ISU-led Group Awarded $25 Million Grant for Land Use, Biofuel Study

A multi-state, interdisciplinary team led by Ken Moore, Charles F. Curtiss Distinguished Professor of agronomy and BioCentury Research Farm (BCRF) affiliate, recently won a $25 million grant from the U.S. Department of Agriculture’s National Institute of Food and Agriculture and will develop the blueprint for using marginal farmlands to grow perennial grasses a biomass source for a drop-in biofuel. The project is administered by the Bioeconomy Institute and part of the work will be conducted at the BCRF.

Growing perennial grasses on marginal Midwest cropland has many environmental advantages, including reducing soil and nutrient runoff, slowing soil erosion and increasing carbon sequestration.

“In general, the lands we are using in the research aren’t really very good for producing food, so we are taking the food-versus-fuel argument out of the equation,” said Moore. “By using perennial grasses on this land, we are reducing soil erosion, improving soil and water quality and even providing wildlife habitat.”

The research will focus on harvesting grasses - mostly native species such as bluestem and switchgrass - and using the biomass as a feedstock for a biofuel process known as pyrolysis.

The BCRF will support major components of the project which include improving biomass feedstocks and determining best management practices, creating sustainable feedstock production systems, and developing strategies to harvest, transport, and store biomass feedstocks. The BCRF pyrolysis unit will be used for the production of biochar.

Information about the grant and latest results can be found on the project web site at www.cenusa.iastate.edu or follow the research on Twitter at cenusabioenergy. To read the article in its entirety go to www.news.iastate.edu/news/2011/sep/cenusa1.
Iowa State Receives Grant to Develop Biorenewable Plant Containers

Ed Adcock, Agriculture and Life Sciences Communication Service

Iowa State University has been awarded a grant by the U.S. Department of Agriculture to develop biorenewable and biodegradable containers for the specialty crop industry.

The $1.9 million grant will be used to develop bioplastic containers as an alternative to petroleum-based pots. Bill Graves, professor of horticulture, will lead the research team that includes David Grewell, associate professor of agricultural and biosystems engineering and Center for Crops Utilization Research (CCUR) affiliate; Michael Kessler, associate professor of materials science and engineering and CCUR affiliate; James Schrader, assistant scientist in horticulture; and scientists at the University of Illinois; University of Nevada-Reno; and Ohio State University. Grewell, Schrader, and Kessler are also members of CCUR’s Biopolymers & Biocomposites Research Team.

The plant containers were produced by Grewell’s research group in CCUR’s Technology Transfer Pilot Plant using the 150-ton hydraulic press. The containers are made of soy protein-based plastic.

“Nearly all specialty crops, including bedding plants, tomatoes and other vegetables, and containerized shrubs and trees that are purchased for residential gardening and landscaping, are grown and marketed in petroleum-based, conventional plastic containers. Few of those are recycled or reused,” said Graves. “Our vision is to provide sustainable alternatives that can meet the needs of horticultural producers, and that will degrade harmlessly when installed with the plant in a garden.”

An estimated $706 million could be saved annually by the specialty crop industry by converting from petroleum-based containers to bioplastic containers, Graves said. Other benefits include shifting resource revenue from foreign oil to domestic biorenewables and eliminating adverse environmental effects of petroleum-based plastics.

Left: Sean Carolan, former student in David Grewell’s research group, is using the 150-ton hydraulic press to make plant containers. Students Jake Behrens, Derek Huser, and Nathan Wagoner also worked on making the containers. Center: James Schrader, left, and Gowrishanker Srinivasan, postdoctoral research associate in Grewell’s research group, look at the condition of the plant containers in the horticulture greenhouse. Right: A closeup of the soy protein-based plant container.
Iowa State Researchers Earn USDA Grant to Compare Bioenergy Cropping Systems

Melea Reicks, Agriculture and Life Sciences Communications

Iowa State University researchers are comparing the economic potential and environmental impacts of bioenergy cropping systems to help policy makers and producers make informed land management decisions.

The project recently received a three-year, $725,000 grant from the U.S. Department of Agriculture - National Institute of Food and Agriculture to compare four feedstock production systems.

“This research will provide a practical framework for answering common questions about alternative cropping systems and their environmental impacts,” said Michael Thompson, agronomy professor, BioCentury Research Farm affiliate and one of the project’s eight principal investigators.

Feedstock production systems included in the large-scale study are continuous corn, with and without a winter cover crop; reconstructed multispecies prairie plants, with and without fertilizer; and a conventional corn-soybean system for baseline comparison.

“By studying a range of production systems, we can gain new insights concerning the tradeoffs in optimizing bioenergy production with greenhouse gas emissions and ecosystem health,” Thompson said.

Specifically, researchers will be comparing and cataloging each system’s potential for:

- biomass production, fossil-fuel replacement, and net energy returns
- reduction of greenhouse gas emissions and increased below-ground carbon storage
- maintenance of soil quality and reduction of water-quality impacts of nutrient exports, and
- net economic return to biomass producers and the environment.

“We hypothesize diverse mixtures of perennial plants used as feedstocks could have energy efficiencies comparable to corn-based feedstock production with fewer detrimental impacts to the environment,” Thompson said.

Results will be used to make predictions about the long-term economic and environmental sustainability of each feedstock production system on a landscape and regional scale.

Hurburgh Receives Grant to Develop Training Program for FDA

Charles Hurburgh, professor of agricultural and biosystems engineering and professor-in-charge of the Center for Crops Utilization Research's Iowa Grain Quality Initiative, is leading a team from Iowa State University and Kansas State University to develop a national training program for food and feed safety in bulk agricultural commodities.

The program supports the expansion of responsibility given to Food and Drug Administration by the recently enacted Food Safety Modernization Act. The team recently received a grant from the FDA for $1.4 million.

Bulk commodities, such as corn, soybeans, and wheat, are a challenge to food safety standards. Tracing and identifying grains is problematic in a supply chain that emphasizes volume, and sometimes grains are processed once or twice before lot identity is established. These processed grains are the basic ingredients in most feeds and many foods. Food retailers are gradually forcing food safety certification and audit requirements back to raw materials.

This program will be the first attempt to address bulk materials on a supply chain basis. Developing a set of consistent standards, practices, and risk assessments between regulators and the supply chain would improve the chance that problems are identified quickly, and reduce the number of potential food safety incidents, either man-made or naturally occurring issues such as mycotoxins and pathogens.
Open House at BioCentury Research Farm Showcases New Equipment and Biofuels Research

Approximately 75 visitors attended the BioCentury Research Farm (BCRF) open house on September 23, including Iowa Secretary of Agriculture Bill Northey and Iowa Senator Herman Quirmbach. This event gave visitors the opportunity to see the work being conducted at the farm and capabilities available to potential partners.

“IT was very gratifying to see so much interest by industry and the general public in what we are doing,” said Lawrence Johnson, director.

Visitors toured the facilities including the Biomass Processing Facility, the biomass hoop structures, and the Biomass Pretreatment and Grinding Building. Field research equipment was on display inside and outside the Harvest, Storage, and Transportation Facility including a telescopic handler, a biomass forage wagon, a tilt trailer, and a Massey Ferguson tractor. BCRF affiliated researchers were stationed around the farm and were available to talk with visitors about how the equipment is used and about current projects. Visitors also walked through the plant zoo and viewed various plants used in biofuels research including miscanthus, fast growing trees, corn, and soybeans.

Johnson gave a presentation to Iowa State faculty on how to partner with the BioCentury Research Farm and capabilities that are available to faculty.

Recent Grants Awarded to CCUR and BCRF Affiliated Faculty Members

2011 Emmetsburg Soil Study: Evaluation of Corn Cob and Stover Removal Levels on Crop Production and Soil Quality, POET Research, $45,010, Stuart Birrell.

Develop P. Alkekengi Harvester, Kemin Industries, $247,176, Stuart Birrell and Brian Steward.


Using Water Stable High Strength Soy-based Plastic for Lawn Care Products, United Soybean Board, $77,797, David Grewell, William Graves, and James Schrader.

Food Safety Inspection-training for Bulk Agricultural Product Handling and Processing, Food and Drug Administration, $1,483,522, Charles Hurburgh and James Roth.

2012 Biopolymers and Biocomposites Workshop, Iowa Department of Economic Development, $5,000, Darren Jarboe and David Grewell.

Agro-Ecosystem Approach to Sustainable Biofuels Production via the Pyrolysis-Biochar Platform (AFRICAP), USDA-NIFA, $25,000,000, Kenneth Moore, Robert Brown, Jill Euker, Raj Raman, Mark Hanna, Dermot Hayes, Keri Jacobs, Stuart Birrell, David Laird, Catherine Kling, and Charles Schwab.


Developing Soybean Oil-based Plastic Fat as Substitute for Paraffin and Beeswax, United Soybean Board, $70,339, Tong Wang, Linxing Yao, Darren Jarboe, and Barbara Walton.

ONLINE – See more photos from the open house or download Johnson’s presentation (PDF).
Innovative Soy Wax Paintings on Display in CCUR Office

Six soy wax paintings by artist Barbara Walton, associate professor of art and design in the College of Design, are now gracing the Center for Crops Utilization Research (CCUR) office in the Food Sciences Building.

Larry Johnson, director of CCUR and the BioCentury Research Farm, said, “These paintings are remarkable in the quality of artistic skills demonstrated by Barbara Walton. The variety of soybean subjects, and the uniqueness of media developed by Tong Wang and her research group.

“We are extremely pleased to have the encaustic paintings ‘Soy Series’ in the offices of the Center for Crops Utilization Research. They highlight our mission and contribute much to our office environment,” said Johnson.

Beginning in 2009 with a grant from the Center for Excellence in the Arts and Humanities at Iowa State University, Walton; Tong Wang, associate professor of food science and human nutrition and CCUR affiliate; Hui Wang, CCUR pilot plant manager; and Johnson, began a partnership to modify soy wax for use in encaustic art.

By altering the structure of partially hydrogenated soybean oil to improve the wax’s properties for use as an encaustic medium, Tong Wang, along with scientists Linxing Yao and Hui Wang, were able to modify the soy molecules to improve the cohesiveness and make them behave like beeswax. Collaboration with Walton’s artistic expertise made it possible to know what degree to alter the oil to make the wax more suitable for painting.

“We are leading the way nationally in encaustic soy wax research via my collaboration with Dr. Tong Wang. I think it is exciting that we have these resources readily available at Iowa State University in order to have this opportunity,” said Walton.

Walton has worked with encaustic painting since 2002. She especially appreciates that soy wax comes from a more sustainable and environmentally friendly source than the petroleum-based micro-crystalline wax. It is also a more affordable source than beeswax, which has been traditionally used in encaustic paintings since approximately 500 A.D.

“This is another opportunity to further expand my investigation and research on alternative artist materials that utilize soy waxes. There is the prospect for a sustainable renewable resource in

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Two internal research projects were recently completed in the Center for Crops Utilization Research’s (CCUR) pilot plant. Jay-lin Jane, Charles F. Curtiss Distinguished Professor of food science and human nutrition and CCUR affiliate, used the pilot plant equipment for her modified starch project. Two types of resistant starch were prepared in the pilot plant: high-amylose cornstarch-stearic acid complex (HA-SA) and octenyl succinate high-amylose cornstarch (OS-HA).

To process the HA-SA, high-amylose cornstarch was heated in a 250-gallon tank to swell the starch molecules, then the starch was treated with enzyme, and finally stearic acid was added to form HA-SA complexes. The starch slurry was dewatered by three-phase horizontal decanter centrifuge and dried in a convection oven.

To produce the OS-HA, high-amylose cornstarch was reacted with octenyl succinic anhydride in a 10-gallon water-heated electric kettle. The OS-HA was collected by filtration and then dried in a convection oven. The final samples were ground using an impact mill.

A total of 24 kg of HA-SA and 12 kg of OS-HA were prepared. The samples will be used in feeding studies led by Diane Birt, Distinguished Professor of food science and human nutrition, and Suzanne Hendrich, University Professor of food science and human nutrition and CCUR affiliate. The feeding studies will focus on the potential health benefits of resistant starches.

A photosynthetic microalgae culture was processed for Tong Wang, professor of food science and human nutrition and CCUR affiliate. Five hundred gallons of microalgae in culture broth arrived from a growing facility and were concentrated by centrifugation using the Alfa Laval disc stack centrifuge. The collected material was stored frozen for further processing and characterization experiments. Funding for this research was provided by the ConocoPhillips Company.

Many industrial clients have been using pilot plant equipment to conduct small-scale research. Some of the projects included:

- purifying corn biomass using a 500-gallon tank and the three-phase horizontal decanter centrifuge;
- extracting bioactive components from fresh soybean tissue using multiple grinders, the three-phase horizontal decanter centrifuge, Alfa Laval disc stack centrifuge, and CEPA tubular centrifuge;
- fungus fermentation using a 500-gallon tank and biomass dewatering using the three-phase horizontal decanter centrifuge; and
- an industrial legume beverage project, which involved extractions, pasteurization, and homogenization.
The BioCentury Research Farm (BCRF) received 40 tons of pine wood chips as part of the second phase of the National Advanced Biofuels Consortium (NABC) project. The material will be ground and shipped to NABC members.

Harvest is underway at the BCRF. Baled corn stover is arriving daily.

The BCRF was a stop on the third annual Biofuels: Science and Sustainability Tour on August 17. The tour was presented by the Iowa Renewable Fuels Association and brought policy makers and regulators together with various renewable fuel experts and farmers in Iowa. The goal was to present current sound, science-based information and a hands-on look at the practices applied in the biofuels industry. Larry Johnson, director of the Center for Crops Utilization Research and BCRF, explained the current biofuels research projects at BCRF and took participants on a tour of the facilities.

The BCRF had the following visitors in September and October:
- MidAmerican Energy
- Visiting scientists from Argentina
- New Holland dealership, Rochester, MN
- Deerfield Retirement Community with ISU Speaker’s Bureau
- Ames Convention and Visitor’s Bureau
- Iowa State University Agricultural Endowment
- ISU Department of Agronomy Alumni
- Iowa State Extension Farm Management Field Specialists
- DHS Holdings
- Chinese delegation
- French delegation
- Ukrainian dignitaries
- Iowa State University Human Resources
- College of Agriculture and Life Sciences Ambassadors with high school students and teachers for Chaminade High School, St. Louis, MO
- American Society of Mechanical Engineers of Central Iowa
- Borlaug Fellows
- Student/teacher from Gifft Hill School in the U.S. Virgin Island St. John
- Rockwell Automation
- North Central Extension and Research Activity (NCERA-219), a regional swine management committee

Left: Forty tons of pine wood chips are unloaded in the Biomass Pretreatment and Grinding Building. Right: The wood chips are placed in the drying trailer to be dried.
Rosentrater Co-editor of Distillers Grains Book

Kurt Rosentrater, assistant professor in agricultural and biosystems engineering and Center for Crops Utilization Research affiliate, co-edited Distillers Grains: Production, Properties and Utilization, which was published last summer. The book is a comprehensive collection of information on distillers grains and serves as a resource for anyone connected with the ethanol and distillers grains industry. Along with Rosentrater, the book was co-edited by KeShun Liu, a research chemist with the USDA Agricultural Research Service.

The idea for the book came from discussions between Rosentrater and Liu revolving around the fact that the industry lacked a solid resource on distillers grains. In recent years there has been a dramatic increase in grain-based fuel ethanol production in North America and elsewhere. Millions of tons of non-fermented residues are produced annually for global trade in the form of distillers dried grains with solubles (DDGS).

Consequently, in a short period of time a tremendous amount of research has been conducted to determine the suitability of DDGS for various end uses, especially livestock feeds. More than 35 experts contributed to the book in order to have as many people involved in the industry from every facet, beginning with the corn kernel, to new production processes and products.

The book includes research summaries on the use of DDGS in beef, dairy, swine, and poultry, as well as uses in pet foods and other types of livestock feeding, including aquaculture.

The book also provides information on the physical and chemical properties of DDGS, methodologies for composition analyses, chemical changes during ethanol processing, and factors causing variations in the compositional, nutritional, and physical values of DDGS.

The book highlights several new and emerging uses, such as feedstocks for cellulosic ethanol and biodiesel production, and substrates for food and other industrial uses. The book also includes information on new enzymes used in ethanol production, and the impact of fractionation, as well as extraction of DDGS lipids.

Distillers Grains: Production, Properties and Utilization can be purchased at Amazon.com.

Grewell to Attend Autodesk University Conference

David Grewell, associate professor in agricultural and biosystems engineering and Center for Crops Utilization Research affiliate, has received an Autodesk University scholarship which fully sponsors his attendance at a three-day conference in Autodesk software training. Grewell’s focus will be on Autodesk’s Moldflow plastic injection molding simulation software that provides tools to validate and optimize the design of plastic parts and injection molds and study the plastic injection molding process. The 3D simulation software helps reduce the need for costly physical prototypes and avoids potential manufacturing defects.

This conference will foster connections between the Autodesk industry and education partners. The education classes will increase proficiency in use of the Autodesk software and increase knowledge of key industry trends. The conference will also offer a wealth of resources, content, and curricula to better engage college students and will provide industry insights on how to effectively prepare these students for successful careers.

The training event will take place in Las Vegas, Nevada, November 28-December 1.
News Briefs

Brehm-Stecher Selected for Biotechnology Council

Byron Brehm-Stecher, associate professor of food science and human nutrition and Center for Crops Utilization Research affiliate, has been selected to serve a three-year term on Iowa State University’s Biotechnology Council. The council makes recommendations to the Office of Biotechnology on program activities supporting biotechnology research, education, and outreach.

Raman Named ABE Associate Chair of Teaching

Raj Raman, professor of agricultural and biosystems engineering and Center for Crops Utilization affiliate, has been named associate chair in the Department of Agricultural and Biosystems Engineering. Raman, whose focus is in biological and process engineering and technology, will serve as associate chair of teaching.

Agricultural Engineering Student Recognized at ASABE Annual International Meeting

Kent Thoreson, senior in agricultural engineering, was recognized at the 2011 American Society of Agricultural and BioSystems Engineers Annual International Meeting. He was elected President of the International Preprofessional Community. Thoreson is an undergraduate research assistant for Matt Darr, assistant professor in agricultural and biosystems engineering and BioCentury Research Farm affiliate.

SOY WAX PAINTINGS

soy wax to replace traditional artist materials beeswax and microcrystalline wax, which are in danger of becoming scarce or that may not be environmentally sound, respectively,” said Walton.

In October of 2010, Walton exhibited 12 soy wax paintings as part of the ReLationShips: From Our Roots exhibition at the Brunnier Art Museum.

A second grant has been awarded to the team of Tong Wang and Walton, along with Yao and Darren Jarboe, program manager for CCUR, by the United Soybean Board for $70,339. The grant, titled Developing Soybean Oil-based Plastic Fat as Substitute for Paraffin and Beeswax, aims to develop soybean oil-based plastic fat with desirable textural and physical properties to substitute for beeswax and petroleum-based paraffin wax for various applications.