

BioCentury Research Farm Summary

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Introduction

The BioCentury Research Farm (BCRF) had several challenges to overcome in 2020, including extreme weather and operational changes due to COVID-19. Despite these challenges, the BCRF supported an increasing group 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, Franzenburg, Green Products, Gross-Wen Technologies (GWT), HydroThermal, Kemin, Marquis, Roeslein and many others. During 2020, the BCRF had more than 70 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. Research work continued at the BCRF to support advancements in the removal of nutrients (nitrogen and phosphorus) and toxic metals from municipal and industrial wastewaters. Increased focus on uses for the nutrient laden algae yielded potential uses in agricultural and other applications. GWT's laboratory and pilot scale-up research continued at the BCRF.

Biochemical. The annual Center for Crop Utilization and Research (CCUR) and Center for Industrial Research and Service (CIRAS) fermentation tour and workshop was canceled this year. CCUR continued to work with industry partners at a high level of fermentation research project activity in 2020. Non-fermentation projects, such as drying wet cake to produce dried distillers grains (DDG) using the BCRF's pilot-scale steam tube dryer, continued.

Biomass feedstock logistics. Projects continued in biomass feedstock research, with the most notable related to stover bale storage and testing for Idaho National Laboratory. Low ash content stover research continued and alternate biomass feedstocks were prepared for industrial use as well as potential ingredients for animal feeds.

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, size, and pelletize the feedstocks. Various hammermills were used to provide biomass material for multiple clients. Various pelleting projects were completed as well.

Biopolymer research. The Biopolymer Processing Facility continued to produce the final phase of biopolymer components for producing asphalt. In 2020, the biopolymer plant produced 25 tons of asphalt binder to support 25 miles of paving projects in 5 states. The binders in the asphalt are soy-based, replacing the petroleum-based binding agents used commercially. The research work is spearheaded by Eric Cochran, professor, (CBE) and the biopolymer team, and is sponsored by the United Soybean Board and others.

Digital agriculture. In 2020, the digital ag group maintained continuity of research with partners in spite of COVID-19-related disruptions and contributed digital ag expertise to ISU Extension programming. The group created two new lab spaces at the BCRF for continued development of new projects and provided on-site space and resources to research partners to enable them to continue research and development while under travel restrictions.

Thermochemical. The Bioeconomy Institute'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 inform the design of a modular 50 ton per day demonstration project currently under construction. Multiple projects were undertaken with industry partners to include solvent liquefaction pilot testing and design work on two new pilot plant skids completed in late 2020. New research began related to waste plastics utilization undergoing autothermal pyrolysis to yield product intermediates.

Educational support/capstone. The BCRF hosted 109 ISU Agricultural and Biosystems Engineering students, which included six classes and two capstone projects.

Facility and equipment improvements. Construction continued at the BCRF to retrofit an existing building to house a new off-road vehicle chassis dynamometer donated by Danfoss. This equipment features 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. COVID-19 disruption at the manufacturing plant in

England caused significant delays in completing the assembly of the unit, testing, and disassembly for shipping. The bulk of the equipment arrived mid-December. Installation is expected to be completed by mid-2021.

Drainage tile upgrades begun in 2019 were completed in 2020 at BCRF. Upgrades included connecting all roof downspouts to tile, grading all yard surfaces to drain to waterways or to tile, and the installation of multiple tile intakes to handle runoff in low areas around the facility. Several large rain events demonstrated the upgrades were successful in mitigating all detrimental standing water and ponding issues.

Outreach, Visitors, Events and Tours

Typically, information dissemination and promotion are mainly accomplished through tours, conferences, and symposiums. Due to COVID-19 restrictions, very few tours were provided in 2020. No large group tours with over six participants were allowed. The BCRF had five groups totaling seven visitors in 2020. Since the dedication in 2009, BCRF has hosted 967 tours totaling 16,575 visitors.

The 2020 tours included visits by potential students, industrial clients, and an undersecretary of the USDA.