

2025

Research Report

& Fiscal Year Annual Report



Pennsylvania
Soybean Board

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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pasoybean.org



Justin Jones
Chair, Pennsylvania Soybean Board

Investing in the Future for PA Growers

2025 brought real challenges for soybean growers across the country and here in Pennsylvania. Shifting global markets and economic pressures tested farm operations at every level. Through it all, Pennsylvania soybean growers demonstrated resilience, adaptability, and determination.

The Pennsylvania Soybean Board continues to work on addressing the question at the forefront of every grower: how do we strengthen profitability today while positioning our farms for the future?

The Board is addressing this challenge by expanding market demand through continued collaboration with our biodiesel partners. We're investing in our animal agriculture partners to present research that demonstrates the value of soybean meal and investing in agronomy research that helps growers maximize the value of input costs and deliver the strongest return on investment.

As a group of local farmer leaders, the Pennsylvania Soybean Board strategically invests checkoff dollars in initiatives that help expand soybean markets and contribute to long term success of the soybean industry. This includes support for leading agricultural research institutions and the innovators behind that work. We encourage you to review the 2025 Research Report & Fiscal Year Annual Report and connect with your local Penn State Extension educator and farm advisors to see how you can incorporate research findings in your farm's operations.

The Board is committed to sharing grower-led success through the annual Soybean Yield Contest. This contest highlights innovations and production practices from participating Pennsylvania farmers, providing data-driven insights that benefit growers across the state. Details from this year's contest, including participant practices, are available in the 2025 Soybean Yield Contest report on the PSB website. www.pasoybean.org

We remain focused on delivering results aligned with our values and responsibilities to Pennsylvania Soybean Growers. We are dedicated to supporting you through challenges and opportunities to ensure the future of the soybean industry remains strong and profitable.

We appreciate your dedication and contribution to the future of soybean farming in PA and wish you continued success in 2026.

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



Visit us at pasoybean.org



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OCT. 1, 2024 – SEPT. 30, 2025

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Dr. Paul Esker, Penn State

Executive Director

Jennifer Reed-Harry
jrharry@pennag.com
(717) 651-5922

* Also serves on United Soybean Board



Pennsylvania Soybean Board Annual Financial Report

Fiscal Year 10.1.2024 to 9.30.2025

Bringing Research 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



CASH & ASSETS	
Operating Funds	\$769,616.90
Emergency Preparedness Fund	\$280,723.60
Dissolution Fund	\$350,904.50
Equipment, Net	\$2,373
Less: Liabilities	\$0
Net Assets at 9.30.2025	\$1,403,618

REVENUE:	
Assessment Income	\$1,599,837
Less Assessments Paid to USB & Other State QSSBs	\$939,869
Other Revenue	\$34,861

PROGRAM EXPENSES:	
Communications	\$104,238
Promotion & Education	\$307,908
Research*	*\$373,227
Administration/Audits/Compliance	\$171,495
Increase/(Decrease) in Net Assets	\$262,072

* This amount reflects the actual disbursement of the funds allocated for research as of September 30, 2025.

2026 Pennsylvania Soybean Board Agricultural Events Highlights

Please visit the PSB website for additional events: pasoybean.org/events

January–March, Penn State Extension Crops Conferences and Crops Days

Locations: Across central Pennsylvania | More info: extension.psu.edu/crops-days

February 3, Lebanon County Crops Conference - Sponsored by Pa Soybean Board

Location: Lebanon Valley Expo Center, 80 Rocherty Road, Lebanon, Pa

More Info: extension.psu.edu/crops-conferences

February 25 – 27, Commodity Classic

Location: San Antonio, Texas | More info: commodityclassic.com

August 11–13, Ag Progress Days

Location: Pennsylvania Furnace, Pa 16865 | More info: agsci.psu.edu/apd



PENNSYLVANIA SOYBEAN YIELD CONTEST



Ian Stamy of Mechanicsburg earned the statewide title as the top producer in the 2025 Pennsylvania Soybean Yield Contest sponsored by the Pennsylvania Soybean Board. Ian won top honors with a yield of 101.67 bushels per acre, outperforming more than 30 other entrants from across Pennsylvania.

THE PENNSYLVANIA SOYBEAN YIELD CONTEST is designed to focus farmers' 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 nonirrigated 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 Yield 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

2025 Pennsylvania Soybean Yield Contest Winners

1st Place State Overall & Central Region
Ian Stamy,
(Cumberland County)
101.67 bu./acre

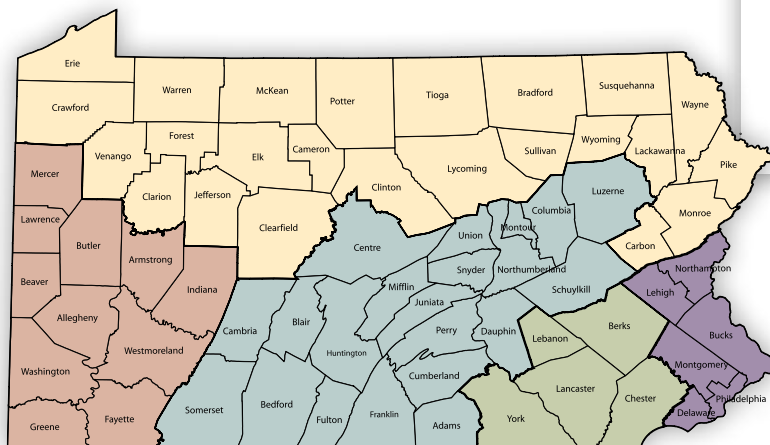
1st Place South Central Region
A. Dale Herr
(Lancaster County)
100.49 bu./acre

1st Place Western Region
Ron Carter
(Washington County)
72.07 bu./acre

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

1st Place Southeast Region
Brad Kiefer,
(Northampton County)
95.33 bu./acre

1st Place Irrigated Class
Eric Meyers,
(Franklin County)
86.71 bu./acre



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

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



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	A. Dale Herr, Jr	Ian Stamy	Ron Carter	John Tebbs	Brad Kiefer
County	Lancaster	Cumberland	Washington	Lycoming	Northampton
Previous Crop	Corn	Corn	Corn	Corn	Corn
Row Width	15"	30"	15"	15"	15"
Tillage Type	No-Till	Min-Till	No-Till	Min-Till	Min-till
Variety	Pioneer 33Z17E	Pioneer 37Z06E	Seed Consultants 7293	Pioneer 33Z17E	Pioneer 43Z44SE
Seeding Date	4/25/25	4/23/25	4/20/25	4/21/25	4/28/25
Seeding Rate	150,000	125,000		140,000	140,000
Final Stand	125,280	93,960	76,560	142,680	52,200
Seed Treatment	Pioneer Premium	Pioneer Premium	LumiGEN	Pioneer Premium	Pioneer Premium
Inoculation	Dry	Pre & Liquid	Dry	-	Pre
Fungicide	Yes	Revytek	None	Revytek	Yes
Insecticides	Yes	PREV-AM	None	Mustang Maxx	None
Pre-Herbicide	Roundup, Sharpen, Tribal	Authority	Glyphosate, Enlist, Dual	Antares Complete Gramoxone	None
Post-Herbicide	Roundup, Enlist, Radiant	Zidua	Enlist, Liberty	Classic Roundup	Roundup, Liberty,
Date of Harvest	10/7/25	10/2/25	10/2/25	10/10/25	11/6/25
Yield	101.49	101.67	72.07	98.68	95.33
Moisture %	14.20	13.30	11.40	14.70	11.40
Ave Pod Count	49	170	65	118	79
Harvest Loss	0.25 bu/a	0.88 bu/a	0.25 bu/a	0.75 bu/a	0.75 bu/a
Biostimulant	Yes	Yes	None	None	None
Foliar Fertilizer	Yes	NEXTAstand, nutriCharge	Yes	Yes	Yes
Cover Crop	Wheat	-	Wheat or Rye	Rye/wheat	Rye



To read the complete Pennsylvania Soybean Yield Contest 2025 Report scan the QR code or request a copy from your local Penn State Extension Educator.

pasoybean.org/initiatives/pa-soybean-yield-contest

PENNSYLVANIA SOYBEAN ON-FARM NETWORK

Principal Research and Co-Investigators:

Dr. Paul Esker, PSU Extension Plant Pathologist and Professor
 Dr. Daniela Carrijo, PSU Extension Agronomist and Assistant Professor
 Dr. Alyssa Collins, PSU Extension Plant Pathologist and Associate Research Professor
 Sarah Frame, 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
 Ashley Isaacson, PSU Extension Field and Forage Crops Educator

Dr. Mihail Kantor, Assistant Research Professor
 Dr. Adriana Murillo-Williams, PSU Extension Field and Forage Crops Educator
 Dr. Heidi Reed, PSU Extension Field and Forage Crops Educator
 Dr. John Tooker, PSU Extension Entomologist and Professor
 Dr. John Wallace, PSU Extension Weed Scientist and Associate Professor
 Delbert Voight, PSU Extension Field and Forage Crops Educator

FUNDED AMOUNT: \$313,829

RESEARCH SUMMARY

For over ten years, the Pennsylvania Soybean On-Farm Network has provided practical, research-based insights to enhance soybean production in the Commonwealth. Our on-farm trials and educational outreach have had a measurable impact. Grower feedback highlights the value of this network, emphasizing the benefits of testing strategies directly on the farm and discovering

what truly works in real production settings, while also creating opportunities for local discussions on soybean production, management, and profitability. Comments have included, “I’ve been to many Penn State Extension events, and I haven’t found them as helpful [as today’s meeting]. If you can replicate this across the state...” (Cambria County, 2024), and “This is the first meeting where I have expressed my opinions because I feel somebody wanted to listen to me” (Centre County, 2025).

A SINCERE THANK YOU!

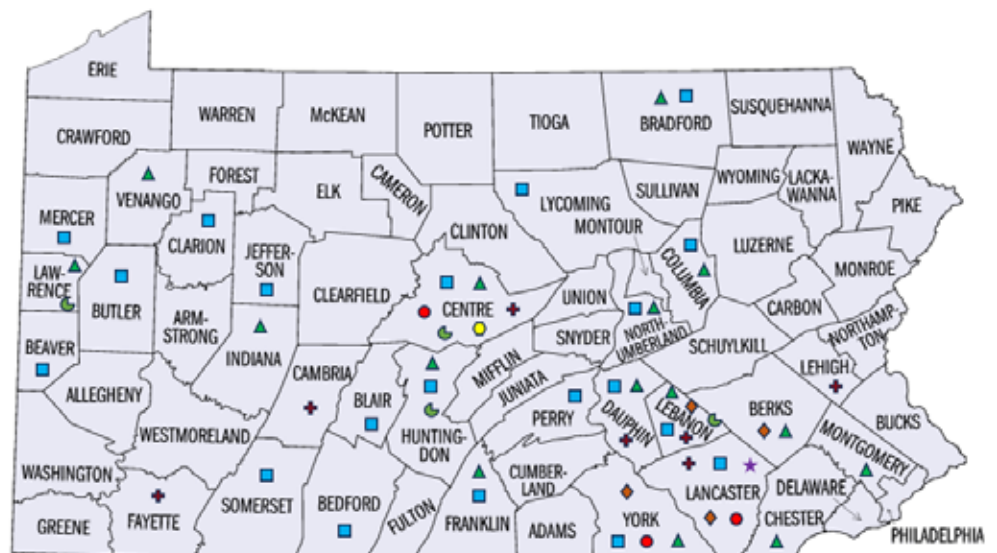
We deeply appreciate the commitment of our 2025 Soybean On-Farm Network cooperators, along with the Penn State Extension Field and Forage Crops Team, and the dedicated scientists, graduate students, and interns who made this research possible. On-farm trials require extra time and effort, and your willingness to test innovative ideas under real production conditions is what drives progress in soybean management. Your collaboration ensures that research translates into practical solutions for Pennsylvania growers.

Thank you for being an essential part of this effort! We look forward to continuing this partnership and advancing soybean production together in 2026.

2025 On-Farm Trial Sites by County

Locations of the 2025 Pennsylvania Soybean On-Farm Network trials and monitoring programs.

- Agronomy Projects
- ◆ Cover Crops
- ★ Research Validation Plots
- Soybean Sentinel and Data-Driven
- ▲ Slug Monitoring
- See and Spray Trials
- ✚ Farmer Meeting Locations
- ◌ White Mold Project



Development of Best Management Guidelines for White Mold in Pennsylvania

Principal Investigator and Co-Investigators:

Dr. Paul Esker, Professor and Extension Plant Pathologist

Tyler McFeaters, Education Program Specialist, Penn State

Alyssa Collins, Research Associate Professor and Director SEAREC

Adriana Murillo Williams, Extension Educator, Penn State Extension

Ryan Spelman, Extension Educator, Penn State Extension

ADDITIONAL FUNDING: NORTHEAST SARE PARTNERSHIP GRANT (ONE24-443)

RESEARCH SUMMARY

White mold has become a yearly problem in many parts of Pennsylvania, with an average yield loss of \$10 per acre since 1996. It is caused by the fungus *Sclerotinia sclerotiorum*, which prefers cool, wet conditions. The pathogen has a broad host range and can survive in soil for five or more years as sclerotia, black structures that overwinter, making disease control more difficult (Figure 1). Given the diverse microclimates and farming practices across Pennsylvania, targeted risk assessments and management strategies are essential.

Our project aims to use an on-farm approach to increase our understanding of the efficacy of fungicides in managing white mold by evaluating the use of drones to scale fungicide applications. We further assess white mold in small-plot, on-farm trials at locations with an extended history of white mold.

In 2025, on-farm drone-based fungicide trials were established at five locations across Pennsylvania; only four completed the trial through harvest. Trials were established using large strip plots, ranging from 20 feet by 200 feet to 100 feet by 1400 feet. The base treatment structure included an untreated check and the application of Viatude™ with Onmira™ active (picoxystrobin and prothioconazole, Corteva Agriscience). Individual trial locations also had the flexibility to increase treatments, with some cooperators opting to examine the effects of different application volumes, compare with ground applications, or explore the impact of manganese on plant health.

Small plot trials were established at an on-farm cooperator's field in Lebanon County, which has a history of white mold. Sixteen treatments were compared, including five experimental compounds. Fungicides were applied once (R1 = beginning flowering) or twice (R1 and R3 = beginning pod). There was also an untreated check (UTC). The experimental design was a randomized complete block with four replications.

Disease assessments were conducted by rating 50 plants in each plot using a 0-3 scale, where 0 = no disease, 1 = disease only on lateral branches, 2 = disease on the main stem, and 3 = disease on the main stem and plant wilt or

death. The disease severity index (DIX, measured as a %) was calculated from the ratings. Yield (bu ac-1) and foliar disease evaluations (%) were also recorded.

FINDINGS

Drone trials: Overall, conditions for white mold development varied across locations. White mold was not observed at all locations; therefore, foliar diseases were assessed in those locations. No differences were observed among treatments in white mold, with disease severity index values less than 10%. Yields were on average 75-85 bushels per acre across locations, and no differences were observed. Our results did find that any drone application had a detrimental effect on soybean growth and development.

On-farm fungicide efficacy trials: White mold was observed in the trial despite somewhat unfavorable conditions. In Figure 2, the results for disease severity index are provided. All fungicide treatments reduced white mold, although the untreated check had a disease severity index of less than 10%. Although the measured yield followed a similar pattern, no differences were observed. The untreated check had the lowest yield (56 bushels per acre), whereas eight treatments exceeded 70 bushels per acre, including four experimental compounds.

These results follow previous trials in which we observed that drone applications did not adversely affect crop productivity and yielded results comparable to ground-based applications. Our small-plot research provided evidence that all fungicides reduced white mold, but yield was much more variable, making it more challenging to detect an effect with this measure.

Figure 1. White mold signs include black sclerotia and white mycelia on soybean stems and pods (Photo: Tyler McFeaters).



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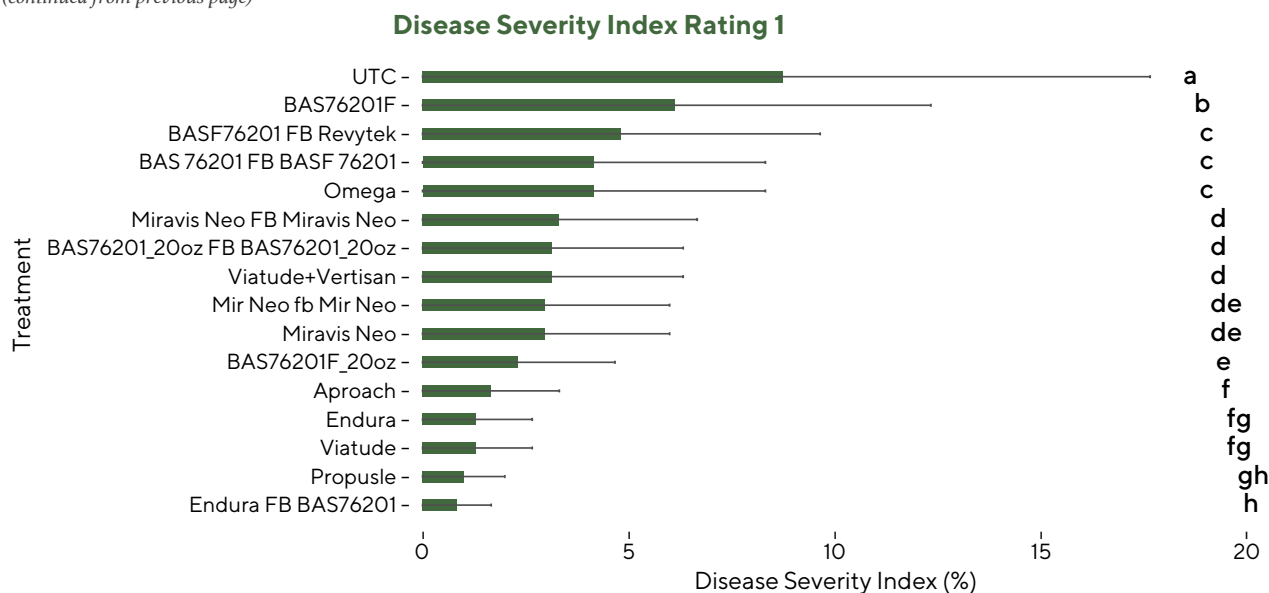


Figure 2. The effect of fungicide application to reduce the disease severity index (%) due to white mold in soybean. Rows (treatments) with the same letter are not statistically different at $\alpha = 0.05$.

Proactively Monitoring Plant-Parasitic Nematodes in Pennsylvania Soybean Fields

Principal Investigator and Co-Investigators:

Dr. Paul Esker, Professor of Epidemiology and Extension Field Crop Pathology

Dr. Alyssa Collins, Associate Research Professor of Plant Pathology and Director SEAREC

Dr. Adriana Murillo Williams, Extension Educator

Dr. Mihail Kantor, Assistant Research Professor of Nematology

Dr. Dilooshi Weerasooriya, Laboratory Coordinator, Plant Pathology and Environmental Microbiology

RESEARCH SUMMARY

Plant-parasitic nematodes pose major threats to crop production worldwide, causing significant yield losses and economic damage. Among these pests, soybean cyst nematode (SCN, *Heterodera glycines*) is the most destructive soybean pathogen in North America, capable of reducing yields by over 50% under severe infestations. SCN was first reported in Pennsylvania in Lancaster County in 2002. Since 2018, we have documented its continual spread through our surveillance efforts. Other nematodes of concern include root lesion nematodes (*Pratylenchus* spp.), which are widely distributed, and root-knot nematodes (RKN, *Meloidogyne* spp.).

To address these threats to soybean production, a free statewide nematode monitoring program was launched in 2018, providing stakeholders with sampling kits and instructions. To date, 1,077 soil samples have been collected from 52 counties. Screening focuses on SCN, root lesion, and root-knot nematodes. In 2024, research expanded to species-level identification using PCR and soil metabarcoding to study nematode-microbe interactions and their impact on soybean health.

FINDINGS

Analysis of samples showed that nematode distribution varies greatly across Pennsylvania. SCN has been detected in 12 counties, including key soybean-producing areas in south-central and southeastern Pennsylvania. Although its occurrence remains relatively low compared to other nematodes, its presence in key production areas is concerning because severe infestations can cause yield losses of more than 50%.

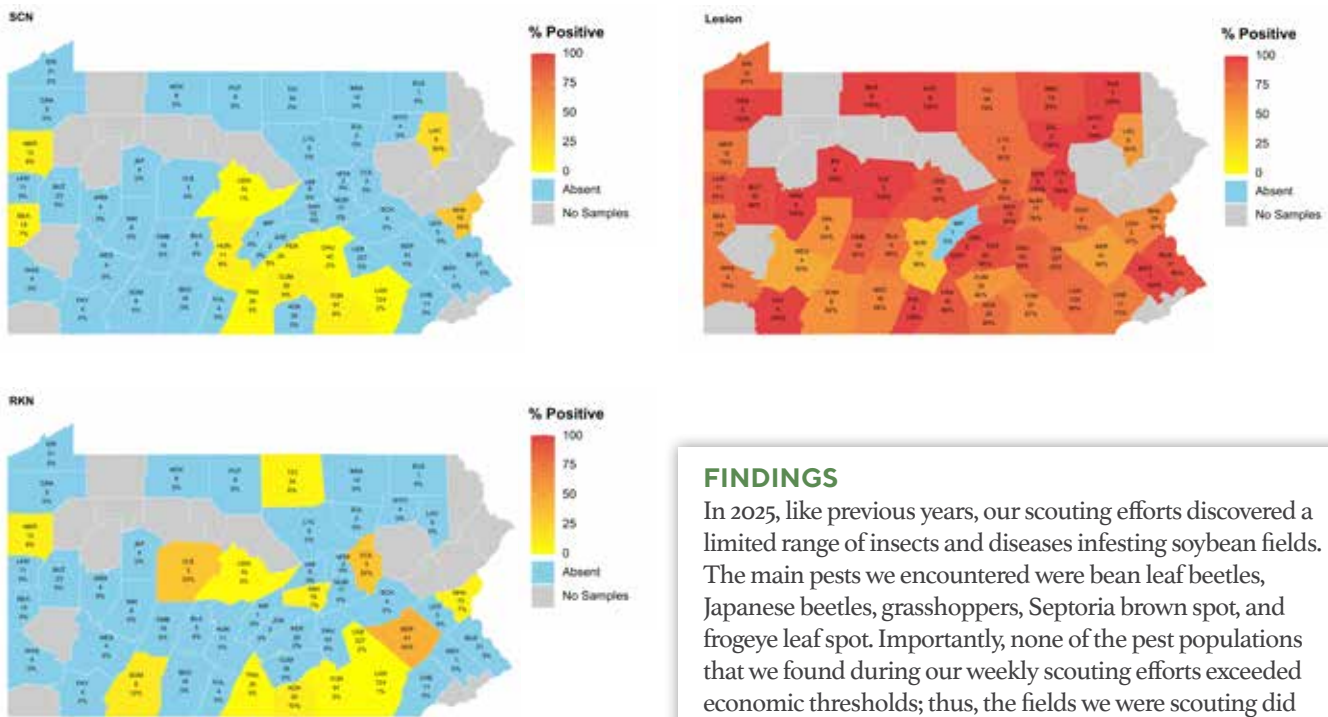
Root-knot nematodes were found in 14 counties, mainly in areas with diverse cropping systems, indicating an emerging threat that needs close monitoring.

Root lesion nematodes are the most widespread group, documented in 51 counties, with high prevalence across central and northern Pennsylvania, indicating strong adaptation to local soil conditions. These findings highlight the need for proactive monitoring and integrated management strategies. Molecular research provides essential insights into nematode-microbe interactions, supporting the development of effective, science-based solutions to protect soybean yields and minimize economic and environmental impacts in Pennsylvania. To date, we have identified six species during our sampling: *Pratylenchus penetrans*, *P. neglectus*, *P. thornei*, *P. crenatus*, *P. scribneri*, *P. alleni*. *P. penetrans* can be a significant pest in soybeans, while several of the other species hold economic importance in other cropping systems in Pennsylvania, including corn and wheat.



Figure 1. Person taking a soil sample for nematode testing. (Photo credit: A. Murillo Williams, Penn State Extension)

Figure 2. Illustrates plant parasitic nematode prevalence by county. These visualizations highlight regional hotspots for SCN and root-knot nematodes (RKN), as well as the near-ubiquitous presence of root lesion nematodes. Values indicate the number of samples tested and the percentage that tested positive. Since 2018, 1,077 samples have been received from 52 counties.



Soybean Sentinel Monitoring and Data-driven Scouting Solutions

Principal Investigator and Co-Investigators:

John Tooker, Professor of Entomology

Paul Esker, Professor of Epidemiology and Field Crop Pathology

RESEARCH SUMMARY

In 13 counties in Pennsylvania, we established sentinel plots in commercial soybean fields. We purposely selected soybean fields that did not receive preventative applications of insecticides and fungicides so we could assess the actual threat of pests to fields. Eleven educators with Penn State Extension then scouted these plots weekly for insects (pest and beneficial species) and diseases. The project sought to provide soybean growers with unbiased and timely regional assessments of insects and diseases active in soybean fields. In these fields without preventative insecticides and fungicides, we expected that insect and disease populations would remain small and not threaten yield. The goal of our project was to demonstrate the value of scouting for understanding local populations, including pests and beneficial species, and encourage growers to adopt Integrated Pest Management in their soybean production.

FINDINGS

In 2025, like previous years, our scouting efforts discovered a limited range of insects and diseases infesting soybean fields. The main pests we encountered were bean leaf beetles, Japanese beetles, grasshoppers, Septoria brown spot, and frogeye leaf spot. Importantly, none of the pest populations that we found during our weekly scouting efforts exceeded economic thresholds; thus, the fields we were scouting did not require rescue treatments of insecticides or fungicides. One of the main reasons that insect pest populations did not grow large enough to threaten yield was the presence of robust communities of natural enemies that help control insect pests. Soybean fields can harbor good populations of beneficial species (mainly insects and spiders), but fields that receive insecticides (seed applied or foliar-applied insecticides) unnecessary do not host good communities of natural enemies and therefore do not benefit from the control that they can provide.

Since 2012, when we started this project, the great majority of soybean fields that we have scouted have not developed large populations of pests. In fact, only three fields out of the 275 or so that we have scouted over the past 14 years have required insecticides (< 1.1% of fields) and none have needed fungicides. This is an important message for growers to hear: insect and disease populations in Pennsylvania soybean fields are not consistently large and infrequently threaten yield. In fact, most fields in most years do not develop economically damaging pest populations; thus, insecticide and fungicide use should provide no advantage. These results suggest that soybean producers should scout their fields regularly and only use insecticides and fungicides if their scouting reveals that pest populations in a field exceed acknowledged economic thresholds. In other words, to manage insects and pathogens, growers should rely on Integrated Pest Management rather than preventative applications.

2025 Pennsylvania Slug Monitoring Project

Anna Hodgson, Penn State Extension Educator, Union County

Dr. John Tooker, Professor of Entomology, Penn State

FUNDED WITH: PROJECTS UNDER THE SOYBEAN ON-FARM NETWORK

RESEARCH SUMMARY

The springs of 2024 and 2025 varied greatly in the number of slugs in fields and the amount of slug damage that soybeans received. In 2024, in many fields, slugs were overwhelming and caused heavy damage, but in 2025, we rarely observed slugs. The winter of 2023-2024 was very mild, leading to large slug populations in spring 2024. We hypothesized that the cold temperatures during winter 2024-2025 helped to knock back the slug population, resulting in fewer slugs observed in spring 2025.

To monitor slug populations in spring 2025, we deployed slug traps in 24 fields (10 shingle traps per field) in 15 counties (Berks, Bradford, Centre, Chester, Columbia, Dauphin, Franklin, Huntingdon, Indiana, Lawrence, Lebanon, Montgomery, Northumberland, Venango, and York). Extension educators checked the traps weekly to count and identify slugs to species and characterize the feeding damage. Each week from mid-April to mid-June, we published a report in Penn State's Field Crop News (an online newsletter that reaches >10,000 subscribers) to summarize what educators were finding (<https://extension.psu.edu/2025-pennsylvania-slug-monitoring-project>). Grey garden slugs were the most common species, followed by marsh slugs. As expected, slug populations were lower in 2025 than in 2024. Nevertheless, populations of grey garden slugs increased in number from mid-April and peaked around mid-May (Figure 1). Slug bait is recommended when traps average 1-2 slugs and moderate crop damage is observed, with increasing damage. Although several fields averaged more than 2 slugs per trap at some point this season, feeding damage remained low, and bait was not necessary. The data we collect from this project will continue to provide insight on populations dynamic of slugs in Pennsylvania fields and contribute to our ongoing effort to develop a model that can help predict when slugs will hatch in spring from overwintered eggs.



Slug in soybean field.

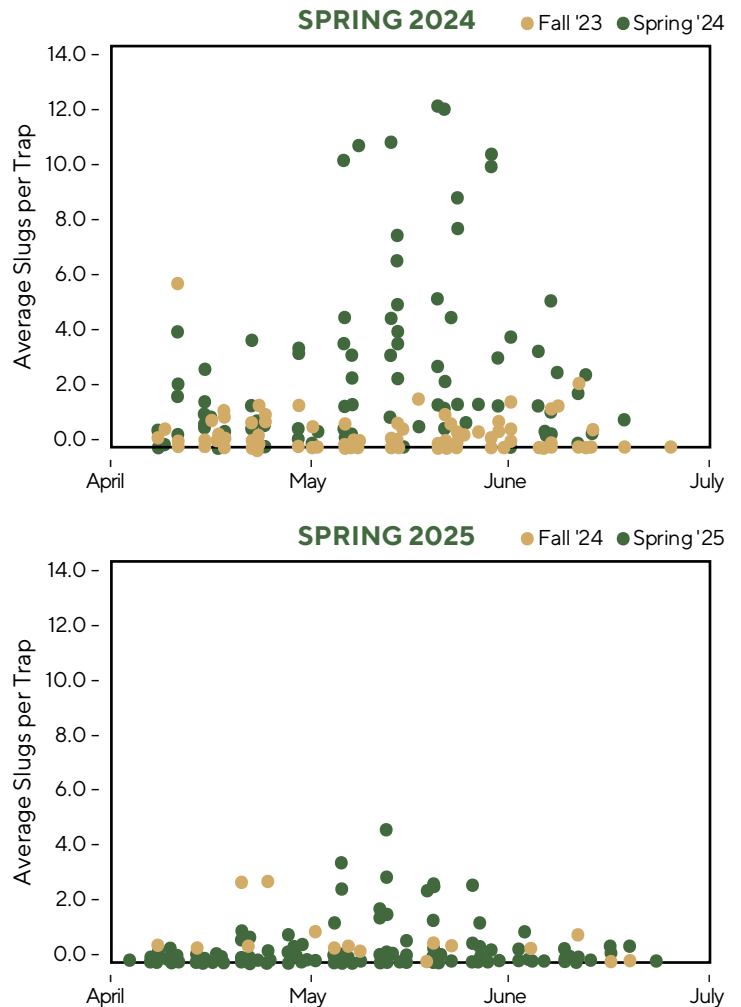


Figure 1. During the spring of 2024 (top) and 2025 (bottom), average number of slugs per trap across monitoring locations (grey garden slugs [black]; marsh slugs [gray]).



Example of a slug trap.

Evaluating Performance of Targeted-Spray Weed Control Technologies in No-Till Soybean

John Wallace (Associate Professor of Weed Science & Extension Specialist)

Grant Hoffer (Research Technologist, Extension Weed Science Program)

PROJECT DESCRIPTION

Significant technological advancements have led to camera-based weed detection systems that can be used on commercial sprayers to make real-time targeted spray applications to emerged weeds. Targeted spraying has the potential to significantly reduce input costs via POST herbicide savings and may also reduce the potential for crop injury from POST herbicide programs. Targeted-spray technologies also have important implications for environmental stewardship, particularly given the likely increase in regulation of herbicide use.

In the 2025 production season, we collaborated with John Deere to compare targeted-spray POST applications to broadcast applications. A 120-ft John Deere sprayer equipped with a See-and-Spray Premium kit was used to perform strip trials. Targeted- and broadcast-applications were evaluated in two production fields, each with four replicates and strip-plots measuring over 2.5 acres per replicate. In each field, Cloak (6.5 oz; chlorimuron + metribuzin) was used as a PRE, soil-residual program. The POST program included Enlist One (32 fl oz/ac) + Liberty 280 (32 fl oz/ac) + Clethodim 2E (6 fl oz/ac), which was applied 42 days after soybean (Enlist 3) planting. Data collection included (1) evaluation of hit-rates on targeted weeds; (2) frequency of late-season weed escapes; and (3) soybean yield.

KEY FINDINGS

1. The percentage of field treated (i.e., as-applied rate %) in target-spray strips ranged 2 to 11%, corresponding to an 89 to 98% reduction in POST herbicide inputs. Two factors likely contributed to this result. First, we used the lowest sensitivity rating, which is a sprayer setting that can be used to prioritize product savings by accepting a higher probability of missed targets. Use of a medium sensitivity setting is typically recommended. Second, strip trials were positioned in field interiors. Previous trials with this technology have demonstrated that as-applied rates are significantly lower in field interiors compared to field edges.

2. We found that targeted spray applications resulted in a lower hit rate (83%) compared to broadcast applications (97%; **Figure 1a**). We randomly sampled weeds for visual symptoms of herbicide injury 7 days after POST applications to quantify the probability of hitting emerged weeds between targeted- and broadcast-spray applications. Weed sizes ranged from small cotyledons to approximately 4" in height. We did not observe differences in hit rates among size categories within targeted strips.

3. The frequency of late season weed escapes was significantly higher in targeted spray strips. However,

late season weed escapes were less than 4" in height, which suggests that missed targets within targeted strips were small at the time of the POST application and were generally suppressed after canopy closure.

4. Soybean yields were significantly greater within targeted-spray strips at one of two field sites (**Figure 1b**). Additional analysis indicated that strips with higher yields were not positioned in historically higher yielding zones within fields. These results suggest that targeted spraying has the potential to improve soybean yields by decreasing the potential for crop injury in response to POST programs. However, we anticipate that yield response from targeted sprays will be variable and a function of as-applied rates (%), the number of active ingredients (and formulations) in POST programs, and weather conditions that influence crop stress near the time of application.

ONGOING WORK

In addition to performing strip trials, we are generating a performance summary of targeted-spray technologies using data shared by early-adopters within Pennsylvania. Currently, we have targeted-spray performance data from 60 production fields and anticipate approximately 120 fields in total. Once completed, our performance summary will quantify herbicide savings and the potential ROI generated by targeted spraying in relationship to PRE herbicide inputs, days to POST application, field size, and other agronomic practices.

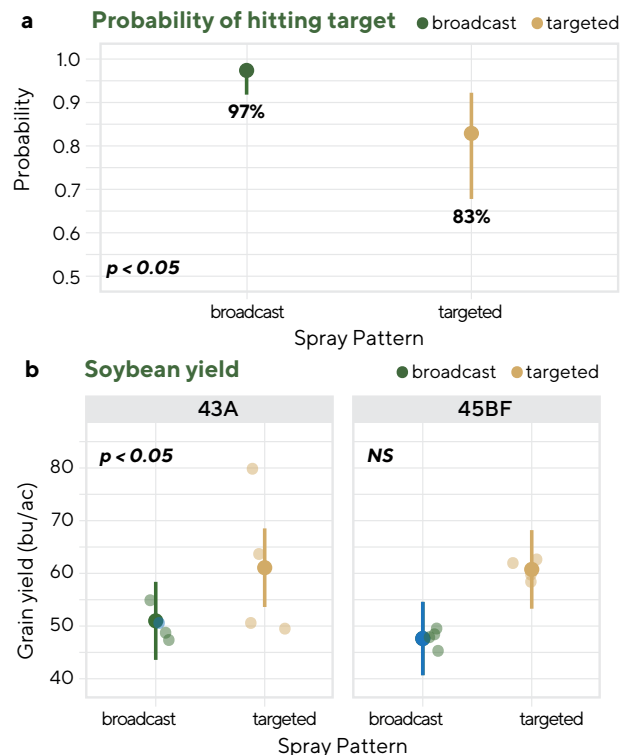


Figure 1. Effect of broadcast vs. targeted POST spray applications on (a) probability of hitting emerged weeds at the time of application; and (b) soybean yield within two commercial production fields (43A, 45BF).

Expanding Cover Crop Options: Drone Interseeding into Standing Soybeans Versus Post-Harvest Seeding

Principal Investigator and Co-Investigators:

Dr. Paul Esker, PSU Extension Plant Pathologist and Professor

Dr. Heidi Reed, Extension Educator

FUNDED AMOUNT: UNDER THE ON-FARM NETWORK UMBRELLA; \$24,447.85

Cooperating Farmers:

Dan Innerst; Jesse Maulfair; Jeremy Meck; Marlin Miller; Mike Schrum



Scan for more information.

extension.psu.edu/what-weve-learned-cover-cropping-into-standing-soybeans

RESEARCH SUMMARY

Farmers struggle to establish cover crops other than winter cereals after soybean harvest. One way around this problem is to drone interseed cover crops into standing soybeans. Hairy vetch was the legume species that established most successfully in previous years of this trial, but best practices for drone seeding hairy vetch have not been established for our region. The objective of this trial was to evaluate establishment success of drone-seeding hairy vetch into standing soybeans at three different dates compared with post soybean harvest drill-seeding.

Identifying when this practice works best on real farms can guide recommendations as the availability of drone-seeding continues to increase, so five farmer cooperators were selected across a range of geographies, soil types, and management strategies in Berks, Lancaster, Lebanon, and York Counties. An additional site was included at the Southeast Ag Research and Extension Center (SEAREC) in Lancaster County.

Hairy vetch was interseeded at 25 pounds per acre at all sites within a few days of September 1; September 15; and October 1, 2024. Post-harvest seeding was done as soon as possible after soybean harvest, which ranged between October 12 and November 15, 2024. There was one replication at each cooperator site, and sites were used as replicates for analysis. Drone service was provided by Snyders Crop Service, LLC; Sky Apply, LLC; Willard Agri-Service; and The Mill.

At SEAREC, broadcast interseeding was done with a chest-mounted spinner spreader on September 6, 20, and 30. Post-harvest drill-seeding was done on October 30, 2024. The field was arranged in a randomized complete block design with four replications. Data for SEAREC replicates was averaged before doing combined analysis on all sites.

We took similar measurements to prior years of this trial; soil nitrate (0 to 6 inches), cover crop density (plants per square foot), and groundcover (percent) in the fall and spring using the Canopeo® app; and cover crop biomass (pounds per acre) in the spring.

The results of this work will contribute to more successful hairy vetch seedings, leading to more nitrogen fixed to feed the next corn crop and reducing the amount of inorganic fertilizer farmers need to purchase.

FINDINGS

At one cooperator site, no hairy vetch emerged; this site is considered a complete failure and data are not included. At another cooperator site, vetch was terminated before spring measurements could be taken, so data are not included for spring measurements.

For remaining sites, Neither fall nor spring hairy vetch density was significantly impacted by seeding date or method. Treatment also had no impact on soil nitrate. There was a simple effect of season on groundcover ($p=0.0032$) with significantly more in the spring (45 percent) than the fall (16 percent). Though not significant, percent groundcover trended higher the earlier the hairy vetch was seeded, when measured in the spring.

Hairy vetch accumulated twice as much biomass when seeded at the earliest seeding date (drone 1, 1033 pounds per acre) than the latest drone seeding date (drone 3, 332 pounds per acre) and waiting to drill or broadcast/incorporate hairy vetch until after soybean harvest reduced spring biomass by 85 percent (150 pounds per acre) compared to the earliest drone seeding ($p=0.0996$, **Figure 1**).

Our results provide evidence that drone seeding in early September can help farmers include hairy vetch as part of their crop rotation. Broadcast interseeding hairy vetch into standing soybeans results in more successful establishment than when hairy vetch is seeded after soybean harvest.

However, the large seed size and high seeding rate of hairy vetch, as well as issues with seed distribution and weed competition are remaining challenges with drone interseeding.

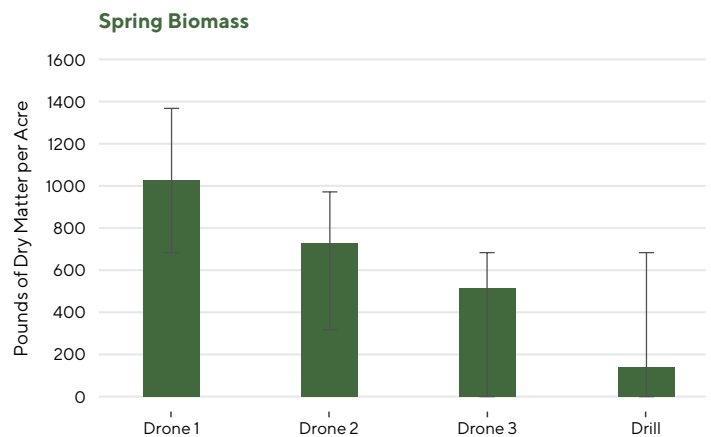


Figure 1. Hairy vetch biomass measured within three days of spring cover crop termination. At each site, drone 1 was seeded within 5 days of September 1; drone 2 was seeded within 5 days of September 15; and drone 3 was seeded within 5 days of October 1. Post-soybean harvest drill seeding took place between October 12 and November 15.

Revisiting Soybean Maturity Recommendations for Pennsylvania

Principal researchers:

Daniela Carrijo, PSU Extension Agronomist and Assistant Professor
 Del Voight, Extension Field and Forage Crops Educator Lebanon County

Co-funders/collaborators of research:

Paul Esker



Soybean Variety Testing Reports

extension.psu.edu/penn-state-field-and-forage-crops-official-variety-testing-program

RESEARCH SUMMARY

When selecting a soybean variety, the first step is choosing the appropriate maturity group (MG) range. Maturity group recommendations for Pennsylvania developed by Penn State Extension have not been updated in the last 25 years. However, much has changed over this period, including soybean genetics, target planting dates, and weather patterns, underscoring the need to revisit these recommendations. Since 2023, we have been leveraging the Penn State Soybean Variety Testing program to address this question. In this program, many varieties representing a range of MGs are compared in replicated, randomized trials. We included additional varieties to expand the range of MGs represented in each trial. The large number of varieties and wide MG range represented in each trial allows us to evaluate soybean response to MG without being highly confounded by varietal specific differences. Here, we present data from 2023 and 2024 variety trials conducted in central (Centre County) and southeast PA (Lancaster and York



Broadcast interseeding hairy vetch in early September resulted in more groundcover and biomass than later interseeding, or post-harvest seeding, but drone seeding resulted in issues with stand evenness.

counties) (Table 1). Data from variety trials conducted at these same locations in 2025 will be included when available for a complete data analysis.

In addition to variety trials, in 2025 we implemented a study in Centre County to determine how optimum soybean MG is affected by planting date. Treatments were combinations of three planting dates (April 28, May 20, June 11) and six varieties representing three MGs (2.1, 3.1, 4.1). For each MG, we selected one variety from Asgrow and one variety from Channel Seed to narrow down the genetic basis and account for potential differences in MG ratings across seed companies.

FINDINGS

Two-year results from the variety trials showed a large variation in yield between varieties and across years, which was typically higher than the variation in yield driven by relative maturity (**Figure 1**). In central PA, a significant decrease in yield was observed with MGs earlier than 2.4, while no significant yield difference was observed between MGs ranging from 2.4 to 4.0. Similarly, in southeast PA, a significant decrease in yield was observed with MGs earlier than 2.6, while no significant yield difference was observed between MGs ranging from 2.6 to approximately 4.5. Overall, results from both regions indicate that, except at extreme MG ranges, variety itself is a more important yield driver than relative maturity, giving farmers more flexibility in variety selection.

First year results from the 2025 trial in Centre County indicated that optimum MG did not vary across the planting dates evaluated (**Figure 2**). The 3.1 MG varieties were the highest yielding across planting dates. Highest soybean yield was achieved with the 3.1 MG varieties planted on April 28, which was driven by a higher number of pods per acre at maturity. Independent of MG, soybean yield decreased as planting date was delayed from April 28 to June 11. Therefore, preliminary data suggest that farmers in Centre County do not need to switch to a different MG when planting date is delayed within this planting window.

Table 1. Variety trials conducted in 2023-2024. Each trial included 20-72 varieties and the MG range evaluated in each trial is indicated, as compared to current recommendations from the Penn State Agronomy Guide. MG = soybean relative maturity group.

Table 1.

Location	Year	Planting Date	Current MG Recommendation	MG Range Evaluated
Lancaster	2023	May 15	3.5 - 4.3	1.4 - 4.8
	2024	May 9		1.3 - 4.4
York	2023	May 10		2.4 - 3.6
	2024	May 17		1.3 - 3.6
Centre	2023	May 24	2.5 - 3.5	2.1 - 4.0
	2024	May 21		1.3 - 4.0

(continued from previous page)

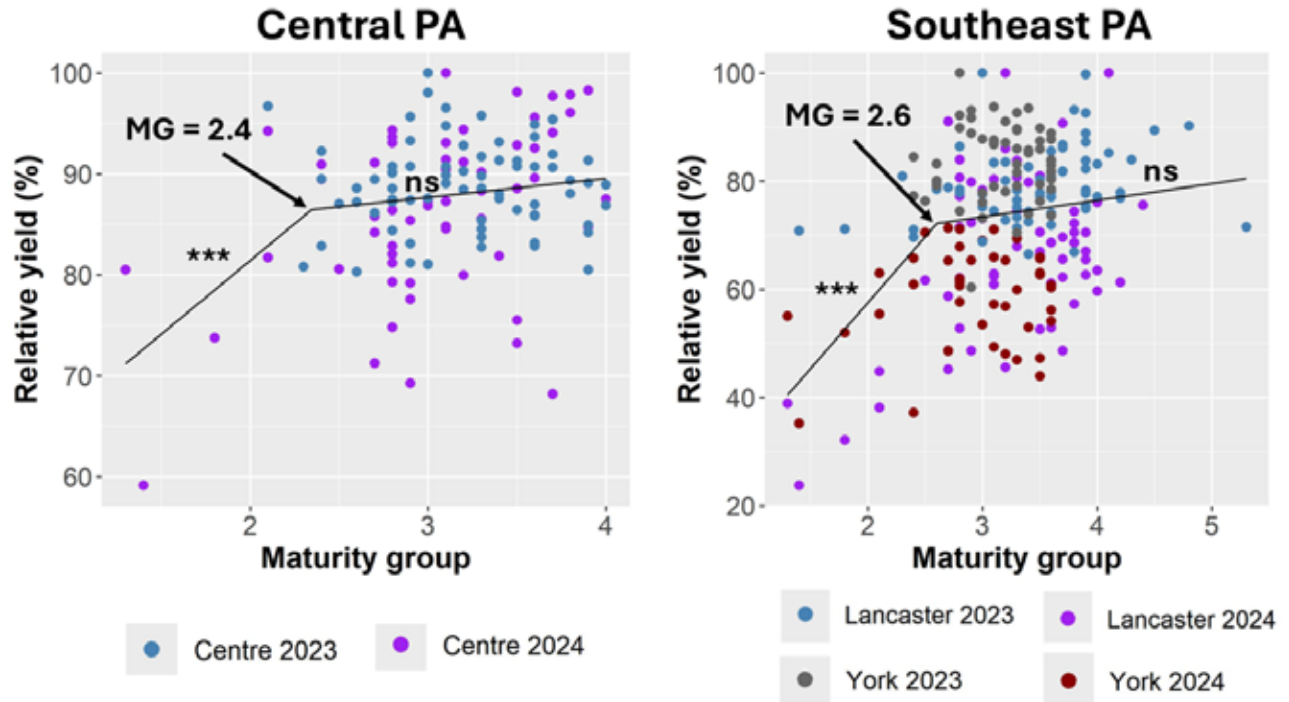


Figure 1. Effect of MG on soybean relative yield from variety trials. Yields are relative to the highest yield within each trial. Each datapoint represents the average relative yield of one variety replicated four times in a trial. Lines represent MG trends from a segmented linear model. In both regions, the first segment is significant (***) indicating an increase in relative yield with increasing MG, while the second segment is not significant (ns), indicating that relative yield plateaus after the MG breakpoint (2.4 in central PA and 2.6 in southeast PA).

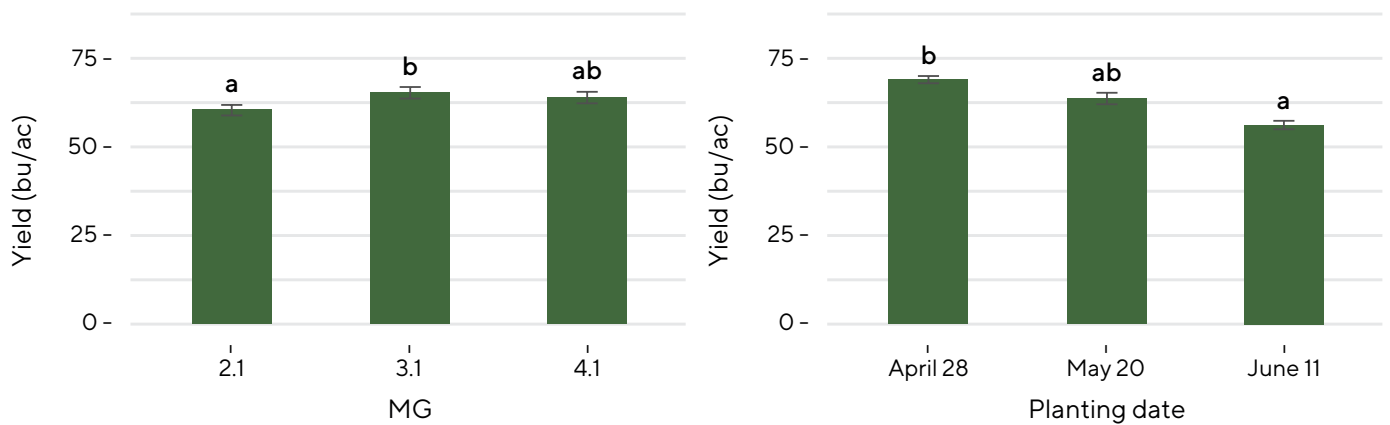


Figure 2. Effect of MG and planting date on soybean yield. No interaction between MG and planting date was observed. Bars represent treatment averages (n=8) and error bars represent standard error of means. Different letters among MGs or planting dates indicate significant differences at the 5% significance level. MG = soybean relative maturity group.



PRODUCTION RESEARCH

Adjusting Soybean Harvest Time to Reduce Late Season Yield Loss and Protect Grain Quality

Principal Researcher:

Daniela Carrijo, Extension Agronomist and Assistant Professor

FUNDED AMOUNT: \$18,188

RESEARCH SUMMARY

When it comes to soybean harvest timing, a general rule of thumb is to start harvesting your acres when the grain moisture reaches 15%. However, harvest delays are sometimes inevitable due to unsuitable weather and equipment or labor unavailability. The objective of this study was to evaluate the effect of harvest timing, across different planting dates and soybean maturity groups, on soybean yield and grain quality. Treatments included combinations of two planting dates (early and late), three maturity groups (MGs 1.9, 2.7, and 3.6), and three harvest timings (timely, two weeks, and four weeks after the first harvest). Field trials were implemented in Rock Springs, PA, in the summers of 2024 and 2025. This study was part of a Science for Success project and was replicated in a total of 14 states across the U.S. over a period of two years.

FINDINGS

Two-year results from Pennsylvania showed no significant yield losses when harvest was delayed by up to 35 days after grain moisture first reached 15% (Figure 1). Overall, lodging, green stem, and pre- and post-harvest losses (measured with a quadrat, immediately before and after a combine pass) were minimal in Pennsylvania trials.

Soybeans yielded on average 7% more when planted early than when planted late. Further, later MGs (2.7 and 3.6) yielded higher than the shortest MG (1.9) when soybeans were planted early, but this was not always the case when soybeans were planted late (Figure 2). For example, in 2025, MG 2.7 yielded 16% more than MG 1.9 when soybeans were planted on May 1, but yields were comparable when soybeans were planted on June 4. Overall, switching to a later MG resulted in a large yield increase when soybeans were planted early, but a small or no yield increase when soybeans were planted late.

Regional data combining studies from northern U.S. states (PA, OH, IN, IL, IA, NE, MN, WI, MI) indicated that in 2024 yields were reduced by 0.006 – 0.07 bushels per acre per day harvest was delayed past 15% grain moisture. Therefore, a 4-week harvest delay reduced yields by 0.17 – 1.96 bushels per acre. Regional data also indicated that across all maturity groups and harvest times, early plantings yielded on average 3.7 bushels per acre higher than late plantings.

Combined, these results indicate that timely planting is more important than timely harvest to maximize yield. The effect of these management practices on grain quality, as well as regional yield data from 2025, still need to be analyzed.

Results will be shared soon at: extension.psu.edu and soybeanscienceforsuccess.org/research-projects/



Aerial view of test crops.



Preharvest losses.

Harvest time.

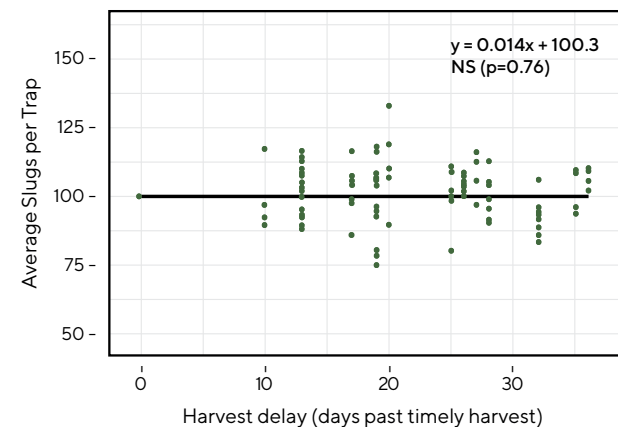


Figure 1. Effect of harvest delay on soybean yield, calculated as a percentage of the yield achieved with timely harvest. Timely harvest is defined as harvesting soybeans when they reach approximately 15% moisture for the first time. Data from 2024 and 2025 trials conducted at Rock Springs, PA. NS = not significant at the 5% level.

Feeding Soybeans in Pennsylvania Dairy Farms: Characterization of Usage Strategy, Economic Benefits, and Environmental Sustainability

Principal researcher & co-investigators:

Dr. Leoni F. Martins, Assistant Clinical Professor of Precision Dairy Nutrition

FUNDED AMOUNT: \$66,200

RESEARCH SUMMARY

Soybeans and soybean coproducts are major ingredients in dairy rations, accounting for up to 30% of the total diet intake. Roasting soybeans is widely used to reduce ruminal protein breakdown and increase the supply of absorbable amino acids to the cow, which can improve milk production and nitrogen use efficiency. With the rapid expansion of high-oleic soybean varieties, interest in roasting and feeding whole soybeans has grown even further.

Most current roasting and steeping recommendations (290–315 °F with 30 minutes of steeping and controlled cooling) were developed in the 1980s–1990s using conventional soybeans, low inclusion rates, and lower-producing cows. Modern dairy farms operate under very different conditions. For instance, our field work across Pennsylvania shows that most farms now roast soybeans on-farm using mobile roasters, with wide variation in temperature, steeping time, cooling method, and particle size. In some cases, soybeans remain hot for 6–12 hours after roasting, which may affect protein quality.

The purpose of this research project is to characterize the particle size, nutritional value, usage strategies, economic benefits, and environmental sustainability of feeding soybeans in dairy rations. This research is important to soybean farmers because it directly links how soybeans are grown, processed, and marketed to their final value in dairy diets. More accurate processing guidelines and protein evaluation methods will help protect and expand demand for Pennsylvania-grown soybeans. The potential economic impact is significant, as even small improvements in milk components, feed efficiency, or nitrogen utilization can translate into meaningful gains in income over feed cost (IOFC) across a herd.

Checking temperature of roasted soybeans.



Checking on the status of the rumen.

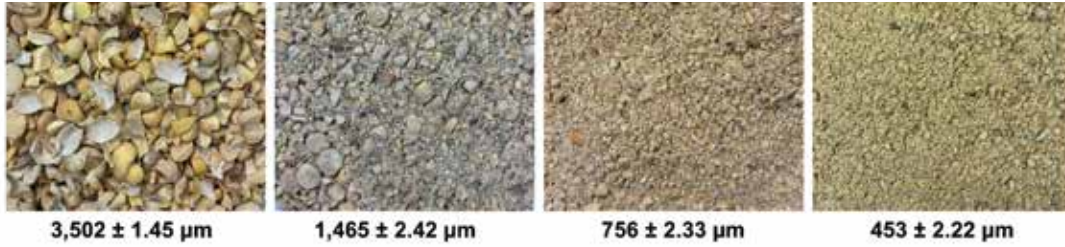
FINDINGS

To date, 15 Pennsylvania dairy farms have participated in the field portion of this study. All milk Holstein cows, and most operate under confinement systems with total or partial mixed rations. Farms currently feed an average of 4.6 lb of soybeans (dry matter basis), with a range of 2.5 to 7.4 lb/cow per day.

Most farms (10 of 15) feed high-oleic soybeans, while 5 feed conventional soybeans. Substantial variation in nutrient composition of soybeans has been observed. For example, high-oleic beans ranged from 71 to 87% oleic acid of total fatty acids, and soybean dry matter ranged from 85 to 97%. These are differences affect both ration formulation and roasting consistency.

Nearly all farms roasted soybeans on-farm using rented mobile roasters. However, processing practices varied widely, and many producers were unsure of exact roasting temperatures, steeping times, or cooling procedures. Only about half of the farms reported using controlled steeping and cooling. Others cooled beans in bins or with fans, sometimes over many hours. Roasting temperature alone explained very little variation in protein digestibility (**Figure 1a**), while longer, controlled steeping was linked to lower undigested protein and improved protein use by the cow (**Figure 1b**).

Mean and Standard Deviation Particle Size of Soybeans



Laboratory analyses revealed large variation in protein dispersibility index (PDI), RUP estimates, and in situ degradability. Current laboratory methods often do not accurately reflect true RUP in roasted or high-oleic soybeans, creating uncertainty during ration formulation. Soybean particle size was inconsistent, ranging from

about 450 to 3,600 µm, even though many farms targeted “½ or ¼” beans. Very fine conventional soybeans tended to be associated with lower milk fat in some herds, while high-oleic soybeans appeared more forgiving across a wider particle size range.

HOW FARMERS CAN USE THIS INFORMATION

- Roasting temperature alone is not enough; consistent steeping and cooling are critical for preserving protein value.
- Test soybeans regularly for dry matter, crude protein, and fat composition.
- Avoid excessively fine grinding, especially for conventional soybeans or at high inclusion rates.
- Use protein lab values as trend indicators, not absolute truth, and monitor milk production, milk protein, and milk urea nitrogen (MUN) when making processing changes.

TAKEAWAY

There is no one-size-fits-all recipe for roasting and grinding soybeans. Inconsistent roasting, cooling, and particle size can reduce the feeding value of soybeans and increase nitrogen losses. By tightening processing control and using better evaluation tools, farmers and nutritionists can capture more value from each bushel of soybeans, improve nitrogen efficiency, and support greater use of Pennsylvania-grown soybeans in dairy rations.

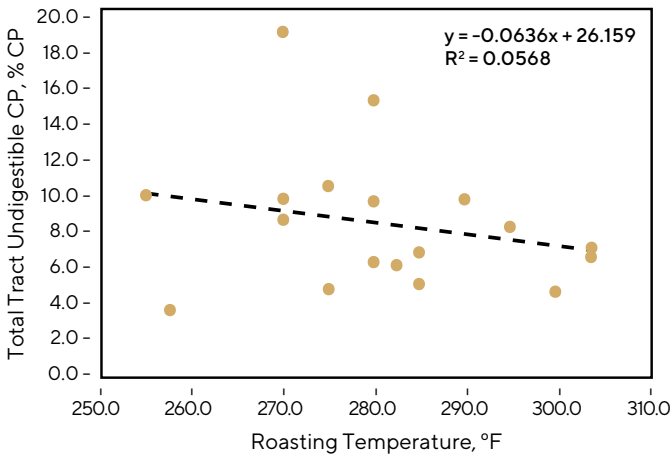


Figure 1a

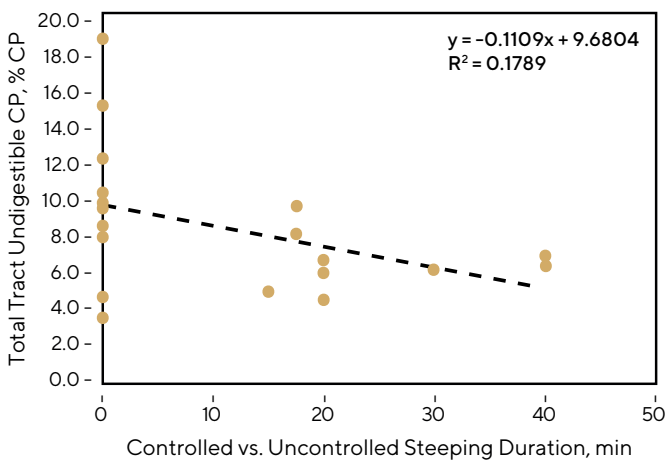
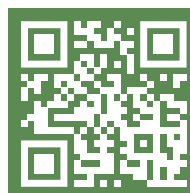


Figure 1b



Scan for more information.

extension.psu.edu/soybeans-for-dairy-heat-treatment-and-protein-fractions

COLLABORATIVE RESEARCH

Using Data-Driven Knowledge for Profitable Soybean Management Systems

Funded by the North Central Soybean Research Program:

Principal researchers and co-investigators:

Penn State Team: Dr. Paul Esker, Extension Plant Pathologist and Professor; Miranda DePriest, Computational Scientist; Tyler McFeaters, Extension Program Specialist; and Dr. Santosh Sanjel, Postdoctoral Scholar

University of Wisconsin Team: Dr. Shawn Conley, Extension Soybean Specialist and Professor; Dr. Spyros Mourtzinis, Data Scientist.

Project collaborators from Iowa, Michigan, Minnesota, Nebraska, North Dakota, and Ohio.

RESEARCH SUMMARY

This project is a multi-state collaboration aimed at improving the use of big data in soybean production by providing valuable, farmer-focused field management tools to maximize profit and yield. Spatiotemporal data are collected in the field, offering insight into the timing and distribution of over 100 soybean stressors. The data collected can be used to identify trends in stressor timing and severity (**Figure 1**). This information is then linked to records on management practices, yield-monitoring files, weather data, and satellite imagery, enabling the development of sophisticated yield-outcome models. Data are collected and protected through the Open Crop Manager platform, with support from the Penn State Institute of Computational and Data Science.

The following information is collected:

- **Field locations:** Field shapefiles enable the remote collection of soil and weather data.
- **Scouting reports:** Geo-referenced field condition surveys record information such as current growth stage, population counts, and present stressors and their severity. Images can be collected alongside these reports, creating a comprehensive image database.
- **Production surveys:** Field management practices and yield outcomes are recorded, including planting, applied treatments, and other details. These data include product prices, allowing for profit evaluation in our model.

FINDINGS

In 2025, we collected 4,662 scouting reports from approximately 107 fields. Overall, our database contains 15,913 scouting reports and 436 fields from 14 states. The scouting reports included 2,155 images of stressors and beneficial species, totaling 10,658 images (**Figure 2**), which are being used to develop algorithms for remotely identifying stressors. Data collected in 2025, along with data from previous years, can be used to identify patterns in stressor occurrence (**Figure 3**) and help farmers identify problem spots within their fields.

The collected data were used to create field summaries for OCM users, highlighting the location and severity of stressors in their fields. We also shared results with users and the community through an interactive disease dashboard app that displayed the spatial and temporal patterns of observed diseases and deer damage. Information from the reports was also shared with the Crop Protection Network to develop a feeder system to include information in the Crop Lookout tool (<https://cropprotectionnetwork.org/crop-lookout>). These projects will continue in 2026.

The OCM mobile app, designed to better facilitate in-field data collection, was deployed in a beta version to 101 users in May 2025. The app supported the creation of at least 1,000 scouting reports. New functions were added, including the ability to provide production information and to manage fields within the OCM platform.

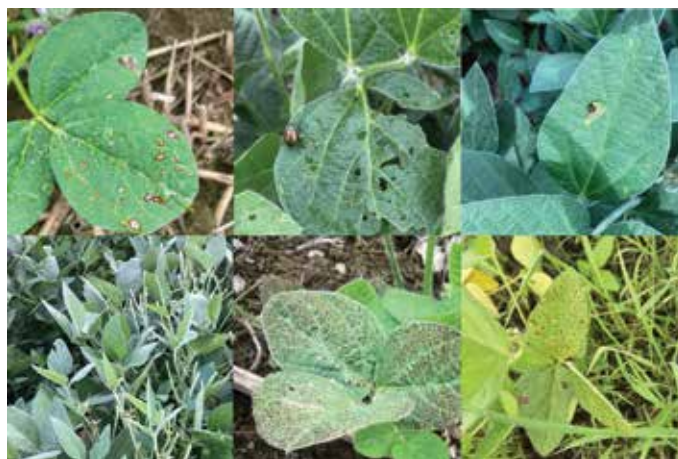


Figure 2. Example images of different pests and diseases collected using the Open Crop Manager app and platform.

To learn more about our data collection efforts and the Open Crop Manager platform, please visit open-crop.vhost.psu.edu. If you're interested in contributing data to the project, please contact Paul Esker at pde6@psu.edu or Shawn Conley at spconley@wisc.edu.

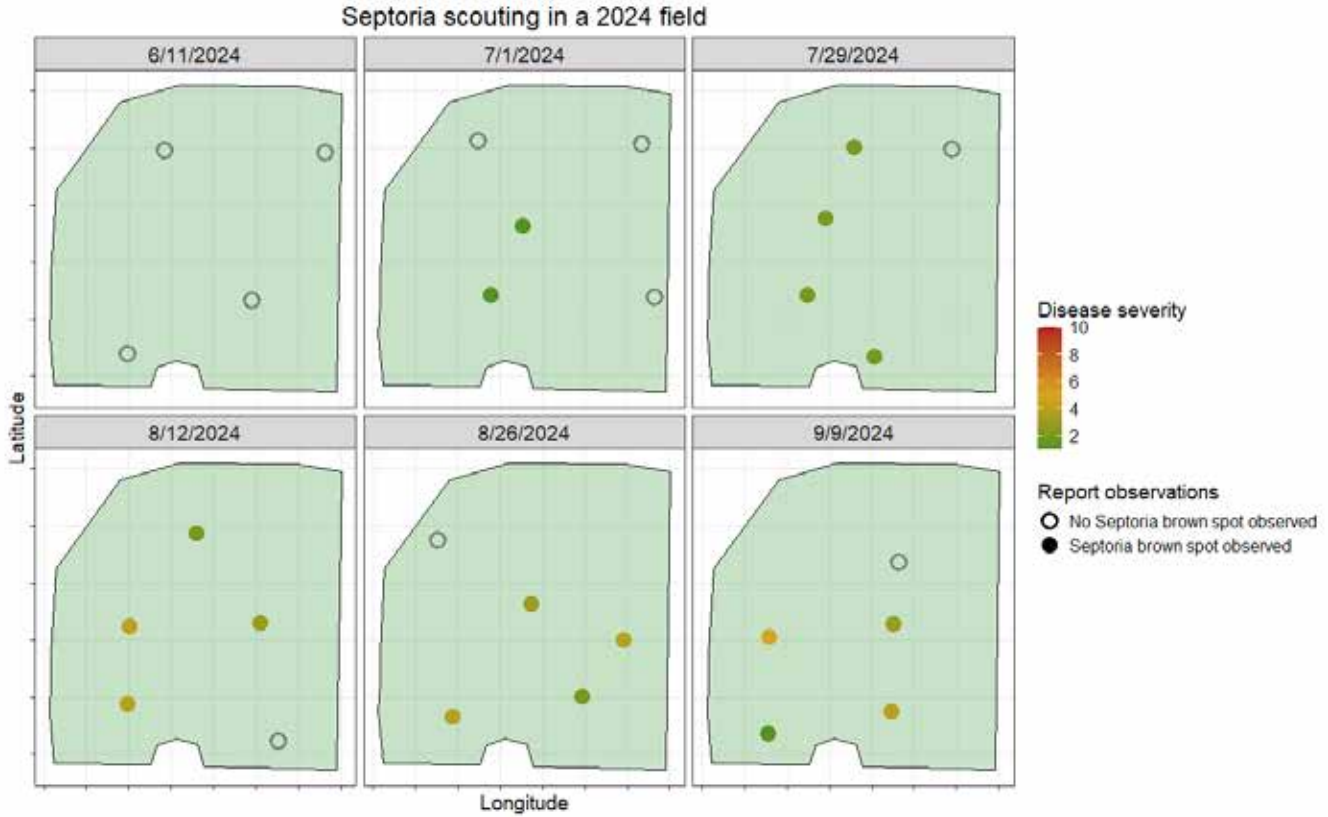


Figure 1. Temporal disease progress of Septoria brown spot over approximately 3 months in a scouted field in 2024.

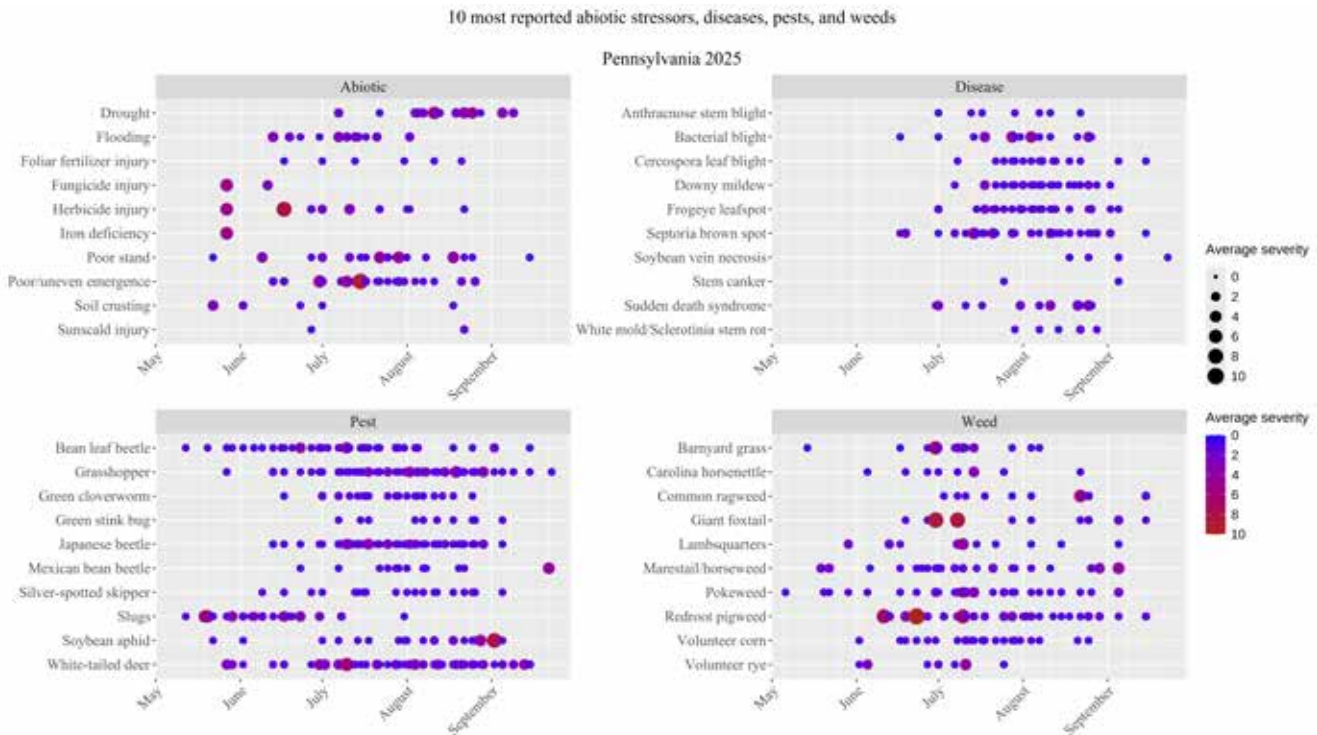
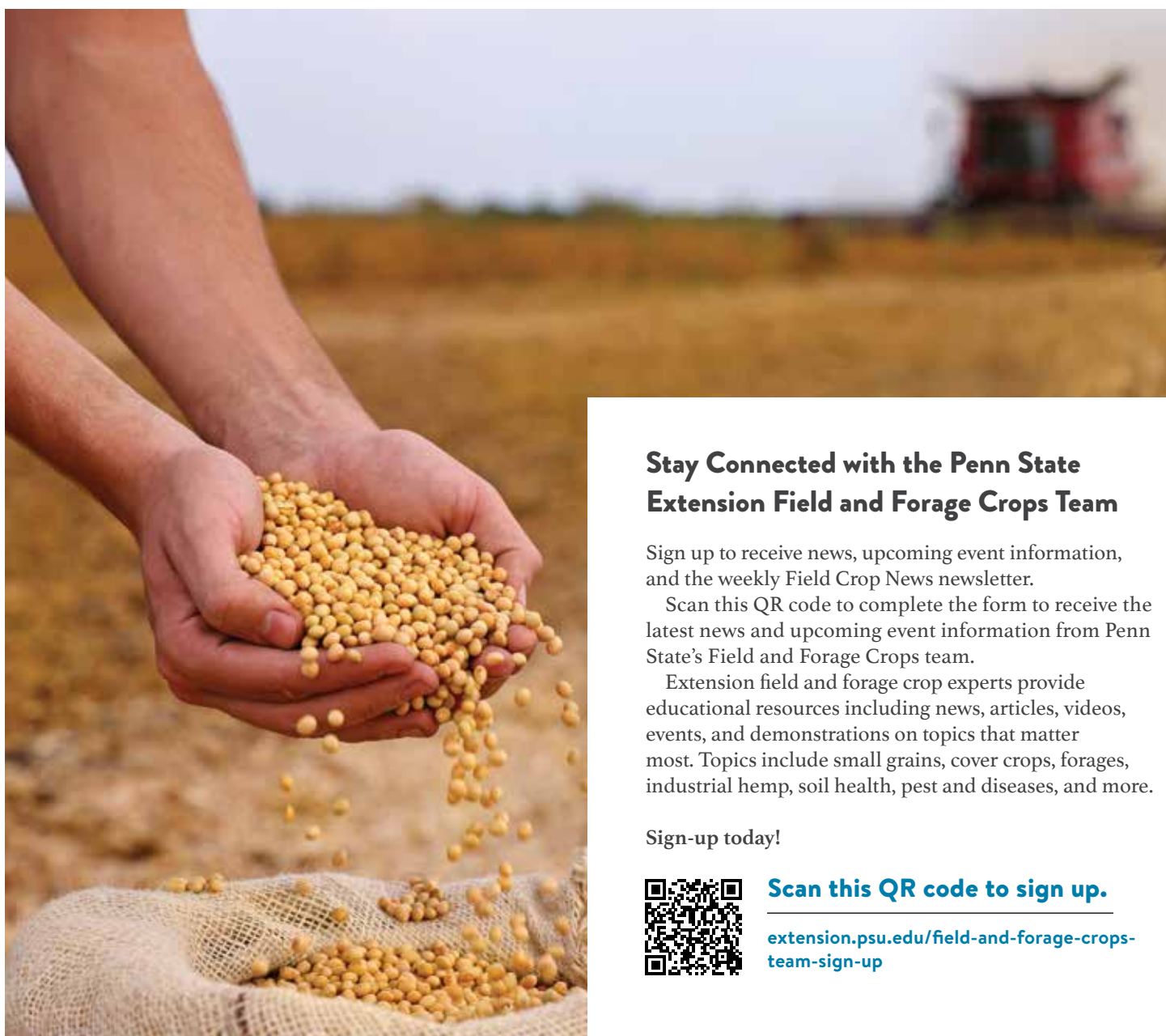


Figure 3. The top 10 most reported abiotic stressors, diseases, pests, and weeds in Pennsylvania in 2025. Data are shown temporally across all scouting reports collected in Pennsylvania.



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