

BioCentury Research Farm Summary

RFR-A1992

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Introduction

The BioCentury Research Farm (BCRF) had another year of diverse users and projects. Iowa State University (ISU) faculty and staff from the Colleges of Engineering (COE) and Agriculture and Life Sciences (CALS) continued to conduct research, teach, and perform outreach at the BCRF. Private industry users included Deere and Company, Feed Energies, Franzenburg, Green Products, Gross-Wen Technologies (GWT), Haber Technologies, Kemin, Marquis, Roeslein and many others. During 2019, the BCRF had more than 80 full- and part-time users with projects.

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
- Digital agriculture
- Thermochemical research
- Educational support/capstone
- Facility and equipment improvements

Algae. A novel revolving algal biofilm (RAB) system and various lab-scale reactors located in the BCRF Algae Facility were 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. Using ISU licensed technology, GWT sold their first commercial water treatment unit and opened corporate headquarters in Slater, Iowa. GWT's pilot scale-up research took place at the BCRF. The BCRF continued to assist

Zhiyou Wen, director, (FSHN) with four new projects in 2019.

Biochemical. The annual CCUR and Center for Industrial Research and Service (CIRAS) fermentation tour and workshop was held May 14-16. Attendees learned basic fermentation methods using the large pilot-scale fermenters. BCRF/CCUR worked with industry partners to complete record levels of fermentation research projects in 2019. Non-fermentation projects, such as drying wet cake to produce distillers dried grains (DDG) using the BCRF's pilot-scale steam tube dryer, were completed at record levels. Evaluation of new DDG drying methods also continued in 2019.

Biomass feedstock logistics. Projects continued in biomass feedstock research with the most notable ones related to stover bale storage and testing for Idaho National Laboratory. Warm season grass ensiling testing continued in 2019.

Industry partner Haber Technologies tested a prototype of novel grain drying technology at bench scale at the BCRF. They are working on moving to testing full scale off-site.

Biomass preparation. BCRF continued to prepare 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. Various pelleting projects were completed as well.

Biopolymer research. The Bio-Polymer Processing Facility was successful in producing the final phase of biopolymer components for producing asphalt. In November, the BCRF

north parking lot was paved to display the new product. The binders in the asphalt are soy-based, replacing the petroleum-based binding agents used commercially. The research teams included Eric Cochran, professor, (CBE), the Center for Bioplastics and Biocomposites (CB²), the Iowa Soybean Association, United Soybean Board, U.S. Department of Agriculture, and 10 companies.

Digital agriculture. In 2019, the digital ag group designed, built, installed, and began operation of a terrain simulator for large agricultural equipment. A drone-generated digital elevation model of the desired field is created and relayed into the test stand controller to simulate dynamic field conditions for the development of chassis suspensions or auto control systems for large agricultural machinery. This system enables year-round testing opportunities with highly repeatable test conditions.

Thermochemical. BEI's fast pyrolysis pilot plant located at the BCRF continued to operate on a weekly basis generating yield, energy, and scale-up data used to feed the design of a modular 50 ton/day demonstration project, currently entering the final stages of design and beginning the construction phase of the project. Research continued on developing new products from pyrolysis oils including bio-asphalt, marine fuel substitutes, and specialty sugars.

Educational support/capstone. The BCRF hosted 181 ISU students and 252 additional students from universities, community colleges, and high schools (including FFA groups). BCRF also supported five Capstone projects.

Facility and equipment improvements. The digital ag group's capabilities for wiring harness assembly and testing were significantly increased by moving electronic assembly lab space and storage from the main

processing building to a new, expanded space in the HST facility in 2019. Also, space in the main building was temporarily converted into office seating for up to nine staff members and additional conference space.

In 2019, construction began at BCRF to retrofit an existing building to house a new off-road vehicle chassis dynamometer donated by Danfoss. This equipment will feature four sets of seven independently controlled rollers, allowing the controlled, indoor testing of equipment as large as harvesters. Engineering students, researchers, and industry partners will be able to work with this state-of-the-art dynamometer. The facility will promote resource sharing and build on existing relationships between Iowa State and Danfoss, as well as other industry partners. It is expected to be completed by mid-2020.

Drainage tile upgrades were started in 2019 at BCRF facility. Additional facility improvements included a concrete walkway connecting the main building to the HST building and the new bio-asphalt parking lot.

Outreach, Visitors, Events and Tours

Information dissemination and promotion was accomplished through tours, conferences, and symposiums. Tours were provided for 54 groups totaling 1,131 visitors in 2019. Since the dedication in 2009, BCRF has hosted 962 tours totaling 16,568 visitors.

The 2019 tours included visits by Verbio, Grain Miller's, Inc., Corteva and Nebraska Public Power District, as well as international visitors from Malaysia, Japan, China, Australia, Argentina, and Germany. A group of 80 attendees of the World Congress on Industrial Biotechnology toured the BCRF July 8.

On August 16, the 10-year anniversary celebration of BCRF was held on-site.