

The North Central Soybean Research Program (NCSRP) is recognized as a leader in multi-state collaborative research and outreach efforts to support soybean farmers and drive the soybean industry forward. The focus of NCSRP is soybean production research and extension outreach. NCSRP's emphasis on enhancing and protecting soybean yield through genetics , basic biology, physiology, molecular biology, agritechnologies, and agronomic practices contributes to soybean farmer success today and tomorrow.



RESEARCH ANNUAL REPORT

FISCAL YEAR 2023



LETTER FROM THE PRESIDENT

Suzanne Shirbroun



Advancements in the soybean industry continue. Scientists and researchers are getting creative with new uses for soybean oil and meal beyond biodiesel. From additives to rubber and plastics, to medical products, to livestock feed for cattle, poultry, swine and aquaculture — Soy is everywhere!

The NCSRP board has funded 12 projects in FY2023 that help farmers like us improve our productivity and profitability as well as improving the soybean itself. Researchers are exploring ways to tolerate environmental extremes such as drought and flooding, to withstand pests and diseases, and to improve the crop's compatibility with herbicides for better weed control, and more.

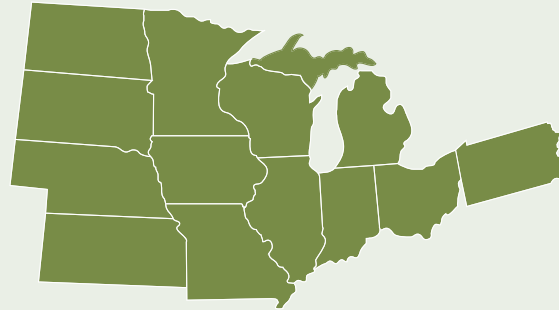
The NCSRP board continues to leverage funding from Qualified State Soybean Boards (QSSBs) and collaborating partners to have a bigger impact on our investment in soybean research. The board works hard in support of strong research results on behalf of all soybean farmers in the North Central region and across the country.

I encourage you to review the projects that NCSRP has funded this year as well as other years to see the larger impact this regional group has made. Visit the Soybean Research & Information Network (SRIN) website to learn more about these projects and others. The SRIN is supported by NCSRP and is the go-to resource for research results, and written in a user-friendly format tailored for farmers.

I am proud to serve as the president of NCSRP, just as I am proud to be a soybean farmer. Thank you for the opportunity to lead this great group of devoted growers!

-Suzanne Shirbroun
FY2023 NCSRP President

NCSRP BOARD OF DIRECTORS - FY23



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FROM THE EXECUTIVE DIRECTOR

Ed Anderson, Ph.D.



This 2023 NCSRP Research Report summarizes the basic and applied production research projects, student training, and Extension and outreach efforts funded during the 2023 fiscal year.

The 13 farmer board members work with university researchers, extension specialists, state staff

and those in private industry to award a variety of multi-state, multi-institution, and multi-disciplinary research programs and projects. Large, ongoing research programs holistically address priority challenges and opportunities facing soybean farmers in their effort to produce the highest yielding, highest quality, and most sustainable soybeans. Research, teaching, and extension topics include advanced breeding to enhance genetics that improve soybean yield, pest resistance, flood and drought tolerance, and seed quality; basic studies to understand and improve agronomics and crop management systems that maximize inputs and manage insect pests, diseases and weeds; and new technology for management decision tools to improve the farmer's bottom line.

NCSRP applies soybean checkoff funds contributed by nearly 355,000 farmers across the Midwest to support and communicate these important production research projects for the success of soybean farmers everywhere. The result is a sustained investment in the improvement of the soybean industry.

The impact of this research goes far beyond the North Central region, as scientists collaborate to find solutions for soybean farmers that can be applied across the Midwest and the U.S. Farmers know all too well that soybean production challenges don't adhere to state lines. Leveraging checkoff investments with state, regional and multi-regional research helps us all.

—Ed Anderson
eanderson@ncsrp.com

MISSION:

NCSRP will serve as a bridge between state and national soybean organizations and will be the recognized leader in funding and communicating basic and applied soybean research programs that are highly collaborative and uniquely appropriate in addressing soybean production, profitability and environmental sustainability for growers across the North Central region.

GUIDING STATEMENTS:

1. NCSRP Executive Board will review overall program impact and success and establish specific research priorities of regional importance on a five year cycle (e.g. key diseases, insects, production practices, etc.).
2. NCSRP funded programs and projects will not be redundant with current state (QSSB) or nationally (USB) funded programs but may complement and extend state or nationally funded projects when addressing the common interests and needs of North Central region soybean growers.
 - NCSRP will maintain communication and collaborative connectivity with QSSBs and the USB to maintain awareness of state and national soybean research priorities and funding.
 - Regional researchers submitting proposals for NCSRP funding must provide clear statements of research being funded by a QSSB or the USB.
3. Multi-year research project or program proposals will be accepted for funding consideration, but annual renewal will be predicated on successful generation and communication of meaningful annual results.
4. NCSRP emphasizes the collection, compilation and dissemination of research results through appropriate peer reviewed scientific abstracts and journals, extension publications, farmer-focused bulletins,

appropriate websites (Soybean Research & Information Network) and databases (National Soybean Checkoff Research Database).

COLLABORATIVE SOYBEAN RESEARCH OBJECTIVES AND PRIORITIES:

1. Soybean yield and quality enhancement through genetic improvement and biotic and abiotic stress mitigation for soybean maturity groups 0-IV.
 - Classical and molecular soybean breeding efforts that will enhance yield potential and yield stability clearly focused to the North Central region.
 - Research that addresses the control of insects and diseases (defensive traits) with consistent or potentially significant economic impacts across the North Central region.
 - Research that addresses weed resistance to herbicides for species of common occurrence and threat across the North Central region.
 - Research that addresses soybean response to water, nutrients, soil and environmental conditions unique to the North Central region.
2. Soybean production practices that will increase yield, profitability and environmental stewardship issues specific to the North Central region.
 - Soybean-corn rotations
 - Plant populations, row spacing and input management
 - Water quality and watershed planning
 - Cover crops and other conservation agronomy
 - Soybean production sustainability and life cycle assessment

RESEARCH BY THE NUMBERS

98 Researchers
(PIs and Co-PIs)

17 Universities
and Extension
programs

23 QSSBs involved

3 USDA-ARS offices
(4 staff members
at 3 locations)

PROJECTS FUNDED IN FY23

1. An Integrated Approach to Enhance Durability of SCN resistance for Long-term, Strategic SCN management (Phase III)

Principal Investigator: Andrew Scaboo, University of Missouri

Scientists continue to search within the soybean cyst nematode genome for traits that can help fight this problematic pathogen. The project enables scientists to develop more efficient SCN management practices. The main challenge is identifying SCN virulence genes to understand how the nematode adapts to reproduce on resistant soybean varieties. The team is testing new cultivars and management strategies to provide farmers with additional tools for SCN resistance beyond PI 88788- and Peking-type varieties.

2. Development and Expansion of Disease Management Decision-Making Tools Across Multiple Soybean Regions

Principal Investigator: Carl Bradley, University of Kentucky

Decision-making tools provide a method to target fungicide applications, improving fungicide efficacy and proactively delaying fungicide resistance development. The Sporecaster app is successful in helping farmers make fungicide application decisions. The Sporecaster platform has since been used to develop a framework for frogeye leaf spot. Given the importance of frogeye leaf spot to Southern, Mid-southern, and Atlantic regions, the project aims to expand the prediction framework to these regions. The team will consolidate research across these regions for Cercospora leaf blight and target spot.

3. Field Phenotyping Using Machine Learning Tools Integrated with Genetic Mapping to Address Heat and Drought Induced Flower Abortion in Soybean

Principal Investigator: Krishna Jagadish, Texas Tech University

A 30 to 80% flower drop in soybeans across the U.S. is an unresolved bottleneck that has limited full genetic yield potential ability. The multi-regional team will develop an image-based field phenotyping system, integrated with deep-learning tools to capture genetic variation in flower abortion and pod retention under different soils and climatic conditions. This knowledge will help discover molecular switches to enhance flower and pod retention and enhance yield potential.

4. Improving Flood & Drought Tolerance for Soybeans in North Central Region

Principal Investigator: Henry Nguyen, University of Missouri

Researchers have been studying the genetic basis of flood tolerance in soybeans, and drought has become a problem as well. Soybean breeders have been developing drought-resilient germplasm and varieties; however, most of the breeding work has been in late maturity groups. The team will characterize soybean germplasm to identify flood-tolerant genetic resources and molecular markers for breeding applications in the North Central region, and develop new soybean varieties with drought and flood tolerance in MG 0 to 4.



5. Mapping Soybean Protein and Oil Quality in Farmer Fields

Principal Investigator: Ignacio Ciampitti, Kansas State University

Measuring soybean protein and oil content used to require laboratory analysis. Previous projects involved calibrating near infrared sensors to produce soybean quality maps. This project will develop a database to benchmark agronomic practices, genetics, management and environmental conditions for soybean quality predictions at regional levels that can lead to large-scale quality improvements. The team intends to have an interactive simulation tool to show in-field predictions based on remote-sensed data collected from the sites.

6. Multi-Dimensional Approaches for Improved Productivity, Sustainability, and Management of Major Soybean Diseases in the North Central U.S.

Principal Investigator: Damon Smith, University of Wisconsin

The project goal is to develop improved strategies for sustainable management of major North Central soybean diseases. Soybeans are susceptible to an array of disease-causing microbes that can result in significant costs for the farmer and the environment. Many factors can affect soybean pathogens including weather, cropping systems, and fungicide resistance. The team will explore prediction tools for stem canker and sudden death syndrome; monitor fungicide resistance; and conduct foliar fungicide trials for white mold, frogeye leaf spot and *Diaporthe* diseases to better understand their biology.

7. Research and Extension on Emerging Soybean Pests in the North Central Region

Principal Investigator: Kelley Tilmon, Ohio State University

This project involves collaborative work on soybean gall midge, stink bugs, and management of aphid-resistant soybean varieties. The team will expand the soybean gall midge emergence monitoring program and screen germplasm for midge resistance traits to help with breeding soybean varieties that are midge-resistant. They will explore mowing and tillage as controls and conduct surveys in new areas to determine the midges' range. The team will also review sticky traps and pheromone lures for better scouting of stink bugs, and test new insecticide chemistries for aphid resistance.

8. The SCN Coalition: Economics and Advancing Management

Principal Investigator: Samuel Markell, North Dakota State University

This project builds on past success, focusing on the economics and research advances in SCN management. The team will include other economically important nematodes, such as the root-knot nematode, and diseases impacted by SCN. Objectives include maintaining and recruiting industry partners; Coalition management including training, educational materials development, and meeting facilitation; and the continuation of communication with media, farmers and partners.

9. Site-Specific Weed Management with Precision Application Technology

Principal Investigator: Chris Proctor, University of Nebraska

Current herbicide practices focus on broadcast applications that deliver a constant distribution rate across an entire field. However, weed populations have great spatial variability influenced by several factors. With recent improvements of sensors and sprayer technologies, the ability to detect and treat weeds on a real-time, site-specific basis can be feasible. The goal of this project is to optimize herbicide applications with a smart sprayer system to stimulate precision ag tool adoption for better weed management.

10. SOYGEN3: Building Capacity to Increase Soybean Genetic Gain in Future Environments for Seed Yield and Composition Through Combining Genomics-Assisted Breeding with Environmental Characterization

Principal Investigator: Aaron Lorenz, University of Minnesota

The goal of this project is to advance genomics-assisted breeding to develop soybean varieties for improved yield and composition. The team will develop better breeding methods and further implementation of genomic prediction in public soybean breeding programs. Objectives include testing methods for predicting cultivar performance in target environments through genomics-assisted breeding models, phenomics, and environment characterization; testing structural variants for improved genomic predictions for yield and seed composition.

11. SoyRenSeq: A Novel Approach for Disease Resistance Gene Discovery and Application for Soybean Improvement

Principal Investigator: Jianxin Ma, Purdue University

The goals of this project are to explore, apply, and optimize the RenSeq technology for accelerated identification of candidate genes conferring resistances to soybean pathogens in the Midwest, and for accelerated development of disease-resistant soybean cultivars by precise resistance gene selection.

12. Using Data-Driven Knowledge for Profitable Soybean Management Systems

Principal Investigator: Shawn Conley, University of Wisconsin

This project addresses soybean management issues and their return-on-investment at the field level, including pre-plant pest management, seeding rates and costs, and other inputs. The goal is to develop a database tool with farmer information from the region, as well as soil properties, weather and remote sensing data. The outcome includes an interactive tool to apply best management practices to maximize soybean yield and profit. A subset of selected farms will demonstrate the developed tool.

**Increase of
\$844,585
for FY23**

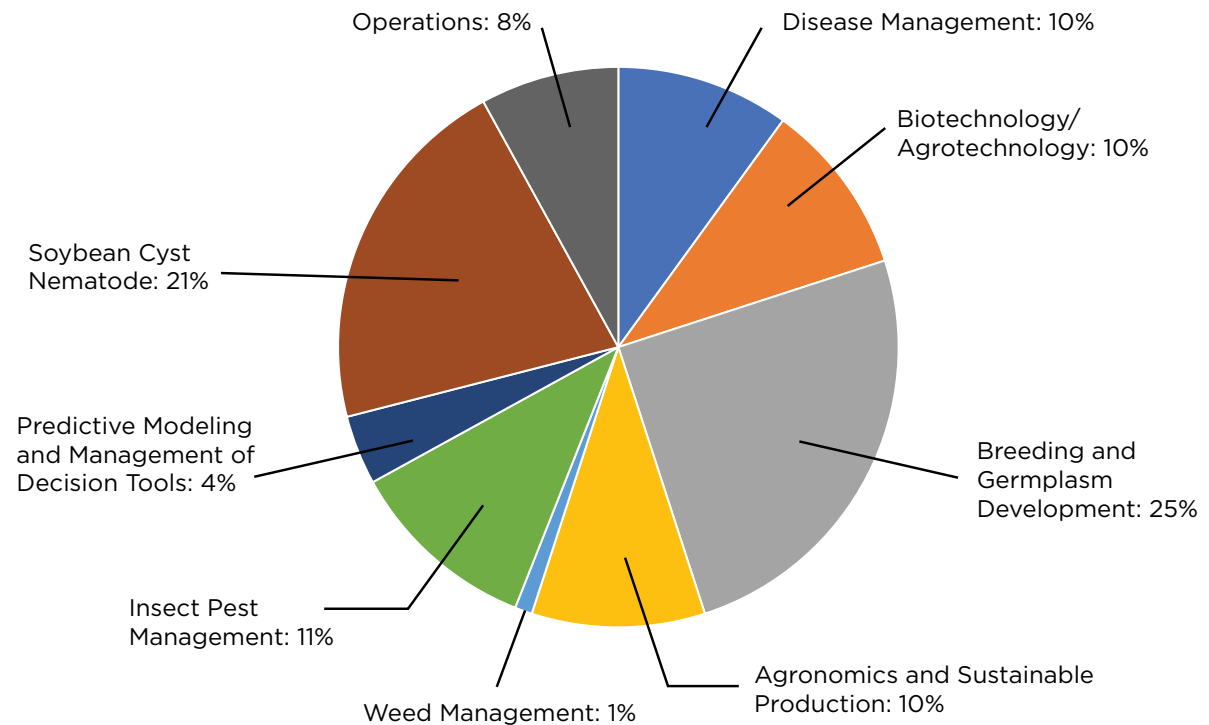
**FY23
TOTAL:
\$4,968,514
12 projects**

**FY22 TOTAL:
\$4,113,929
9 projects**

Checkoff amount invested in production and applied research in FY23

\$4,968,514

**Knowledge-Powered Portfolio: Crafting a Well-Balanced
Investment Mix for Research and Innovation**



FY2023 Budget Details: State Contributions: \$4,793,514

USB Partial Support for Operations and SRIN: \$175,000



SOYBEAN RESEARCH & INFORMATION NETWORK



SoybeanResearchInfo.com

Your go-to resource for NCSRP and other checkoff funded research results. The Soybean Research & Information Network (SRIN) site includes information about agronomics, pests and disease management, as well as videos, publications and more.



SoybeanResearchData.com

Take a deeper dive into checkoff-funded research. Read about funded projects and their technical reports from the researchers themselves.

The National Soybean Checkoff Research Database is funded by the United Soybean Board to help all stakeholders find information about national soybean research projects funded by the soybean checkoff.



1255 SW Prairie Trail Parkway
Ankeny, Iowa 50023

Funded by the soybean checkoff

