FINAL REPORT

Support for the 4th Pan-American Congress on Plants and Bioenergy

DOE Award No.: DE-SC0011783

Applicant/Institution: Purdue University

Principal Investigator: Nicholas C. Carpita
Dept. Botany & Plant Pathology
915 West State Street
Purdue University
West Lafayette, IN 47907-2054
Tel.: 765-494-4653
FAX: 765-494-0363
E-mail: carpita@purdue.edu

DOE/Office of Science Program Office:
http://science.energy.gov/~/media/grants/pdf/foas/2014/SC_FOA_0000995.pdf

(3) Biological and Environmental Research
(a) Biological systems Science

DOE/Office of Science Program Technical Program Contact:
Dr. Catherine Ronning
Tel.: 301-903-9549
FAX: 301-903-0567
E-mail: catherine.ronning@science.doe.gov

Through joint support of the Office of Science's Basic Energy Sciences and Biological and Environmental Research, the 4th Pan-American Congress on Plants and Bioenergy was held at the University of Guelph, Canada, June 4-7, 2014. Rowan Sage (University of Toronto), Marcos Buckeridge (University of São Paulo), and Nicholas Carpita (Purdue University) served as the International Organizing Committee for this congress. A steering committee comprised representatives of the major bioenergy research centers in Brasil, Canada, and the United States. Each of the steering committee members provided input to the sessions and composition of the final program (see Appendix I).

Dan Cosgrove, Penn State (CLSF)
Bill Deen, University of Guelph
Richard Dixon, University of North Texas (BESC)
Udaya Kalluri, Oak Ridge National Lab (BESC)
Ken Keegstra, Michigan State University (GLBRC)
Shawn Mansfield, University of British Columbia
Maureen McCann, Purdue University (C3Bio)
Markus Pauly, University of California-Berkeley (EBI)
Richard Sayre, Los Alamos National Lab (New Mexico Consortium)
Henrik Scheller, University of California-Berkeley (JBEI)
Marie-Anne Van Sluys, University of São Paulo (Bioen)

All of the funds were directed to support participation by graduate students, post-doctorals, and pre-tenured faculty and equivalent staff scientists. Registration costs ($595) included all meals during the meeting as part of the program. There were no other options for meals. Housing costs will be $400 for the four days of the congress. We were able to award all 25 U.S. applicants of stipends of $995 each to cover these costs to young scientists, based on abstracts submitted before the meeting, to present a contributed lecture or poster presentation. An opportunity was made for selected posters by students and post-docs to be delivered as short oral presentations during one of the poster session time slots. The remaining funds were used to support U.S. invited speakers who expressed a need for support.

About 125 attended the congress, with 79 submitting abstracts for consideration as oral or poster presentations. The meeting and the provisions for young scientist support were advertised through the American Society of Plant Biologists (ASPB) in their newsletters and the website, which reached more than 5,000 members worldwide. In addition, we have contacted the relevant committees (Minority Affairs Committee [MAC] and Women in Plant Biology Committee) of the American Society of Plant Biologists to seek likely women and minority candidates who might be interested in this meeting. The ASPB MAC routinely reviews more than 100 applications for travel support to the annual meeting, and we coordinated with them to identify relevant students and abstracts. An African-American graduate student, Simara Price, was provided a stipend. Among the 25 awardees were ten female

scientists (See Appendix II). All DOE funding received went towards stipends. ASPB hosted both the abstract submission site and the travel stipend site, and the executive committee awarded stipends based on electronic exchange. Additional students from Brasil and Canada were awarded stipends through their respective national agencies or from additional private support.

A proposal was made by the *Journal of Experimental Botany* to support the meeting through invitations to speakers and students to submit reviews and primary research articles in a special issue named "Plants and Bioenergy". Six of the articles were by young scientists, for which the joint support by BES and BER was acknowledged. I also acknowledge the support in our preface article.

4th Pan-American Congress on Plants and Bioenergy
University of Guelph Conference Center
June 4-7, 2014

CSPB/SCBV

Final Program
and
Abstract Book

MEETING ORGANIZERS

The program for 4TH Pan-American Congress on Plants and BioEnergy was organized:

International Organizing Representatives:
Rowan Sage, University of Toronto
Marcos Buckeridge, University of São Paulo
Nicholas Carpita, Purdue University

The steering committee:
Dan Cosgrove, Penn State (CLSF)
Bill Deen, University of Guelph
Richard Dixon, University of North Texas (BESC)
Udaya Kalluri, Oak Ridge National Lab (BESC)
Ken Keegstra, Michigan State University (GLBRC)
Shawn Mansfield, University of British Columbia
Maureen McCann, Purdue University (C3Bio)
Markus Pauly, University of California-Berkeley (EBI)
Richard Sayre, Los Alamos National Lab (New Mexico Consortium)
Henrik Scheller, University of California-Berkeley (JBEI)
Marie-Anne Van Sluys, University of São Paulo (Bioen)

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We thank our many sponsors for their support of the congress. Please visit their exhibits during breaks!

We are especially grateful to the U.S. Department of Energy, Office of Science, Basic Energy Sciences and Biological and Environmental Sciences, whose support made possible 25 travel stipends for young scientists to attend this meeting.

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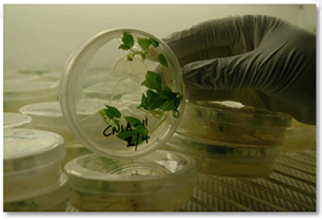
Biofuels at Los Alamos National Laboratory

- **Biofuels Research Areas**
  - Algae: Systems Biology, Biotechnology, Harvesting and Lipid Extraction
  - Cellulosics: Biomass Conversion, Cellulose Structure and Pre-treatment, Cellulase optimization
  - Fuel Conversion
  - Water and Nutrient Management
  - Crop Science and Technology



- **Partnerships for Success**

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NAABB National Alliance For Advanced Biofuels and Bio-products
NABC National Advanced Biofuels Consortium — Biofuels for Advancing America

DOE-SC Consortia

Energy Frontier Research Centers

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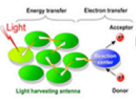

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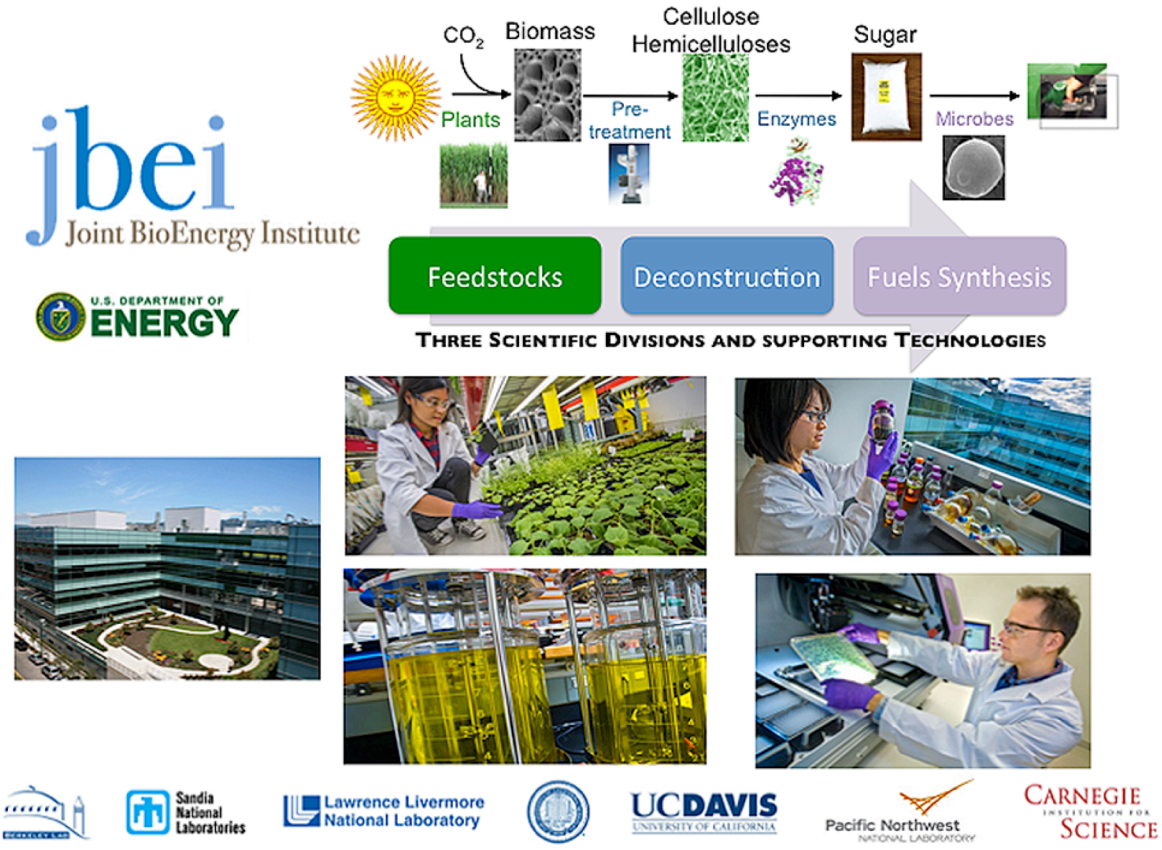
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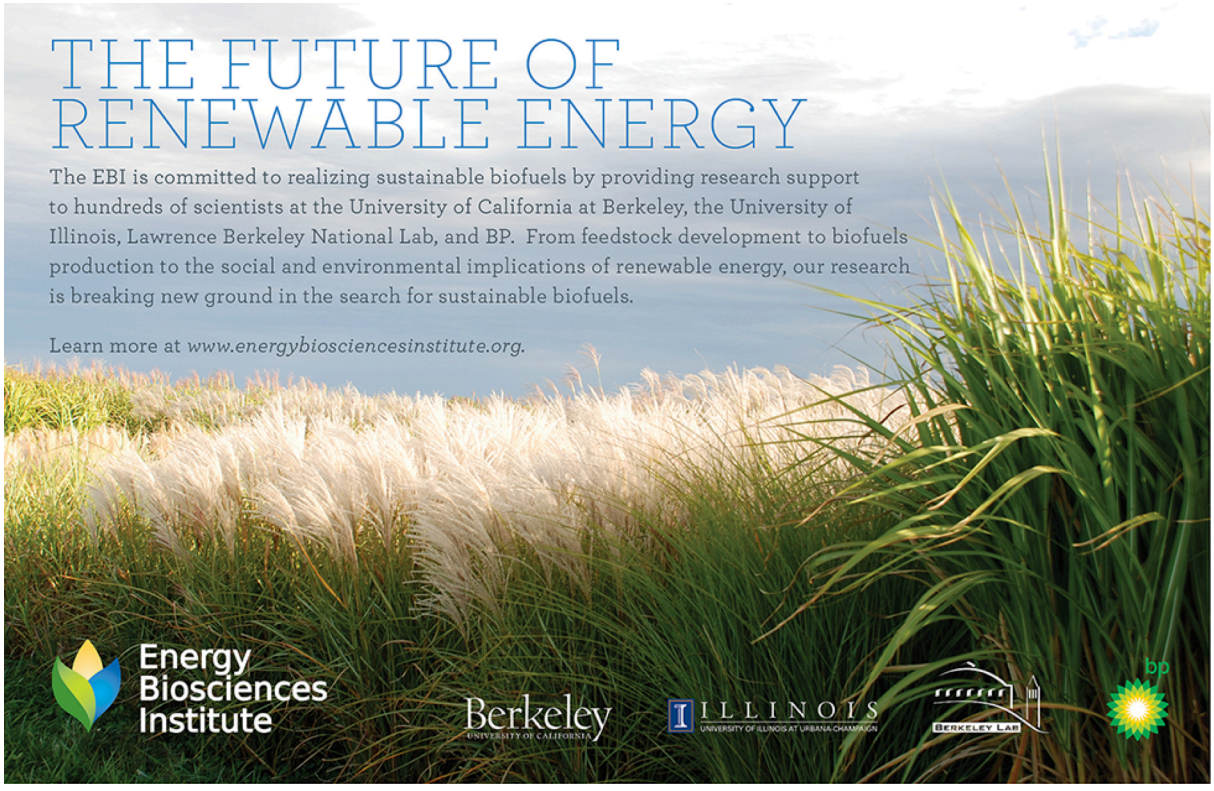
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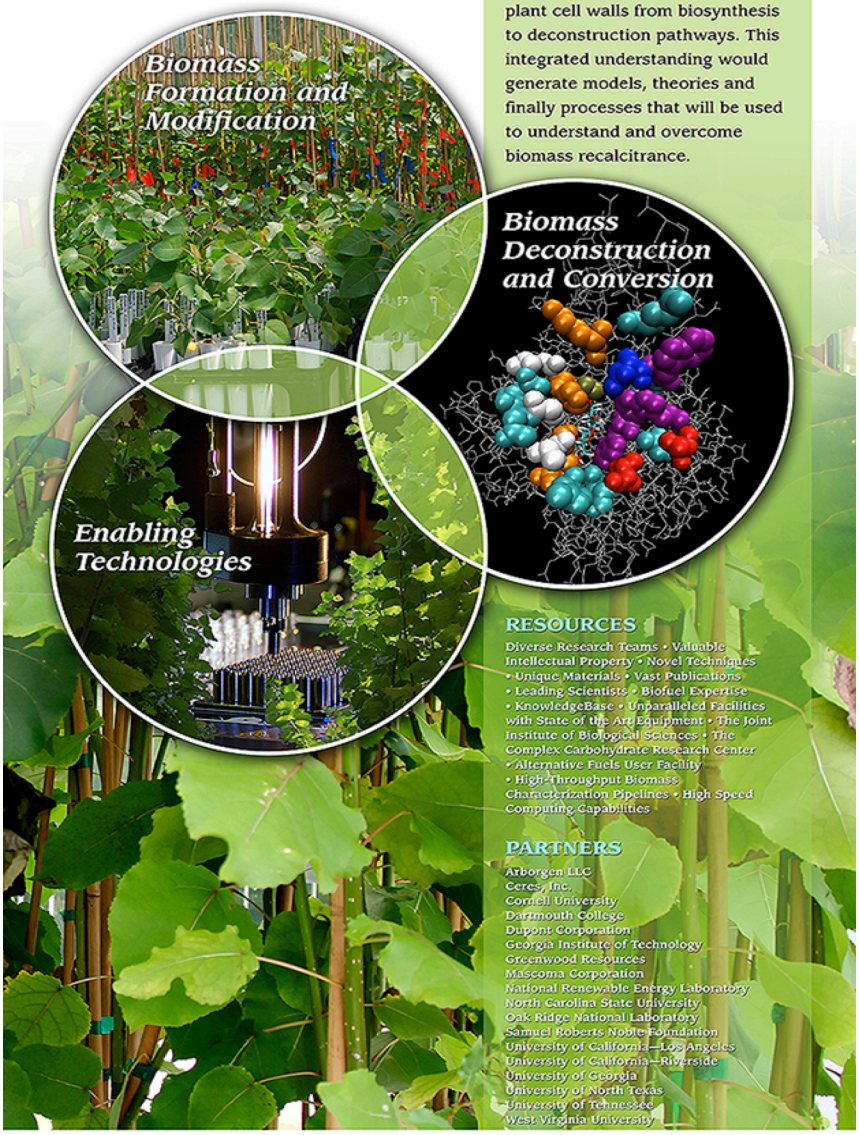
Redefining the Frontiers of Bioenergy

BESC's approach to improve accessibility to the sugars within biomass involves 1) designing plant cell walls for rapid deconstruction and 2) developing multitalented microbes for converting plant biomass into biofuels in a single step (consolidated bioprocessing). Addressing the roadblock of biomass recalcitrance will require a multiscale understanding of plant cell walls from biosynthesis to deconstruction pathways. This integrated understanding would generate models, theories and finally processes that will be used to understand and overcome biomass recalcitrance.



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DOE Bioenergy Research Centers

The Center for Direct Catalytic Conversion of Biomass to Biofuels

In 2009, the Department of Energy established pioneering Energy Frontier Research Centers to address grand challenges in basic energy science. C3Bio develops transformational knowledge and technologies to directly convert non-grain plant biomass to "drop-in" biofuels, closely resembling oil–based fuels. The research integrates a large interdisciplinary team of plant biologists, chemists and chemical engineers to study interactions between catalysts and plant cell walls at the molecular level, designing improved chemical reactions and biomass tailored for the biomass-to-biofuels pipeline. C3Bio researchers explore plant genetics, new chemical catalysts, thermal treatments, and analytical, imaging and computational technologies toward expanding the range of biofuels beyond ethanol to advanced liquid hydrocarbons.

Impacts

- Maximizing carbon efficiency and utilizing any type of plant material minimizes the land area required for biomass production
- Advanced drop-in hydrocarbon biofuels utilize the existing infrastructure
- High-value co-products improve the economics of fuel production

Key discoveries

- New knowledge of molecular interactions in assembly of biomass molecules,
- Unique biomass variants engineered for conversion using synthetic biology approaches,
- Computational modeling of cellulose microfibrils with geometries obtained directly from fitted experimental data,
- Integration of imaging platforms across a range of scales,
- Mass spectrometry for characterization of complex product mixtures,

- Mechanistic understanding of biomass conversion through chemical catalysts,
- Novel catalytic transformations that enable consolidated conversion of biomass to hydrocarbon fuels and low molecular weight aromatics,
- Molecular level understanding of biomass conversion under fast hydropyrolysis in real time,
- Integrated systems engineering to maximize carbon efficiency.

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Contact chuettem@purdue.edu

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Center for Lignocellulose Structure & Formation

U.S. DEPARTMENT OF ENERGY

CLSF

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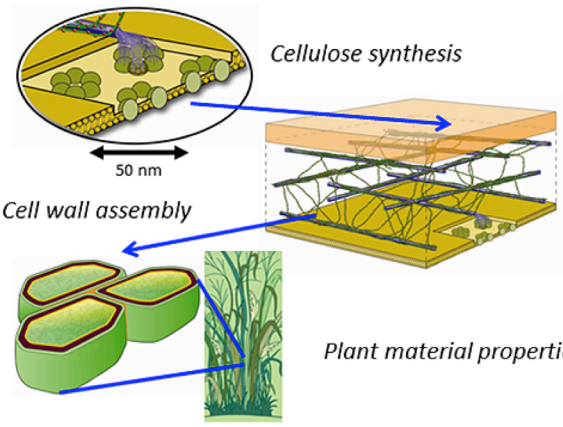

Mission: to develop a nano-scale understanding of the structure and formation of lignocellulose, the main structural material in plants, forming a foundation for significant advances in sustainable energy and materials.

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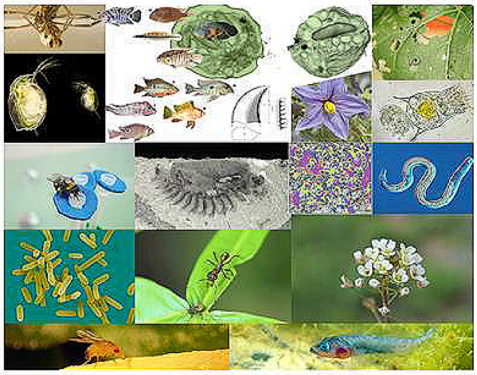

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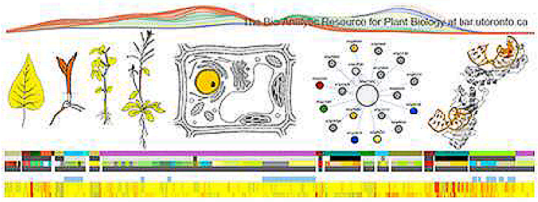

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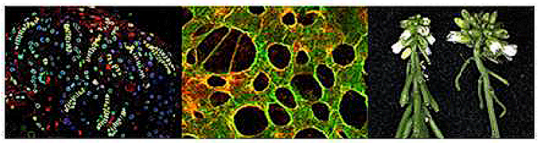

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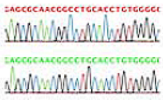
Genomics



Next generation sequencing
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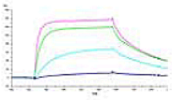
Microbiome & metagenomics

Proteomics



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Protein-ligand interactions
Post-translational modification

Bioinformatics

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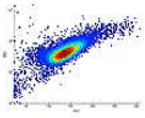
And more...



Chemical genomics
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Special issue
Plants & Bioenergy
Journal of Experimental Botany
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Plants & Bioenergy Special Issue
Editors: Rowan Sage & Nicholas Carpita
Drought stress in sugarcane Marcelo Menossi*1 and Helaine Carrer2
Sugarcane genomics Marie-Anne Van Sluys*
Development of bioenergy feedstocks for semi-arid and arid lands John Cushman*
A new twist on cellulose fibrils Lee Makowski*
Transcriptional regulation of wood formation in plants Zheng-Hua Ye*
Changes in cell wall structure, deconstruction, microscopy and modeling Bryon S. Donohoe*, Michael Crowley
Genetic localization of bioenergy related traits in sweet sorghum Lekgari A. L. and I. Dweikat*
Identification of QTLs and associated candidate genes for nitrogen use efficiency traits in sorghum Malleswari Gelli1, Sharon E. Mitchell4, Jianming Yu5, Thomas E. Clemente1,3, Donald P. Weeks2,3, David R. Holding1,3, Ismail M. Dweikat1*
TBA Marcos Buckeridge*
C4 Bioenergy Crops for Cold Climates Rowan Sage*
Novel transcriptional factors impacting lignin abundance and digestibility in maize Nicholas C. Carpita1, Maureen C. McCann2

Congress Program

Wednesday, June 4

4:30 PM	8:30 PM	**Registration Open**
6:30 PM	7:30 PM	**Evening Arrival and Reception**
7:30 PM	8:00 PM	**Opening remarks**: Rowan Sage, Marcos Buckeridge, Nick Carpita
8:00 PM		**Opening Keynote Lecture:** Chair: Shawn Mansfield, University of British Columbia Jack Saddler, University of British Columbia, *The Biorefining Story: Progress in the evolution of the forest products industry to a forest-based biorefining sector*

Thursday, June 5

8:00 AM	9:40 AM	**Genetic ddvances in algal and plant systems for bioenergy I** Chair: Marcos Buckeridge
		8:00: Richard Sayre, Los Alamos National Lab, *Engineering light capture, conversion and energy storage in algae and plants for increased biomass yield*
		8:25: Ed Cahoon, University of Nebraska-Lincoln, *Biotechnological development of oil-based advanced biofuels*
		8:50: Gerald Tuskan, Oak Ridge National Lab/BESC, *Rich genomics resources facilitate progress in understanding wood formation*
		9:15: Shawn Mansfield, University of British Columbia, *Next-generation bioenergy feedstocks: genomic strategies for improving poplar*
9:40 AM	10:10 AM	**Coffee Break**
10:10 AM	12:15 PM	**Genetic advances in algal and plant systems for bioenergy II** Chair: Shawn Mansfield
		10:10: Christian Tobias, USDA, Western Regional Research Center, *Switchgrass Biotechnology: Let's make it easier*
		10:35: Ismail Dweikat, University of Nebraska-Lincoln, *Sorghum: One of the most efficient species for bioenergy production*
		11:00: John Mullet, Texas A&M University, *Energy Sorghum: A genetic model for designing C4 grass energy crops*
		11:25: Marcelo Menossi, University of Campinas*, Improvement of sugarcane for drought stress tolerance*
		11:40: Marcos Buckeridge, University of São Paulo, *Using plant biological mechanisms to decrease cell wall recalcitrance for applications in bioenergy*
12:15 PM	1:30 PM	**Lunch**
1:30 PM	1:55 PM	Marie Anne van Sluys, University of São Paulo, *Strategies for interpreting the sugarcane polyploid genome*
1:55 PM	2:20 PM	Helaine Carrer, University São of Paulo, *Bioengineering sugarcane for bioenergy*
2:20 PM	2:45 PM	Tom Brutnell, Donald Danforth Center, *Setaria viridis as a model system for C4 grasses*
2:45 PM	3:15 PM	**Tea**

3:15 PM	5:00 PM	**Biomass structure and behavior during bioprocessing** Chair: Marie-Anne van Sluys
		3:15: Lee Makowski, Northeastern University/C3Bio*, Structure of cellulose and cellulose synthases*
		3:40: Dan Cosgrove, Penn State University/CSLF, *β-Expansins dissolve the middle lamella of grass cell walls*
		4:05: John Ralph, University of Wisconsin/GLBRC, *Designing plant cell walls for deconstruction: using monolignol ferulate conjugates to introduce ester bonds into the lignin backbone*
		4:30: Rick Dixon, University of North Texas/BESC, *Novel lignins and the case for valorization of lignin in the biorefinery*
5:00 PM	7:00 PM	**Posters I, Open bar at 6pm**
7:00 PM		**Dinner** **Featured Keynote Lecture**: Chair: Marcos Buckeridge, University of São Paulo Gonçalo Guimarães Pereira, GranBio Celere, Brasil, *Energy Cane: Growing Petroleum*

Friday, June 6

8:00 AM	9:40 AM	**Genetic Improvement of Bioenergy Crops** Chair: Henrik Scheller
		8:00: Zheng-Hua Ye, University of Georgia, *Complexity of the transcriptional network controlling secondary wall biosynthesis*
		8:25: Henrik V. Scheller, Lawrence Berkeley National Lab/JBEI*, Gene discovery for biosynthesis of matrix polysaccharides*
		8:50: Federica Brandizzi, Michigan State University/GLBRC, *Discovery of novel genes enabling and regulating polysaccharide biosynthesis in the plant cell wall*
		9:15: Lacey Samuels, University of British Columbia, *Mechanisms of developmental lignin deposition.*
9:40 AM	10:00 AM	**Coffee Break**
10:00 AM	12:15 PM	**Strategies for 3rd generation production of biofuels and bio-based products** Chair: Nick Carpita
		10:00: Michelle Chang, UC-Berkeley, *Constructing synthetic pathways for advanced biofuel production*
		10:25: Joseph Bozell, University of Tennessee/C3Bio, *Catalytic oxidation of organosolv lignin: Structural and computational analysis for improved catalyst design*
		10:50: Maureen McCann, Purdue/C3Bio, *Dissecting cell wall architecture with catalysts: Insights gained from application of chemical conversion technologies to lignocellulosic biomass*
		11:15: Bryon Donohoe, National Renewable Energy Lab/C3Bio*, Multi-scale imaging of changing cell wall architecture during biomass deconstruction*
		11:40: Wilfred Vermerris, University of Florida, *Enhancing sweet sorghum for the environmentally and economically sustainable production of fuels and chemicals*
12:15 PM	1:30 PM	**Lunch**

1:30 PM	3:30 PM	**Afternoon Sessions of short talks selected from abstracts** **Biomass**
		B1. Biomass Structure and Synthesis I Chair: Markus Pauly, UC-Berkeley/EBI **1:30:** Markus Pauly, UC-Berkeley/EBI, *Characterization of Cal-1, a high glucan maize mutant with enhanced properties for biofuel production* **1:50:** Paul D. Hussey, Lawrence Berkeley National Lab/JBEI, *Arabidopsis GUX proteins catalyze glucuronic acid substitution with distinct patterns on xylo-oligomers* **2:10:** Debra Mohnen, Complex Carbohydrate Research Center, *Down regulation of a matrix polysaccharide biosynthetic gene in Populus leads to reduced recalcitrance and increased plant growth* **2:30:** Michael G. Hahn, Complex Carbohydrate Research Center, *S-Lignin-directed monoclonal antibodies as probes for studies of lignin structure, deposition, and dynamics* **2:50:** Charles T. Anderson, Penn State University/CSLF, *Seeing through walls: Molecular imaging of lignification in plants* **3:10:** Candace H. Haigler, North Carolina State University/CLSF, *Cellulose synthase structure and function viewed through the lens of freeze fracture transmission electron microscopy and computational methods*
		B2. Genetic Improvement of Plant Biomass I Chair: Udaya Kalluri, Oak Rdige National Lab/BESC **1:30:** Christine Shyu, Donald Danforth Plant Science Center, *Setaria viridis as a model system to study jasmonate signaling in bioenergy grasses* **1:50:** Laura E. Bartley, University of Oklahoma, *Gene expression vs. cell wall composition correlations vary among switchgrass genotypes* **2:10:** Annie Claessens, Agriculture and Agri-Food Canada, *Genetic variability and potential of switchgrass as feedstock for the bioindustry in eastern Canada* **2:30:** Simara Price, University of Pennsylvania, *SHORT-ROOT (SHR) interacting proteins conferring C_4 Kranz anatomy in maize* **2:50:** George Chuck, USDA/Plant Gene Expression Center, *Overexpression of the Cg1 microRNA gene improves the biofuel properties of multiple crop plants* **3:10:** John Sedbrook, Illinois State University/GLBRC, *Phenylalanine ammonia lyase reduction in Brachypodium distachyon alters cell wall composition and fungi susceptibilities while minimally affecting caterpillar herbivory and abiotic stress tolerances*
		B3. Environmental Impacts of Bioenergy Crops I Chair: Marcos Buckeridge, University of São Paulo **1:30:** Danielle A. Way, University of Western Ontario, *Growth and physiological responses of isohydric and anisohydric poplars to drought* **1:50:** Chuansheng Mei, Institute for Advanced Learning and Research, B*eneficial bacterial endophytes enhance switchgrass performance in fields with different fertility and their molecular mechanisms*

		2:10: Vijaya Gopal Kakani, Oklahoma State University, *Ecosystem level responses of dedicated bioenergy feedstocks* **2:30:** Sharon L Doty, University of Washington-Seattle, *Increasing biomass with reduced inputs using symbiosis* **2:50:** Emily Kuzmick, Ohio University, *Potential for Agave americana as a bioenergy feedstock with low water requirements in arid regions* **3:10:** Amanda P. de Souza, University of São Paulo, *Starch is central to metabolism in sugarcane, a sucrose accumulating bioenergy crop*
3:30 PM	4:00 PM	**Tea**
4:00 PM	5:40 PM	**Afternoon Sessions of short talks selected from abstracts Biomass**
4:00 PM 5:45 PM	5:40 PM 7:00 PM	**B1. Biomass Structure and Synthesis II** Chair: Markus Pauly **4:00:** Raja S Payyavula, Oak Ridge National Lab/BESC, *KORRIGAN-like genes are important in cellulose biosynthesis and carbon allocation and partitioning in Populus* **4:20:** Jonathan K. Davis, North Carolina State University/CSLF, *Site-directed spin-labeling EPR to probe the topology and structure of plant cellulose synthase transmembrane domains* **4:40:** Erin Slabaugh, North Carolina State University/CLSF, *Computational and genetic evidence that different structural conformations of a non-catalytic region affect the function of plant cellulose synthase* **5:00:** Phillip Rushton, Purdue University/ C3Bio, *Small-angle x-ray scattering reveals the structure of the catalytic domain of a plant cellulose synthase and its assembly into dimers* **5:20** Jonathan S. Griffiths, University of British Columbia, *Arabidopsis seed coat epidermal cells as a model system to study cellulose biosynthesis*
		B2. Genetic Improvement of Plant Biomass II Chair: Udaya Kalluri **4:00:** Annick Bertrand, Agriculture and Agri-Food Canada, *Recurrent selection for improved saccharification efficiency in alfalfa and switchgrass* **4:20:** Kevin M Dorn, University of Minnesota, *Genomics and domestication of the winter biofuel crop field pennycress (Thlaspi arvense L.)* **4:40:** Enkhtuul Tsogtbaatar, The Ohio State University, *Mapping the metabolic pathways in pennycress (Thlaspi arvense L.), a source of renewable jet fuel* **5:00:** Huanzhong Wang; University of Connecticut*, Identification of new regulators of cell wall development in Arabidopsis* **5:40:** Yarmilla Reinprecht, University of Guelph, *Genetic loci for soybean fiber performance in polypropylene thermoplastic composites*
		B3. Environmental Impacts of Bioenergy Crops II Chair: Marcos Buckeridge **4:00:** T. Edward Yu, University of Tennessee, *Analyzing the quality of perennial grass from a densification technology in lignocellulosic biomass feedstock supply system*

		4:20: Christian A Voigt, University of Hamburg, *Glucanocellulosic biomass: Learning from marine biomass to optimize terrestrial biomass conversion* **4:40:** Umakanta Jena, Desert Research Institute, *Advanced thermochemical methods of algal biomass conversion into liquid fuel* **5:00:** Sivakumar Pattathil, BESC, Complex Carbohydrate Research Center, *Changes in composition and extractability of cell wall glycans in plant biomass subjected to diverse pretreatment technologies* **5:20:** Thomas Canam, Eastern Illinois University, *Chemical and physical properties of Miscanthus straw pretreated with Trametes versicolor*
		Poster session II, open bar at 6PM
7:00 PM		**Dinner** **Congress Banquet Keynote Speaker** Chair: Nick Carpita Catherine Ronning, U.S. Department of Energy, *Current Landscape for Bioenergy Research in the U.S. – A DOE Perspective*

Saturday, June 7

8:35 AM	10:15 AM	**The Dean Tiessen Memorial Session** **Bioenergy feedstocks for marginal landscapes** Chair: Bill Deen
		8:35: Bill Deen, University of Guelph, *Sustainable bioenergy production systems for southwestern Ontario, Canada*
		9:00: Rowan Sage, University of Toronto*, C4 Bioenergy grasses for cold climates: Miscanthus versus Spartina*
		9:25: Lindsay Clark, University of Illinois/EBI, *Diversifying the feedstock potential of bioenergy grasses*
		9:50: Emily Heaton, Iowa State University, *Miscanthus and switchgrass cropping systems - ecophysiology to landscape*
10:15 AM	10:45 AM	**Coffee**
10:45 AM	12:00 PM	**Bioenergy production and the environment** Chair: Rowan Sage
		10:45: Marcelo Galdos, BioEthanol Science and Technology Center (CTBE), Campinas, Brazil, *Spatiotemporal dynamics of carbon stocks and greenhouse gas emissions in sugarcane production in Brazil*
		11:10: John Cushman, University of Nevada-Reno, *Development of bioenergy feedstocks for semi-arid and arid lands*
		11:35: Virginia Dale, Oak Ridge National Lab, *Opportunities to design biofuel systems for multiple environmental services and socioeconomic benefits*
12:00 PM		**Closing comments**: Nick Carpita, Marcos Buckeridge, Rowan Sage, Bill Deen

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APPENDIX II. Travel Awardees

Charles T Anderson	The Pennsylvania State University
Anuj Chiluwal	Fort Valley State University
George Chuck	University California-Berkeley
Lindsay Clark	University of Illinois
Bryon Donohoe	National Renewable Energy Laboratory
Kevin M Dorn	University of Minnesota
Sharon Doty	University of Washington
Kristen Engle	University of Georgia
Joseph L Hill Jr.	Penn State University
David Hodge	Michigan State University
Paul D Hussey	University of California
Umakanta Jena	Desert Research Institute
Vijay Gopal Kakani	Oklahoma State University
Udaya Kalluri	Oak Ridge National Laboratory
Emily Kuzmick	Ohio University
William Moore	Lawrence Berkeley National Laboratory
Sona Pandey	Donald Danforth Plant Science Center
Raja S Payyavula	Oak RIdge National Laboratory
Simara Price	University of Pennsylvania
Phillip S Rushton	Purdue University
Erin Slabaugh	North Carolina State University
Christine Shyu	Donald Danforth Plant Science Center
Enkhtuul Tsogtbaatar	The Ohio State University
Huanzhong Wang	University of Connecticut
Yanbin Yin	Northern Illinois University