2021 Stakeholder Report

In collaboration with the Iowa Soybean Association

IOWA SOYBEAN RESEARCH CENTER

IOWA STATE UNIVERSITY
About the ISRC
The Iowa Soybean Research Center (ISRC) works in partnership with the Iowa Soybean Association, industry, farmers and researchers at Iowa State University. The goal of this collaborative effort is to identify and fund research in the areas of soybean production and protection. The center involves and helps coordinate research, teaching and extension activities of faculty and staff who work in the areas of soybean biology, breeding, economics, precision agriculture, production and pest management at Iowa State and scientists at the Iowa Soybean Association’s Research Center for Farming Innovation.

Research Focus
ISRC-funded research includes traditional and multidisciplinary problem-solving approaches, molecular research and machine learning and artificial intelligence tools to accelerate and enhance research efforts. Specific research areas for the ISRC are identified by the center’s Industry Advisory Council.

Funding
Financial support for the ISRC comes from Iowa State University’s College of Agriculture and Life Sciences, the Iowa Soybean Association and industry partners. Our goal is to seek widespread input and support from individuals representing key segments of the soybean production and protection system. Partners from select non-governmental organizations with expertise on policy, social and environmental issues also are desired.

ISRC Staff
Greg Tylka, director
Kara Berg, communications specialist
Jill Cornelis, center administrator
Steve May, industry partner recruiter
Clarke McGrath, on-farm research & extension coordinator

ISRC staff salaries are funded by ISU, ISA and generous donors through the ISU Alumni Foundation; three of the positions are part-time.
Industry Advisory Council

Iowa soybean farmers, industry partners and the Iowa Soybean Association have representation on the center’s Industry Advisory Council. The council provides input on research needs, which includes identifying new areas of research, gaps in research and opportunities to expand and build upon existing research.

Industry partners currently represented on the council include AMVAC, BASF, Bayer, Cornelius Seed, Corteva Agriscience, FMC, GDM, Merschman Seeds, Syngenta, and our newest partners joining in 2021, UPL and Innvictis/Simplot.

Due to the pandemic, the 2020 ISRC Industry Advisory Council meeting was held simultaneously in person with social distancing at ISU and via Zoom.

ISRC Management Team

Funding decisions are made by the center’s management team based on guidance from the Industry Advisory Council.

The management team consists of:

- Iowa State University’s College of Agriculture and Life Sciences Dean Daniel Robison and Department Chairs Steven Harris, Kendall Lamkey and Amy Kaleita
- Iowa Soybean Association Senior Director of Research Ed Anderson
- ISRC Director Greg Tylka
Progress on 2020-2021 ISRC Research Projects

Hyperspectral Imaging for Early Detection of Herbicide-Resistant Weeds in Soybean

Prashant Jha, associate professor of agronomy & extension weed specialist, Iowa State University

Greenhouse and laboratory experiments were started at the end of 2020 to identify spectral reflectance of different biotypes of waterhemp plants resistant to ALS inhibitors, atrazine, and/or glyphosate herbicides using ground-based hyperspectral imaging. Seeds used in these experiments were collected in fall 2019 from the survey of herbicide-resistant waterhemp populations in Iowa.

In summer 2021, a hyperspectral camera mounted onto a DJI Matrice 600 Pro drone or UAV was used to collect hyperspectral data in soybean fields with confirmed herbicide-resistant waterhemp populations. Images will be analyzed to differentiate waterhemp from other weed species and to identify susceptible vs. resistant waterhemp biotypes. A neural network machine-learning algorithm will be used to develop classification images for field-scale maps.

This project is a collaborative effort between Iowa State University Weed Science and Montana State University Optics and Electrical Engineering programs. Due to the pandemic, this project received extended time to conduct the work. Complete results will be reported later this fall. This project received additional funding of $752,518 through a USDA-NRCS-CIG grant for a multi-state (ISU, Texas A&M and NC State) project on 3-D classification and mapping of weeds in corn and soybean fields to fight herbicide-resistant weeds.

Prashant Jha’s research at Iowa State is focused on improved understanding of weed biology and ecology to develop effective, integrated weed management strategies in corn and soybean production systems, optimization and stewardship of herbicide application technology and herbicide use and understanding the evolution of herbicide resistance.
Virus-Mediated Gene Editing in Soybean

Steve Whitham, professor of plant pathology and microbiology, Iowa State University

The first part of this project focused on building the resources needed to test if a CRISPR guide RNA delivered by a soybean virus can induce gene edits in a soybean plant expressing the Cas9 protein. Plants were grown from seed and will be tested for the presence of Cas9, and rub-inoculate with the virus carrying the Pds guide RNA. Inoculated plants will be characterized by 1) confirming presence of virus, 2) confirming virus carries the Pds guide RNA, 3) observing plants for a photobleaching phenotype due to mutation (edits) in the Pds gene, and 4) extracting DNA from the infected plants and testing for presence of edits by DNA sequencing.

This project builds on previous experiments using plant viruses to perform gene editing in soybean, work that initially was funded by Iowa State’s Plant Sciences Institute. Due to the pandemic, this project received extended time to complete the research; more complete results will be reported later this fall.

Steve Whitham’s research at Iowa State is centered on an interest in the molecular mechanisms that underlie viral and fungal pathogenicity as well as plant defense against these organisms. He studies soybean and corn and utilizes model host plants. He uses functional genomics approaches to study molecular changes that occur in susceptible and resistant genotypes of crop and model plant species.
Progress on Current ISRC Research Projects 2021-2022

Mechanisms of Defense Suppression by Cyst Nematode Effectors

*Thomas Baum,* professor of plant pathology and microbiology, Iowa State University

Cyst nematodes such as the soybean cyst nematode (SCN) are sedentary parasites that feed at single feeding sites inside the root throughout their life. It is, therefore, critical for cyst nematodes to avoid or inactivate strong plant defense responses. The Baum Laboratory has discovered a small group of molecules called effectors in cyst nematodes that suppress or inactivate plant immunity and they will explore the mechanisms of this phenomenon. Understanding how cyst nematodes interfere with plant defense mechanisms can pinpoint strategies to strengthen natural plant defense mechanisms.

*Thomas Baum’s research at Iowa State is centered on studying the compatible interaction between cyst nematodes and their hosts. He is particularly interested in characterizing the changes in soybean and nematode gene expression during the different phases of parasitism.*

Time of Disease Onset as an Early Indicator of Soybean Resistance to SDS

*Leonor Leandro,* professor of plant pathology and microbiology, Iowa State University

Leandro’s research group has observed that the time of onset of SDS foliar symptoms, i.e. the time when the first SDS foliar symptoms are observed, is strongly correlated with late-season SDS severity and soybean yield. These results were seen in a few soybean genotypes grown in commercial fields and fields in which research was being conducted, but it suggests that management practices that delay disease onset should be most effective at protecting soybean yield. The Leandro lab is studying if time of SDS onset can be a useful measure for early screening of soybean genotypes for...
Progress on Current ISRC Research Projects (cont.)

resistance against SDS. If SDS onset is discovered to be well correlated with SDS resistance, this could greatly benefit resistance breeding programs. Leandro’s team will monitor SDS progress in soybean genotypes with varying levels of resistance and determine the relationship between resistance and time of foliar disease onset.

Leonor Leandro’s research at Iowa State is focused on the biology and epidemiology of fungal diseases of soybean. Primary research interests are on soilborne fungi in the genus Fusarium, particularly F. virguliforme, the causal agent of soybean sudden death syndrome (SDS).

In-field Soybean Seed Pod Analysis on Harvest Stocks Using 3D Imaging and Machine Learning

Lie Tang, professor of agricultural and biosystems engineering, Iowa State University

Soybean seed pods directly contribute to yield and their morphologic characteristics represent important traits for soybean breeding. Traits such as total number of pods, number of seeds in each pod and the corresponding pod grouping, and the distribution of pods over the plant all are of great interest to soybean breeders and plant scientists, but data on these plant attributes have been difficult to collect in an automated and high-throughput fashion, particularly under field conditions. With the advancement of 3D sensing technologies and the deep convolutional neural networks, the Agricultural Robotics and Automation Lab at Iowa State University has made breakthroughs in field-based plant phenotyping for plants like maize and sorghum. In this project, Tang’s research team will investigate how these technologies and innovations can be extended into field-based soybean plant phenotyping.

Lie Tang’s research at Iowa State is focused on agricultural automation, optimization, machine intelligence and robotics. He is working on developing advanced sensing, optimization and robotic technologies for agricultural production systems in 21st century.
ISRC Approaching $1.5 Million in Research Funding

In its first five years of supporting soybean research, the ISRC reached $1 million in funding. By the end of 2021, the center will have awarded nearly $1.5 million. Funding for research is coordinated by the center with 100% of funding provided by its partners going to research. Funding partners of the center include the Iowa Soybean Association and 11 industry partners: AMVAC, BASF, Bayer, Cornelius Seed, Corteva Agriscience, FMC, GDM, Innvictis/Simplot, Merschman Seeds, Syngenta and UPL.

ISRC Research Projects Overview

<table>
<thead>
<tr>
<th>Award Year</th>
<th>Researcher</th>
<th>Project</th>
<th>Funding Amount</th>
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<tbody>
<tr>
<td>2021-2022</td>
<td>Thomas Baum</td>
<td>Mechanisms of Defense Suppression by Cyst Nematode Effectors</td>
<td>$116,000</td>
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<td>2021-2022</td>
<td>Leonor Leandro</td>
<td>Time of Disease Onset as an Early Indicator of Soybean Resistance to SDS</td>
<td>$40,000</td>
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<td>2021-2022</td>
<td>Lie Tang</td>
<td>In-field Soybean Seed Pod Analysis on Harvest Stocks Using 3D Imaging and Machine Learning</td>
<td>$100,000</td>
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<td>2020-2021</td>
<td>Steve Whitham</td>
<td>Virus-mediated Gene Editing in Soybean</td>
<td>$100,000</td>
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<td>2020-2021</td>
<td>Prashant Jha</td>
<td>Hyperspectral Imaging for Early Detection of Herbicide- Resistant Weeds in Soybean</td>
<td>$120,000</td>
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<td>2019-2020</td>
<td>Fernando Miguez</td>
<td>ISOFAST – Mastering Agronomic Decisions Through Interactive On-line Summaries of On-farm Replicated Strip Trials</td>
<td>$46,000</td>
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<td>Peter Kyveryga</td>
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<td>2018-2020</td>
<td>Arti Singh</td>
<td>Machine Learning Framework to Identify and Quantify Multiple Biotic and Abiotic Stresses in Soybean</td>
<td>$80,000</td>
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<td>2017-2020</td>
<td>Gwyn Beattie</td>
<td>Root and Microbiome Traits to Tailor the Next-Gen Soybean Cultivars</td>
<td>$400,000</td>
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<td>Danny Singh</td>
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<td>2015-2016</td>
<td>Steve Bradbury</td>
<td>Iowa Pest Resistance Management Plan</td>
<td>$60,000</td>
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<td>2015-2016</td>
<td>Sotirios Archontoulis</td>
<td>Cropping Systems Modeling Tools to Improve Soybean Management and Yield in Iowa</td>
<td>$80,000</td>
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<td>2015-2016</td>
<td>Matt Darr</td>
<td>Integrated Research and Education Program for Use of Remote Sensing and UAVs for Enhanced Soybean Production</td>
<td>$37,000</td>
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<td>2015-2016</td>
<td>Thomas Baum</td>
<td>RNA-based Approaches for Resistance to Nematode and Fungal Pathogens of Soybean</td>
<td>$64,000</td>
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Total research funded by the ISRC since 2015: $1,243,000
Federal Funding Obtained by ISRC Affiliates for Research Related to Work Funded by the ISRC

2020

Danny Singh, Arti Singh, Daren Mueller and Peter Kyveryga are part of a research group that received a five-year Cyber-Physical Systems Frontier award jointly funded by the National Science Foundation (NSF) and U.S. Department of Agriculture’s National Institute of Food and Agriculture (USDA-NIFA).

$7,000,000

Peter Kyveryga and Fernando Miguez received two-year USDA-NIFA funding for a project titled “FACT: Web-Based Dynamic Data-Analytics Framework for On-Farm Research Networks,” which builds upon their ISOFAST (Interactive Summaries of On-Farm Strip Trials Tool) project.

$395,000

Thomas Baum and Roger Innes (Indiana University) received four-year support for a project titled “Use of the PBS1 Decoy System to Engineer Resistance to Plant-parasitic Nematodes.” The project is funded by the Plant Biotic Interactions Program, which is a coordinated grant program of the NSF and USDA-NIFA.

$300,000

Matt O’Neal, Erin Hodgson and Brad Coates received three-year USDA-NIFA funding for a project titled “Detecting Insecticide-Resistant Aphids before Field Failures Cost Farmers.”

$200,000

2019

Gwyn Beattie received three-year USDA-NIFA funding for a project titled “Mechanistic Drivers Shaping Root Microbiomes and Microbiome Drivers of Fitness Benefits in Drought-stressed Plants.”

$750,000

Arti Singh received three-year USDA-NIFA funding for a project titled “Scalable Cyber Ecosystem for Acquisition, Curation, and Analysis of Multispectral UAV Image Data.”

$500,000
ISRC Education and Outreach Activities

SoyFest
The ISRC hosted its inaugural SoyFest on August 25, 2021. This fun and educational event was held on ISU’s central campus to coincide with August as "Soybean Month" in Iowa and the start of fall semester. Activities included a free cookout featuring soy veggie and pork burgers, soy-related snacks, robotic demonstrations, giveaways, games and a photo booth. The ISU Creamery created a tasty new ice cream flavor that was a hit with students called “SoyFest” which featured chocolate custard ice cream with soymilk and dark-chocolate-covered roasted soybeans. Iowa State University President Wendy Wintersteen, Dean of Agriculture and Life Sciences Dan Robison and CY all made appearances at the event.

Thanks to the following businesses and student groups that contributed to SoyFest: Cargill, Syngenta, REG, Iowa Soybean Association, Iowa Food & Family Project, Okabashi Shoes, Iowa Smokehouse, Iowa Turkey Federation, Morning Bell Coffee, ISU Creamery, Center for Crops Utilization Research, Agricultural Research Service - U.S. Department of Agriculture; and ISU Clubs: Agronomy, Culinary, Dietetics, Food Science, Grill Team and the research labs of Eric Cochran, Danny Singh and Lie Tang. The event was a huge hit with students!

Photos clockwise from top: Soybean farmer and ISA board member Morey Hill (left) with friends, family and Cy; ISU President Wendy Wintersteen sampling the ISU Creamery’s SoyFest ice cream; line for the free cookout.
In a kick-off event to SoyFest, the ISRC hosted Meals from the Heartland. ISU students, faculty and staff packaged 20,000 meals in which the main ingredient was soy protein. Meals from the Heartland is a nonprofit organization that helps feed food-insecure populations in over 37 countries. Some of the meals packaged will be sent to Haiti. Soy protein is considered to be the most lifesaving ingredient in their formula. Special thanks to Cargill and Syngenta for providing funding to cover the costs that included soy protein, making this very special SoyFest-related event possible.

Farm and Industry Tours

Each year, the ISRC engages students, staff and faculty by organizing farm and industry tours. In April, May and June 2021, the ISRC hosted a series of six virtual tours with ISRC industry partner Corteva Agriscience. ISRC affiliate Mark Licht (pictured) served as the ISRC’s host, Corteva staff led online tours of their facilities in Iowa and Indiana, offering valuable insight into their research and advice to ISU students interested in agricultural industry careers.

Media Meet and Greet

The ISRC hosted an ag media “meet and greet” event on August 6 with ISRC affiliates and extension researchers at the Iowa State University Field Extension Education Laboratory (FEEL) Farm near Boone, IA. The event served as a way for reporters to better connect with crops extension contacts for a variety of story ideas going into the harvest season.
Thank you to our industry partners!