

BioCentury Research Farm Update

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Introduction

The BCRF had another year of diverse users. Iowa State University (ISU) faculty and staff from the Departments of Agricultural and Biosystems Engineering (ABE); Agronomy; Chemical and Biological Engineering (CBE); Civil, Construction, and Environmental Engineering (CCEE); Mechanical Engineering (ME); and Food Science and Human Nutrition (FSHN), as well as the Bioeconomy Institute (BEI), Center for Crops Utilization Research (CCUR), College of Agriculture and Life Sciences (CALs), and Extension and Outreach conducted research, teaching, and outreach at the BCRF. Private industry users included ARGO, Chevron, Deere and Company, DuPont Cellulosic Ethanol, and many others. By the end of 2018, the BCRF had more than 80 full- and part-time users with projects in all available spaces. The BCRF separated from CCUR July 1 to become an independent unit under the CALs administrative umbrella with Matt Darr as the administrative leader.

Research, Education, and Equipment

Project activity occurred in these areas:

- Algae research and production methods
- Biochemical research
- Biomass feedstock logistics research
- Biomass preparation
- Biopolymer research
- Thermochemical research that included biomass gasification, pyrolysis, and solvent liquefaction processes

Various production systems, including flat panel bioreactors, a raceway pond system, a novel revolving algal biofilm (RAB) system, and various lab-scale reactors located in the BCRF Algae Facility are being used to grow

algae. The major focus for these algal growth systems is removal of nutrients (nitrogen and phosphorus) and toxic metals from municipal and industrial wastewaters. In 2018, Gross-Wen Technologies (GWT) received a patent for RAB and a \$2 million investment from Doerfer Corporation to further develop water quality technology.

The CCUR and CIRAS inaugural fermentation tour and workshop was held July 12, and will become an annual event. No fermentation projects occurred in 2018 due to the retirement of John Strohl, CCUR Fermentation Pilot Plant Manager. The BCRF has since assisted Zhiyou Wen with assembling four projects scheduled to begin the first half of 2019. Other non-fermentation projects included drying wet cake to produce Distillers Dried Grains (DDG) using the BCRF's pilot-scale steam tube dryer, and the evaluation of new DDG drying methods using a novel technology provided by private industry.

Multiple projects continued in biomass feedstock with the most notable ones related to stover bale storage and testing for Idaho National Laboratory and warm season grass ensiling testing.

The BCRF prepared biomass feedstocks for several internal and external clients. The farm's biomass preparation lab was used to fine grind, screen, and size the feedstocks. Various hammermills were used to provide biomass material from 200 microns up to 3,175 microns. Particle size distributions were performed and moisture contents and bulk densities were determined. Various pelleting projects were completed. Over 100 tons of material were processed in 2018.

The Bio-Polymer Processing Facility was successful in producing the final phase of

biopolymer components for use in producing asphalt. New work focused on evaluating the soybean and glycerin-based biopolymers as curable waterborne glues and pressure-sensitive adhesives at the bench scale. The intention is to scale up to production at the BCRF and allow the research teams to “manufacture material for demonstration projects nationwide.” The research teams include Eric Cochran, CBE, and other ISU staff; the Center for Bioplastics and Biocomposites (CB²); the Iowa Soybean Association; United Soybean Board; U.S. Department of Agriculture, and 10 companies.

Continuing work from 2017, Robert Brown’s, ME, fast pyrolysis unit located at the BCRF was used for bio-oil production from red oak and corn stover for internal and external projects. This work explored possible uses for individual fractions, including a path to fermentable sugars and generation of pilot-plant data for system scale up. Further progress was made in increased throughput using autothermal pyrolytic processes, sustainable corn stover processing, and alternative collection stage design.

The BCRF hosted 186 ISU students from the departments of ABE, Agronomy, CBE, and FSHN, and 135 additional students from other universities, community colleges, and high schools. The BCRF also supported four Capstone projects from ABE, ME, and Agricultural Systems Technology (AST).

The Harvest Storage and Transportation (HST) building underwent a major remodel. The roof was replaced with a standing seam metal roof and the building was insulated with interior metal panels. Radiant heaters were installed with ceiling fans for cooling and circulation. Internet access, domestic cold water, and compressed air were extended from the main building.

The processing building received a water treatment system upgrade to increase the reliability of the deionized water system. The BCRF also received a novel bale spear allowing three large square bales to be handled in a single pick.

Outreach, Visitors, and Tours

Information dissemination and promotion was accomplished through tours, conferences, and symposia. Tours were provided for 54 groups with approximately 900 visitors in 2018. Since the dedication in 2009, BCRF has hosted 908 tours with 15,437 visitors.

The 2018 tours included visits by Ames Rotary Club; Jim Balloun and family; Basin Electric Power Cooperative; Boone Area Leadership Program; CALS Global Programs; Cool Planet; Cultivation Corridor; Deere and Company; Delft University of Technology; Emerson; Future Farmers of America; Iowa Farm Bureau Federation Energy Advisory Committee; Jiangnan University; Jupeng Bio; Ozark Wood and Fiber; Pennsylvania State; Poet DSM; the Schleisman Family; Smart Ag; U.S. Congressional Aides; U.S. Grains Council on Ethanol Trade with China; University of Costa Rica; Wageningen University; Women in Agriculture; and delegations from Argentina, Australia, Brazil, China, Ireland, Germany, and the United Kingdom. The BCRF was an exhibitor at the 2018 Iowa Renewable Fuels Summit and Trade Show in Altoona, Iowa.

Governor Kim Reynolds, Lt. Governor Adam Gregg, and Iowa Secretary of Agriculture Mike Naig, along with other political, agricultural, and community leaders attended the fifth anniversary celebration of the Iowa Nutrient Reduction Strategy held at the BCRF. The BCRF participated in the Biotech Spotlight Series as the final stop with presentations given by ISU professors Robert Brown and Brent Shanks.