BRINGING RESEARCH TO FARMERS

2024 Research Report

NEBRASKA SOYBEAN BOARD

Nebraska Soybean Association
4435 O Street, Suite 210
Lincoln, NE 68510

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RESEARCH IMPACT

Dr. Jim Specht

I am Jim Specht, a retired UNL Professor. For the past decade, I have served as a Research Advisor for the Nebraska Soybean Board (NSB), providing reviews/ratings of research proposals submitted to NSB each year.

Soybean-focused research is known to generate novel and innovative genetic and agronomic technologies that (1) enhance on-farm soybean yield, (2) improve resistance/tolerance to biotic pests and abiotic stress, and (3) improve seed compositional traits to optimize soybean use in human food project, or in livestock and aquaculture rations, and in non-food industrial products. Ultimately, research leads to scientifically verified farm practices that increase crop & animal productivity, reduce production costs, and improve overall profitability and sustainability.

In this document, the lead PI of each FY24 NSB-funded research project provided a brief summary of the objectives, methods, and results (discoveries/findings to date). In the "applied" research projects, the discoveries will likely be quickly translated into on-farm use, whereas in the more "basic" research projects, the findings may require more developmental research to be converted into farm-ready genetic or agronomic tools.

I congratulate the Nebraska Soybean Board Members for their due diligence in their selection of the most meritorious soybean research projects that are funded each year, using soybean checkoff dollars contributed by the 22,000+ NE soybean producers.

IMPROVING NEBRASKA SOYBEANS THROUGH COLLABORATION

Doug Saathoff

Hello, I am Doug Saathoff, a soybean farmer from Trumbull, Nebraska, and a director on the Nebraska Soybean Board. I am also the chair of the production and crop research committee. This Annual Research Report shares the exciting progress of research funded by NSB.

Five board members make up the production and crop research committee. The committee's main goal is to ensure that Nebraska soybean production and quality show continuous improvement. With every project considered for funding, we ask ourselves: *Will this research and its findings benefit Nebraska soybean producers?* Doing this requires a lot of time and energy from all board members along with a trusted team of industry advisors who help us understand the details of each research project.

We work closely with UNL researchers and extension educators to provide quality research projects with positive outcomes for producers. Some of our research investments also go to the North Central Soybean Research Program. We combine our dollars with 13 other states in this program to help fund even higher-level research to increase soybean quality and production throughout the United States.

I especially want to thank our research advisors, who dedicate their time to evaluating each project. We could not do this without them. I also want to thank everyone involved in helping make Nebraska soybean producers the most productive and efficient growers in the world.

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On the Cover: Dr. Dylan Mangel conducts soil sampling with a probe at a University of Nebraska-Lincoln plot in September 2024.

SOYBEAN BREEDING AND GENETICS STUDIES FOR NEBRASKA

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $461,581**
LEAD RESEARCHER | **Dr. George Graef** *(University of Nebraska–Lincoln)*

Our soybean breeding program has three main objectives: (1) improve yield, particularly in Nebraska production environments, (2) protect yield from diseases and pests, as well as from abiotic stresses like drought and high-pH soil that are important issues in Nebraska, and (3) improve seed compositional quality. Our program aims to address important constraints to soybean production for farmers in Nebraska.

Last year we showed examples of our progress in creating a better balance of seed protein, oil, and soluble carbohydrates to enhance value for producers, processors, and end users, and highlighted our progress in developing soybeans that are highly tolerant of high-pH soil. For this update, I'd like to discuss more generally the role of our public soybean breeding program and how it complements industry efforts to fill gaps that in the end benefit soybean producers in Nebraska and across the north-central U.S.

Our ongoing research focuses on integrating genetic, agronomic and image/sensor data to aid effective decision-making and improve efficiency of the variety development program. With the continued support from the Nebraska Soybean Board, we are able to produce new soybean varieties that are competitive with the best industry cultivars. Superior soybean cultivars from our program impacts soybean producers in different ways: (1) improving ROI when grown directly as a new cultivar on their farm, (2) contributing to success of other programs when we share the germplasm with our colleagues at other USDA and university research and development programs, and (3) supporting industry programs by providing superior germplasm that is marketed directly or used as parents in programs in Nebraska and throughout the U.S.

During 2024 we shared 48 unique new soybean lines with superior yield, disease resistance, and seed composition traits with seven companies, plus more than 11 university and USDA programs. Thirty-five new soybean cultivars were licensed in 2024. The companies represent smaller, independent and family-owned state and regional operations and newer companies using gene editing and predictive breeding technologies. It's great to see the broad and direct impacts providing more choices and opportunities and contributing to the long-term success of soybean producers.

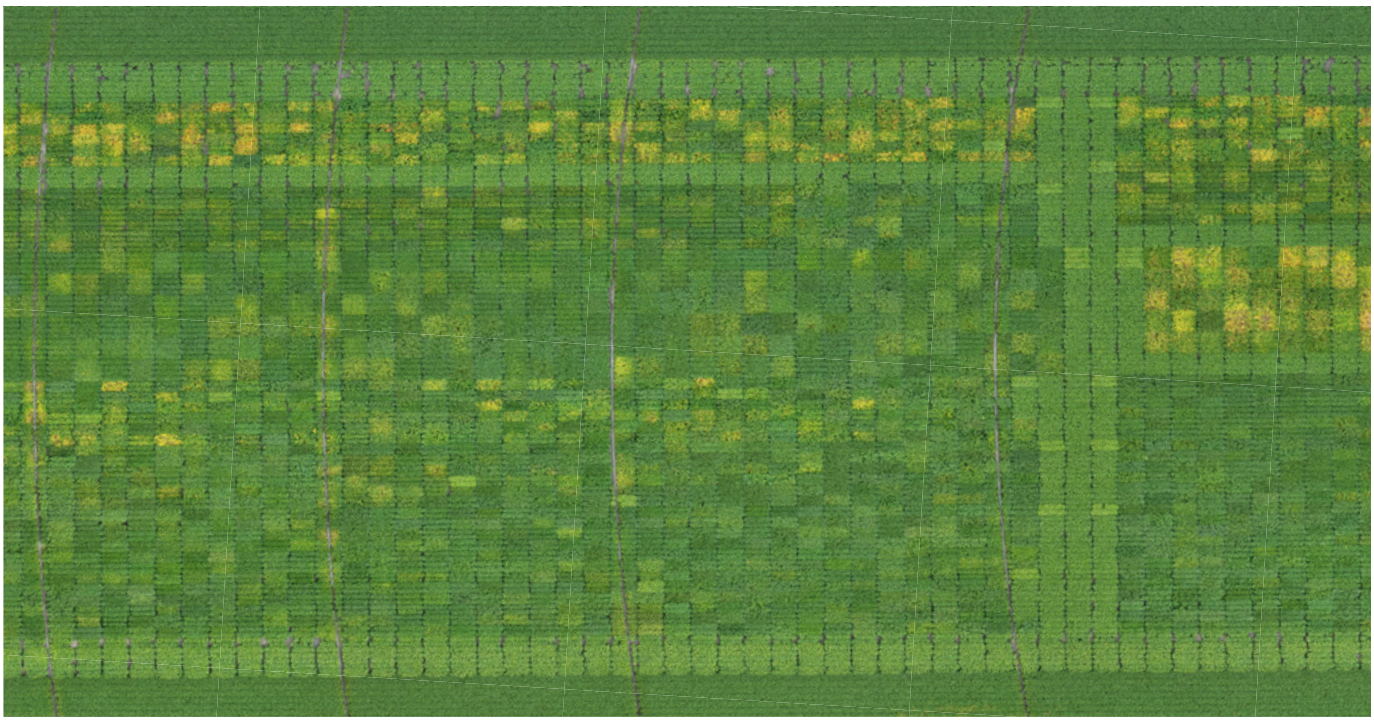


Figure 1. Image from UAV of one of our farmer cooperator sites in Nebraska 2024 *(photo by Arthur Bernardeli - UNL).*

WINTER NURSERY SUPPORT FOR SOYBEAN BREEDING & GENETICS

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $280,412**
LEAD RESEARCHER | **Dr. George Graef** *(University of Nebraska–Lincoln)*

The contra-season nurseries in Puerto Rico and Chile provide us with five additional generations per year in our research and development programs. That is a significant benefit for developing populations for research projects and for our variety development efforts. In the Puerto Rico environment, we use two lighted generations and two unlighted generations from October 1 to June 1. The lighted areas allow good production of F1 plants, crossing block areas, and single plants for specific objectives. In the Chile nursery, our primary use is for progeny rows, growing about 12,000 per season from November to April. The growing environment at the Chile nursery correlates well with Nebraska, so selection for traits important in Nebraska production environments is effective. Plant populations and small increases for research and development programs also occur to enhance overall program efficiency. We routinely collect leaf tissue for DNA analysis in our Puerto Rico F1 and crossing block areas and can do that as needed for specific objectives in the Chile nursery. Overall, the nurseries are invaluable to the success of our research and development programs.

Some specific material and crossing objectives in our Puerto Rico 2025 nursery include:

(1) Developing research populations to identify genes and characterize resistance to soybean gall midge. This follows up on work during the past 3-4 years with Dr. Justin McMechan at UNL and entomologists in IA, MN, and SD to characterize host plant response to soybean gall midge infestation. We identified several soybean lines with very low levels of damage, consistent over years and locations. Now we can focus on the more extreme resistant and susceptible types to try to identify specific genes and mechanisms involved in the resistance response.

(2) SCN yield crosses for cultivar development. We have a group of elite, high-yielding soybean lines in our program that have strong, unique resistance to all prevalent SCN types in Nebraska and the north-central U.S. They contain the 3-gene combination of rhg1-a, rhg2, and Rhg4 from different soybean accessions. From decades of research and development efforts in the public sector at the University of Illinois, University of Missouri, USDA, and all of the university and USDA breeding programs, our program and others have elite soybean lines with superior SCN resistance now available to soybean producers.

Other material in the crossing block and in our generation advance fields includes superior tolerance to iron deficiency chlorosis on high-pH soil, resistance to frogeye leaf spot, soybean aphid and soybean mosaic virus, and unique seed composition balance between protein, oil, and carbohydrates to maximize oil production and still produce a hi-pro meal.

Progeny rows in Chile nursery February 5, 2025.

Crossing block in Puerto Rico nursery, March 2024

GENETIC CONTROL OF SOYBEAN NODULATION BRADYRHIZOBIUM STRAINS IN NEBRASKA SOILS

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $104,208**
LEAD RESEARCHER | **Dr. David Hyten** *(University of Nebraska–Lincoln)*

Research Conducted: A key advantage of soybeans is that it is a legume that gets a large proportion of its nitrogen from a symbiotic relationship with the bacteria Bradyrhizobium which forms nodules on soybean roots. While this symbiosis supplies soybeans with a significant amount of nitrogen through biological nitrogen fixation, it has been found that it can be insufficient in high-production environments and can limit yields. Increasing the amount of biological nitrogen fixation is a strategy that could help increase yields in highly productive environments where current nitrogen fixation is insufficient to meet the requirements for optimum soybean yield. Bradyrhizobium strains vary in their efficiency at fixing nitrogen and soybean cultivars grown in Nebraska may not be selecting to form nodules with strains that fix the most nitrogen for the plant. The focus of this project is to determine how variation within soybean selects for different Bradyrhizobium strains that are present within high-production fields and which strains are superior for increasing biological nitrogen fixation.

Importance: The goal of this project is to increase farmer yields and profit by increasing the amount of nitrogen supplied to the soybean without the use of nitrogen fertilizer. This project aims to identify the most efficient nitrogen fixation Bradyrhizobium strains in Nebraskan soils and the host genetics required to ensure that current cultivars will preferentially nodulate with the efficient nitrogen fixation strains. This will allow soybean seeds inoculated with the efficient nitrogen fixation strains to preferentially nodulate with them over other naturally occurring strains that are less efficient at fixing nitrogen.

Findings: We have worked on growing our diverse soybean populations in soil collected throughout Nebraska (Figure 1). DNA was extracted from the collected nodules and are now undergoing DNA sequencing (Figure 2). This DNA sequence will be used to identify the different Bradyrhizobium strains that formed nodules with the diverse soybean germplasm. This project will also identify regions in the soybean genome that select for different Bradyrhizobium strains and identify which strains are more efficient at biological nitrogen fixation.

Benefits: Through the identification of genes in soybeans that select for superior biological nitrogen fixation Bradyrhizobium strains, breeders will be able to breed Nebraskan cultivars to preferentially form nodules with these strains if they occur in their fields or if it's being supplied as an inoculate. We will then be able to test whether these superior strains are able to increase yields by providing more biological nitrogen to the soybean plant.

Figure 1. Soil was collected from multiple high-production soybean fields across Nebraska. Diverse soybean plants were grown in the greenhouse planted in the collected soil. This soil provided a natural inoculum of the bacteria found in high production fields that produces nodules on the roots of these diverse soybeans.

Figure 2. The soybeans grown in the greenhouse had their roots washed revealing lots of nodules present on the roots. Nodules were collected followed by DNA extraction and sequencing of the Bradyrhizobium present in the nodules to help identify the different strains present on each diverse soybean line.

ASSESSING THE GENETIC DIVERSITY AND VULNERABILITY OF NEBRASKAN SOYBEAN

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $49,391**
LEAD RESEARCHER | **Dr. David Hyten** *(University of Nebraska–Lincoln)*

Research Conducted: This project characterized the genetic diversity currently within the University of Nebraska-Lincoln (UNL) soybean breeding program. We performed DNA sequencing of key germplasm from the program including historical lines, germplasm lines, released cultivars, and parents of current breeding lines. With the DNA sequence we worked to identify regions across soybean's 20 chromosomes which have low genetic diversity in the UNL soybean breeding program. We also used DNA sequence information to identify potential germplasm from the United States Department of Agriculture's germplasm collection that has novel genetic variation not present in the breeding program.

Importance: Maintaining genetic diversity within the breeding program is crucial for the sustained improvement of soybeans in Nebraska. This research lays the foundation for understanding the genetic diversity present in the state's soybean germplasm and how selection practices impact that diversity. Genetic gain and yield potential directly correlate with the genetic variability in the population. Identifying novel diversity that complements the elite background is essential for future improvements and the enduring success of the Nebraska soybean breeding program.

Findings: Our findings reveal key insights into the genetic makeup of Nebraskan soybean breeding lines (Figure 1). In the breeding lines we found regions throughout soybean's 20 pairs of chromosomes that have low amounts of genetic diversity that could be targets for genetic improvement (Figure 2). We also found other regions with higher diversity where environmental influences are playing a role in maintaining genetic variance to help soybean be resilient when grown across diverse environments. Our results will be used as a roadmap to identify new germplasm that brings in novel genetics for soybean improvement. This newfound understanding of the genetic architecture of soybean diversity in the breeding program will enable breeders to select new parental lines more effectively, aiding in boosting genetic gain.

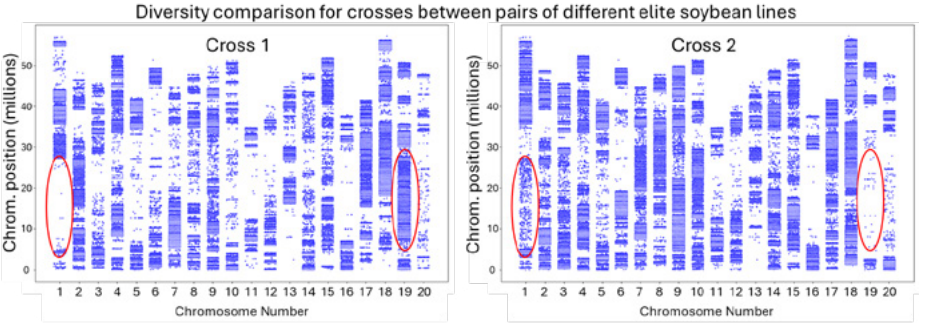


Figure 1. In a soybean breeding program, breeders begin the process by making crosses between pairs of different elite soybean cultivars. These will be the parents of each cross. Soybean has 20 pairs of chromosomes. With the DNA sequence we can compare the sequence for the two parents and plot out the differences across the chromosomes. This is the genetic variation that segregates within each cross and is inherited by the progeny created from each cross. In the graphs above we can plot those differences as blue dots. Some regions of the genome have more genetic variation than others and each cross has genetic variation present in different regions across the chromosomes such as the areas circled in the figure above. This results in different traits being inherited by the progeny for the breeder to select throughout the breeding pipeline.

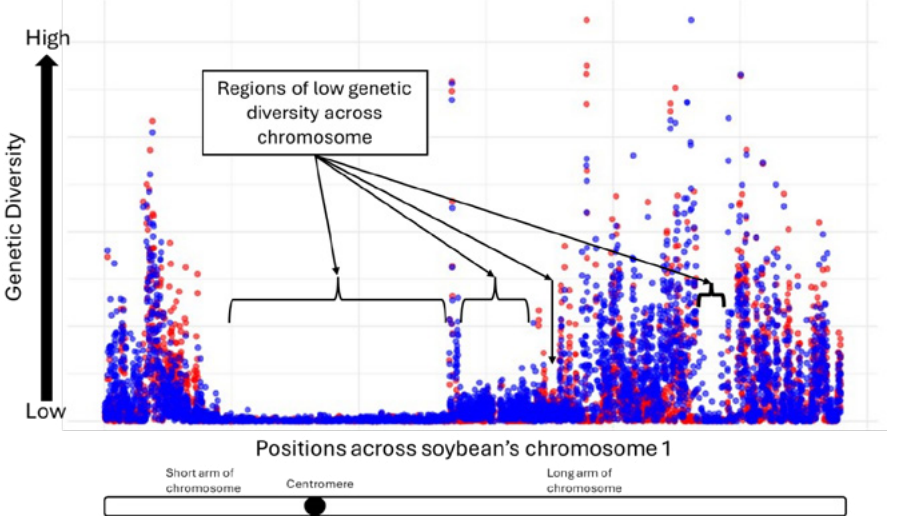


Figure 2. Instead of just looking at diversity in individual populations, the DNA sequence obtain allows us to look at genetic diversity for different collections of soybean lines. We can then identify regions of low genetic diversity within the breeding program. In this example we are just looking across the first chromosome of soybean. We have analyzed the amount of genetic diversity present across two different groups of breeding lines (red and blue dots) that have undergone selection. There are large regions of the chromosome that have low levels of diversity along with some regions that have high levels of genetic diversity. This roadmap allows us to begin exploring other soybean populations that might have genetic variation present in these low-diversity regions.

Benefits/Recommendations:

Introducing Novel Diversity: Our research emphasizes the importance of identifying lines that are most likely to incorporate novel diverse germplasm to counteract low-diversity vulnerabilities in the breeding program.

Identifying Regions of Selection: Identifying genomic regions under selection is crucial. Selecting for these regions while incorporating diverse germplasm is vital for local adaptability of new cultivars developed from diverse germplasm.

In conclusion, our ability to identify novel diversity that can complement the adapted soybean elite parental background can be used for future improvement to ensure the long-term success of the Nebraska soybean breeding program.

DEVELOPING HIGH SEED PROTEIN GENETIC TOOLS WITH CONTRASTING NITROGEN FIXING CAPABILITIES

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $25,966**
LEAD RESEARCHER | **Dr. Luis Gerardo Alejandro Posadas Martinez** *(University of Nebraska–Lincoln)*

Currently, no line pairs with contrasting biological nitrogen fixation (BNF) capacity exist in soybean high-protein (HP) backgrounds. The HP germplasm developed by the UNL soybean breeding program is among the highest protein-producing materials, containing 57% protein on a dry-matter basis. This proposal aims to develop six isoline pairs with contrasting BNF abilities. One pair for each of two genetic backgrounds—elite and exotic—across maturity groups (MGs) I, II, and III.

Nitrogen is a vital component of soybean seeds, playing a key role in the production of essential molecules such as nucleic acids, amino acids, and proteins. Proteins constitute a significant portion of the soybean seed, ranging from 35% to 42% at 13% seed moisture. To meet its nitrogen demands, the soybean plant relies on (i) the uptake of soil nitrates and (ii) BNF, a symbiotic process in which soil bacteria form root nodules that convert atmospheric nitrogen into a usable form.

Recent findings indicate that while increased BNF activity comes with a higher energetic cost, potentially leading to yield penalties, our research suggests that BNF is also crucial for the plant to reach its full yield potential. Notably, seasonal nitrogen applications in the field cannot easily replace BNF.

In this NSB-funded project, we aim to investigate the metabolic mechanisms of BNF by developing nearly identical soybean lines that differ only in their ability to acquire nitrogen from the atmosphere (BNF+ vs. BNF-). The creation of these genetic tools in HP backgrounds across three MGs, alongside the recently deployed isoline pairs in high-yielding backgrounds, will enable scientists to determine the optimal BNF modulation needed to maximize on-farm soybean yield.

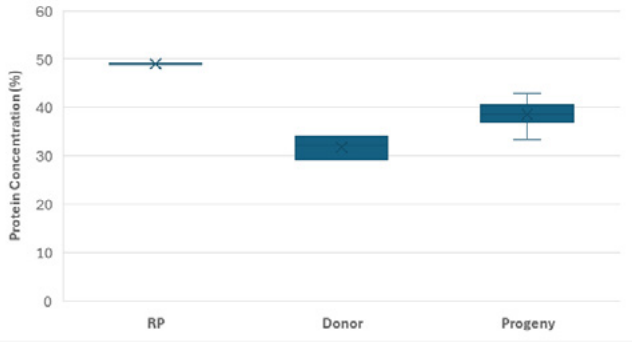
The first round of crosses was completed in the summer of 2023, followed by the first round of backcross breeding in the summer of 2024 (Figure 1). Additionally, we collected NIR data to compare the protein content of the first-generation progeny with that of their HP parents. As illustrated in Figure 2, the protein content of the progeny falls approximately midway between that of their donor and HP parents (13% moisture basis).

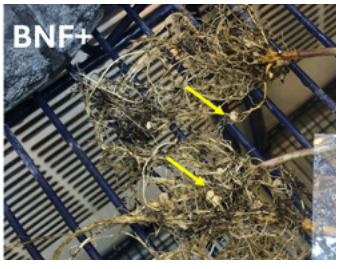
These genetic tools will enable researchers in the region—including physiologists, agronomists, and breeders—to gain deeper insights into the different N-assimilation pathways and their impact on source-sink N-allocation in the HP plant versus the high-yielding background. This research can have significant implications for soil health, soybean quality for animal feed, and, most importantly, the development of biological methods to enhance or sustain nodulation in soybeans without compromising yield.

Figure 1. Breeding scheme proposed for the development of six isoline pairs in exotic and adapted high-protein backgrounds across three maturity zones.

YEAR	SEASON	LOCATON	GENERATION	ACTION	Recurrent Parent		DONOR	% RP GENOME
2023	Summer	Lincoln	Crossing		Rj1Rj1-HP	X	rj1rj1+MG	
2023-2024	Winter 1	Puerto Rico	F1	Confirm-Self		Rj1rj1		50% RP
2023-2024	Winter 2	Puerto Rico	F2	Genotype-Select		2% rj1rj1+MG		
2024	Summer	Lincoln	F2:3	Cross	Rj1Rj1-HP	X	2% rj1rj1+MG	
2024-2025	Winter 1	Puerto Rico	BC1F1	Confirm-Self		Rj1rj1		75% RP
Nursery			BC3F3:4	Increase	NIL HP-Rj1Rj1 HP-BNF+		NIL HP-rj1rj1 HP-BNF-	

Figure 2. Average seed protein content in 2024





ROLE OF SOYBEAN MEAL IN SUSTAINABLE POULTRY RATIONS

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $48,999**
LEAD RESEARCHER | **Dr. Sheila Purdum** *(University of Nebraska–Lincoln)*

Laying hen flocks are being kept in production for longer periods of time due to challenges such as avian influenza. As hens age, diets typically go lower in total protein and amino acids as the rate of lay also decreases. Current practices expect hens to lay more eggs for a longer lifespan (up to 2 years of age). Our research objective was to test the protein level with essential amino acids during late lay in White Leghorn hens up to 100 weeks of age.

Three diets were fed in two phases: 60–80 weeks and 80–100 weeks of age.

- **Diet 1 (Negative Control):** Formulated to provide 90% overall protein and 100% essential amino acids, meeting Dekalb breeder nutrition recommendations.
- **Diet 2 (Positive Control):** Formulated to meet 100% of protein and amino acid recommendations.
- **Diet 3 (Enriched Diet):** Contained 10% more protein and essential amino acids than Diet 2.

All diets were isocaloric and equal in calcium and available phosphorus.

During Phase 1 (60–80 weeks of age), egg production was 92.5%, 93.6%, and 94.0% for hens fed Diets 1, 2, and 3, respectively. Hens fed Diet 3 (higher protein and amino acids) laid larger eggs, produced more egg mass throughout the phase, and had the best feed conversion ratio.

Phase 2 (80–100 weeks) posed a challenge for hens on the negative control diet (Diet 1), as protein intake was too low. These hens dropped to 0% production and showed signs of morbidity. After only one month, Diet 1 was discontinued, and only Diets 2 and 3 were continued. During this phase, hens fed Diet 3 continued to lay larger eggs. We plan to repeat the Phase 2 diets for older laying hens in Year 2 of research.

In summary, older laying hen flocks approaching 2 years of age cannot be fed low protein and essential amino acids as typically recommended by breed nutrition guidelines without seriously compromising bird health and egg production. Supplementation of protein and essential amino acids from soybean meal to a level of 10% above low baseline levels improves egg size and feed conversion in older hens.

EFFECTS OF USING SOYBEANS, ROASTED SOYBEANS OR SOYBEAN MEAL IN FEEDLOT DIETS

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $51,769**
LEAD RESEARCHERS | **Dr. Pablo Loza** *(prior faculty member at the University of Nebraska–Lincoln),* **Dr. Galen Erickson** *(University of Nebraska–Lincoln),* **Melissa Bausch** *(Ruminant Nutrition Graduate Student)*

Three experiments have been conducted on growing and finishing cattle to evaluate feeding soybeans as either soybean meal, whole soybeans, or roasted soybeans. In each experiment, these were compared to either use of two other common protein/energy feeds: urea only added to a corn diet, or using distillers grains.

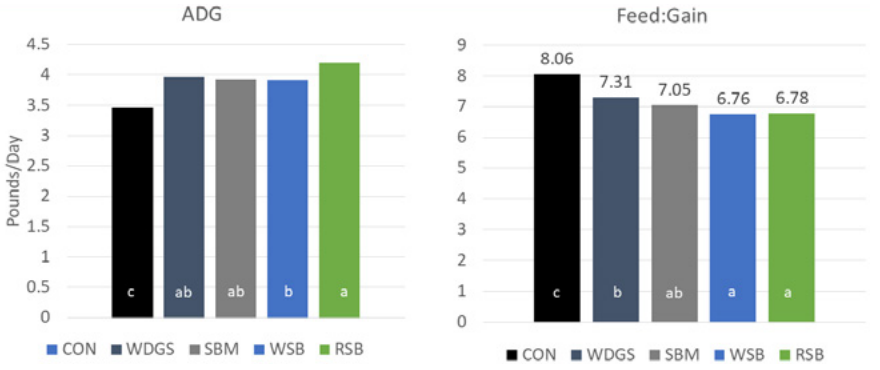
Many perceive that you cannot feed whole soybeans to livestock but this is not a concern for cattle as any antinutritional factors are a non-issue for cattle as they are a ruminant. These three projects were all large cattle feeding studies with two focused on finishing and one focused on growing cattle. Growing and finishing cattle benefit from protein that we call bypass protein, which is protein not used in the rumen by microbes, but bypasses them and can be used by the cattle directly. Soybeans are an excellent source of amino acids, like lysine, which is why feeding soybean meal works so well for pigs and chickens. But, if fed to cattle, then the microbes actually decrease the lysine, and some other amino acids, by chewing up some of the good amino acids and replacing it with others. But, heating and other treatments can prevent that modification by microbes in the rumen of cattle. When we look at whole soybeans as a protein (and energy from the oil) for growing or finishing cattle, performance was enhanced as cattle gained more and were more efficient at using the diet. Roasting the soybeans (heating), further enhanced this growth and efficiency response. In fact, these feeds were better protein and energy sources for finishing cattle and similar to distillers for growing cattle.

These experiments show beef producers that feeding soybeans and soybean meal is a viable alternative as supply of beans increase. This provides a value to the beef industry when formulating diets for protein and allows for a cost-benefit calculation. Feeding whole beans provides better energy than soybean meal as the oil intact still in the soybean provides energy as well. Roasting does further increase the protein and energy value and prevents oil from becoming inhibitory if diet inclusion increases. While roasting costs extra, these data again provide a value to evaluate against any increase in cost. Soybeans fed whole, soybean meal, and roasted soybeans are all good supplements at 10 to 20% inclusion in diets for growing and finishing cattle.

Finishing Study

- 400 Yearling Steers (average 950 lbs)
- 8 pens per treatment

Ingredient	Control (CON)	Distillers (WDGS)	Soybean Meal (SBM)	Whole Soybean (WSB)	Roasted Soybean (RSB)
Corn Silage	20	20	20	20	20
DRC	71	62	65	64	64
WDGS	-	12	-	-	-
SBM	-	-	9	-	-
WSB	-	-	-	10	-
RSB	-	-	-	-	10
Supplement	9	6	6	6	6
Urea	1.5	1	0.5	1	1
CP	13.1	14.5	14.5	14.3	14.7



The WSB group ate less than the CON, WDGS, and RSB. The RSB group had the best gain, significantly more than CON and WSB

Regular soybeans used in trials

Roasted soybeans used in trials

SOYBEAN SCLEROTINIA STEM ROT FUNGICIDE NURSERY VALIDATION AND RISK ASSESSMENT TOOL VALIDATION

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $26,332**
LEAD RESEARCHER | **Dr. Dylan Mangel** *(University of Nebraska–Lincoln)*

Research Conducted: Sclerotinia stem rot (SSR), commonly known as white mold, poses a significant threat to soybean production. To help soybean producers manage SSR, this study aimed to (1) establish an SSR disease nursery to test new products under field conditions; (2) test the Sporecaster decision support tool under Nebraska conditions; (3) conduct laboratory evaluation to establish fungicide activity baselines and (4) provide educational outreach to support cost-effective SSR management decisions. This project also included an On-Farm Research (OFR) trial in Seward County, Nebraska, evaluating the effectiveness of SSR management through chemigation applications.

Importance: SSR is caused by Sclerotinia sclerotiorum, a soilborne pathogen that can cause yield losses of up to 50% in severely affected fields. Once established, the pathogen survives for years as sclerotia in the soil, making effective management a critical concern for soybean farmers. SSR thrives in cool, moist conditions, with soybean plants being particularly susceptible during flowering. Nebraska's large, irrigated acreage has contributed to the establishment of disease, making effective management a priority for soybean farmers. While fungicides are commonly used for control, their effectiveness depends on application timings and environmental conditions. Additionally, an available disease prediction tool developed in the Great Lakes region, has yet to be validated under Nebraska's climate. This study aims to provide Nebraska farmers with reliable data to make informed, cost-effective decisions for SSR management.

Findings: Findings from the SSR disease nursery provide data on the most effective fungicide options. These have been published in the UNL 2025 Guide to Weed, Disease and Insect Management in Nebraska, and Crop Protection Network, offering insights into fungicide efficacy against S. sclerotiorum. Additionally, extension outreach programs have been conducted across the state to provide growers and consultants information on SSR management. The 2024 OFR trial in Seward County tested the efficacy of SaniDate 12.0 applied via chemigation three times throughout the summer. However, due to environmental conditions unfavorable for SSR development, no white mold was observed in the trial fields, and no differences were detected between treated and untreated plots. Similar trials will persist in future seasons.

Benefits/Recommendations: This project plays a crucial role in monitoring disease trends, evaluating management strategies, and equipping growers with data to make informed, effective decisions for white mold control. While fungicides remain an option, their cost-effectiveness depends on economic factors, which may be unlikely to be a practical solution in fields without a history of white mold.

Greenhouse research led by Roshani Baral in the UNL Applied Soybean Pathology Lab, on susceptibility of soybean plants to infection from the white mold pathogen.

Mushroom-like structures of the white mold causing pathogen, Sclerotinia, preparing spores to infect Nebraska soybeans.

TRACKING THE SEVERITY, FREQUENCY, AND HOSTS OF SOYBEAN GALL MIDGE

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $49,645**
LEAD RESEARCHER | **Dr. Justin McMechan** *(University of Nebraska–Lincoln)*

Soybean gall midge emerged as a significant soybean pest in 2018 and was initially detected in 65 Midwest counties. By 2024, larval presence of soybean gall midge had been detected in 176 counties across seven states, encompassing 19.3 million soybean acres at the county level. In Nebraska alone, 58 counties are infested, covering 90% of Nebraska's soybean acres. Five years after its occurrence, wilting and dead plants (Fig. 1) from larval feeding are still occurring in several counties in Nebraska. Field observations in recent years reveal significant variability in infestation levels and plant injury, prompting questions about the factors driving increased risk in certain areas.

Research Conducted: Our objective was to conduct a field survey to evaluate the presence, abundance, and plant injury from soybean gall midge in Nebraska and establish a database to determine any weather or management-related factors for increased risk. In addition, the larvae from these fields would be analyzed for any genetic differences.

Findings of Research: In a 2024 random field survey across 62 counties, soybean gall midge larvae were detected in 49 counties, with 28 showing elevated larval presence (Fig. 2a). Plant injury was observed in 23 counties, with elevated injury levels in 9. In 20 counties, more than 10% of plants were infested (Fig. 2b). To date, an analysis of the surrounding landscape indicates that key factors influencing larval presence, infestation frequency, and plant injury include the presence of dense vegetation, distance from the previous year's soybean field, and the proportion of soybean planted in the area the prior year. Genetic analyses indicate that the genetics of soybean gall midge are very similar across its geographic range. This has also been conducted with a few key regions of its genetic code, so further work will be needed.

Benefits or Recommendations: None of the identified risk factors can be easily modified by growers. However, these factors help areas at higher risk of soybean gall midge infestation and damage. The most effective management strategies are preventative, requiring action before the pest is present in the current season. Growers can make informed management decisions by considering the risk factors from this survey alongside historical field data. Additionally, this survey has enhanced scouting efforts for detecting soybean gall midge in new counties.

Figure 1

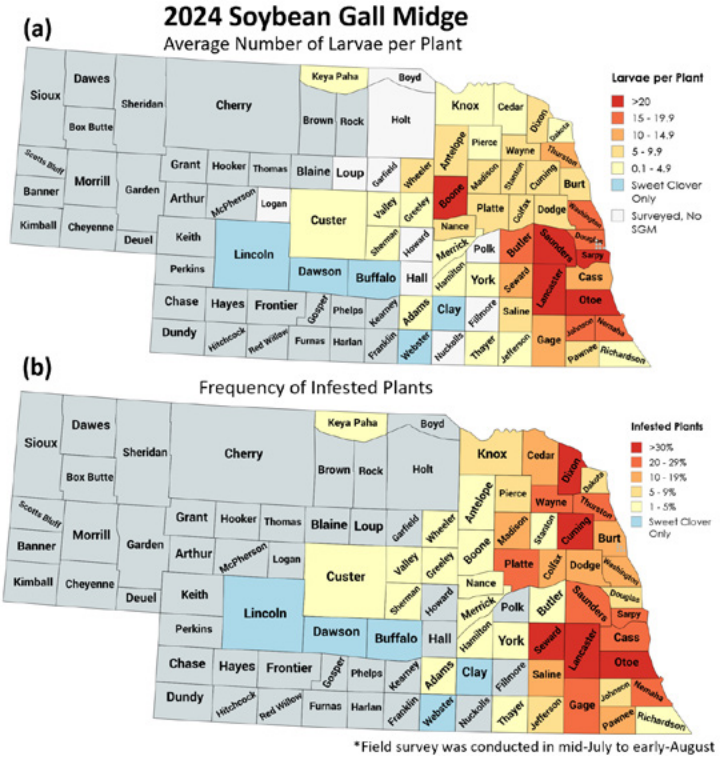


Figure 2

EVALUATING THE IMPACT OF INSECT PESTS AND PLANT DISEASES IN SOYBEAN

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $59,834**
LEAD RESEARCHER | **Dr. Justin McMechan** *(University of Nebraska–Lincoln)*

Insect pests and plant diseases have the potential to cause significant yield losses in soybean each year in Nebraska. Estimating their economic impact on soybean is difficult due to the variation in their geographic distribution, weather patterns, or differences in crop management practices. Over the past decade, Nebraska soybean producers have dealt with the introduction of soybean gall midge, the increased presence of Dectes stem borer, and the continued pressure from plant diseases such as phytophthora root rot, sudden death syndrome, and numerous foliar fungal pathogens in soybean. For soybean farmers to make an informed investment in pest management research, a project is needed to determine the severity and impact of these pests that account for the different soybean growing districts in Nebraska.

Research Conducted: To evaluate the impact and interactions of these key pests and pathogens, untraditional management practices (hilling, fipronil, and multiple fungicide applications) were used to provide near-complete control of soybean gall midge, Dectes stem borer and plant pathogens.

Findings of Research: Among the pests and pathogens evaluated, soybean gall midge had the greatest impact on yield (Fig. 1), with losses ranging from 12 to 34 bu/acre. At the three sites where no impact was observed, larvae were either absent, no nearby overwintering source was present, or significant early-season flooding had occurred. Dectes stem borer caused substantially less losses (Fig. 2), with its impact limited to sites also affected by soybean gall midge. In some cases, both pests were found in the same part of the plant, suggesting potential interaction between the species. The wide variation in Dectes stem borer impact aligns with previous studies, emphasizing the need to understand why losses occur at some sites but not others. Plant diseases had the least impact, likely due to unfavorable conditions for disease development.

Benefits or Recommendations: This is the first year of this study; however, current findings suggest that soybean gall midge is the primary cause of soybean losses and should be the focus in areas where pressure has occurred and risk is high. Given the unpredictable impact of Dectes stem borer, growers should prioritize scouting and managing lodging losses that occur when larvae girdle the plant at harvest. Disease pressure was unusually low this year, highlighting the need for additional data to assess future risks.

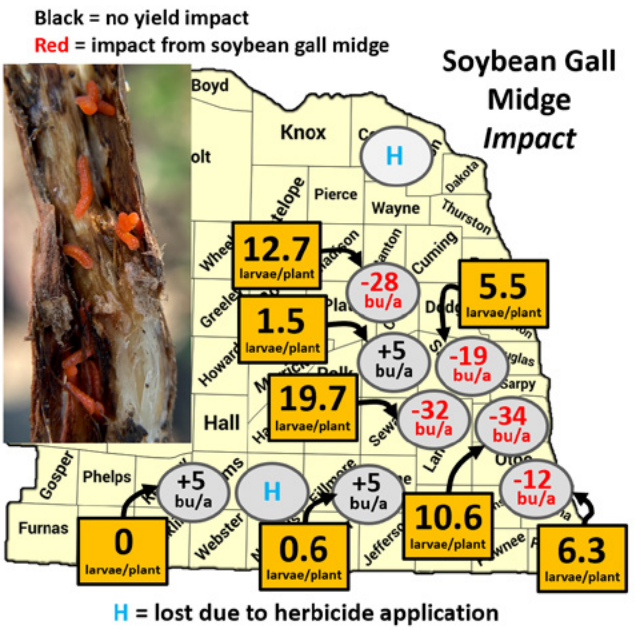


Figure 1: SGM Impact 2024

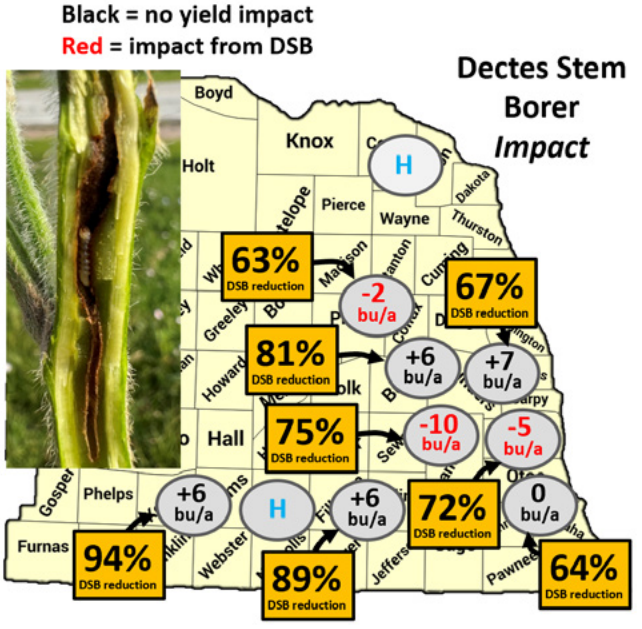


Figure 2: DSB Impact 2024

SURVEYING AND DEVELOPING ALTERNATIVE MANAGEMENT STRATEGIES FOR SEEDLING PATHOGENS IN NEBRASKA

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $52,107**
LEAD RESEARCHER | **Dr. Teddy Garcia-Aroca** *(University of Nebraska–Lincoln)*

Research Conducted: Soybean plants in Nebraska can get sick because of fungal pathogens in their roots. However, scientists don't fully understand which fungi are present and how much they vary between different locations. In our study, we set out to do two things:

1. Identify the fungal pathogens affecting soybean roots in Nebraska.
2. Test how well common fungicides work against these pathogens.

We collected soybean plants that showed signs of disease, such as stunted growth, damaged roots, or wilting leaves. Then, we took these plants to a lab to identify the fungi living in their roots. We tested different fungicides, including single-ingredient and multi-ingredient mixtures, to see which ones were most effective. We also looked for fungi that might actually help soybean plants stay healthy.

Importance: Fungal diseases can cause serious problems for soybean farmers. If a fungus becomes resistant to fungicides, farmers may struggle to control the disease. Our research helps by:

- Identifying which fungi are most common in Nebraska.
- Checking if the current fungicides are still effective.
- Exploring natural solutions, like helpful fungi, to support plant health.

By understanding the diversity of these pathogens, we can develop better, long-term disease management strategies that benefit farmers and the agricultural industry.

Findings: We studied 182 soybean plants from 23 counties across Nebraska. Our main discoveries include:

- **Fusarium fungi:** We identified 89 different Fusarium strains, including types that are harmful to soybeans.
- **Fungicide effectiveness:** Fungicides with two or three active ingredients were still effective against Fusarium oxysporum and Fusarium solani. However, some fungi showed resistance to single-ingredient fungicides.
- **Beneficial fungi:** We found two strains of Clonostachys fungi. One is known to attack other harmful fungi and nematodes, which could make it useful for plant protection. The other Clonostachys species has never been reported on soybeans in the U.S. before.

Benefits/Recommendations: Our research shows that the fungicides used in Nebraska are still working, especially those with multiple active ingredients. However, resistance is becoming a concern for some single-ingredient fungicides.

One exciting finding is the presence of fungi that naturally attack harmful fungi and pests. These beneficial fungi could be used in the future to support plant health in a more natural way. By continuing to study pathogens and these beneficial fungi, we can help farmers protect their crops while finding sustainable solutions for soybean disease management.

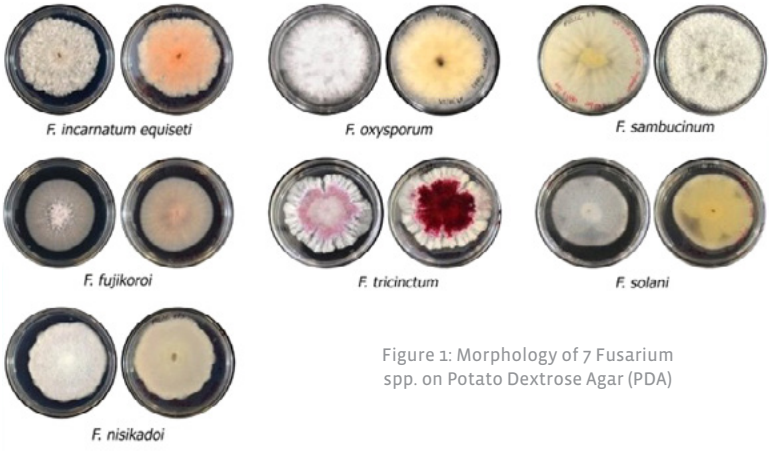


Figure 1: Morphology of 7 Fusarium spp. on Potato Dextrose Agar (PDA)

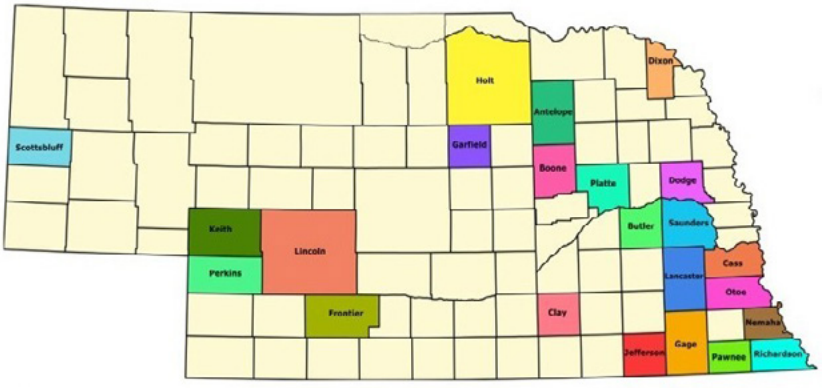


Figure 2: Map of NE showing counties where samples collected

USING A SYSTEMS APPROACH TO INCREASING SEED PROTEIN IN SOYBEAN

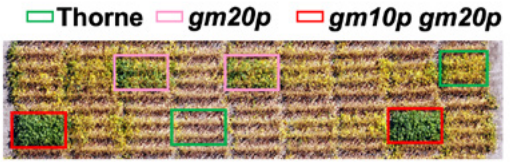
CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $37,360**
LEAD RESEARCHER | **Dr. Chi Zhang** *(University of Nebraska–Lincoln)*

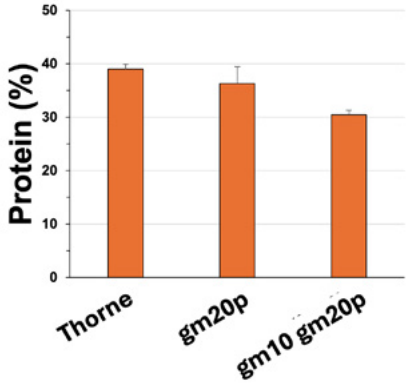
Research Conducted: We studied the soybean mutants with the goal of increasing seed protein content. Currently, the protein genes directly influencing soybean production remain inadequately comprehended. Dr. Tom Clemente, Dr. Ming Guo, Dr. Bin Yu, and Dr. Chi Zhang labs conducted an investigation of the mechanisms of seed-protein gene expression regulation during soybean maturity. A group of genes that control seed storage proteins were discovered in the soybean transcriptional network. The essential result will take us to the next steps for improving soybeans with elevated protein content without yield penalty.

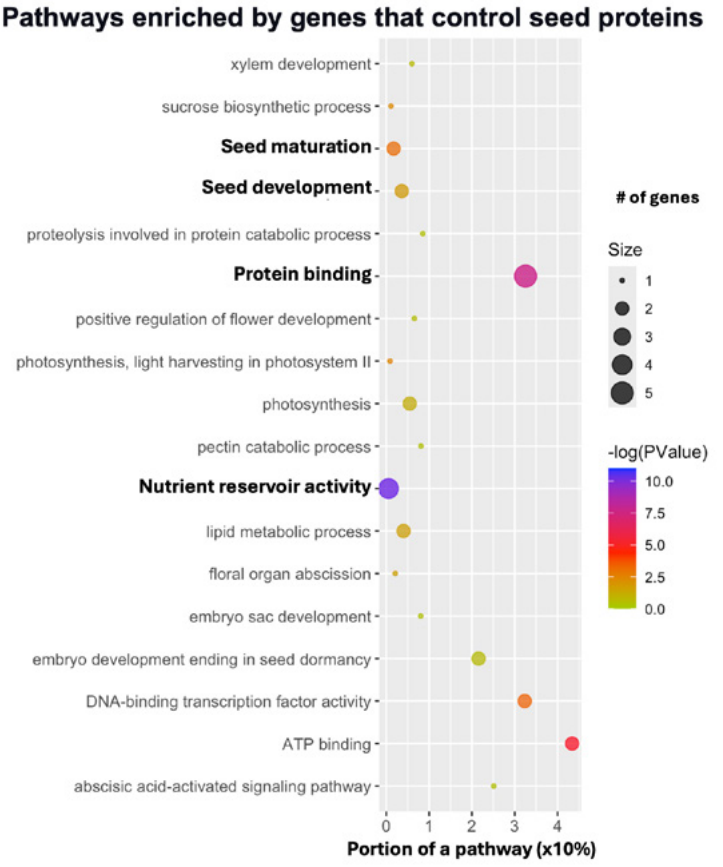
Importance: Finding important genes will open the path for genetic engineering solutions able to change connected systems and get over hereditary restrictions. Our present work on soybean seed protein synthesis intends to produce high-protein soybeans, which are in demand in the feedstock market. A study published in the Journal of Applied Poultry Research in 2023 indicates that a 1% increase in the crude protein content of soybean meal raises its value by almost $12 per ton. Hence, this would benefit the soybean grower in Nebraska and the whole U.S. as well.

Findings: We generated two soybean mutant lines at multiple sites, harvested seeds at different developmental phases, and performed transcriptome analyses on 24 samples. These two mutants exhibited reduced protein content in soybean seeds. Our investigation of these two mutants revealed several intriguing genes and their associated pathways related to protein synthesis in soybeans. We found that various photosynthetic mechanisms are significantly modified in the mutant. We present a novel hypothesis that altering the photosynthetic pathway may optimize energy utilization during seed development, hence improving yields and augmenting protein and oil content in soybean seeds. We also examined individual significant genes we identified, focusing on their gene structure, functions, and alternative splicing. These genes possess the potential to enhance the accumulation of protein in soybean seeds.

Benefits/Recommendations: Identifying the intricate relationships among the genes implicated in protein synthesis and regulation pathways is essential, as it is a vital step toward producing ideal transgenic soybeans to enhance protein accumulation in soybean.







ENHANCING SOYBEAN GERMPLASM THROUGH BIOTECHNOLOGY

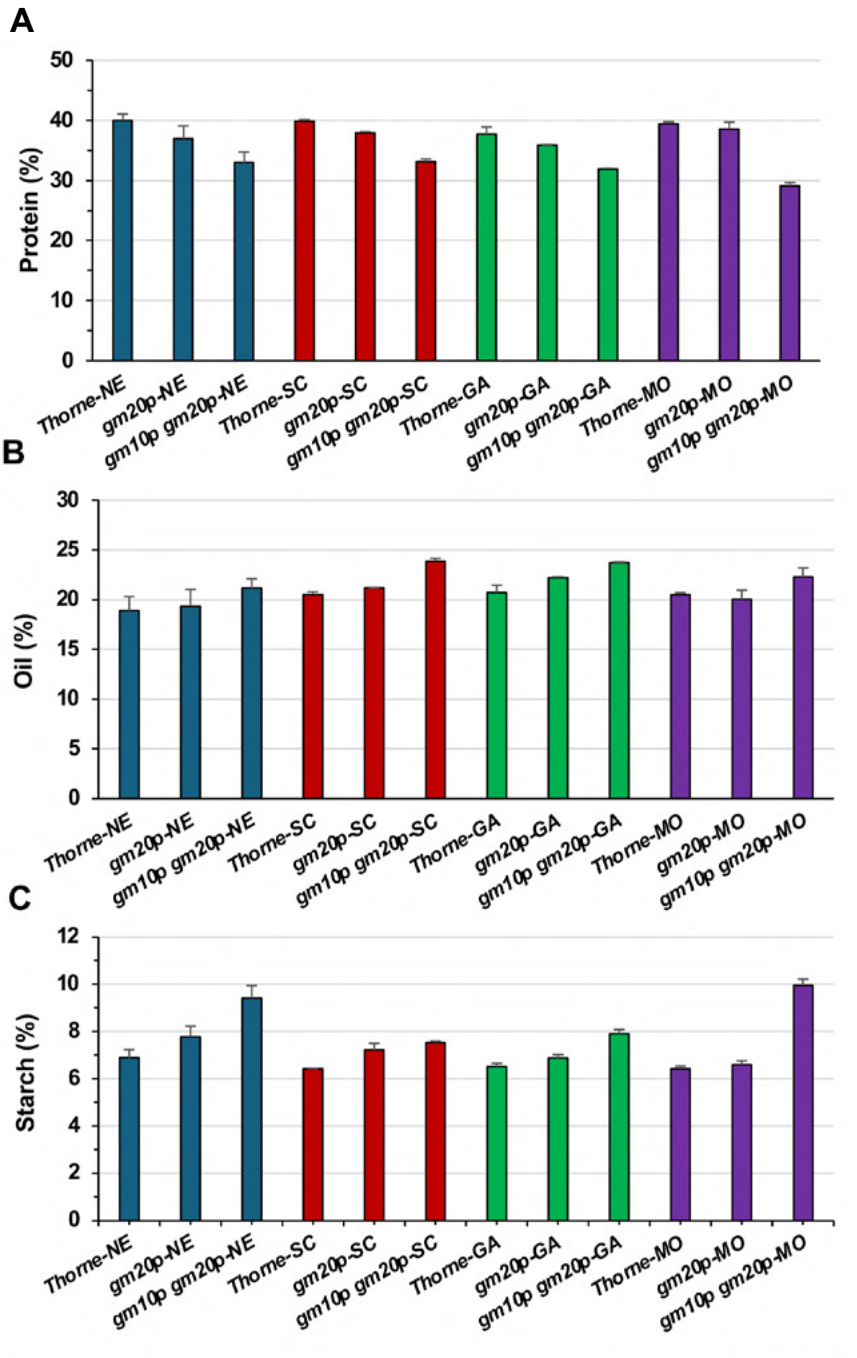
CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $139,328**
LEAD RESEARCHER | **Dr. Thomas Clemente** *(University of Nebraska–Lincoln)*

Research Conducted: A component of this program is gaining insight into the mechanism by which the gene identified by researchers at the University of Illinois, which underlies the major protein QTL on chromosome 20, impacts seed reserves (protein/oil/starch). To do this edits were created to the gene on chromosome 20 and its paralog on chromosome 10. These mutants, dual mutation (chrom20/chrom10) or single mutation (chrom 20) and were field-tested across four locations in 2023 and the harvest characterized in 2024. In addition, soybean lines have been created that carry the dual edit, and single edits (only chrom 20 or chrom 10). Moreover, we completed a set of complementation transformations that introduced expression cassettes that carry four genetic designs of the gene on chrom 20, that are being introgressed into WT, dual and each single edit genetic background.

Importance: The soybean biologicals created in this program are designed to allow for the elucidation by which the gene on chrom 20 impacts seed reserve content. Understanding the mechanism on how this gene functions will help inform soybean breeding programs on genetic strategies that improve predictability on quality of the soybean harvest (i.e desirable protein/oil/starch content).

Findings: Soybean lines carrying the dual edits are delayed in maturation, have significant reduction in protein content, with a concomitant elevation in starch content, with slight increases in oil. This outcome was observed across all locations tested, with more pronounced differences seen in the two more northern locations (see graphs).

Benefits/Recommendations: Continued characterizations of the soybean biologicals generated in this program holds great potential in broadening our knowledge on the genetic underpinnings that control seed reserve content. This understanding will help guide soybean breeding program in their genetic strategies to maintain and improve the nutritional quality of soybean across environments.



Composition analysis of soybean seeds from multiple locations in field trials in 2023. A, protein (total amino acid); B, oil; C, starch. NE, Nebraska; SC, South Carolina; GA, Georgia; MO, Missouri.

IMPROVEMENT OF SOYBEAN GERMPLASM FOR AQUACULTURE FEED

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $75,211**
LEAD RESEARCHER | **Dr. Ed Cahoon** *(University of Nebraska–Lincoln)*

The Cahoon and Clemente labs are working to genetically improve soybean for higher value food and feed markets, including aquaculture. This industry is one of the fastest-growing global food production sectors. To date, soybean oil has had limited use as a feed source because it lacks fish oil omega-3 fatty acids EPA and DHA that promote heart health. Soybean oil also has no astaxanthin, the high-value pigment that provides the consumer-preferred red color of salmon and shrimp.

To enhance the marketability of soybean oil for aquaculture feed, we are introducing algae and plant genes into soybeans to produce EPA- and DHA-rich oils. We are also incorporating genes from the red petals of the Adonis flower to develop astaxanthin-rich soybean seeds. This research involves the assembly of up to 10 genes and their introgression into soybean germplasm by the University of Nebraska-Lincoln Plant Transformation Core Research Facility, run by Tom Clemente. Our work is at the forefront of soybean biotechnology, creating oil traits unattainable through conventional breeding. We initially evaluate engineered soybeans in the greenhouse and test top EPA, DHA, and astaxanthin lines in the biotech field at the Eastern Nebraska Research, Extension and Education Center (ENREEC). To date, we have developed soybean lines with up to 10% EPA and a combined 3% DHA/5% EPA. While these levels are commercially viable, we are now focusing on mitigating reductions in oil content and germination in engineered lines. Over the past year, we have applied patent-pending technology to develop soybean seeds that produce astaxanthin. Using this technology, we have succeeded in developing seeds that produce high-purity astaxanthin without impact on oil amounts and seed quality in greenhouse trials.

In 2024, we leveraged Nebraska Soybean Board funding to secure a grant from the National Science Foundation's (NSF) Global Centers program. This grant titled "Food Innovation and Diversification to Advance the Bioeconomy (FoodID)" is led by the UNL Department of Food Science and Technology and involves a collaboration with a food innovation lab in Finland. The NSF funding will develop new oil extraction technologies for high-value oil components such as astaxanthin and new food formulations. This grant is a win-win for the Nebraska Soybean Board and Nebraska producers as it will hasten commercialization of our aquaculture germplasm and other oil traits and develop new food markets for genetically enhanced soybeans.

Production of astaxanthin in soybean for high-value aquaculture feed components. Shown are the seed images (left) and chloroform extracts (right) from non-engineered 'Thorne' seeds and soybeans engineered for astaxanthin production. The red color is the extracted astaxanthin pigment.

Field testing of aquaculture soybeans at the Eastern Nebraska Research, Extension and Education Center in Mead, NE in the summer of 2024.

BALANCED NUTRITION & NUTRIENT PRIORITIES FOR 80+ BU/ACRE SOYBEANS

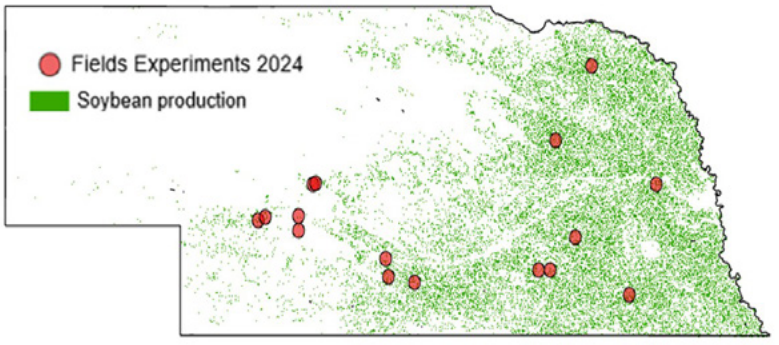
CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $99,313**
LEAD RESEARCHER | **Dr. Nicolas Cafaro La Menza** *(University of Nebraska–Lincoln)*

Research Conducted: Information regarding macro-nutrient (NPKS) requirements to sustain current soybean yield gains in Nebraska is scarce. Therefore, the primary goal of this project is to investigate soybean macro-nutrient needs in terms of extent (number of fields with limitation), severity (magnitude of yield and nutrient uptake limitation), and establish nutrient priorities (ranking based on their extent and severity of limitation) to sustain the current yield gains. We conducted 15 on-farm soybean field experiments across the state to assess the macro-nutrient needs and limitations.

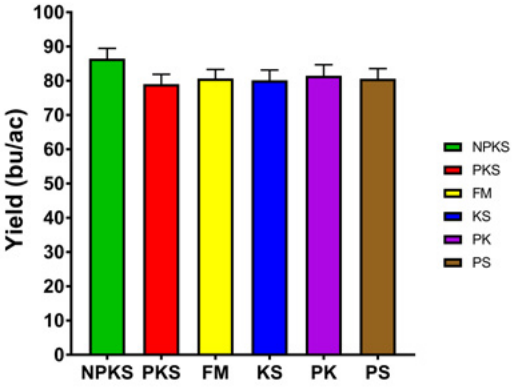
Importance: Nebraska's soybean production has a value of 3.4 billion dollars, and over 50% of planted soybean acres are under irrigation. Nebraska has the highest average irrigated soybean yield and gains across U.S. irrigated soybean states. Maximizing soybean production value and seed quality sustainably is important for Nebraska and U.S. soybean production.

Findings: Preliminary results show that around 10% of soybean seed yield (~8 bu/ac) is limited by nutrients on irrigated fields that consistently achieve around 80 bu/ac. Likewise, seed protein concentration is limited by a nutrient supply of about 0.3 percent. No changes in seed oil concentration were found due to nutrient limitations in high-yielding soybeans in 2024 experiments. Among the macronutrients tested, the treatment with nitrogen was the most responsive, indicating that nitrogen supply from the soil, biological nitrogen fixation and fertilizer need to be well-complemented to consistently obtain 80+ bu/ac soybean yield. In most cases, the farmer fertilization program used across these 15 experiments was sufficient to cover nutrient requirements for high-yielding soybeans, except for nitrogen. Still, we observed some cases of overapplication of sulfur, especially when accounting for sulfur credits from irrigation water.

Benefits/Recommendations: While we continue this research on nutrient priorities for 80+ bu/ac soybeans, we encourage farmers to continue adopting early planting soybeans and the best crop management practices for weed and pest control before moving to a more aggressive fertilization program. Testing nutrients from irrigation water and crediting these nutrients to current fertilization programs can provide considerable savings on fertilizer expenses. Finally, if you want to test changes in your fertilization program for 80+ bu/ac soybeans, you can contact us at nicolas.cafaro@unl.edu or (308) 696-6712 as we are conducting several on-farm trials in 2025, and we can possibly include your field.



NSB Balanced Nutrition 2024 experiments



Yield data

DETERMINANTS OF NITROGEN & OIL CONTENT WITH DEPTH IN THE SOYBEAN CANOPY

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $73,282**
LEAD RESEARCHER | **Dr. John Lindquist** *(University of Nebraska–Lincoln)*

Research Conducted: Soybean seed protein and oil concentrations are critical to soybean seed quality and are determined by genetics, soybean physiology, and the environment in which they are grown. The long-term goal of this work is to contribute to the fine-tuning of management recommendations in soybean to optimize seed protein and oil content.

The steady increase in soybean yield over time owing to breeding efforts has resulted in a decline in seed protein concentration. Moreover, soybean seed protein (and oil) concentration varies depending on its position within the soybean canopy. Seeds toward the top of the plant have greater protein and lower oil concentration than seed lower on the plant. This suggests dynamic variation in the way that the products of photosynthesis and nitrogen uptake are partitioned to maturing seeds during the soybean reproductive period. However, these dynamics have not been well studied. The specific objective of this project was to quantify the variation in soybean seed protein and oil content within each of five canopy layers (strata) and determine their dependence on soybean growth, and biomass and nitrogen partitioning over time.

Importance: The value of soybean grain is linked to its' protein and oil content. If breeding for greater yield continues to result in reduced seed protein and oil concentrations, the value of soybean, pound for pound, may decline. Understanding why soybean seed protein and oil concentration varies with position in the canopy and across genotype, environment, and management can inform management to improve overall soybean seed protein and oil content, thereby increasing the value of soybean harvest.

Figure 1. Two soybean cultivars sown at three planting dates. Skips indicate destructive sampling subplots.

Findings: Preliminary results showed that seed protein and oil content vary with vertical location within the canopy. Seed protein and oil content are primarily determined by the rate of protein or oil accumulation in those seeds, which is driven by the amount of available photosynthetic supply to each seed, which is determined by the amount of leaf area feeding each seed and the amount of light intercepted by those leaves. At the whole plant level, seed protein content was strongly determined by the amount of nitrogen that is remobilized from vegetative organs during reproduction. Therefore, the amount of nitrogen accumulated within soybean vegetative tissues prior to the R5 development stage is critical in determining the potential seed protein content.

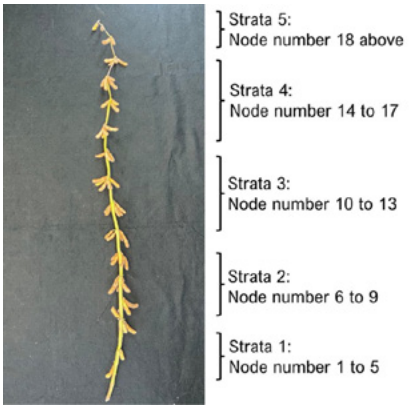


Figure 2. Mature soybean plant and the method of separation by strata.

Benefits/Recommendations: Long-term benefits may include management recommendations to optimize vegetative tissue nitrogen content in order to maximize seed protein content.

DEVELOPING AN APPROACH TO GUIDE NITROGEN FERTILIZER APPLICATION IN SOYBEAN

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $90,175**
LEAD RESEARCHER | **Dr. Patricio Grassini** *(University of Nebraska–Lincoln)*

Nitrogen supply can limit soybean yields, especially in highly productive irrigated crops that are planted early and receive good management. However, there are no explicit guidelines on nitrogen fertilizer application for soybean.

The team led by UNL Professor Patricio Grassini and Assistant Professor Nicolas Cafaro La Menza is working to develop recommendations on nitrogen fertilizer application for Nebraska's soybean farmers. Over the past years, the team has conducted more than 50 trials in farmer soybean fields across the state. In each field, the researchers have evaluated the yield response to nitrogen fertilizer application and assessed different methods to predict the yield response so that farmers can determine in which cases a nitrogen fertilizer application should be considered.

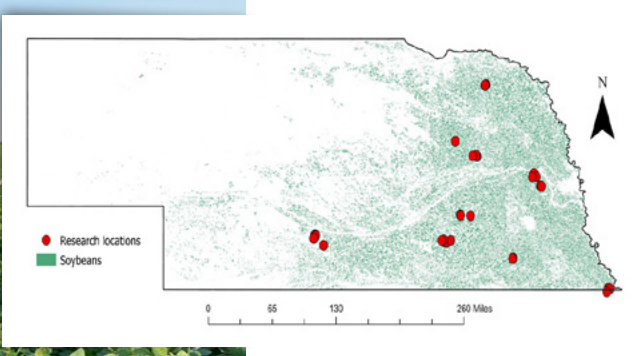
"We found that a cost-effective yield response to application of 70 lbs of N around flowering stage in half of the trials" says Professor Grassini. "The challenge is how to identify those fields where an economically profitable yield response is expected."

However, finding a way to predict the yield response to nitrogen has not been an easy task. "We analyzed more than 100 plant, soil, weather, and management-related variables that could allow the identification of nitrogen-limited soybeans. Among them, we found that plant N content around flowering can be used to predict the response to fertilizer N application," says Assistant Professor Nicolas Cafaro La Menza.

The team is now using this information to develop practical recommendations for Nebraska soybean producers to help guide their nitrogen application in soybean. "We are excited as we are coming closer to developing the first nitrogen recommendation for soybean in the state and this could have a positive impact on the yield and profit of NE soybean producers" adds Cafaro La Menza.

However, it is important to keep in mind that nitrogen application should only be considered for high-yielding environments and for crops in which other management practices have already been optimized. "First things first. Farmers should not forget about the most obvious ways to achieve high soybean yields, including early planting, proper management of weeds, insect pests and diseases, and adequate soil and water management," says Dr Grassini. "Producers should think about applying nitrogen only after optimizing these other management practices.

Field experiment near Sutton, Nebraska.



Field experiment locations across the state with nitrogen fertilizer application treatments.

SURVEYING SOYBEAN GROWER'S UNDERSTANDING OF EMERGING PESTS TO INFORM RESEARCH AND EXTENSION

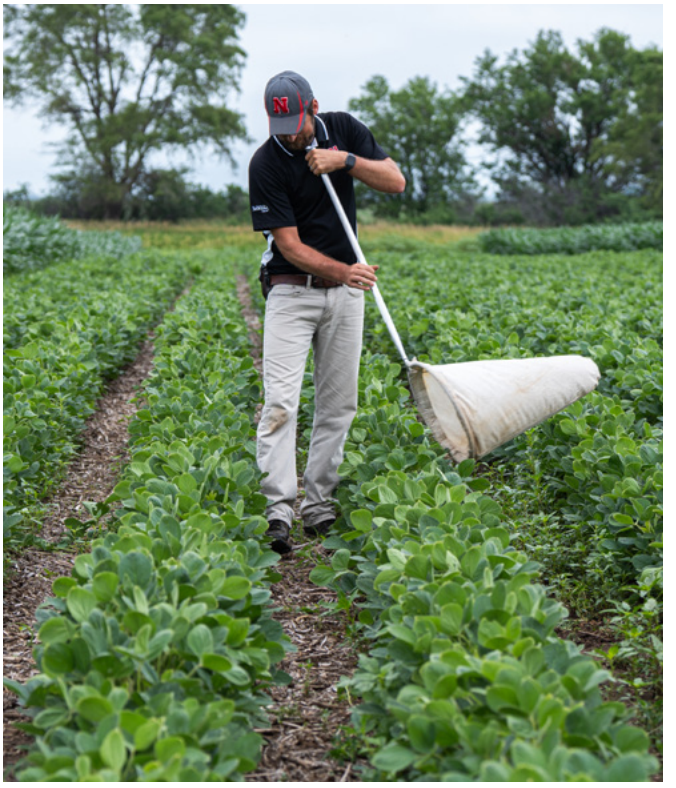
CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $10,472**
LEAD RESEARCHER | **Dr. Doug Golick** *(University of Nebraska–Lincoln)*

In 2024, Nebraska soybean growers and agriculture professionals completed surveys regarding their management of and concerns regarding emerging insect and weed pests. Of those who completed the survey (116), 84% reported that they are at least somewhat concerned about managing soybean gall midge (SGM) with 36% of those being very concerned. 56% of responding producers were at least somewhat concerned about managing Dectes stem borer (DSB), with 15% being very concerned. 95% of growers expressed at least some concern with managing herbicide-resistant weeds (HRW) with 38% reporting that they are very concerned about managing herbicide-resistant weeds.

Nearly all agricultural professionals had concerns about HRW management with Soybean gall midge and Dectes stem borer ranking second and third respectively.

In examining the likelihood of using strategies to manage soybean gall midge agriculture professionals responded from most likely to least likely to use; seed treatments, mowing field margins and waterways, foliar insecticides, late planting of soybeans, tillage of rows, granular pesticides, and hilling of plant stems to deal with soybean gall midge. Not surprisingly, hilling and tilling were among the least likely to use strategies as respondents elaborated that they either adopted no-till practices and/or no longer had the equipment to deploy these strategies. Of the respondents, 58% reported having SGM (n = 57), 47% having DSM, and 95% having HRW issues in their fields in the last three years seasons. There was no statistical relationship between the level of concern and the total number of strategies used to manage soybean gall midge, Dectes stem borer or herbicide-resistant weeds. This indicates that producers are being selective in their use of management strategies to address these issues possibly due to increased cost in using multiple strategies and/or the limited availability of effective strategies to manage these pests.

The results of year 1 of this 3-year survey are being used to inform Nebraska extension educators and researchers on growers' educational and management needs and improve practical interventions for SGM, DSB, and other pests. Based on year 1 survey results, our team has adjusted our year 2 survey to ask more questions regarding the relationships between emerging pests issues and to include small group interview sessions to allow elaboration on questions.



A COMPREHENSIVE PLAN FOR SCN EDUCATION IN NEBRASKA

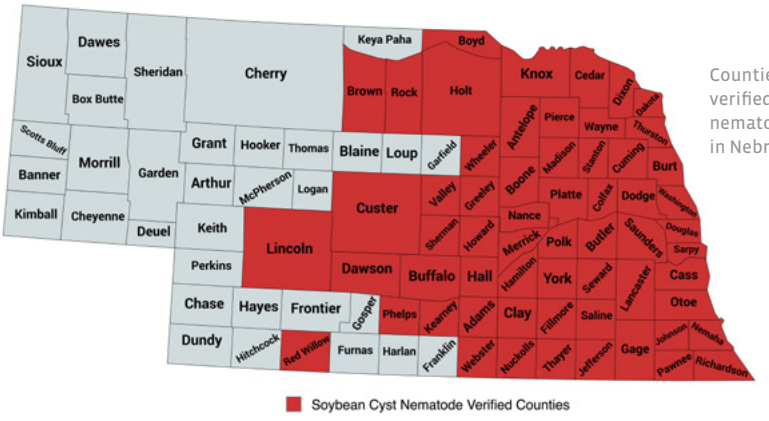
CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $59,801**
PRIMARY EXTENSION EDUCATOR | **Dr. Dylan Mangel** *(University of Nebraska–Lincoln)*

Research Conducted: Soybean cyst nematode (SCN) is the number one yield-limiting pest of soybeans. However, it often goes unnoticed because it rarely causes noticeable above-ground symptoms. The purpose of this Extension project was to increase grower recognition that SCN is causing yield loss in Nebraska fields and to increase identification. The second objective of this project is to provide management resources to farmers and agronomic professionals who help implement active management practices to reduce the impact of SCN and improve grower profitability. The third objective of this project is to evaluate the effectiveness of different SCN soybean resistance genes in different regions of the state. This combination of these objectives will help growers select the most effective resistance source for their operation.

Importance: This project provides necessary opportunities for face-to-face communication about the principles of SCN management and includes testing services for Nebraska growers. The SCN testing program saves soybean producers money by improving the accessibility to testing, which is the only way to accurately identify this pest. After the identification of SCN, continued testing of infested fields is the best way to determine if management is working. Through this program, we are able to map the growing distribution of SCN throughout Nebraska. This program helps us direct information directly where it is needed.

Findings: This grant helps producers identify SCN in their fields and allows us to be the first line of contact to provide unbiased information about active management. This project identified SCN in 43.2% of 506 fields sampled in 2024. The counties with the highest rate of positive samples were Antelope, Dodge, Holt, and Burt ranging from 80.0% to 66.7% positive. The highest egg counts were found in: Holt, Antelope, Pierce, Cass, and Seward counties with the highest being 20,600 eggs/100cc soil. Additionally, we observed that SCN populations from across the state are no longer being controlled effectively by the 'PI88788' resistance source.

Benefits/Recommendations: Each sample submitter receives a report with management guidelines for their results. Generalized results, protecting the individual's data, were included in articles in CropWatch, Market Journal, radio, and in-person educational programs around the state. These platforms are used to indicate to producers that SCN is a problem anywhere present, and that active management, which relies on the critical step of resistance gene selection, is the only solution while new technologies and resistance sources are researched and developed.



Counties with verified soybean cyst nematode presence in Nebraska as of 1-1-25

Soybean varieties with known resistance genes being tested against Nebraska SCN populations in a greenhouse system_Source Pratibha Karki, UNL Applied Soybean Pathology Lab

EXTENSION PROJECT

SOYBEAN MANAGEMENT FIELD DAYS AND SOYBEAN TAPS UPDATE

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $188,901**
PRIMARY EXTENSION EDUCATOR | **Aaron Nygren** *(University of Nebraska–Lincoln)*

Research Conducted: During 2024, Nebraska Extension integrated a Testing Ag Performance Solutions (TAPS) soybean competition into the longstanding Soybean Management Field Days (SMFD) program. Located at the Eastern Nebraska Research, Extension and Education Center (ENREEC) near Mead, NE, the competition included 18 teams. Each team was randomly assigned four small, replicated plots under center pivot irrigation upon which management decisions were applied by university personnel. The soybean competition had seven general management decisions, which included crop insurance, variety and seed treatment selection, seeding rate, nutrient management, herbicide, pest management, and marketing for a simulated 1500-acre soybean farm. These decisions have a direct effect on productivity and profitability.

Importance: Finding ways to increase production and profitability are key for Nebraska soybean farmers. The TAPS program is designed to provide a low-risk, competitive environment where participants can enhance their agricultural management skills and knowledge. By engaging in real-time competitions, participants have the opportunity to test and implement tools, technology, and strategies for profitable and input-efficient farm management before trying them on their own farm.

Findings: Even in its first year, the TAPS soybean competition has resulted in findings on one of the management decisions, seeding rates. Participants chose seeding rates ranging from 110,000 to 180,000 seeds per acre, which when combined with seed and seed treatment decisions resulted in a range of seed costs from $45.00 to $96.43 per acre. Typically, we would expect to see final stands that are 60 to 80 percent of the seeding rate due to "self-thinning." This was apparent in the TAPS plots, with stand counts taken before harvest showing final stands ranging from 90,307 to 108,900 plant per acre (Figure 1). What was of interest was that each increase of 10,000 seeds at planting only increased final stands by 2,075 plants per acre, with more "self-thinning" happening as seeding rates increased. In addition, higher seeding rates did not result in higher yields among participant teams, which supports long-term UNL On-Farm Research results.

Benefits/Recommendations: For those interested in staying updated on the TAPS program throughout the season, UNL recommends following UNL-TAPS on social media platforms such as Twitter/X or Facebook. Additionally, individuals can subscribe to the TAPS digital newsletter to receive regular updates and insights into the progress and outcomes of the farm management competitions. Those interested in competing in TAPS or in the digital newsletter can find more information at **taps.unl.edu**.

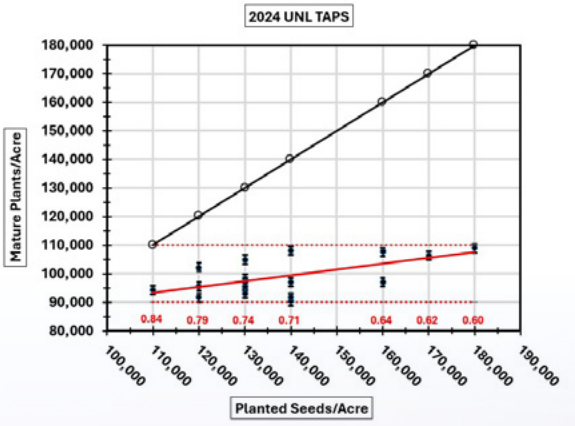


Figure 1. Planted seeds versus mature plants and percentage of planted seeds that reach maturity (red values)

THE NEBRASKA ON-FARM RESEARCH NETWORK

CONTRIBUTING ORGANIZATION | **Nebraska Soybean Board - $57,400**
PRIMARY EXTENSION EDUCATOR | **Adam Leise** *(University of Nebraska–Lincoln)*

Research Conducted: The Nebraska On-Farm Research Network (NOFRN) is a collaboration between farmers and UNL Extension to design, implement, and analyze projects tailored to specific answers the producer may have. In 2024, the NOFRN conducted 102 studies, including 47 soybean-related studies on soybean production in farmers' fields. These 47 studies were represented across 11 counties in Nebraska. Popular topics included soybean seeding population, biological seed treatments, fungicide product and timing. Other topics studied in 2024 include the use of interseeding cover crops, planter down pressure and speed, sensor-based nutrient management and others that are not included in these 47 projects but will have a direct impact on soybean production and environmental sustainability.

Why it is important: The NOFRN provides an avenue to test ideas, products, and alternative systems in a way that is directly in the producer's field. This large scale replicated research hopes to provide answers that can be translated into an entire operation. By combining agronomic and economic decision-making, our hope is to find specific answers for each farmer which may be different from area to area. On-farm research has two purposes: to build upon previous research and answer the questions and challenges we face today, and also prepare and protect our operations in a constantly evolving industry.

Findings: The collection of 2024 projects conducted is a link in research, building upon previous findings and preparing us for 2025. One specific area of focus was Irrigation Management. By including groundwater sensors in fields to determine Irrigation scheduling, producers applied only 77% of water compared to what they traditionally would have scheduled across 5 fields. In each of these field sites, water was not a limiting factor until August. In dryer years, we hope this number continues to improve our water use efficiency.

Benefits: The benefits of the NOFRN include both informational and the assistance of the entire UNL Extension team. The information we gather and previous reports are aggregated on our website at **on-farm-research@unl.edu**. Another benefit of the NOFRN is the presence of UNL Extension. We have so many great faculty who are willing to share what they know in hopes of finding an answer together. This is the real strength of the program.

ADVANCING RESEARCH THROUGH COLLABORATION

NCSRP
NORTH CENTRAL SOYBEAN RESEARCH PROGRAM

NEBRASKA NCSRP DIRECTOR
Mike Tomes - Utica, NE

The North Central Soybean Research Program (NCSRP) is a regional coalition of 13 states dedicated to multi-state, collaborative soybean checkoff research.

Farmer leaders representing each of the 13 states comprise the NCSRP board. Each member state also provides technical staff and consultants to assist the farmer board in program prioritization, progress monitoring, portfolio and budget management and communication of research results. NCSRP is supported from combined checkoff funds from each state board, including Nebraska, to fund, monitor and communicate extensive basic and applied production research projects. The NCSRP board teams up with staff from Qualified State Soybean Boards (QSSB), university researchers and extension programs to work on behalf of approximately 355,000 soybean farmers in the North Central region.

The program focuses on increasing profitability, enhancing yields and improving quality. Research funded by NCSRP has led to major advancements, including new genetic tools to combat soybean cyst nematodes, improved farm management tools and better understanding of pests and diseases. By supporting multi-state research, NCSRP drives innovation across the soybean industry.

Projects Funded for FY24

Nebraska Soybean Board Investment in FY24 - $575,000

- An Integrated Approach to Enhance Durability of SCN Resistance for Long-Term Strategic SCN Management (Phase III)
- Using Data-Driven Knowledge for Profitable Soybean Management Systems
- Mapping Soybean Protein and Oil Quality in Farmer Fields
- Multi-Dimensional Approaches for Improved Productivity, Sustainability, and Management of Major Soybean Diseases in the North Central U.S. – Year 3
- Research and Extension on Emerging Soybean Pests in the North Central Region
- Site-Specific Weed Management with Precision Application Technology
- SOYGEN3: Building Capacity to Increase Soybean Genetic Gain for Yield and Composition Through Combining Genomics-assisted Breeding with Characterization of Future Environments
- SoyRenSeq: A Novel Approach for Disease Resistance Gene Discovery and Application for Soybean Improvement
- The SCN Coalition: Building on the Impact of Public-Private Partnership

FY24 NSB RESEARCH FUNDING AREAS

Funding critical research and exploring topics that matter to Nebraska farmers is a top priority for the Nebraska Soybean Board.