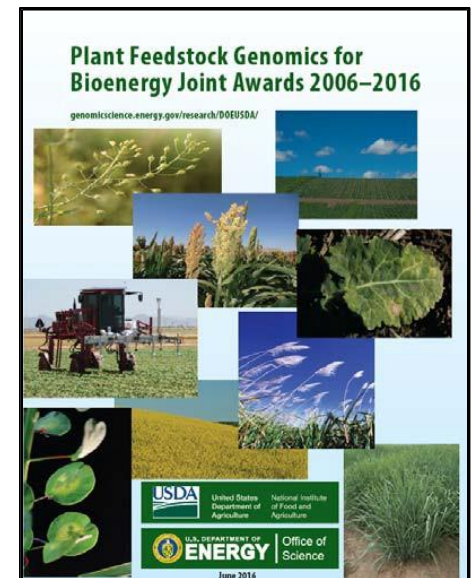
- DOE Office of Science

Office of Biological and Environmental Research

- USDA National Institute of Food and Agriculture (NIFA)

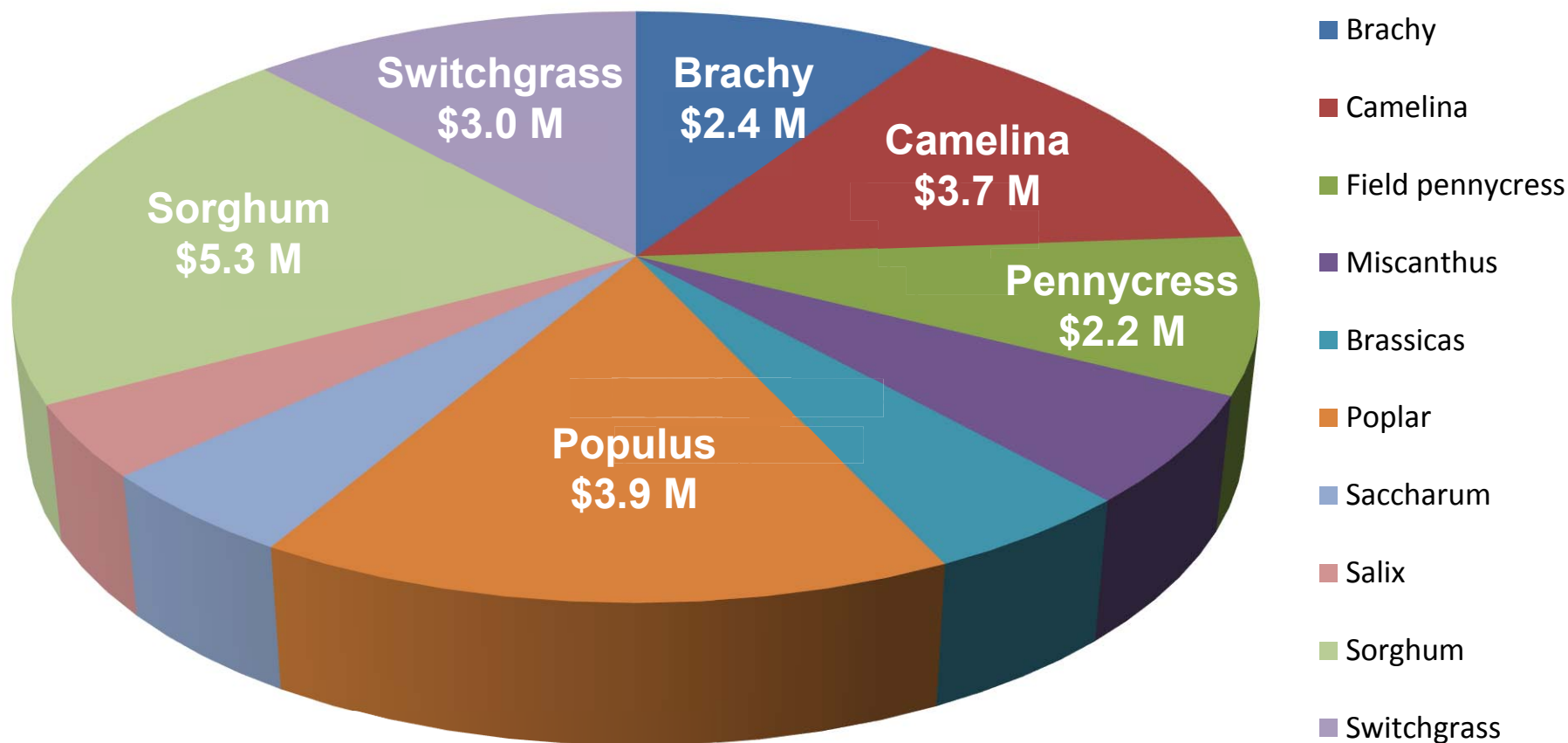
- Goal: Genomics-based research leading to improved use of biomass and plant feedstocks for the production of fuels such as ethanol or renewable chemical feedstocks

**Program Managers:**  
**Cathy Ronning (DOE BER)**  
**Jeff Steiner (USDA NIFA)**



NATIONAL INSTITUTE OF FOOD AND AGRICULTURE  
U.S. DEPARTMENT OF AGRICULTURE

# Plant Feedstocks Program: \$\$ Allocations by Crop (2014-2016)



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science



NATIONAL INSTITUTE OF FOOD AND AGRICULTURE  
U.S. DEPARTMENT OF AGRICULTURE

# ***FY17 Plant Feedstocks Genomics for Bioenergy: USDA, DOE (DE-FOA-0001688)***

Supporting research to investigate and exploit new opportunities for accelerated breeding of dedicated bioenergy and bio-based product feedstocks.

Applications sought:

- 1) Identification and characterization of the molecular mechanisms underlying plant resistance/tolerance to pathogens
- 2) Genomic and genetic research on non-food oilseed feedstock crops.

***FOA issued November 9, 2016***  
***Preapplications due December 7, 2016***  
***Proposals due February 15, 2017***

FINANCIAL ASSISTANCE  
FUNDING OPPORTUNITY ANNOUNCEMENT



U. S. Department of Energy  
Office of Science  
Biological and Environmental Research  
**USDA**

U. S. Department of Agriculture  
National Institute of Food and Agriculture

**Plant Feedstocks Genomics for Bioenergy: A Joint Research  
Funding Opportunity Announcement USDA, DOE**

Funding Opportunity Number: DE-FOA-0001688  
Announcement Type: Initial  
CFDA Number: 81.049 and 10.310

Issue Date:	11/09/2016
Pre-Application Due Date:	12/07/2016 at 5 PM Eastern Time (A Pre-Application is required)
Encourage/Discourage Date:	12/21/2016 at 5 PM Eastern Time
Application Due Date:	02/15/2017 at 11:59 PM Eastern Time



# ***Systems Biology Research to Advance Sustainable Bioenergy Crop Development***

*(DE-FOA-0001207, Awards made in FY15)*

Research to enable the integrated development of sustainable bioenergy feedstock systems in terrestrial environments within the ecosystem context:

- Development of integrative physiology-based models to understand the plant-soil-microbiome ecosystem and identify key parameters of bioenergy plant sustainability
- Incorporation of key variables to enable quantitative, accurate prediction of plant performance and ecosystem processes under changing environments.

FINANCIAL ASSISTANCE  
FUNDING OPPORTUNITY ANNOUNCEMENT



U. S. Department of Energy  
Office of Science  
Office of Biological and Environmental Research

**Systems Biology Research to Advance Sustainable Bioenergy  
Crop Development**

Funding Opportunity Number: DE-FOA-0001207  
Announcement Type: Initial  
CFDA Number: 81.049

Issue Date:	10/01/2014
Pre-Application Due Date:	11/14/2014 at 5 PM Eastern Time (A Pre-Application is required)
Encourage/Discourage Date:	11/28/2014
Application Due Date:	01/16/2015 at 11:59 PM Eastern Time

# ***Sustainable Bioenergy Crop Development***

## **FOA Objectives:**

1. Investigate molecular and physiological mechanisms controlling bioenergy crop vigor, resource use efficiency, and adaptability to abiotic stress, to increase biomass productivity under changing and at times suboptimal conditions
2. Investigate role(s) of microbial and microbial communities in plant-soil-environment interactions, bioenergy feedstock plant performance, adaptation, and resilience under changing environmental conditions and abiotic stressors

**Program Manager: Cathy Ronning**



# ***Sustainable Bioenergy Crop Development***

**Six awards totaling \$66.4M (FY15-19)**

- **Gloria Coruzzi, NYU**, “EvoNet: A Phylogenomic and Systems Biology Approach to Identify Genes Underlying Plant Survival in Marginal, Low-Nitrogen Soils”
- **Sarah Evans, Michigan State U**, “Connecting Nitrogen Transformations Mediated by the Rhizosphere Microbiome to Perennial Cropping System Productivity in Marginal Lands”
- **Mary Firestone, UC Berkeley**, “Establishment to Senescence: Plant Microbe and Microbe-Microbe Interactions Mediate Switchgrass Sustainability”
- **Tom Juenger, U Texas Austin**, “Climate Adaptation and Sustainability in Switchgrass: Exploring Plant-Microbe-Soil Interactions Across Continental-Scale Environmental Gradients”
- **Peggy Lemaux, UC Berkeley**, “Epigenetic Control of Drought Response in Sorghum (EPICON)”
- **Daniel Schachtman, U Nebraska**, “Systems Analysis of the Physiological and Molecular Mechanisms of Sorghum Nitrogen Use Efficiency, Water Use Efficiency, and Interactions with the Soil Microbiome”

# Biosystems Design

*Systems biology research applications focused on the design of new plant and microbial systems for bioenergy production*

## *FY12 Awards “Plant systems design for bioenergy”*

- **Clint Chapple**, Purdue U  
*Modeling and manipulating phenylpropanoid pathway flux for bioenergy*
- **Thomas Brutnell**, Danforth Plant Science Center  
*A systems-level analysis of drought and density response in the model C4 grass *Setaria viridis**
- **John Cushman**, U Nevada Reno  
*Engineering CAM photosynthetic machinery into bioenergy crops for biofuels production in marginal environments*
- **Eduardo Blumwald**, UC Davis  
*Expanding the breeder’s toolbox for perennial grasses*



**Program Manager: Pablo Rabinowicz**

# FY17 *Biosystems Design to Enable Next-Generation Biofuels and Bioproducts*

## (DE-FOA-0001650)

Supports research on design of new biological systems that address challenges associated with the production of biofuels and related coproducts from renewable resources.

Applications sought:

- 1) Model, design, and engineer microbial systems for the production of biofuels and bioproducts;
- 2) **Plant systems design for bioenergy:** Develop novel technologies for genome-scale engineering to re-design bioenergy crops that can grown in marginal environments and produce high biomass yields that be easily converted to biofuels and bioproducts.

***FOA issued October 12, 2016***

***Preapplications due December 19, 2016***

***Proposals due March 20, 2017***

FINANCIAL ASSISTANCE  
FUNDING OPPORTUNITY ANNOUNCEMENT



U. S. Department of Energy  
Office of Science  
Biological and Environmental Research

Biosystems Design to Enable Next-Generation Biofuels and  
Bioproducts

Funding Opportunity Number: DE-FOA-0001650  
Announcement Type: Initial  
CFDA Number: 81.049

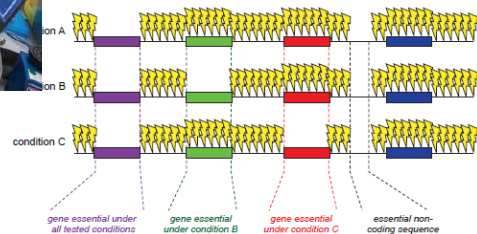
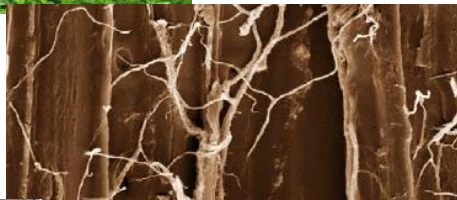
Issue Date:	10/12/2016
Pre-Application Due Date:	12/19/2016 at 5 PM Eastern Time
Encourage/Disencourage Date:	01/06/2017 at 5 PM Eastern Time
Application Due Date:	03/20/2017 at 11:59 PM Eastern Time



# DOE Joint Genome Institute (JGI)

**Mission:** *To enable advances in energy and environmental science by providing access to state-of-the-art genomic capabilities in support of the US Department of Energy's national research agenda*

**Vision:** To evolve into a next-generation genome science user facility developing and applying genomics capabilities in support of solving the most pressing worldwide energy and environment challenges

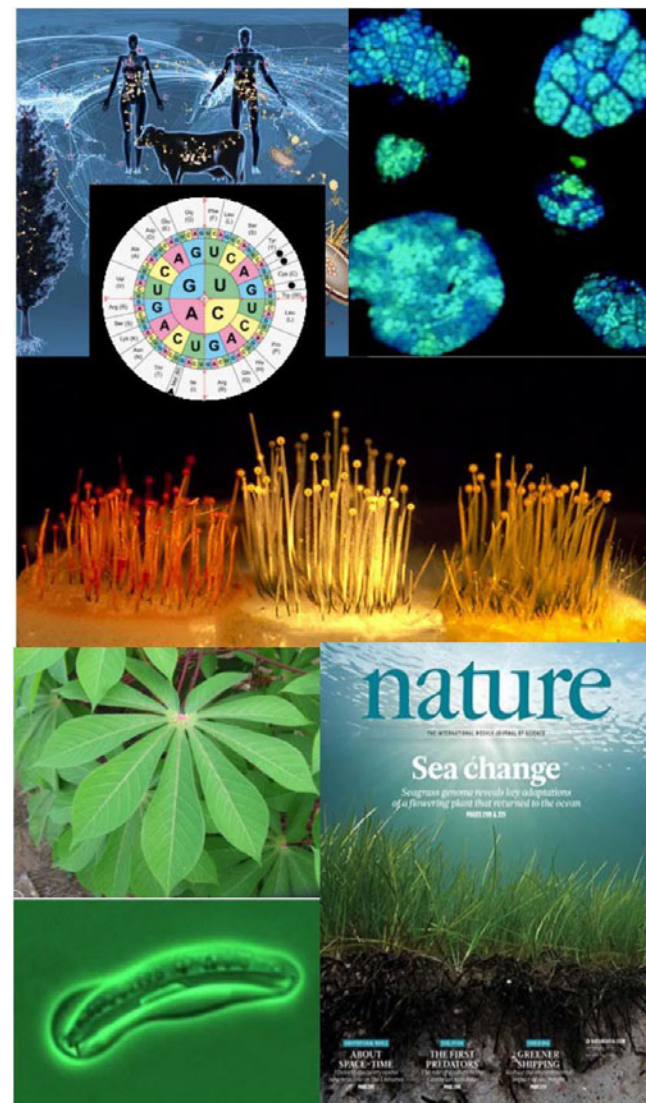


## Community Science Program (CSP) Annual Call:

Large-scale sequence-based genomic science projects that address DOE missions in sustainable biofuel production, global carbon cycling, and biogeochemistry.

### ***Plant functional genomics:***

- Gene Atlas and ENCODE-like projects
- Large scale germplasm resequencing
- High quality or comparative grade *de novo* genomes
- Plant microbiomes



**CSP FY17 (status: CLOSED)**

## JGI CSP FY17 awarded projects include:

- **Karen Aitken, CSIRO (Australia)**, “Understanding polyploidy through the generation of the first sugarcane genome sequence”
- **Joerg Bohlmann, U British Columbia (Canada)**, “Exploring the G3 “Gymnosperm Giga-Genomes” for Carbon Sequestration, Biofuels, and Bioproducts”
- **Devin Coleman-Derr, USDA ARS**, “Exploring the role of drought-induced plant associated microbes in promoting plant fitness in *Sorghum bicolor* and *Oryza sativa*”
- **David Des Marais, Harvard U**, “Perenniality, abiotic stress tolerance, and biomass allocation in *Brachypodium*, a model grass genus for bioenergy”
- **Sharon Doty, U Washington**, “Functional genomics of poplar endophytes for elucidation of mechanisms of improved plant growth under challenging conditions”
- **Jared LeBoldus, Oregon St U**, “RNAseq enabled metabolic modeling of disease resistance to Septoria canker in the DOE flagship *P. trichocarpa*”
- **Todd Mockler, Danforth Center**, “A Complete-Sequence Population for Pan-Genome Analysis of *Sorghum*”
- **Christine Smart, Cornell U**, “Genetic diversity of shrub willow pathogen *Melampsora americana* aided by genome sequence”

## Facilities Integrating Collaborations for User Science (FICUS):

Collaboration between DOE Joint Genome Institute (JGI) and Environmental Molecular Science Laboratory (EMSL)

- Opportunity to utilize the unique capabilities at each facility in one research project in support of DOE's energy, environment and basic research missions
- High risk/high payoff

Topic areas for 2017:

- Biofuels and bioproducts
- Plant-microbe interactions in the context of climate change
- Biogeochemistry of select inorganic elements of interest to BER

**FY17 JGI-EMSL Collaborative Science Call (status: CLOSED)**

## Biomass-related FICUS awards:

### FY16:

- **Sharon Doty, U Washington**, “Nitrogen fixation in *Populus*: Identification and localization of the key diazotrophs in planta”
- **Chongle Pan, ORNL**, “Integrated Omics Analyses of a *Populus* Pedigree for Crop Improvement”

### FY17:

- **Laura Bartley, U Oklahoma**, “Systems analysis of grass secondary cell wall development and regulation for biofuel production”





# Office of Science Early Career Research Program

Supports the development of individual research programs of outstanding scientists early in their careers and stimulates research careers in the disciplines supported by the DOE Office of Science.

## Eligibility:

- Within 10 years of having received Ph.D.
- Either untenured assistant or associate professor on tenure track, or full-time, nonpostdoctoral permanent DOE national lab employee
- Employed by either a US academic institution or a DOE national lab.

# Office of Science Early Career Research Program: *Plant-focused BER awards*

## **Fiscal year 2013 “*Systems Biology and Biosystems Design for Bioenergy Production by Novel Platform Organisms*”:**

- Extreme expression of cellulases in poplar (PI: Heather D. Coleman, Syracuse University, NY)
- Developing synthetic biology tools to engineer plant root system and improve biomass yield and carbon sequestration (Dominique Loque, Lawrence Berkeley National Laboratory)

## **Fiscal year 2016 “*Systems biology-enabled research on the role of microbes and microbial communities in the plant-soil-environment interactions*”:**

- Molecular interactions of the plant-soil-microbe continuum of bioenergy ecosystems (Kirsten Hofmockel, Pacific Northwest National Laboratory)
- Does mycorrhizal symbiosis determine the climate niche for Populus as a bioenergy feedstock? (Kabir Peay, Stanford University, CA)
- Spatially resolved rhizosphere function: Elucidating key controls on nutrient interactions (James Moran, Pacific Northwest National Laboratory)
- Adaptive evolution of membrane-bound receptors mediating host-symbiont specificity in the genus *Salix* (Wellington Muchero, Oak Ridge National Laboratory)

# DOE Office of Science

## Graduate Student Research (SCGSR) Program

Provides supplemental awards to outstanding graduate students to spend 3 to 12 months conducting part of their doctoral thesis/dissertation research at a DOE national laboratory in collaboration with a DOE laboratory scientist.

### Priority Research Area for DOE BER: Plant Science for Sustainable Bioenergy

- Genomic research seeking improved bioenergy crop characteristics such as high biomass yields, modified cell walls, and optimized growth and development. Research is also encouraged to further understanding of molecular mechanisms underlying traits that increase sustainable production of such crops, such as nitrogen/water use efficiency and drought tolerance.

**2016 Solicitation 2 – Applications Due: November 21, 2016**





***Thank you!  
Questions?***

**<http://science.energy.gov/ber/>**