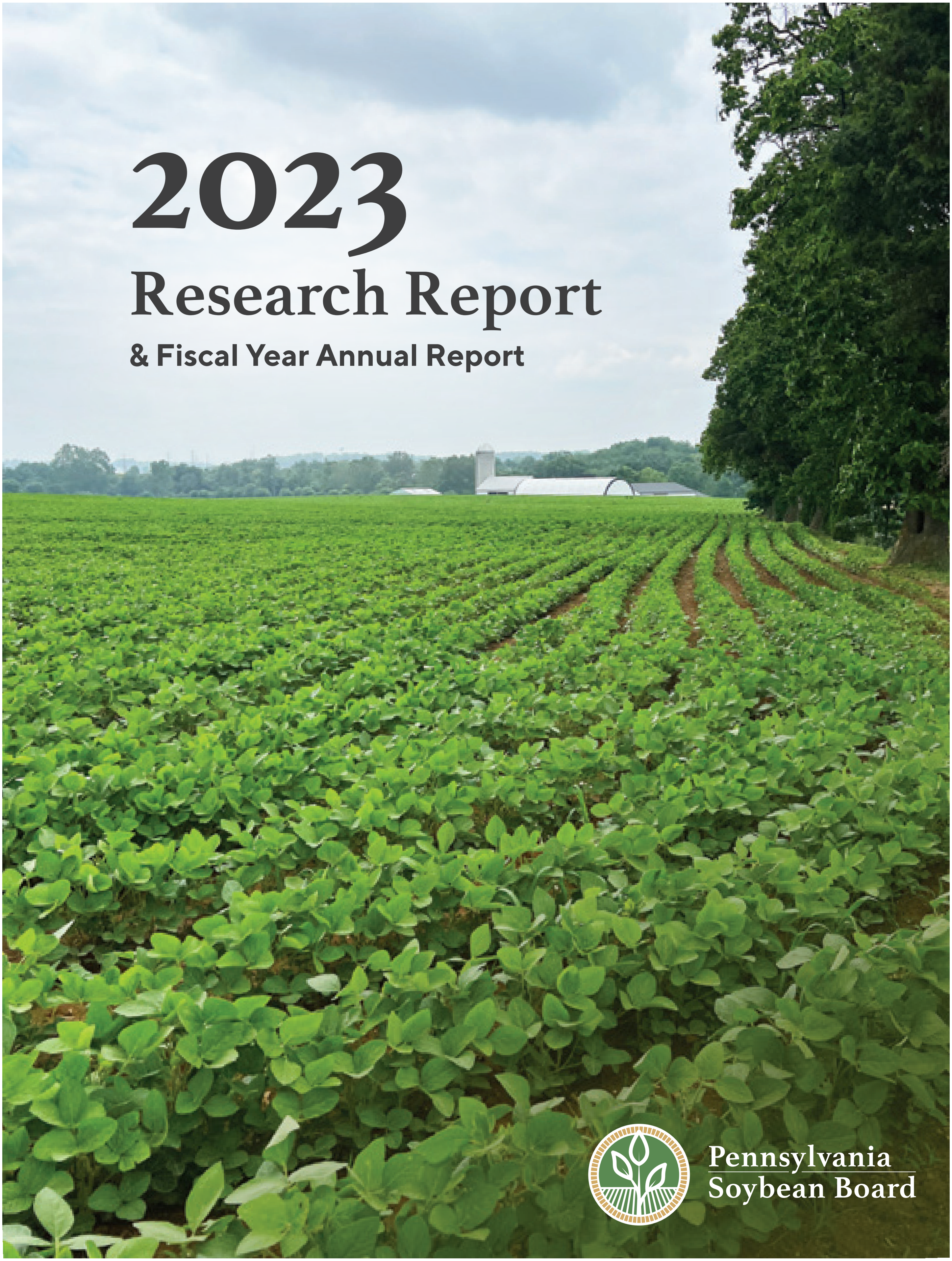
2023 Research Report

& Fiscal Year Annual Report



Pennsylvania Soybean Board

Ensuring a strong and profitable future for Pennsylvania's soybean growers.

Here's How the Soy Checkoff Works

The national soy checkoff was created as part of the 1990 Farm Bill. The Federal Act & Order that created the soy checkoff requires that all soybean farmers contribute 0.5% of the market price per bushel to the soy checkoff at the first point of sale of the soybeans. These funds are used for promotion, research, and education. Led by volunteer farmers, the United Soybean Board and the Pennsylvania Soybean Board invest and leverage soy checkoff dollars to MAXIMIZE PROFIT OPPORTUNITIES for all U.S. soybean farmers.

Pennsylvania Soybean Board

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Paving the Way for Continued Success

John Harrell
Chair, Pennsylvania Soybean Board

This year marked a milestone for the Pennsylvania Soybean Yield Contest. We received harvest report forms from a record number of growers who took the extra time at harvest to verify their yield and share information on their production practices.

While the state-wide winner was the only grower to surpass 100 bu./acre in the 2023 contest, three farmers produced over 90 bu./acre, and eight had beans that yielded over 80 bu./acre. Considering the type of growing year we had, those are pretty impressive figures.

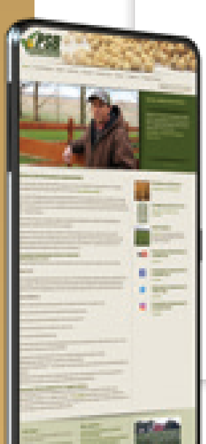
The yield contest is just one of the initiatives supported by the Pennsylvania Soybean Board. The growers who participate in the contest don't just vie for bragging rights. They play a role in providing insight into the production practices of some of Pennsylvania's top growers.

As farmers ourselves, all of us on the Pennsylvania Soybean Board are mindful that checkoff dollars are spent wisely and will yield a payoff to our fellow soybean growers. A cornerstone of our efforts has been investing in cutting-edge research projects with leading agricultural researchers to advance the sustainability, profitability, and overall success of the soybean industry.

This report shows the results of the research conducted on behalf of growers during the 2023 Fiscal Year. We hope you'll read it and follow up with your Extension educator if you'd like additional details about any of these research projects.

Thank you for your part in shaping the future of soybean farming and best wishes for your continued success in 2024.

For the latest news, events, research updates and more:



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Bringing Research Findings to Farmers

The articles in this research report summarize the checkoff-funded research being conducted in Pennsylvania. But checkoff-funded research goes far beyond the state.

Check out the findings from the research projects the soy checkoff invests in at the national and state levels on the Soybean Research & Information Network (SRIN) website.

SRIN was launched to communicate checkoff-supported research projects to soybean farmers across the country and be a virtual resource full of information and toolkits for more efficient soybean production.

Each article on the SRIN website provides insight and explanation on the research findings and links directly to the study in the research database for further exploration.

Follow SRIN on social media:

Soybean Research Information Network

@SoyResearchInfo

soybeanresearchinfo.com

Pennsylvania Soybean Board Annual Financial Report

Fiscal Year 10.1.22 to 9.30.23

CASH & ASSETS	
Operating Funds	$829,262
Emergency Preparedness Fund	$399,407
Dissolution Fund	$269,942
Equipment, Net	$396
Less: Liabilities	$(1,038)
Net Assets at 9.30.23	$1,497,969
REVENUE:	
Assessment Income	$2,041,983
Less Assessments Paid to USB & Other State QSSBs	$(1,316,142)
Other Revenue	$5,298
PROGRAM EXPENSES:	
Communications	$(77,774)
Promotion & Education	$(209,699)
Research*	$(540,522)
Administration/Audits/ Compliance/Insurance/Other	$(172,388)
Increase/(Decrease) in Net Assets	$(269,244)

* This amount reflects the actual disursement of the funds allocated for research as of September 30, 2023.

Cooperators for On-Farm Network Soybean Research

The Pennsylvania Soybean Board along with Penn State Extension is looking for farm cooperators willing to participate in On-Farm Network soybean research.

The Network works by conducting research in real-world conditions on test plots planted by farmer/collaborators throughout Pennsylvania on their own farms with their own equipment to see which management practices have an appreciable impact on production.

This project is open to all soybean producers in Pennsylvania. Growers interested in participating in any of the trials are encouraged to contact their local Extension Educator for more information. The On-Farm Network is funded by the soybean checkoff and administered by Penn State.

PENNSYLVANIA **SOYBEAN YIELD CONTEST**

Eric Charles, top grower in the 2023 Pennsylvania Soybean Yield Contest.

Lancaster County farmer Eric Charles was the Commonwealth's top producer in this year's Pennsylvania Soybean Yield competition, sponsored by the Pennsylvania Soybean Board. His winning yield topped more than 30 other entrants at 101.00 bu./acre.

THE PENNSYLVANIA SOYBEAN CONTEST is designed to focus farmer attention on agronomic and management skills that will increase soybean profitability. The contest showcases crop management practices of some of the top soybean producers in the state. It recognizes not only the state-wide grand champion, but also the top growers in each of five production regions of Pennsylvania, based on maturity map.

ELIGIBILITY: Any bona-fide farmer who farms in Pennsylvania and grows 5 acres or more of soybeans within the state is eligible.

PRODUCTION: For the state-wide and regional yield contest winners, participants must use non-irrigated soybeans, but are not restricted as to variety, fertilization, spacing or other cultural practices.

PRIZES! In addition to bragging rights, the state champion receives an educational trip for two (the winner and one other individual* with a direct financial interest in their farming operation) to the Commodity Classic. (Up to $2,500.) The top yield winner in each region receives an educational trip for the winner to the Commodity Classic. (Up to $1,500.)

HOW TO ENTER: If you would like to enter the Pennsylvania Soybean Contest, you must register by September 1. Online registration is available at www.pasoybean.org. Harvest report forms must be postmarked by November 15.

You may also request a registration form from your local Penn State Extension Educator, or by contacting:

Penn State Extension-
Lebanon County
PA Soybean Contest
c/o Del Voight
2120 Cornwall Road, Suite 1
Lebanon, PA 17042-9777
717-270-4391

Penn State Extension-
Montgomery County
PA Soybean Contest
c/o Andrew Frankenfield
1015 Bridge Road, Suite H
Collegeville, PA 19426-1179
610-489-4315

2023 Pennsylvania Soybean Yield Contest Winners

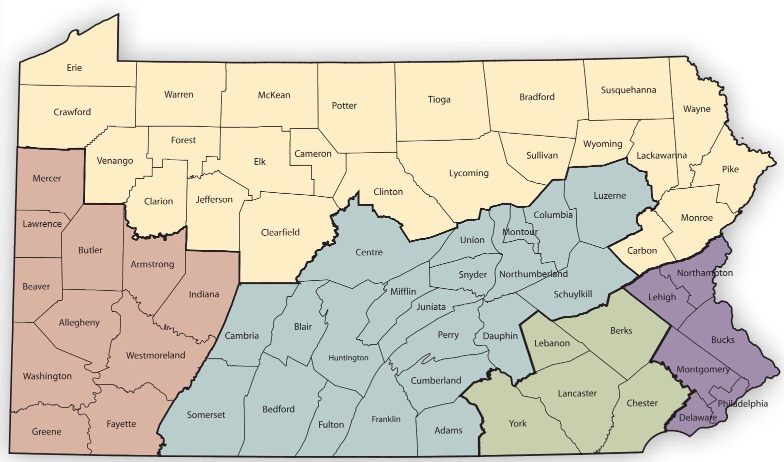
1st Place State Overall & South Central Region
Eric Charles
(Lancaster County)
101.00 bu./acre

1st Place Central Region
Ian Stamy
(Cumberland County)
84.71 bu./acre

1st Place Southeastern Region
Brad Kiefer
(Northampton County)
93.73 bu./acre

1st Place Western Region
Thomas Hoovler
(Mercer County)
74.74 bu./acre

1st Place Northern Region
John Tebbs
(Lycoming County)
78.98 bu./acre



Scan the QR code to learn about the Pennsylvania Soybean Yield Contest

pasoybean.org

Soybean Management Practices – Regional Award Winners

Region	South Central	Central	West	Northern	Southeast
Winner	Eric Charles	Ian Stamy	Thomas Hoovler	John Tebbs	Brad Kiefer
County	Lancaster	Cumberland	Mercer	Lycoming	Northampton
Previous Crop	Corn/ryelage	Corn	Corn	Corn	Corn
Row Width	7.5″	20"	30″	7.5″	15″
Tillage Type	No-Till	Min-Till	No-Till	Conventional	Min-till
Variety	Pioneer P34A65PR	Pioneer P37A18E	Asgrow AG30XF2	Asgrow AG35XF	Pioneer P37A18E
Seeding Date	5/4/23	5/8/23	5/11/23	4/17/23	5/2/23
Seeding Rate	180,000	135,000	165,000	175,000	140,000
Final Stand	160,000	62,712	106,140	69,600	99,180
Seed Treatment	Pioneer Premium	Pioneer Premium	Acceleron	Cruiser Max	Pioneer Premium
Inoculation	Pre	Pre	Dry	Pre	Pre
Fungicide	Miravis Neo	Revytek	None	Revytek	Delaro Complete
Insecticides	Endigo ZC	Yes	None	Mustang Max	Hero
Pre-Herbicide	Glyphosate	Gramoxone Solstice	Glyphosate, Xtendimax	-	None
First Rate	Zidua Pro	Glyphosate	Antares Complete	-	Glyphosate
Gramoxone	None	9/29/22	10/25/22	-	10/21/22
Post-Herbicide	Glyphosate	None	Glyphosate, Glufosinate	Classic	93.38
Glyphosate	Glyphosate	16.40	12.00	-	13.30
Glufosinate	43	90	32	-	58
Date of Harvest	10/11/23	10/12/23	11/12/23	10/19/23	10/26/23
Yield	101.00	84.71	74.74	78.98	93.73
Moisture %	12.93	11.90	13.30	17.10	11.40
Ave Pod Count	50	61	49	135	60
Harvest Loss	0.2 bu/a	0.2 bu/a	3.75 bu/a	0.31 bu/a	0.25 bu/a
Biostimulant	None	None	None	None	No
Foliar Fertilizer	AlfaPower MP	Maximum N-Pact	None	Yes	No
Cover Crop	Wheat	None	None	Rye	Rye

To read the complete Pennsylvania Soybean Contest 2023 Report scan the QR code or request a copy from your local Penn State Extension Educator.

pasoybean.org

PENNSYLVANIA
SOYBEAN ON-FARM NETWORK

Principal investigator & co-investigators:

Dr. Paul Esker, PSU Extension Plant Pathologist and Associate Professor

Dr. Daniela Carrijo, PSU Extension Agronomist and Assistant Professor

Dr. Alyssa Collins, PSU Extension Plant Pathologist and Associate Research Professor

Zachary Curtis, PSU Extension Field and Forage Crops Educator

Andrew Frankenfield, PSU Extension Field and Forage Crops Educator

Anna Hodgson, PSU Extension Field and Forage Crops Educator

Dr. Mihail Kantor, Assistant Research Professor

Mariah Kidd, Graduate Student

Shannon McAmis, Summer Intern

Dwane Miller, PSU Extension Field and Forage Crops Educator

Tyler McFeaters, Education Program Specialist

Dr. Adriana Murillo-Williams, PSU Extension Field and Forage Crops Educator

Dr. Heidi Reed, PSU Extension Field and Forage Crops Educator

Cody Smith, M.Sc student, AEPS Program

Dr. John Tooker, PSU Extension Entomologist and Professor

Dr. John Wallace, PSU Extension Weed Scientist and Assistant Professor

Dr. Dilooshi Weerasooriya, Postdoctoral Scholar

Delbert Voight, PSU Extension Field and Forage Crops Educator

FUNDED AMOUNT: $262,843

RESEARCH SUMMARY

Since 2009, the Pennsylvania Soybean On-Farm Network has conducted on-farm research to address important questions that drive soybean production in the Commonwealth. The importance of these trials and educational efforts is evident. Since 2017, 85% to over 90% of participants in trials and workshops have indicated that there has been a moderate to high ("a lot") amount of knowledge gained from the program.

Also, 75% to over 90% of workshop participants have indicated that they would adopt a new practice on their farm during the next one to two growing seasons. Interviews with farmer cooperators also show the value of the network, with comments ranging from indicating the importance of testing ideas at the farm scale to figuring out what works and does not work under production situations.

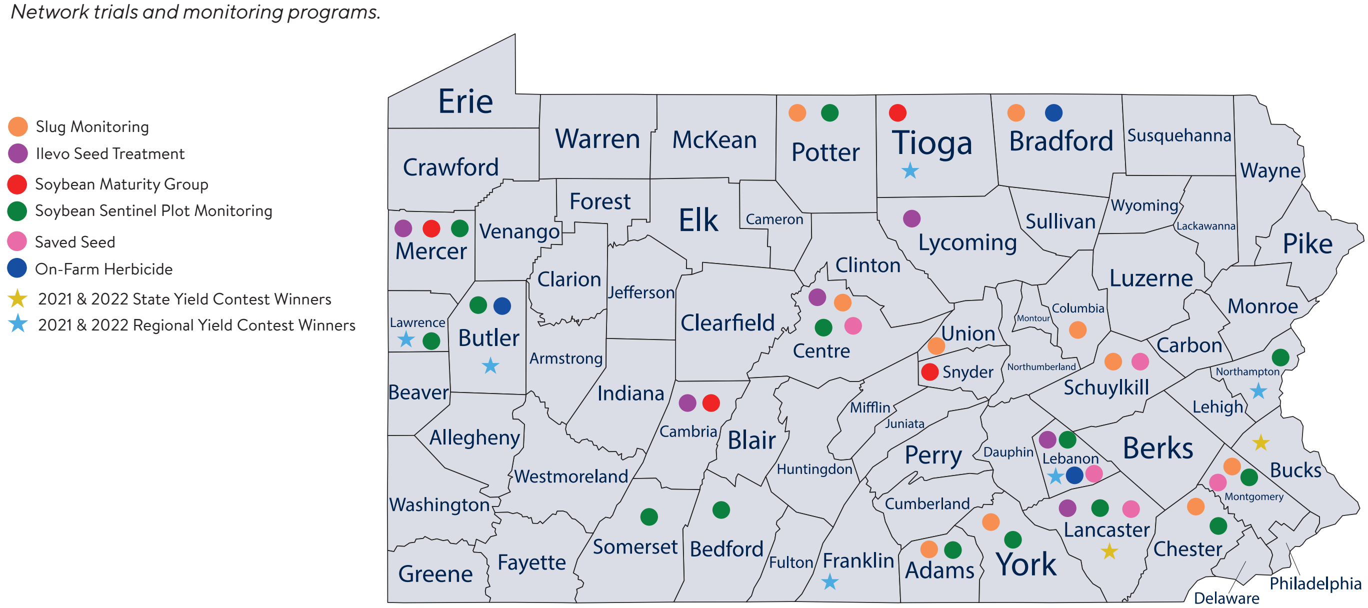
THANK YOU!

Our sincere thanks to the grower/cooperators who participated in the 2023 Soybean On-Farm Network and to the Penn State Extension Field and Forage Crops Extension Team members and Penn State staff scientists, graduate students and interns who made this research possible.

Conducting on-farm research requires time and effort from our growers. We value their participation in testing new and novel ideas in their own fields, and look forward to continued collaborations in 2024.

2023 On-Farm Trial Sites by County

Locations of the 2023 Pennsylvania Soybean On-Farm Network trials and monitoring programs.



2023 Ilevo Seed Treatment Trials

RESEARCH SUMMARY

Sudden Death Syndrome (SDS) caused by the fungus Fusarium virguliforme is one of the most important soilborne diseases in soybeans in Pennsylvania and the U.S. and has caused approximately $16.8 million in local economic losses since 2020 (Crop Protection Network, 2023). Owing to a decade of consistent success, Ilevo seed treatment has stood out among competitors against nematodes and SDS in other parts of the U.S. However, before recommendations could be made for Pennsylvania, we aimed to conduct multi-location, multi-year trials to test its efficacy.

Trials were established in 2023 in five farmer fields with a history of SDS in four counties of Pennsylvania: (1) Centre County (two locations), (2) Lackawanna County, (3) Lancaster County, and (4) Lebanon County.

In each trial site, Ilevo-treated and control plots without the Ilevo seed treatment were planted with the same seed variety. To estimate the density of plant parasitic nematodes and four important soilborne fungal pathogens, *Pythium* spp., *Phytophthora* spp., *Fusarium* spp., and *Rhizoctonia* spp, bulk soil samples were collected from each site before planting. The same soil samples were used to determine the soil nutrient profile for each site.

At the R2 growth stage, the normalized difference vegetation index (NDVI) was recorded using a "GreenSeeker" handheld crop sensor to measure crop health. The initial plant stand was also recorded at this growth stage. SDS incidence and severity and crop growth parameters such as plant height, root length, and biomass were measured using destructive sampling of 15 soybean plants per plot at this growth stage. At the season's end, each plot's yield was recorded to compare the two treatments.

To determine if the Ilevo seed treatment has contributed to any noticeable changes in the soil microbial profile and composition, a soil microbiome study was also performed using root ball samples collected within selected blocks of each site at emergence (VE), unrolled unifoliolate leaves (VC), and first trifoliolate (V1) growth stages from Ilevo treated and control plots.

FINDINGS

Overall, no differences were observed for most destructive and non-destructive measurements (Table 1), except for plant height and shoot-to-root ratio at the Lebanon County location and yield at the Lackawanna County location. Yields across locations ranged from 38 to 81 bushels per acre.

We detected the presence of soybean cyst and lesion nematodes in field locations in Centre and Lackawanna Counties, respectively, at damaging densities. Soil nutrient profiles were variable between the fields, however, with the site at Lancaster showing higher Phosphorus and Sulphur levels than the rest.

For the microbiome portion of this project to detect fungal and bacterial pathogens in the rhizosphere, DNA extraction and quality check of all samples were completed and submitted to an external service provider for library preparation and sequencing. This process can take 1-2 months to receive results. At that point, data will be analyzed using our existing data pipelines. We expect the results will provide a thorough understanding of how Ilevo treatment affects soil microbiome composition.

Overall, the results remained consistent with our observations in the previous two years. We have not observed a strong positive trend with applying Ilevo seed treatment.

Root ball samples for microbiome analysis are taken at three different growth stages: VE (left), VC (middle), and V1 (right).

Table 1. *Results for both destructive and non-destructive parameters measured at the R2 growth stage.*

County	Treatment	Plant population per acre	NDVI	Plant height (inch)	Tap root length (inch)	Shoot to root ratio	Yield (bu/ac)
Centre1	Ilevo	NA	0.85^{a}	18.9^{a}	7.9^{a}	4.2^{a}	65.4^{a}
	Control	NA	0.86^{a}	16.9^{a}	7.3^{a}	3.8^{a}	66.1^{a}
Lebanon	Ilevo	1196701^{a}	0.87^{a}	14.1^{b}	5.6^{a}	3.5^{b}	81.4^{a}
	Control	135957^{a}	0.87^{a}	18.3^{a}	6.2^{a}	4.6^{a}	80.8^{a}
Lancaster	Ilevo	139044^{a}	0.82^{a}	19.6^{a}	3.9^{a}	5.6^{a}	48.8^{a}
	Control	125569^{b}	0.81^{a}	20.8^{a}	3.9^{a}	5.6^{a}	47.9^{a}
Centre2 (RS)	Ilevo	NA	NA	15.6^{a}	5.8^{a}	4.3^{a}	48.8^{a}
	Control	NA	NA	15.9^{a}	5.9^{a}	4.5^{a}	48.0^{a}
Lackawanna	Ilevo	NA	NA	19.3^{a}	7.9^{a}	2.4^{a}	50.0^{a}
	Control	NA	NA	21.9^{a}	7.8^{a}	2.6^{a}	37.7^{b}

**Values for a specific parameter within a location followed by the same letter indicate no statistical difference between treatments at $p<0.05$.*

Refining 2-Pass Herbicide Programs for Horseweed Management

RESEARCH SUMMARY

Glyphosate-resistant horseweed populations are becoming more widespread in the state and are now a significant management issue in western Pennsylvania and the Northern Tier. In addition to varying levels of resistance throughout the state, including glyphosate- or glyphosate and ALS-resistant biotypes, horseweed is challenging to control because of variable emergence patterns. Understanding regional (i.e., environmental) or management-driven trends in emergence patterns is the first step at designing more effective herbicide programs for horseweed control.

The objective of this project was to conduct coordinated on-farm trials across distinct Pennsylvania production regions to (1) describe horseweed emergence patterns relative to soybean planting dates; and (2) evaluate preemergence herbicide programs for horseweed control, including single- and multiple-active ingredient programs; and (3) quantify the length of residual activity across production regions of soil applied herbicides for control of small-seeded annual weeds (e.g., horseweed, waterhemp, Palmer amaranth).

In 2022, we conducted trials in Butler (n = 2), Bradford (n = 1) and Lebanon (n = 2) Counties. In 2023, we conducted trials in Centre (n = 1), Bradford (n = 1), Lebanon (n = 1) and York (n = 1) Counties. The York County location was located in a field infested with Palmer amaranth, but recruitment was too low to quantify treatment effects.

Table 1. *Growth stage of horseweed population prior to pre-plant burndown application (listed below).*

Location (burndown)		% of horseweed population		
		cotyledon	rosette	bolting
Bradford Co.	(4/22/22)	42	31	21
Bradford Co.	(5/12/23)	0	99	1
Centre Co.	(4/26/23)	0	99	1
Butler Co. I	(5/06/22)	0	87	13
Butler Co. II	(5/26/22)	0	9	91
Lebanon Co. I	(4/26/22)	0	99	1
Lebanon Co. II	(none)[a]	0	0	0
Lebanon Co.	(4/20/23)	0	78	22

[a] soybean planted (5/25/22) into cereal rye and then roll-crimped at anthesis; no horseweed observed

Table 2. *Emergence timing of horseweed relative to soybean planting (pre- or post- plant).*

Location (plant date)		% of total emerged	
		pre-plant	post-plant
Bradford Co.	5/20/22)	53	47
Bradford Co.	(5/11/23)	22	78
Centre Co.	(4/26/23)	99	1
Butler Co. I	(5/31/22)	27	73
Butler Co. II	(5/25/22)	70	30
Lebanon Co. I	(5/3/22)	92	8
Lebanon Co. II	(5/25/22)[a]	0	0
Lebanon Co.	(4/19/23)	83	17

a soybean planted into cereal rye and then roll-crimped at anthesis; no horseweed observed

FINDINGS

A key management goal for effective control of horseweed is to target populations with pre-plant herbicide applications prior to the bolting stage because the efficacy of commonly used burndown products [saflufenacil (i.e., Sharpen), 2,4-D, dicamba or paraquat] decreases after horseweed bolts.

Horseweed populations were characterized by growth stage just prior to the time of pre-plant burndown applications by growers (Table 1). As expected, later planted soybean fields (mid- to late-May) were more likely to have horseweed plants that had already bolted.

Additional horseweed emergence occurring after typical soybean planting dates is becoming more common and understanding this pattern can help design effective tactics for managing horseweed in crop. Monitoring results showed significant horseweed emergence after planting in our Northern Tier and western locations compared to southeastern and central Pennsylvania locations. This finding suggests that soil-applied herbicide programs will be a key component of horseweed management in these regions.

Herbicide trials consisted of single- and multiple-active ingredient preemergence programs, including two ALS Inhibitors (Group 2; chlorimuron and cloransulam), metribuzin (Group 5) and flumioxazin (Group 14). Effective burndown applications were applied at each location but varied depending on the soybean trait. Treatments varied at each location to include each grower's program that was applied in the rest of the field.

Horseweed control 35 days after planting is reported in Table 3. The efficacy of single active ingredients varied across locations. In general, Group 2/5 herbicide mixtures provided the most consistent control across locations (95-99%). Moderate to high levels of residual control observed in Classic and FirstRate (Group 2) treatments applied alone or in mixture were observed in regions with documented ALS resistance in horseweed populations. This result indicates that these herbicides may still have utility as a soil-residual component in PRE programs that utilize multiple sites-of-action.

Table 3. *Horseweed control (% population reduction) 30-35 d after application.*

PRE application	Bradford (2022)	Bradford (2023)	Butler I (2022)	Butler II (2022)	Lebanon (2022)	Lebanon (2023)
S-metolachlor +	––––– % reduction in horseweed population –––––					
chlorimuron (0.03 lb ai; Classic)	–	–	87	70	95	–
cloransulam (0.04 lb ai; FirstRate)	66	98	99	99	95	98
metribuzin (0.2 lb ai; Tricor)	99	90	99	91	70	65
flumioxazin (0.06 lb ai; Valor)	96	85	94	–	75	96
chlorimuron + metribuzin	–	99	–	99	95	99
cloransulam + metribuzin	–	–	98	99	95	–
cloransulam + flumioxazin	85	85	89	–	90	99
metribuzin + flumioxazin	99	85	99	–	70	99

Updating Pennsylvania Soybean Maturity Recommendations

RESEARCH SUMMARY

Selecting the right soybean maturity is one of the first and most important steps in variety selection. The maturity group (MG) of a variety influences when the plant will start flowering, when it will start setting pods, and how many days it will take to complete its life cycle. Soybean development is mainly driven by day-length and heat units (i.e., growing degree days). While day-length has remained constant, the weather has changed over the years. We now experience more growing degree day accumulation and more weather variability compared to 30 years ago.

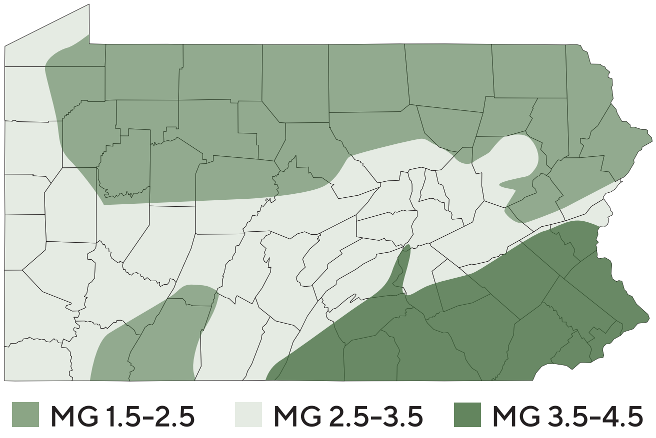
The goal of this project is to update recommendations for soybean maturity groups grown in Pennsylvania (Figure 1). In this second project year, we leveraged the Soybean Official Variety Testing program to expand on the number of trials and include additional varieties representing maturity groups outside of the typical range at each trial location. We planted varieties of varying maturities in Lancaster (full season and double crop), York (full season and double crop), and Centre (full season) Counties, for a total of five field trials (Table 1).

Table 1. *Summary of 2023 field trials. Full season and double crop trials were planted at 30- and 15-inch row spacing, and at 165,000 and 200,00 seeds per acre, respectively.*

County	Cropping scenario (planting date)	Varieties evaluated	MG range evaluated	MG range recommended	Yield response to MG
Lancaster	Full season (May 15)	68	1.4 – 5.3	3.5 – 4.3	NS
	Double crop (July 12)	27	1.4 – 4.2		Yield increased with later MG
York	Full season (May 10)	52	2.4 – 3.6	3.5– 4.3	NS
	Double crop (July 12)	23	2.1 – 4.0		Yield increased with later MG
Centre	Full season (May 24)	72	2.1 – 4.0	2.5 – 3.5	NS

NS: not significant

Figure 1. Current maturity recommendation for full season soybeans in Pennsylvania. Source: Penn State Extension Agronomy Guide. MG = maturity group.



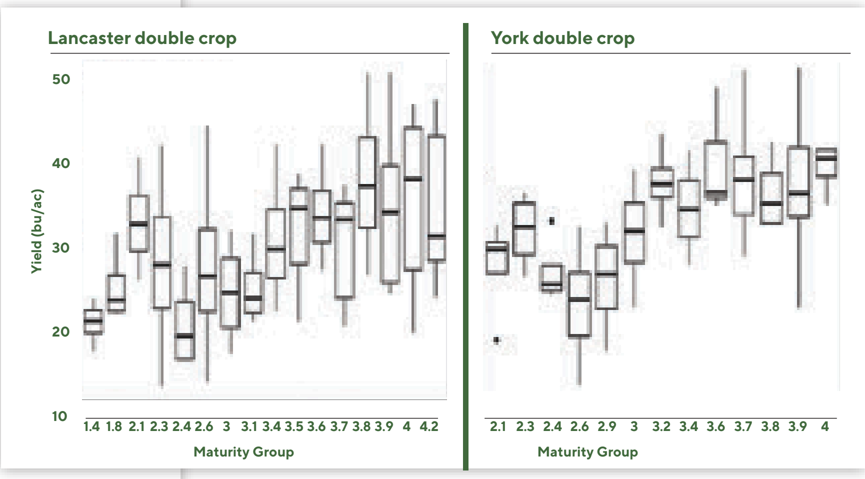
FINDINGS

In both double crop trials, there was a significant increase in yield with later MGs (Figure 2). These results agree with PA trials conduced in 2016 in which late 3.0 MG varieties outyielded those in the early 3.0 MG in double-crop scenarios. It is less likely that early MGs do not achieve the minimum vegetative growth and canopy cover needed for high yield potential in double-crop scenarios. That said, this yield advantage of late MGs in double-crop scenarios remains to be tested in cooler regions of the state where yield potential may be more limited by the number of frost-free days.

No significant yield trend was observed in the full season soybean trials and indicate that late MG varieties yielded similar to early MG varieties in the full season scenarios tested. These results agree with results observed in the first year of this project (2022), although a narrower range of MGs were included in 2022. Average full season soybean yields in Lancaster, York, and Centre Counties were 64, 63, and 75 bushels per acre, respectively.

Protein and oil concentration will be assessed in grain samples. In 2022, despite the lack of a yield response to maturity in full season soybean trials, poorer grain composition (low protein and/or oil concentration) was associated with later MGs. This negative relationship between maturity and grain composition was observed elsewhere and was attributed to the later MG varieties experiencing cooler temperatures during grain fill.

Figure 2. Yield response to MG in double crop trials. Boxes and whiskers represent the spread of the yield data for each MG (minimum, lower quartile, median, upper quartile, and maximum). Within the MG range evaluated in each location, for every unit increase in MG, there was an average yield increase of 4.7 (Lancaster) and 5.2 (York) bushels per acre. Results represent only one year of double crop trials. p=probability value.



This research project is associated with the Penn State Soybean Variety Testing Program. The 2023 Variety Testing Report can be accessed here.

Saved Seed Trials

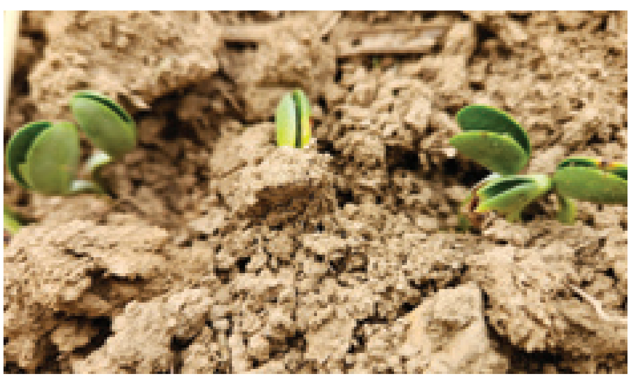
RESEARCH SUMMARY

The purchase of certified seeds is often the largest single contributor to the variable cost of producing a soybean crop. This project aims to answer the questions: (1) How does a soybean crop grown from off-patent saved seed perform compared to one grown from certified seed? (2) Are there scenarios where planting off-patent saved seed can be more profitable than planting certified seed?

Since 2019, we have been maintaining seed stocks and evaluating the performance of three off-patent Round Up Ready One varieties (maturity groups, MG 2.9, 3.1, and 4.0). The varieties were purchased as certified seed in 2019 and since then have been saved, cleaned and used for seed every year.

In 2023, the fourth generation of saved seeds was evaluated in six commercial farms (Montgomery, Lebanon, Lancaster, and Tioga Counties, two in double crop in a full season environment) and in two of the Penn State Official Variety Testing (OVT) trials (full season trials in Lancaster and Centre Counties). Further, large blocks of each saved seed lot were planted at the Penn State Southeast Agricultural Research and Extension Center in Landisville, PA, for seed production for 2024 assessment.

One important point here is growers intending to gain saved seed have to ensure that the saved seed is legal: both the herbicide traits have to be off patent and also the variety needs to also be off patent to be legal to plant. Further, any signed agreements that testify that the seed is not permitted to be saved needs to be observed by the purchaser. This is the challenge to find saved seed that is legal to plant.



FINDINGS

In previous reports in 2020, 2021 and 2022 saved seed performed well in both on-farm and research station plots. However in 2023 growing season represented the first year that the saved seed plots included in the OVT trials performed generally poor compared to the commercial varieties evaluated (Table 1). In both locations, all three saved seed MGs yielded substantially lower than the trial average except for MG 4.0 in Centre County (73 bushels per acre, compared to the trial average of 75 bushels per acre). Test weights were comparable between saved seed plots and commercial entries. Yield results diverge from what was observed in 2022, when saved seed yields were comparable to most commercial varieties in the OVT trials.

We suspect that the lower saved seed yields observed this year were caused by low seed vigor as indicated by cold germination tests performed on the saved seed lots (ranging from 57% to 74% germination under cold temperatures). This was the case at one on-farm trial in Lancaster with poor germination and resulting stands. However at season end, the saved seed on that farm performed similar to the purchased seed source. The impact of low germination rates on the performance of saved seed plots was likely worsened in the OVT trials because the saved seeds did not receive any type of seed treatment, while all commercial varieties were treated.

With certified seeds, a standard (warm) germination test is the only seed test required (often reported on the seed tag as "germ"). Additional seed vigor tests like the cold germination test provide more information on seed quality and may be more important for saved seeds as they are produced under grain production systems, which typically prioritize yield over seed quality.

Yield data from the commercial farm fields are still being processed. Visually, saved seed lots planted on commercial farms look good and comparable to side-by-side commercial varieties. It is possible that seed vigor did not interfere with soybean performance at the cooperators' fields because they were double-crop soybeans and temperature was warm at germination.

Table 1. *Return on investment for using saved seeds in a full season environment, based on the performance of saved seed included in the 2023 Penn State Official Variety Testing (full season trials).*

Location	Entry	Average yield* (bu/ac)	Gross Revenue** (US$/ac)	Seed costs (US$/bag**)				ROI (US$) to saved seed
				Purchase of new seed	Production	Cleaning & bagging	Seed quality tests***	
Centre Co.	Saved seed entries	61.2	$795.60	$0.00	$13.00	$3.00	$0.45	-$78.80
	Commercial varieties	75.5	$926.95	$70.00	$0.00	$0.00	$0.00	
Lancaster Co.	Saved seed entries	54.1	$703.30	$0.00	$13.00	$3.00	$0.45	-$21.60
	Commercial varieties	64	$777.45	$70.00	$0.00	$0.00	$0.00	

**Commercial varieties were treated while saved seed entries were not.*
***Assuming 140,000 seeds in a bag.*
****Seed quality tests include cold germ, warm germ, broken seeds, and dormant seeds.*

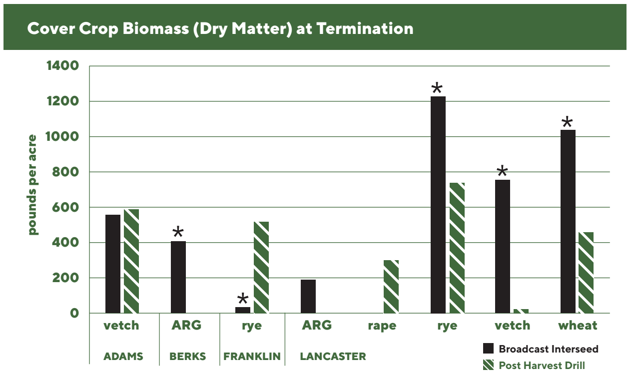
For the 2023 growing season, 4.04 bushels per acre of additional yield would be needed to replace seed cost of purchased seed in both double and full season environments.

Commercial Cost per Unit	
Purchased Seed	$70.00
Saved Seed Costs	
Soybean market	$13.00
Seed cleaning	$3.00
50 lb. bag cost	$1.00
Germination testing	$0.45
Total cost per unit	$17.45
ROI of Purchased vs Saved Seed in Bushels Per Acre	**$4.04**

Expanding Cover Crop Options After Soybeans

RESEARCH SUMMARY

The objective of this study was to compare the establishment success of broadcast interseeding selected cover crops into standing soybeans with post-harvest drill-seeding. The findings are important to farmers because cover crops can be challenging to establish after soybean harvest, and one possible way to help get them established sooner is planting into standing soybeans. However, the establishment success of this interseeding method needs to be worth it for farmers to bother with potential extra expense compared to post-harvest seeding.



*Indicates statistical diference between seeding methods for a cover crop species at an individual sites.

FINDINGS

Broadcast interseeding provided significantly higher cover crop density and biomass at termination than post-harvest seeding at Berks (409 lb/ac and 0 lb/ac, respectively) and Lancaster Counties (643 lb/ac and 302 lb/ac, respectively, averaged across species), shown in Figure 1. There was no difference in hairy vetch biomass between establishment methods at Adams County (616 lb/ac and 555 lb/ac, respectively), but broadcast interseeding provided higher hairy vetch density than post-harvest drill-seeding; rapeseed didn't establish at the Adams County site for either method. Post-harvest drill-seeding cereal rye out-performed broadcast seeding for all measures at the Franklin County site (589 lb/ac and 211 lb/ac, respectively).

Broadcast interseeding performed better this year than in prior years of the study, likely due to early seeding in combination with timely rainfall (Table 1). However, the maximum biomass achieved at any site was 1,220 lb/ac at SEAREC, below the recommended NRCS minimum for optimal cover crop benefits. Delaying termination until early May could have helped reach that 2,700 lb/ac recommended threshold, but delaying termination is not a standard practice in the area or viable for all situations.

These data provide evidence that broadcast interseeding into soybeans can be as successful or more successful than drill-seeding after soybean harvest. But, interseeding must be done early, preferably by the end of September in this region. And, timely rainfall after seeding continues to play a major role in the success of this method. Lastly, we found that there is a larger benefit to broadcast seeding the later post-harvest seeding gets.

Table 1

Location	Adams County	Berks County	Franklin County	SEAREC (Lancaster County)
Cover Crop	Hairy Vetch + Rapeseed	Annual Ryegrass	Cereal Rye	5 Species°
Broadcast Interseeding	10/15/2022	9/14/2022	10/7/2022	9/28/2022
Days b/t Broadcast and Rainfall	8	5	5	2
Soybean Harvest	10/29/2022	11/9/2022	11/5/2022	11/9/2023
Drill Seeding	11/3/2022	11/9/2022	11/7/2022	11/10/2023
Days b/t Interseeding and Drill Seeding	19	56	31	43
Fall Measurements	11/3/22, 12/14/22	11/9/2022	11/21/22, 12/14/22	11/10/2023
Spring Measurements	5/24/2023	4/17/2023	4/10/2023	1/12/23, 4/12/23

Pennsylvania Slug Monitoring Project

RESEARCH SUMMARY

Slugs can be a problematic pest when they occur in large numbers during spring and fall planting seasons. Replanting fields due to slug damage is often unsuccessful and results in multiple re-plantings. Managing slugs with molluscicides can be challenging because slug damage typically occurs during cool, wet weather and finding a dry gap in the weather for application can be difficult.

Since 2018, Extension Educators across Pennsylvania have assessed slug populations and crop damage each week at 15 to 20 sites. Each site is a problem slug field identified by the farmer cooperator. Educators scout for slug eggs at the beginning of the season in each field. Ten shingle traps are installed randomly over the field. The traps are installed prior to planting, removed during planting, and replaced after planting. Each week, or more frequently after crop emergence, the traps are checked for slugs. Crop damage is measured for 21 days after emergence.

FINDINGS

Each week during the planting season, a report is published in Penn State's Field Crop News that shares weekly updates from slug monitoring.

Due to the lack of eggs found, scouting for slug eggs in the spring has not been effective for predicting slug populations. The two most abundant slug species were marsh and gray garden slugs.

From 2018-2020 and 2022-2023, most sites reported low slug numbers and minimal crop damage. In 2021, higher slug numbers and significant crop damage were reported at some sites. Slug populations continue to vary each year. We plan to adjust the protocol to better capture slug emergence in the spring to predict when slug egg hatch occurs.

Shingle slug trap.

Learn more.
https://extension.psu.edu/2023-pennsylvania-slug-monitoring-project

Proactive Monitoring and Management of Soybean Cyst Nematode

RESEARCH SUMMARY

Soybean cyst nematode (SCN, *Heterodera glycines*) is North America's most damaging soybean pathogen. Yield losses associated with SCN damage can be greater than 50%. The nematode was first detected in 1954 in North Carolina and is currently found in every major soybean-producing state. SCN was first detected in Lancaster County, Pennsylvania, in 2002. Subsequent surveys conducted by the Pennsylvania Department of Agriculture did not report further findings of SCN.

In 2018, we established a new SCN monitoring program to increase stakeholder knowledge about the importance of SCN and soil sampling. With the support of the Pennsylvania Soybean Board, we currently offer a free SCN testing program for farmers across the Commonwealth. In 2023, we continued to use the North Carolina Department of Agriculture and Consumer Services for testing soil samples but also began to use the Nematology Laboratory in the Department of Plant Pathology and Environmental Microbiology at Penn State, which was recently established.

FINDINGS

We have received and tested 766 soil samples from 50 counties (75% of the counties) since the program started. Focusing on the three most important plant parasitic nematodes (PPN), we found SCN-positive fields in 8 additional counties beyond Lancaster County (Figure 1.) Overall, SCN has only been found in less than 2-3 % of the samples tested, and the infestation levels remain low (below 200 eggs per 100 cc).

A second nematode important to soybean production in Pennsylvania is the root-knot nematode (Figure 2.) Root-knot nematodes have been found in 9 counties, mainly in Pennsylvania's central to south-central portions. Test positivity is low, with only 2% positivity for all samples.

Root lesion nematodes have been found in 49 of 50 counties where samples have been tested (Figure 3.) Overall, test positivity is approximately 80% based on 766 samples tested.

In 2023, we also commenced a new program to identify the species of root lesion nematode, given that recent results indicated a higher-than-expected percentage of fields at moderate to high damage thresholds. Initial surveys from sampled fields in six counties (16 fields) revealed four *Pratylenchus* spp.: *P. crenatus*, *P. neglecuts*, *P. alleni*, and *P. scribneri*. In some samples, we found a mixture of these species. Our goal for 2024 is to focus on estimating the impact of the importance of this PPN.

Soybean root infected with soybean cyst nematode. White, lemon-shaped females can be observed protruding out of the root about 6 weeks after planting. Photo credit: Greg Tylka, Iowa State University.

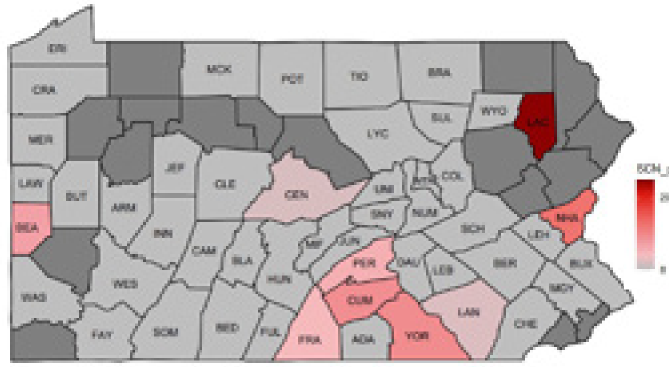


Figure 1. Prevalence of soybean cyst nematode across Pennsylvania at the county scale. The prevalence is defined as the number of SCN-positive fields divided by the total number of samples tested in each county. Please note that the number of fields tested in each county differs. Gray boxes with no text are for counties where no samples have been tested. Darker red indicates higher prevalence.

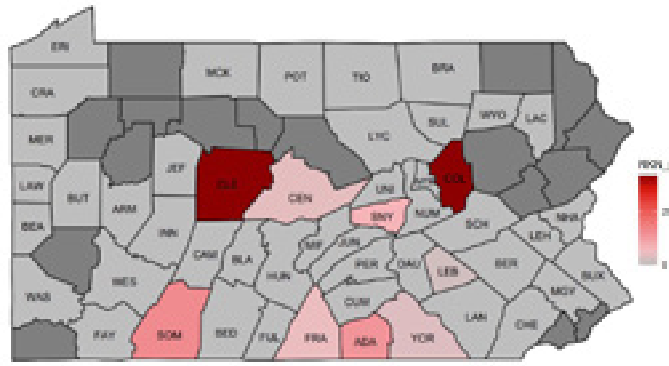


Figure 2. Prevalence of root-knot nematode across Pennsylvania at the county scale. The prevalence is defined as the number of SCN-positive fields divided by the total number of samples tested in each county. Please note that the number of fields tested in each county differs. Gray boxes with no text are for counties where no samples have been tested.

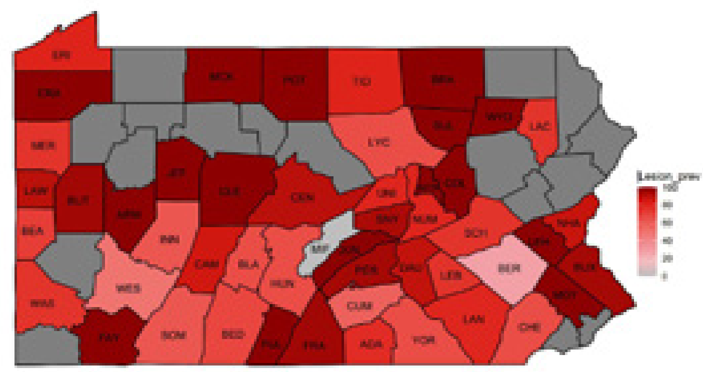


Figure 3. Prevalence of root lesion nematode across Pennsylvania at the county scale. The prevalence is defined as the number of SCN-positive fields divided by the total number of samples tested in each county. Please note that the number of fields tested in each county differs. Gray boxes with no text are for counties where no samples have been tested.

RECOMMENDATIONS

It is essential to sample for nematodes. Best management recommendations incorporate knowledge of PPN. Our current results suggest that we are doing many things correctly to limit the increase in PPN. But we also receive reports from farmers that they have seen decreases in yield in time that they cannot easily explain. We need sampling and testing for nematodes to determine which factors explain the reduced yield.

We aim to increase our educational efforts on lesion nematode, while for SCN, we know that this PPN can reduce yields without causing any symptoms in the above-ground part of the plant. In the meantime, SCN populations continue to grow below ground until they reach levels that cause stunting or yellowing and, finally, plant death. By the time symptoms are noticeable, SCN populations can far exceed the damage threshold for yield, and management becomes more challenging.

Those who detect SCN in their fields early have the greatest chance of deploying the most effective strategies to protect their yield (including crop rotation and genetic resistance) at the lowest cost to the grower.

Contact Paul Esker (pde6@psu.edu), Alyssa Collins (acc18@psu.edu), or Adriana Murillo-Williams (axm1119@psu.edu, office phone: 355-4897, txt 814-360-5517) if you have any questions about our free SCN testing program or would like to participate.

Learn more at thescncoalition.com

Development of Best Management Guidelines for White Mold in Pennsylvania

Principal researcher and co-investigators: *Dr. Paul Esker, Extension Field Crops Plant Pathologist and Associate Professor; Dr. Alyssa Collins, Extension Plant Pathologist and Associate Research Professor; Dr. Beth Gugino, Assistant Dean and Professor; Karen Luong, Graduate Student; Tyler McFeaters, Education Program Specialist*

FUNDED AMOUNT: $39,951

RESEARCH SUMMARY

Since 1996 in Pennsylvania, white mold has caused soybean yield loss equivalent to an average of $10 per acre. White mold disease is caused by the fungus *Sclerotinia sclerotiorum*. The fungus thrives in cool, wet weather, and disease severity varies each year. The pathogen can infect numerous host plants and survive in the soil for five or more years as sclerotia, black overwintering structures.

Given the variability of microclimates and production practices across Pennsylvania, targeted risk assessments and management strategies are needed. Our project aims to improve white mold disease management by (1) elucidating the biology of the pathogen, (2) estimating the extent of the problem, (3) examining the feasibility and limitations of management strategies, and (4) determining the efficacyof fungicides.

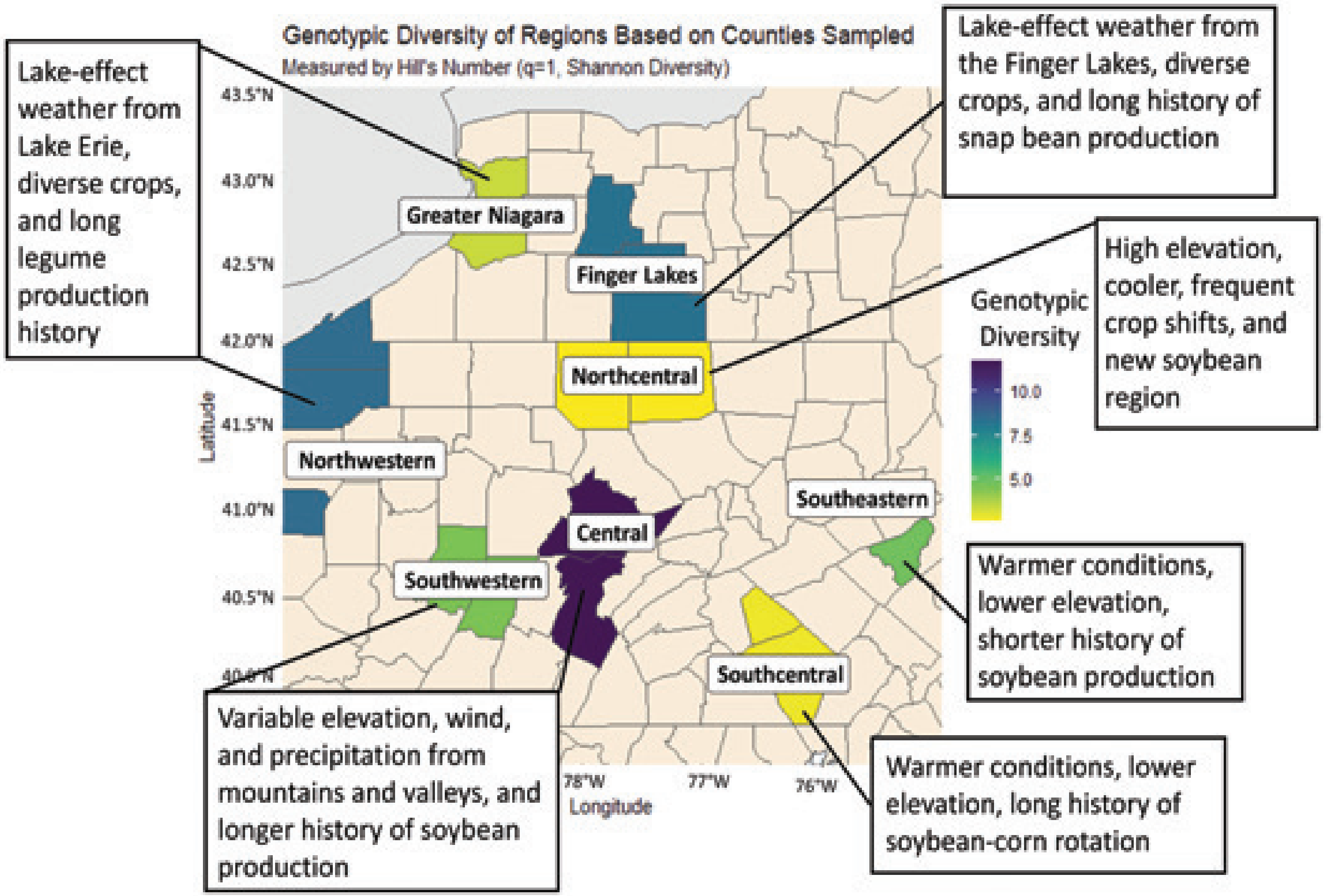
White mold-infested soybeans and soil were collected throughout Pennsylvania during the summer of 2019 through 2022. In addition, we received New York isolates from our collaborator, Dr. Sarah Pethybridge (Cornell University), to use for a comparison study. In the laboratory, *S. sclerotiorum* was isolated. DNA was extracted, from which nine different genes were amplified using PCR and processed by Penn State Huck Genomics Facility to distinguish unique groups (multilocus genotypes).

Thirty isolates were selected to develop a high-throughput fungicide assay. A 24-well tissue culture plate was used to test 20 treatments, four fungicides at five different concentrations, negative control (no fungicide and no pathogen), and positive control (pathogen growing in no fungicide). A traditional Petri plate assay was performed as a comparison.

On-farm fungicide efficacy trials were performed in two counties with eight fungicides using one-pass and two-pass applications. One-pass applications were made at R1, and two-pass applications were made at R1 and 10-14 days afterward. In Lawrence County, a comparative study of fungicide applications with a drone at three gallons per acre (GPA) and a backpack sprayer at 15 GPA was conducted.

Lastly, grower discussion meetings and paper surveys were implemented to elucidate the extent of the problem of white mold, current effective management practices, limitations of each management tool, and factors that influence the adoption of specific management strategies. Analyses are currently being performed.

White mold signs: black sclerotia and white mycelia on soybean stem and pods.



Regional diversity of Sclerotinia sclerotiorum and brief descriptions of each region's microclimatic conditions and production histories. Central Pennsylvania has the highest genotypic diversity, and Northcentral Pennsylvania has the lowest.

FINDINGS

Regional pathogen diversity: A total of 287 isolates from 25 fields across Pennsylvania and New York were analyzed, and 41 multilocus genotypes were found, of which 26 were unique to Pennsylvania. The overall sampled population exhibits clonality, and there are no strong distinctions between regional subpopulations. However, some regions had high numbers of distinct multilocus genotypes or unique groups of *S. sclerotiorum* isolates. There is evidence that soil types and microclimates may explain the difference in regional genotypic diversity, whereas specific management practices are not associated with diversity.

High throughput fungicide sensitivity method testing: The two methods did not produce the same EC50 value, where fungal growth is inhibited by 50 percent, perhaps due to the high-throughput method measuring mycelial density, whereas the Petri plate assay captures radial growth. However, the high-throughput assay reduced materials, cost, and time by half. Isolates from our collection will be screened to capture the status of the pathogen's fungicide sensitivity, reduced sensitivity, and resistance.

On-farm fungicide efficacy trials: One-pass applications of Endura, Omega, and Aproach were better at reducing white mold disease severity. Two-pass treatments of Miravis Neo, Delaro Complete, and Aproach Prima also reduced disease severity and performed slightly better than one-pass treatments. Coverage was better with the backpack sprayer, but the severity of white mold disease was lower in drone-applied plots. However, disease incidence was lower in all drone plots. This trial was not randomized or replicated; therefore, further work on drone comparisons will be continued in 2024.

Establishing an Herbicide Resistance Monitoring Program for Pennsylvania Soybean Growers

***Principal researcher:** Dr. Caio Brunharo, Assistant Professor, Applied Weed Physiology Laboratory*

FUNDED AMOUNT: $15,440

RESEARCH SUMMARY

Herbicide resistant weeds have become very common in Pennsylvania soybean production fields. Although there is anecdotal information on resistance distribution and patterns, formal herbicide resistance surveys have not been comprehensively performed in the Commonwealth.

One of the pillars of herbicide resistance management is timely detection of resistant populations, as well as the identification of alternative chemistries and management practices. The long-term goal of this project is to establish an herbicide resistance monitoring program to provide timely detection of resistant weeds for soybean farmers in Pennsylvania. Once this project is completed, growers would be able to submit leaf samples for herbicide resistance diagnostics with short turnaround time (i.e., days, as opposed to several months with current techniques).

The first steps towards this long-term goal are to map where herbicide resistance is, what types of resistance have evolved, and identify which herbicides still work. We aim to complete these studies in 2022-2024. In the 2022 growing season, we surveyed fields for annual ryegrass, marestail, Palmer amaranth, and waterhemp, the most observed species in fields. We then conducted greenhouse studies to characterize herbicide resistance at the whole-plant level against 17 commonly used herbicides.

In the 2023 growing season, we expanded our sampling (Figure 1). We collected our last sample in the last week of October 2023, and are now beginning to test them in greenhouse. We had considerable assistance from farmers and consultants who reached out to us for site visits or mailed seed samples.

FINDINGS

We found that, in the populations sampled in 2022, resistance to glyphosate, ALS inhibitors (e.g., Pursuit), and atrazine in waterhemp is widespread, but not in all populations. A single population displayed resistance to 2,4-D and dicamba.

We also observed that products containing flumioxazin (e.g., Valor), fomesafen (e.g., Reflex), glufosinate (e.g., Liberty), and tiafenacil (Reviton) are still effective.

Populations of Italian ryegrass displayed resistance to fluazifop (e.g., Fusilade) and glyphosate.

All marestail populations were resistant to glyphosate and chlorimuron (e.g., Classic), but were controlled with atrazine, 2,4-D, glufosinate, and dicamba.

RECOMMENDATIONS

Given weed populations displayed distinct resistance patterns, growers could benefit from a system for quick herbicide resistance diagnosis. We are currently studying the populations collected in 2023, and this work will be completed in the first part of 2024. Future work will develop quick molecular tests for identification of herbicide resistance in waterhemp.

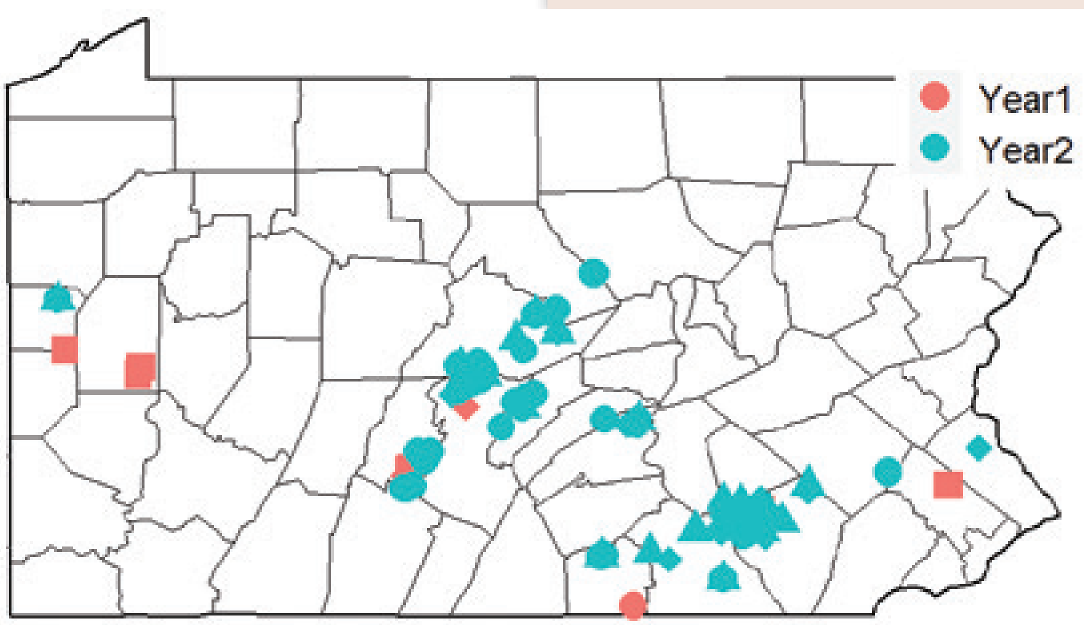


Figure 1. Map of Pennsylvania and locations where weed populations were collected in 2022 (red) and 2023 (blue).

COLLABORATIVE **RESEARCH**

Checkoff Dollars Invested in Collaborative Research

Through the checkoff program, soybean growers from various states are pooling their resources, knowledge, and efforts to tackle challenges together. Collaboration allows innovative projects to be developed and funded for research that's most important to farmers with the results disseminated to a wider audience of soybean growers and researchers.

Identifying projects that can apply to multiple states helps to leverage those checkoff funds and enable a bigger impact. By sharing resources and costs, the Pennsylvania Soybean Board can join with other states to conduct more in-depth research projects that might have been financially challenging individually.

ATLANTIC SOYBEAN COUNCIL

The Atlantic Soybean Council invests checkoff dollars from producers in Pennsylvania, Delaware, Maryland, New Jersey, New York and Virginia as well as growers represented by the Eastern Region Soybean Board in West Virginia, Florida, and the New England states.

The smaller, East Coast soybean-growing states face unique challenges when it comes to agricultural research and development. Limited resources and expertise can impede progress in understanding crop diseases, optimizing yields, and adopting sustainable practices. This is where collaboration steps in.

The Atlantic Soybean Council provides the opportunity for researchers and producers to identify common areas of research needed. The Council combines soybean checkoff funds from its member states to sponsor basic and applied research to increase soybean profitability and enhance yield, while maintaining or improving soybean composition. The Council accepts proposals annually to develop and coordinate a multi-state on-farm research program with the purpose of creating a network of replicated field experiments.

Explore other regional checkoff investments by the Atlantic Soybean Council at *atlanticsoybeancouncil.com*

The Pennsylvania Soybean Board hosted farmer/leaders on the board of the North Central Soybean Research Program (NCSRP) in State College for their 2023 summer NCSRP meeting.

NORTH CENTRAL SOYBEAN RESEARCH PROGRAM (NCSRP)

The Pennsylvania Soybean Board is a member of the North Central Soybean Research Program (NCSRP), a leader in multi-state collaborative research and outreach efforts to support soybean farmers and drive the soybean industry forward.

Farmer leaders, state staff and funded researchers work together to prioritize, monitor and communicate the basic and applied science efforts on behalf of more than 350,000 soybean farmers in the region, representing more than 85% of the nation's soybean production.

The focus of NCSRP is soybean production research and Extension outreach. They invest soybean checkoff funds in university research and Extension programs to better understand and manage plant stressors that reduce soybean yield and farmer profitability. NCSRP's emphasis on enhancing and protecting soybean yield through genetics and agronomic practices contributes to soybean grower success today and tomorrow.

Learn more about the work of NCSRP at *ncsrp.com*.

Soybean Research and Information Network

The Soybean Research and Information Network (SRIN) highlights results, provides resources, and promotes the importance of soybean research. SRIN is administered by NCSRP and is supported by United Soybean Board and other state and regional soybean boards. The SRIN website includes information about agronomics, pests and disease management, as well as videos, publications and more. It's your go-to resource for checkoff-funded research results.

Check it out at soybeanresearchinfo.com.

Mid-Atlantic Regional Soybean Project

Principal researcher and co-investigators: *Dr. Paul Esker, Extension Field Crops Plant Pathologist and Associate Professor; Dr. Alyssa Collins, Extension Plant Pathologist and Associate Research Professor; Tyler McFeaters, Education Program Specialist*

FUNDED AMOUNT: $15,000

RESEARCH SUMMARY

Uniform fungicide efficacy trials (UFT) were conducted at the Southeast Agricultural Research and Extension Center (SEAREC) in Manheim, PA, and the Russell E. Larson Agricultural Research Center (RELARC) at Rock Springs in Pennsylvania Furnace, PA. These trials compared seven foliar fungicides applied at the R3 growth stage (pods 3/16 inch long) against an untreated check.

Trials were conducted using a randomized complete block design and were replicated four times. Plots in SEAREC were bulk planted with mowed alleys cut out before spraying. The harvested plot size was 5 feet wide by 20 feet long. Plots at RELARC were plot-planted four rows wide by 17.5 feet long. The trial at SEAREC was sprayed on July 26, while the RELARC trial was delayed by the drought in May and reached R3 on August 16.

Two low-cost spore traps were deployed on the edge of each field. One trap was placed approximately 3 feet above ground level and the other at 5 feet. The batteries were replaced every 7-10 days, and new microscope slides were attached with fresh Vaseline to catch spores. Once microscope slides were collected from the field each week, they were kept refrigerated until the end of the season, when they were shipped to the University of Wisconsin for analysis.

FINDINGS

There was very low foliar disease severity in the trial at SEAREC. No formal disease assessments were obtained from the end of soybean flowering throughout the pod-fill period (Figure 1). We used Canopeo to measure plot greenness to determine if any plant health benefits from the fungicides were observed.

At RELARC, low disease severity levels were observed for Septoria brown spot and frogeye leaf spot. Most fungicides reduced Septoria brown spot compared to the untreated check (Figure 2). Nonetheless, no differences in frogeye leaf spot incidence or yield were observed between fungicides and untreated checks. These results continue a trend since 2019 as we have observed low disease severity levels in our trials at these locations.

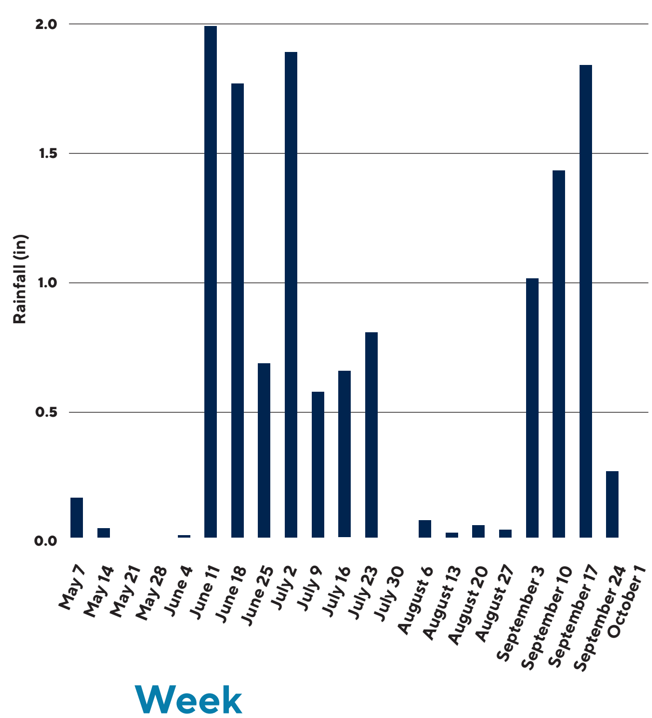


Figure 1. Rainfall by week at SEAREC in 2023.

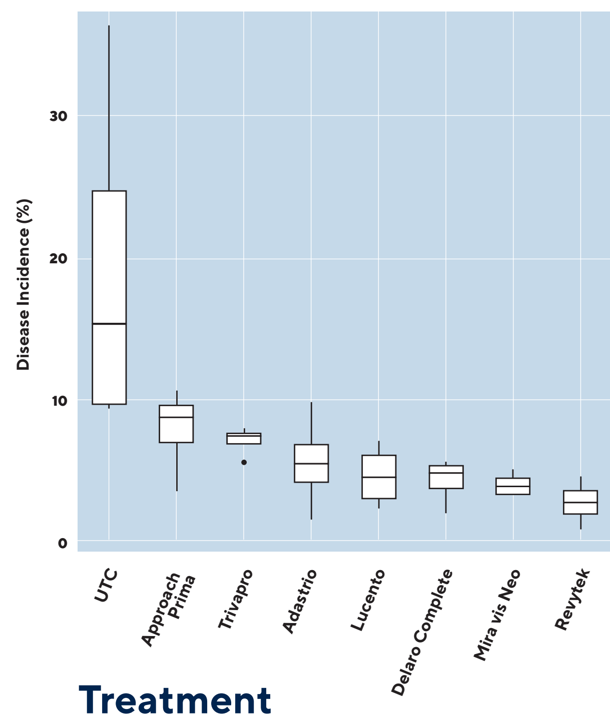


Figure 2. The soybean UFT at RELARC showed significantly reduced Septoria brown spot. (UTC = Untreated Check)

Using Data-Driven Knowledge for Profitable Soybean Management Systems

Funded by the North Central Soybean Research Program

Principal researchers and co-investigators: *This 3-year interdisciplinary and collaborative regional project is co-directed by Penn State and the University of Wisconsin-Madison, with collaborators in OH, MI, IA, MN, NE, and ND, and funded by the North Central Soybean Research Program.*

Penn State Team: *Dr. Paul Esker, Extension Plant Pathologist, and Associate Professor; Miranda DePriest, Computational Scientist; Tyler McFeaters, Extension Program Specialist; Dr. Santosh Sanjel, Postdoctoral Scholar. University of Wisconsin Team: Dr. Shawn Conley, Extension Soybean Specialist and Professor; Dr. Spyros Mourtzinis, Data Scientist*

RESEARCH SUMMARY

Using data-driven knowledge for profitable soybean management systems is a research endeavor to improve the usefulness of big data in soybean production and management at the field level, ultimately providing real-time decision support for growers to maximize profit and yield. An essential facet of this project is collecting information about spatial heterogeneity within a field, improving our understanding of conditions contributing to various soybean stressors and the result of different management practices.

As part of these efforts, we collect the following types of reports:

- **Scouting reports:** In these geo-referenced field conditions surveys, information is collected, including growth stage, population counts, beneficial species, 100+ stressors, and their severity. This data can be paired with remote weather sensing data, soil characteristic data, and satellite imagery to understand the drivers of soybean health.

- **Production surveys:** Here, we collect information about field management practices, including planting information, fertilizers used, pesticide applications, yield outcomes, and more. We also collect information about product prices so that profit can be evaluated in our model.

FINDINGS

We created the Open Crop Manager platform and app to facilitate data collection and reporting. We field-tested our tools in eight states in 2022 and 2023. Overall, we intensively scouted 135 fields (range: 3 to 36, depending on the state), which yielded several thousands of individual field reports. Our tools also provide the option to upload field images. We have received over 3,000 images that will be used to develop algorithms to identify different stressors remotely.

The OCM mobile app will be launched in Spring 2024, allowing offline data collection in the field. We will announce when this is available before the start of the planting season. See opencropmanager.com for information.

The data collected by this project is protected (data security) with the help of the Penn State Institute of Computational and Data Science. If you're interested in contributing data to the project, please get in touch with Paul Esker at pde6@psu.edu or Shawn Conley at spconley@wisc.edu.

Learn more about the Open Crop Manager browser platform.

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extension.psu.edu/field-and-forage-crops-team-sign-up