BioCentury Research Farm Summary

Andrew Suby—assistant director, BioCentury Research Farm

The BioCentury Research Farm (BCRF) supported a diverse group of users and projects in 2022. Iowa State University 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, Frontline Bioenergy, Gross-Wen Technologies (GWT), Hy-Vee Inc., Kemin, Roeslein, and others. The BCRF had more than 83 full- and part-time users with projects, and 34 student workers to support operations and research.

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, chassis dynamometer lab, digital agriculture, polymer and food protection program, thermochemical research, educational support/capstone facility, and equipment improvements.

Algae. Research work continued at the BCRF to support advancements in using algae to remove nitrogen and phosphorus from wastewater. Additional projects that were funded through US DOE BETO grant program focused on cultivating rapidly growing algae strains for use as a biofuel and bioplastic feedstock. The BCRF also housed the algae biofertilizer processing facility for GWT. The fertilizer produced at the BCRF facility was used to fertilize parks, lawns, and golf courses throughout Iowa.

Biochemical. The Center for Crop Utilization Research (CCUR) continued to work at the BCRF with industry partners at a high level of fermentation research project activity. Non-fermentation projects, such as milling, falling film evaporation, and drying wet cake to produce distiller's dried grains (DDG) using the BCRF's pilot-scale steam tube dryer, were continued. In all, 24 different companies received services during 2022.

Biomass feedstock logistics. A multiyear stover storage project was extended with the Idaho National Laboratory (INL). Various biomass feedstocks were prepared for industrial use.

Biomass preparation. The 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 and to prepare samples for the Agronomy Department, the Iowa State Kent Feed Mill and Grain Science Complex, and others.

Biopolymer research. The Biopolymer Processing Facility produced enough asphalt binder material in 2021 to continue to supply demonstration projects in 2022. Commercialization of related materials and products continued for other applications, some of which were demonstrated at the 2022 Farm Progress Show in Boone, Iowa. The products are soy-based, replacing the petroleum-based binding agents used commercially as components in asphalt binder as well as a variety of maintenance products for asphalt shingles, asphalt pavement, and concrete. The research work is spearheaded by Eric Cochran, professor (CBE), and the biopolymer team and is sponsored by the United Soybean Board and others.

Chassis Dynamometer Lab. Upon completion of the construction phase, commissioning continued in earnest during the second and third quarter. The dedication ceremony was held on November 17 with participation of key contributors from Danfoss, Iowa State and others. The inaugural private industry project commenced in the fourth quarter.

Digital agriculture. The digital ag group continued growing their partnership with industry sponsors to a new record high since the inception of the BioCentury Research Farm. Reorganization of the facilities and equipment occurred to support the increased volume of ongoing projects, while maintaining security. In partnership with ISU Extension and Outreach, the group has shared equipment, technology, and agronomic expertise with farmers around Iowa to aid them in making sound decisions for their farming operations.

Polymer and Food Protection Program (PFPP). Keith Vorst's group moved into the east bay of the equipment building and began work on various research projects after the installation of necessary equipment. This work included characterizing landfill plastic material and creating compostable plastics by using biomass feedstocks and various other projects.

Thermochemical. The culmination of a three-year collaboration, the Bioeconomy Institute (BEI) continued its research partnership with Renewable Energy Group (REG) based in Ames, Iowa, via operation of a pilot scale multi-reactor hydrotreater. The pilot plant is designed to support REG's Geismar, Louisiana, renewable diesel plant and has been used to evaluate feedstocks and process variables that mimic the commercial facility. The fully automated system is designed to safely operate for weeks-long campaigns with minimal operator input.

Additionally, the BEI has completed the first round of collaborative testing with an internationally based startup company using their 1kg./hr. solvent liquefaction pilot plant. Promising results prompted the project to continue through 2023, which will expand testing and fund plant upgrades to better reflect next scale plant design.

Educational support/Capstone. The BCRF hosted or gave class support to 220 Iowa State Agricultural and Biosystems Engineering (ABE) and other students, which included seven classes and two capstone projects.

Facility and equipment improvements. Completion of work started in late 2021 included the new electrical panels installed to support PFPP equipment in the equipment building.

Outreach, Visitors, Events, Tours

Information dissemination and promotion mainly are accomplished through tours, conferences, and symposiums. The BCRF had 75 groups totaling 1,130 visitors in 2022. Since the dedication in 2009, BCRF has hosted 1,059 tours totaling 18,006 visitors.

The 2022 tours included visits by potential students, industrial clients, the Chinese Ambassador to the United States, and governmental officials.