2021 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 then used for promotion, research, and education at both the state and national level.

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.

Contact us at:

Pennsylvania Soybean Board
Northwood Office Center
2215 Forest Hills Drive, Suite 40
Harrisburg, PA 17112

Phone: (717) 651-5922
Fax: (717) 651-5926
contact@pasoybean.org
pasoybean.org

John Harrell
Chair, Pennsylvania Soybean Board

How does the soybean checkoff help individual soybean farmers?

As the chair of the Pennsylvania Soybean Board, that's a question I'm often asked. One of the most important ways the checkoff serves the state's farmers is by providing farmers with cutting-edge research they can use to better manage their crops.

The checkoff sponsors the Pennsylvania On-Farm Network and collaborates with university agronomists and weed and insect specialists to provide valuable information to help you make informed crop management decisions that will improve your bottom line. The checkoff also backs research that helps sustain animal agriculture, the No. 1 customer for soy meal and a vital part of Pennsylvania agriculture and our state's economy.

This year, we've combined our annual report with summaries of the research projects we supported in Fiscal Year 2021. If you want to take a deeper dive into any topic, there's lots more information available online and through Penn State Extension. We urge you to take advantage of it.

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

Visit us at *pasoybean.org*

Like the Pennsylvania Soybean Board on Facebook

Follow us on Twitter @PaSoybean

Subscribe to the Pennsylvania Soybean Board YouTube channel

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:

Facebook.com/SoybeanResearchInformationNetwork

Twitter.com/SoyResearchInfo

soybeanresearchinfo.com

Pennsylvania Soybean Board Annual Financial Report

Fiscal Year 10.1.20 to 9.30.21

CASH & ASSETS	
Operating Funds	$551,758
Emergency Preparedness Fund	$500,000
Dissolution Fund	$262,939
Equipment, net	$1,354
Less: Liabilities	-
Net Assets at 9.30.21	$1,316,051

REVENUE:	
Assessment Income	$1,646,849
Less: Assessments Paid to USB & QSSB's	($930,147)
Interest/Other Revenue	$9,515

PROGRAM EXPENSES:	
Communications	($59,629)
Promotion & Education	($202,025)
Research*	($170,675)
Administration/Audits/ Compliance/Insurance/Other	($131,788)
Increase/(Decrease) in Net Assets	$162,100

* This amount reflects the actual disbursement of the funds allocated for research as of September 30, 2021.

Pennsylvania Soybean On-Farm Network

Principal researcher & co-investigators: Dr. Paul Esker, Extension Field Crops Pathologist and Associate Professor, Delbert Voight, Senior Extension Educator, Dr. Terrence Bell, Assistant Professor; Dr. Elizabeth Bosak, Extension Educator; Dr. Alyssa Collins, Extension Plant Pathologist and Associate Research Professor; Andrew Frankenfield, Senior Extension Educator; Dr. Heidi Reed, Extension Educator; Dr. Dilooshi Weerasooriya, Postdoctoral Scholar; Michelle Paukett, Graduate Student

FUNDED AMOUNT: $167,647

PROJECT 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 are clear. Since 2017, 85% to 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, approximately 75% to 90+% of the participants in workshops 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. For example, comments have included: "It is important to continue to participate in the on-farm trials because there are always new issues," and that they "like to learn for both their benefit and for others what works and what doesn't".

Thank you!

Thank you to all the grower cooperators who participated in the 2021 On-Farm Network trials, and to the entire Penn State Extension Field and Forage Crops Extension Team for making this research possible. Conducting on-farm research requires additional time and effort from our growers. We value their participation as new and novel ideas are tested on their fields. We look forward to continued collaborations in 2022.

2021 On-Farm Trial Sites by County

Locations of the 2021 Pennsylvania Soybean On-Farm Network Trials and Monitoring programs.

- **CCI** = *Cover Crop Incorporation (4 sites)*
- **GIP** = *Good Inoculation practices (8 sites)*
- **SM** = *Slug Monitoring (25 sites)*
- **DR** = *Deep Ripping (4 sites)*
- **ST** *and* **YL** = *Seed Treatment and Yield-limiting (5 sites)*

Scan this QR code to learn more.

soybeanresearchdata.com

Broadcasting Cover Crops into Standing Soybeans

The purpose of this project is to compare how nine different cover crop species perform when broadcast seeded into soybeans just before soybean leaf drop. We measured soil nitrate in the fall and spring to see if cover crops tie up or supply nitrogen for the next crop.

Additionally, plants are counted, and ground cover measured in fall, with repeated measurements made in the spring.

Lastly, dry matter for each cover was estimated, along with how well the cover crops established. This research is important to farmers because many struggle to get cover crops planted after soybean harvest. The results from this study will help farmers decide whether broadcasting into standing soybeans might be a worthwhile practice on their farm.

Broadcasting cover crops can open the planting window to species other than winter cereals or can allow a farmer who usually doesn't have enough time to plant cover crops in the fall to grow a winter cereal.

Potential economic impacts

- Lowered cost of cover crop establishment by broadcasting into standing soybeans instead of drill-seeding after harvest
- Reduced herbicide cost with improved weed control from earlier-seeded, higher biomass cover crops
- Reduced N fertilizer cost if legume cover crops can supply some N for the next crop.

FINDINGS

Overall, dry matter production was very low in this experiment. Cereal rye was the most productive species at four out of five sites but grew less than 2,000 lb/ac everywhere except the York County site, which grew 5,940 lb/ac. Wheat was the next most productive species on average across sites, followed by inconsistently productive hairy vetch, annual ryegrass, and crimson clover. The NRCS recommends at least 2,700 lb/A of cover crop dry matter to really see cover crop benefits, so we likely did not see significant benefits from the rye or other cover crop species at most sites.

Cereal rye also produced the most plants/sq ft at four out of five sites, followed in density by wheat and annual ryegrass. Though establishment was very inconsistent within each plot, random sampling showed an average of at least 10 to more than 20 plants/sq ft depending on the site, meeting the NRCS minimum recommendation. Additionally, cereal rye provided the most groundcover at three out of five sites. Rape, wheat, hairy vetch, and annual ryegrass also provided significant but varying levels of groundcover compared to the no cover crop control.

Lastly, at four out of five sites, spring soil nitrate levels were significantly lower in the cereal rye compared to the no cover crop control and legume species, showing that even less than optimum levels of rye biomass provide some N catching.

The main "take home" is that broadcasting cover crops into standing soybeans worked across sites with cereal rye better than any other species but grew comparable to rye drilled late after soybean harvest. Inconsistent stands were a problem at every site. The practice does have potential to work better with cereal rye as well as with wheat, annual ryegrass, crimson clover, hairy vetch, and rape. Planting should be done as soon as possible when leaf yellowing begins, and success is highly dependent on timely rainfall. Red clover and Balansa clover would not be recommended based on our first year of trials.

Photos: Heidi Reed

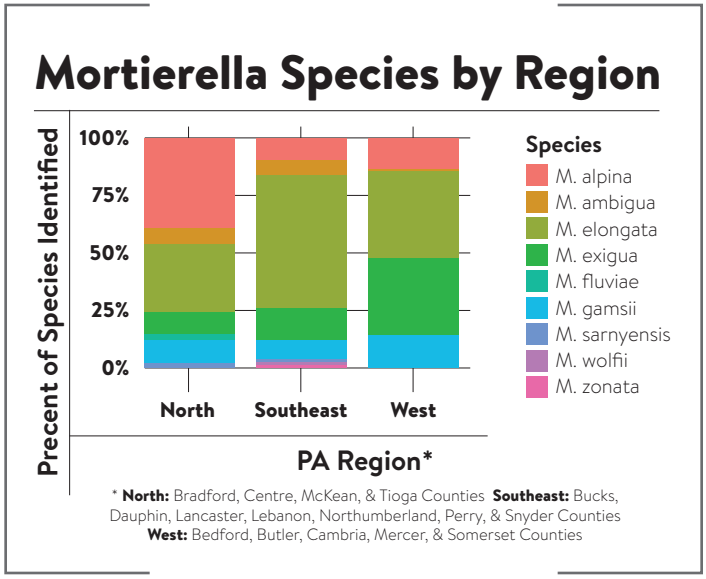
Left: *Cereal rye harvested at the York County cooperator site on April 15, 2021, produced 5,940 pounds per acre dry matter and over 10 plants per square foot.*
Right: *Cereal rye harvested at the Montgomery County cooperator site on April 30, 2021, produced only 756 pounds per acre biomass and fewer than three plants per square foot.*

Soybean Seed Treatments and Yield Limiting Factors

After three years of research focused on understanding the yield-limiting factors that drive soybean production in Pennsylvania, we shifted focus in 2021 to test the product Ilevo in strip trials around Pennsylvania.

Ilevo has been shown to benefit soybean production in areas with soybean cyst nematodes and Sudden Death Syndrome (SDS) can reduce yield. SDS is one of the leading yield-limiting soybean diseases in North America which is caused by the fungus (Fusarium virguliforme). SDS has two phases, the first being a root rot phase and the second a leaf scorch phase. Foliar symptoms of SDS are the result of a toxin produced by the fungus that moves from roots to the leaves. Foliar symptoms rarely appear until after flowering. SDS has caused a total loss of approximately 326,000 bushels, which equates to around $3.13 million in economic losses to farmers in the Northeastern USA in 2019 and 2020.

Furthermore, we continued to explore and build from our yield-limiting trial research to improve understanding of the complex interactions that occur in the soil. In 2021, our focus was on Mortierella species, which are beneficial soil fungi that support soil and plant health such as by enhancing nutrient availability, pesticide remediation, influencing plant defense hormones, and inhibiting root rot pathogens.



Frequency of detection of different Mortierella species by region (North, Southwest, and West) in Pennsylvania.

In 2021, the objective was to identify what Mortierella species are found in Pennsylvania soybean agroecosystems that can be studied further to understand their biocontrol potential and effectiveness in suppressing root rot pathogens under different management practices.

FINDINGS

Ilevo seed treatment trials: Across all locations, there was no evidence of differences between Ilevo-treated plots and the control for measures obtained at the second trifoliate (R2) growth stage for initial plant stands, root to shoot ratio, greenseeker measurements of crop health. Furthermore, no differences in yield were observed in our trials in 2021.

Additionally, there were reports from some farmers indicating a burning appearance on the cotyledons at the seedling stage. The observation showed that the damage was more cosmetic and did not impact production during the rest of the growing season. Nematode assays showed a range of different nematodes, but none of the sites were positive for soybean cyst nematode or root know nematodes.

Site information indicated that trials were conducted across a range of pH values (5.22 to 7.25) and organic matter (2.26 to 4.23). There was also variability for different mineral elements. Further work continues to examine the microbiome and we expect that this information may help improve our understanding of why there were no differences between the treatments.

Mortierella spp.: Working from soil collected in previous growing seasons from around Pennsylvania, a survey of bulk soil samples collected throughout the growing season in 2018 from soybean fields in 16 counties across Pennsylvania identified nine different Mortierella species to date. The three most common species are Mortierella elongata, Mortierella alpina, and Mortierella exigua.

A larger number of Mortierella isolates were recovered at the V1 growth stage and the number of isolates decreased at each growth stage through post-harvest. Mortierella species were recovered from both high and low-yielding field areas. Since Mortierella are known to be active in cold conditions when other organisms are overwintering and active under conditions favorable to root rot pathogens like Pythium, it is a suitable candidate for long-term establishment and use as a biocontrol.

This survey originally was looking to identify the root rot pathogen Pythium; however, only three Pythium isolates were found across all regions. Additionally, Talaromyces species, a potential white mold biocontrol organism, were identified from samples originating from Lancaster and Centre Counties.

Preliminary tests have identified some Mortierella and Talaromyces isolates insensitive to metalaxyl, ethaboxam, and mefenoxam which would allow the use of this organism as a biocontrol alongside seed treatments as needed.

Response of Soybean Nodules in Rhizobium

Treatment	Rate	Growth Stage = VE	Growth Stage= V2		Chlorophyll (SPAD) readings	Growth Stage = R2	Growth Stage = R3	Yield (bu/acre)	Grain Moisture (%)	Test Weight (lb/bu)
		Plants per acre	Plant height (inches)	Number of nodules	Chlorophyll SPAD Meter readings	NDVI (Greenseeker)	Plants per acre	Yield	Moisture	TW
UTC	-	105821 a	6.1 bc	13.6 NS	37.5 NS	0.804 NA	95185 a	80.7 NS	16.3 NS	54.7 NS
Rhizobium	2g/1000 seed	103849 a	6.5 ab	16.2	37.9	0.812	91321 abc	81.4	15.6	54.6
Rhizobium **Moly power**	2g/1000 seed 3ml/1000 seed	105589 a	6.2 abc	16.0	37.9	0.802	92452 ab	80.9	16.3	54.6
Rhizobium **Azospirillum**	2g/1000 seed 2.4ml/1000 seed	105270 a	6.6 a	18.2	38.2	0.808	94540 ab	78.8	16.0	55.3
Rhizobium **Moly power** **Azospirillum**	2g/1000 seed 3ml/1000 seed 2.4ml/1000 seed	98716 b	5.9 c	14.1	37.4	0.800	90828 bc	78.0	15.7	55.9
Biofix		98542 b	5.8 c	17.7	37.0	0.800	88131 c	79.4	14.9	55.8
	LSD (P=0.10)	3797	0.4312	3.08	1.285	0.0094	4150	2.4	4.5	1.153
	CV	3.7	7.1	19.5	3.5	1.1	4.6	3.0	6.1	1.9

Results of a field trial conducted at the Southeast Agricultural Research and Extension Center (Manheim, Pa.) studying the response of soybean nodules to biological and mineral additions of Rhizobium. Abbreviations: NDVI = normalized difference vegetation index, NS = not significant; NA = not applicable, LSD = least significant difference; CV = coefficient of variation.

Good Inoculation Practices

Currently, many farmers consider inoculants cheap insurance and use this as part of their production system on an annual basis. The ability to adapt seed-applied technology to field-specific situations is a great management tool.

By using a liquid delivery, the inoculant, fungicide, and insecticide may be placed in the row at planting time and thus save pre-treatment costs by the seed dealer. The addition of molybdenum results in better nodulation depending on pH and the question is if Azospirillum will also aid in this infection as its ideal rhizobium infection of roots occurs from VE to V3.

FINDINGS

Trials were established at two on-farm locations. The first, located in Lebanon County, did not show any differences for yield. This location was impacted by slugs and bean leaf beetles, which may have increased the observed yield variation. The second location was not successful due to spring rains that negatively affected the ability to establish the trial at the optimum timing.

The trial at the Russell E. Larson Agricultural Research Center at Rock Springs was successful and results are being finalized. A small plot trial conducted at the Southeast Research and Extension Center was successfully established with six replications of each treatment. While some growth-related measures were different among treatments, no yield differences were noted.

Photo: Jeff Graybill

Early season seedling damage in Ilevo treated soybean.

Deep Ripping to Improve Soil Compaction in No-Till Soybean

Long-term no-till and the use of cover crops has significantly reduced soil erosion on Pennsylvania farms over the past decade or more. Many Pennsylvania fields receive traffic from heavy farm equipment at times when the soil moisture is less than ideal and create wheel tracks or ruts.

As farmers have improved their soil health with no-till and cover crops they are hesitant to go back to tillage to alleviate compaction and simply want to just level the soil surface to smooth out any ruts and let nature take care of the rest.

Since 2019, trials have been conducted around Pennsylvania to explore the use of deep ripping to alleviate compaction and determine if this could be a beneficial approach for farmers especially given current climate uncertainty.

FINDINGS

In 2021 we did not rip any additional fields due to spring conditions. We continued our research on plots at the Southeast Research and Extension Center in Lancaster. We planted soybeans in the plots ripped in 2019 to see if there was any yield advantage from ripping a couple of years later. We also planted corn in plots that were ripped in 2020. Both plots were harvested, and yield data were analyzed. Both fields did not show statistical differences between the plots that were ripped and those that were not.

Previous on-farm research in 2020 showed similar results the year of ripping in Montgomery, Schuylkill, and Cambria Counties. One drawback from the Montgomery County location in 2020 was at harvest the combine made deep ruts in the ripped plots and the field required tillage to fix. This limited the farmer's interest in continuing the trial in 2021.

Photo: Andrew Frankenfield

Deep ripping trial.

Pennsylvania Slug Monitoring Project

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 20 to 30 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. Scouting for slug eggs in the springs of 2018, 2019, 2020, and 2021 did not predict the juvenile and adult slug population. The two most abundant slug species were marsh and gray garden slugs.

From 2018 to 2020, most sites reported low slug numbers and minimal crop damage. In 2021, higher slug numbers and significant crop damage were reported at some sites but not at all monitoring project sites.

We have learned that scouting for slug eggs is probably not a good way to assess slug populations. Slug populations vary each year and in the first four years of the monitoring project we have built a good base of data that can be used in the future years to establish whether slug populations follow a predictable pattern.

Photo: Liz Bosak

Shingle slug trap.

Soybean Foliar Fungicide Trials

Principal researcher & co-investigators: Delbert Voight, Senior Extension Educator; Andrew Frankenfield, Senior Extension Educator; Dwane Miller, Extension Educator; Dr. Paul Esker, Extension Field Crops Pathologist & Associate Professor; Dr. Mladen Cucak, Postdoctoral Scholar; Dr. Dilooshi Weerasooriya, Postdoctoral Scholar

Thanks to collaboration and support with our industry partners, foliar fungicide trials were conducted in 2021 at the Russell E. Larson Agricultural Research Center at Rock Springs and the Southeast Agricultural Research and Extension Center in Manheim.

The varieties CZ 2550GTLL (Rock Springs) and CZ 4241GTLL (Manheim) were used. Planting dates were 5/17 (Manheim) and 5/18 (Rock Springs), and all trials were managed using local recommendations. At Rock Springs, plots were sprayed on 7/21, while at Manheim, they were sprayed on 8/13. Spray timing was R3 in both situations with an adjuvant also used.

At the Manheim location, we had our first test of Xyway LFR, which was applied with a 2x2 methodology. Overall, disease intensity was low in both trials, typically less than 1%. Insect damage was also minimal and non-significant. Yields ranged from 66 to 83 bu/ac at Rock Springs, and from 79 to 91 bu/ac at Manheim. No differences were noted in either of the two trials.

FINDINGS

An interesting observation was that the saved seed, which was cleaned and treated, had germination percentages of 95% or higher with quality vigor. These results suggest that there is potential for using saved seed for producing profitable soybean. Further work will explore the causal reasons behind higher germination and vigor.

Saved Seed Exploration Project

Principal researcher & co-investigators: Delbert Voight, Senior Extension Educator; Andrew Frankenfield, Senior Extension Educator; Dwane Miller, Extension Educator; Dr. Paul Esker, Extension Field Crops Pathologist & Associate Professor; Dr. Mladen Cucak, Postdoctoral Scholar; Dr. Dilooshi Weerasooriya, Postdoctoral Scholar

Off-patent Round Up Ready One soybean seed was purchased in 2019. In 2019, the seed was used as part of the good inoculation practices trials at a cost of $26 per unit. That trial used a residual herbicide followed by an in-season application of glyphosate. Seed were saved from the original lot, cleaned, and bagged at a cost of $4 per unit and then used for plant in 2021.

We compared the original seed lot (2019) to the seed saved at the end of 2019 and a seed lot purchased in 2020. Finally, these were all compared to an industry release.

FINDINGS

The 2021 results showed that the saved seed performed as well as the original seed lot and the new seed lot. Yield averaged 82 bu/ac. When considering the return on investment, the saved seed lot performed better given the lower cost per unit.

Additionally, on-farm plots were established in Lebanon (two trials), Montgomery, and Schuylkill Counties. The saved seed lot was compared to a farmer-selected seed. Yields were average to above average across trials, but preliminary results suggested a $60 savings per acre in seed savings.

Foliar Fungicide Trials

Treatment	Rate	Rock Springs	Manheim
		Yield (bu/ac-1)	Yield (bu/ac-1)
Untreated check	NA	77.5	82.3
Xyway LFR	15.2 fl oz/ac^{-1} (2x2)	NA	79.2
Topguard EQ	5 fl oz/ac^{-1}	65.0	90.1
Lucento	5 fl oz/ac^{-1}	69.8	87.2
Miravis Neo	20.4 fl oz/ac^{-1}	67.4	88.7
Trivapro	13.7 fl oz/ac^{-1}	72.8	85.9
Revytek	8 fl oz/ac^{-1}	76.1	88.8
Veltyma	7 fl oz/ac^{-1}	82.6	90.2
Delaro Complete	8 fl oz/ac^{-1}	65.7	90.7
	Trial average	**72.1**	**87.0**

Proactive Monitoring & Management of Soybean Cyst Nematode

Principal researcher & co-investigators: Dr. Paul Esker, PSU Extension Plant Pathologist & Associate Professor; Dr. Alyssa Collins, PSU Extension Plant Pathologist & Associate Research Professor; Adriana Murillo-Williams, PSU Extension Field and Forage Crops Educator

FUNDED AMOUNT: $11,272

PROJECT SUMMARY

Soybean cyst nematode (SCN, Heterodera glycines) is the most damaging soybean pathogen in North America. 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 almost every county where soybean is grown.

The nematode was first detected in Pennsylvania in 2002 in Lancaster County. In subsequent nematode surveys conducted by the Pennsylvania Department of Agriculture up to 2015, there were no reports of additional SCN findings. However, SCN has continued to spread, and it has been documented in many counties along Pennsylvania borders, and in at least 30 counties in New York in the last five years.

The objective of this project is to provide free SCN testing for farmers across the Commonwealth. Pre-labeled soil bags with soil sampling instructions and a field history form were sent to all Extension offices. They were also made available to participants at the PSU Ag Analytical Laboratory and were sent to farmers, industry representatives and ag consultants when requested. Nematode identification and quantification were performed at the North Carolina Department of Agriculture and Consumer Services.

FINDINGS

To date, over 500 soil samples from 40 counties have been tested for SCN (Figure 1). Soybean cyst nematode has been detected in at least one field in six counties, in addition to Lancaster County. In collaboration with the Pennsylvania Department of Agriculture, the presence of SCN was confirmed in York County in 2020. In the same fashion, the fields that tested positive for SCN in the remaining five counties will be re-sampled and tested again for SCN for confirmation.

Figure 2 shows the counties where SCN has been officially documented, and counties where fields are pending confirmation. In fields where SCN has been detected, infestation levels remain low (below 200 eggs per 100 cc).

Our findings are relevant since York is the county in Pennsylvania with the largest area dedicated to soybean production. Farmers in the area should be aware of the threat SCN represents for soybean production and take a proactive approach to management, starting with soil sampling.

Soybean growers across Pennsylvania must scout and test their fields for SCN. The pathogen is known to reduce yields without causing any symptoms in the above-ground part of the plant. In the meantime, below ground, SCN populations continue to grow 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.

Growers 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.

If you have questions or would like to participate in our free SCN testing contact:

Dr. Paul Esker: pde6@psu.edu
Dr. Alyssa Collins: acc18@ psu.edu
Adriana Murillo-Williams: axm1119@psu.edu,
phone: 814-355-4897,
text 814-360-5517

Figure 1

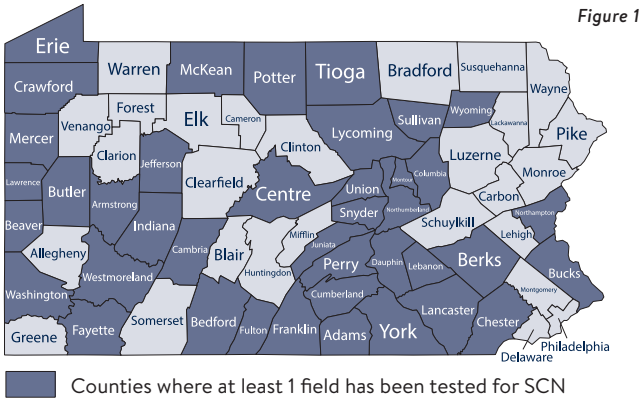


Figure 2

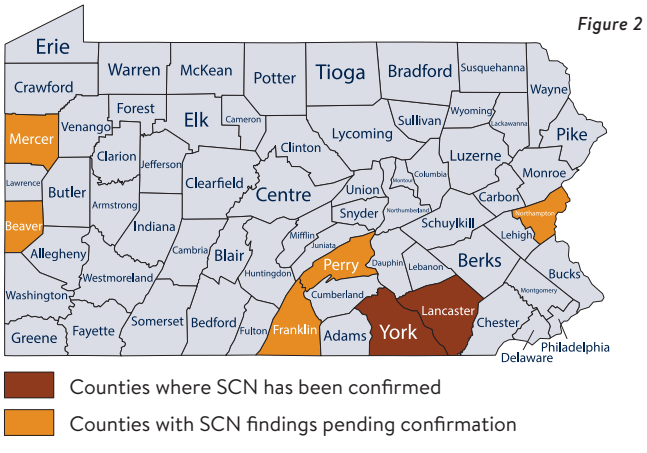


Figure 1. *Counties in Pennsylvania (green color) where at least one field has been tested for soybean cyst nematode since 2019.*

Figure 2. *Soybean cyst nematode findings in Pennsylvania.*

Best Management Guidelines for White Mold in Pennsylvania

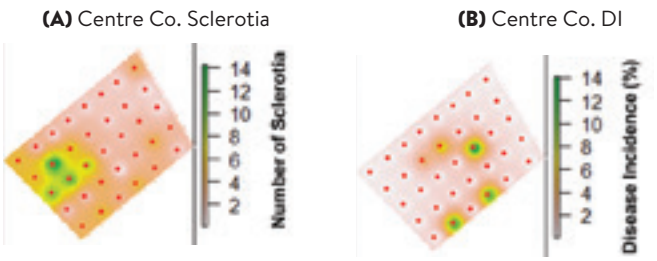
Principal researcher & co-investigators: Dr. Paul Esker, PSU Extension Field Crops Plant Pathologist & Associate Professor; Dr. Alyssa Collins, PSU Extension Plant Pathologist & Associate Research Professor; Karen Luong, PSU Graduate Student; Tyler McFeaters, PSU Graduate Student

FUNDED AMOUNT: $38,440

PROJECT SUMMARY

Since 1996 in Pennsylvania, white mold has caused soybean yield loss equivalent to an average of $62 per acre. White mold is a disease caused by the fungus Sclerotinia sclerotiorum and thrives in cool, wet conditions. Weather conditions during flowering, soybean variety, row spacing, and soybean management practices influence white mold disease development. S. sclerotiorum can infect many other hosts 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.

The goal of this research is to improve understanding of the white mold pathogen S. sclerotiorum at the regional and field scales and to develop management strategies for Pennsylvania soybean growers. A combination of regional and field pathogen distribution and diversity studies along with Sporecaster app validation were performed to address the research goal.



Top: *Example of a field from Centre County that was soil sampled at a field-scale (A) and scouted for disease incidence at R6 (B), to determine the distribution of the pathogen and disease.*

Bottom: *Counties where white mold has been observed and samples collected since 2019.*

To map the distribution of S. sclerotiorum at a regional-scale, white mold infested soybeans and soil were collected throughout Pennsylvania during the summer of 2019 through 2021. To map the pathogen distribution and density at the field-scale, eight fields were divided into 35 plots and soil was sampled from each section during the spring of 2020 and 2021. Later in the growing season, these fields were scouted for white mold, and disease incidence was estimated. In the laboratory, S. sclerotiorum was isolated from samples and DNA was extracted for further genetic analysis.

In 2021, 23 fields were monitored to validate the accuracy of the Sporecaster app in forecasting white mold in the Northeast. The Sporecaster app predicts the risk of white mold for a given field based on local weather conditions and several cultural factors. The mobile app uses several models developed by researchers at the University of Wisconsin-Madison to predict the risk, but its usefulness for northeastern climates requires validation. Forecasted risks during the flowering period (growth stages R1 to R4) were monitored and compared to the actual disease incidence from scouting fields at R6 (full seed).

FINDINGS

Regional and field distribution studies: White mold samples were collected from diseased soybean plants and soil samples from 22 fields across 13 different counties. A total of 153 S. sclerotiorum isolates have been obtained. Laboratory analyses are in progress to determine if S. sclerotiorum can be managed either as one large population or distinct regional populations. Furthermore, the collected isolates will be tested to see if there is evidence of fungicide resistance. The field-scale sampling showed that white mold clustered in hotspots, typically along tree lines and in low-lying areas.

Sporecaster validation: From the 2020 Sporecaster validation, a threshold of at least 50% was the most accurate action threshold for Pennsylvania. In 2021, only 17% of monitored fields were infected. The accuracy of the Sporecaster app forecasts ranged from 57% to 65% when using a 50% action threshold, depending on the disease incidence level. The accuracy ranged from 65% to 87% when using a 60% action threshold. The 50% threshold represents a more conservative approach, while the 60% action threshold is riskier by comparison because there is a greater probability of white mold occurring before a fungicide is applied.

Our results show that white mold is found in many locations across Pennsylvania. Fungicides can be an effective tool to reduce yield loss but relying on Sporecaster alone is not sufficient. Other information such as the field history and weather conditions at flowering should be considered when deciding on fungicide applications. Furthermore, improved knowledge of the pathogen will continue to help us fine-tune disease management recommendations.

Soybean Response to Nitrogen and Sulfur Rate and Timing of Fertilizer Application

Principal researchers: Dr. Charles White, PSU Assistant Professor & Extension Specialist, Soil Fertility and Nutrient Management; Zachary Sanders, Research Technician & Ph.D. Student, Departments of Plant Sciences and Ecosystem Science and Management

FUNDED AMOUNT: $11,854

PROJECT SUMMARY

The purpose of this research project was to evaluate the effects of N and S fertilizer applications on soybean performance in a corn-soy rotation. Due to the continued reduction in atmospheric S deposition, there is a growing concern about S deficiencies causing yield reductions or a change in amino acid profiles in soybeans. Ammonium sulfate is one of the most common and cheapest forms of S fertilizer available, however the S in ammonium sulfate is only cheap if the crop also takes advantage of the N. Otherwise, applying N with S unnecessarily raises the cost of the S fertilizer.

The recent dramatic increase in N fertilizer costs highlight the importance of carefully managing N and S sources in the context of a crop rotation. For instance, at current market prices, applying 40 lbs/acre-1 S as ammonium sulfate to soybeans would cost $50/ac if the soybean crop does not benefit from the N, whereas the same rate of S applied as gypsum would only cost $25/acre. Previous research indicated that S applied in the corn year of a rotation could carry over to the soybean year, and applying 40 lbs/acre S as ammonium sulfate to corn only costs $12/acre for the S because the corn will benefit from the N. This research untangles the effects of N and S fertilizers applied to either the corn or soybean phase of a crop rotation system on soybean yield and quality.

At the time of corn planting in 2020, we applied 40 lbs/acre-1 S as ammonium sulfate, gypsum, poultry litter and elemental sulfur to plots in a randomized complete block design. We maintained four untreated plots in each replicate. At the time of soybean planting in 2021, we applied 40 lbs/acre-1 S as ammonium sulfate or gypsum and 35 lbs/acre-1 N as urea to three of the untreated plots in each replicate, while one plot remained untreated in both years (Figure1).

FINDINGS

During the soybean year, we found a significant increase in soybean plant tissue S at V2 in the 2021 gypsum and 2020 elemental S treatments compared to the untreated. Other treatments had similar plant tissue S concentration to the untreated at V2, except for the urea treatment, which was significantly lower than the untreated, perhaps due to N uptake inhibiting S uptake. However, once soybeans had reached R1, treatments which had received S in either year had significantly higher plant tissue S concentration than the untreated or urea treatments

We found that there was no effect of S, N or S+N fertilizer, whether applied during the corn or soybean year, on soybean yield (yield ranged from 54 – 76 bushels acre-1; average was 68). We collected grain subsamples to be analyzed for S containing amino acids, cysteine, and methionine, at the time of harvest. We found a significant effect of S fertilizer application on cysteine and methionine concentration at our previous site (Figure 2) and expect similar results from this trial.

The key takeaway from these results is that S fertility is perhaps best applied during the corn year of corn-soy rotations. Farmers can get the maximum return from using ammonium sulfate, both as an N source for the corn crop and an S source, where unused S can be retained on clay particles in the subsoil to be utilized by the following year's soybean crop.

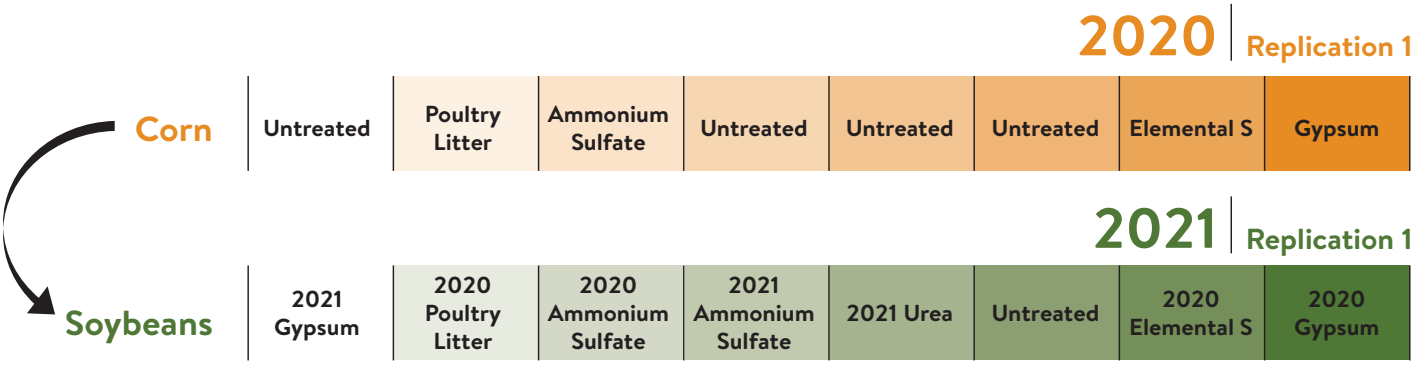


Figure 1. *An example of the experimental design in one replication over the two years of the experiment.*

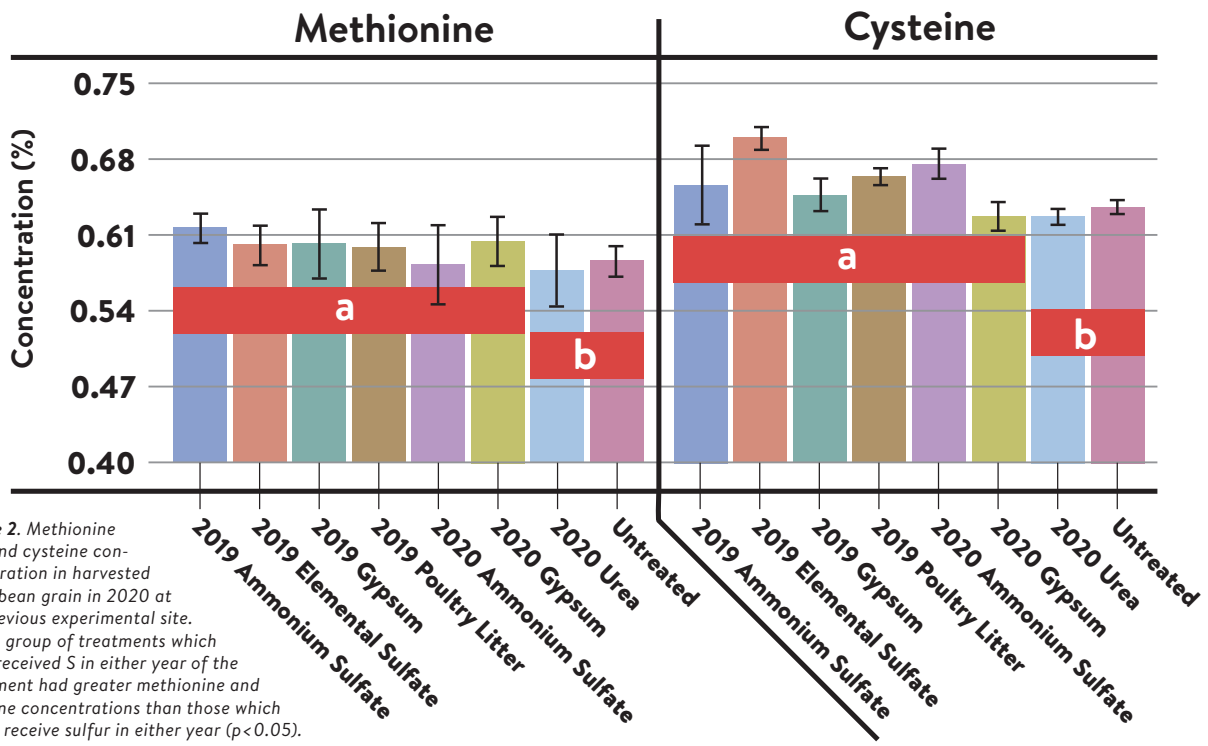


Figure 2. *Methionine and cysteine concentration in harvested soybean grain in 2020 at the previous experimental site. The group of treatments which received S in either year of the experiment had greater methionine and cysteine concentrations than those which did not receive sulfur in either year ($p<0.05$).*

Scan this QR code to learn more.

soybeanresearchdata.com

Sentinel Plot Program for Detection of Insect Pests and Diseases

Principal researcher: Dr. John F Tooker, PSU Professor of Entomology

FUNDED AMOUNT: $23,033

PROJECT SUMMARY

This project involves establishing a sentinel plot program by scouting 27 fields in 21 Pennsylvania counties weekly for insect and pest populations. The project is run collaboratively between Penn State's Department of Entomology and Penn State Extension to provide soybean growers with a statewide assessment of insects and diseases active in soybean fields. The main goal of the program is to encourage growers to adopt Integrated Pest Management.

Scan this QR code to learn more.

soybeanresearchdata.com

FINDINGS

Throughout the growing season, soybean growers are exposed weekly to realistic, unbiased assessments of populations of insects and diseases in soybean fields. This exposure may seem unnecessary to some, but ample research has shown that soybean farmers over-rely on insecticides and fungicides because they do not have a firm understanding of the threats that insects and fungal pathogens pose to their fields. Our scouting efforts of "typical" soybean fields, usually grown without insecticides and fungicides, provide qualified assessments of pest populations that have colonized fields around the state. We expect that these fields are representative of most in Pennsylvania and that growers can use our reports as indicators of what is active in their fields.

After seeing our reports, we hope that growers will then seek to learn what is active in their fields. If they see that pest populations are mild, then they will understand that insecticides and fungicides are not needed in most soybean fields. This first-hand experience can lead them to embrace scouting, which is the key to implementing Integrated Pest Management and the second benefit of our project, which is lowering production costs by allowing farmers to avoid using necessary inputs.

Evaluating the Effects of Intense Precipitation on the Efficacy of Weed Management in Soybeans

Principal researcher & co-collaborator: Dr. Carolyn Lowry, PSU Assistant Professor of Weed Ecology and Management; Dr. John Wallace, PSU Assistant Professor of Weed Science

FUNDED PROJECT: $16,757

PROJECT SUMMARY

The Northeast is experiencing a 71% increase in extreme precipitation events, which can increase soil-applied herbicide leaching and runoff, thereby decreasing pre-emergent residual herbicide efficacy. Cover crop surface residues can suppress weeds, providing backup weed control when residual herbicides fail. However, cover crop surface residues increase soil moisture, which may exacerbate the loss of residual herbicides in response to extreme rain events.

Our objectives were two-fold: 1) to determine the level of precipitation that results in loss of efficacy of residual pre-emergent herbicides; and 2) evaluate whether cover crop surface residues can provide backup weed control when extreme precipitation events decrease residual herbicide efficacy.

We compared the efficacy of both a pre-emergent residual herbicide (with and without S-metolachor) and cover crop surface residues (with and without cereal rye) on weed control of two summer annual weed species (smooth pigweed and giant foxtail), under varying extreme precipitation scenarios of 0, 1, 2, and 3 inches of added rainfall in a single day event. (Only data from 0- and 3-inch precipitation treatments are presented here).

Prior to S-metolachlor application, 500 viable seeds of each weed species were sown into a 0.5 m2 quadrats. One week after s-metolachlor (Dual II Magnum, 1.6 pints/acre) was applied, the precipitation treatments were imposed using rainfall simulators, and weed seedlings were counted weekly for five weeks.

FINDINGS

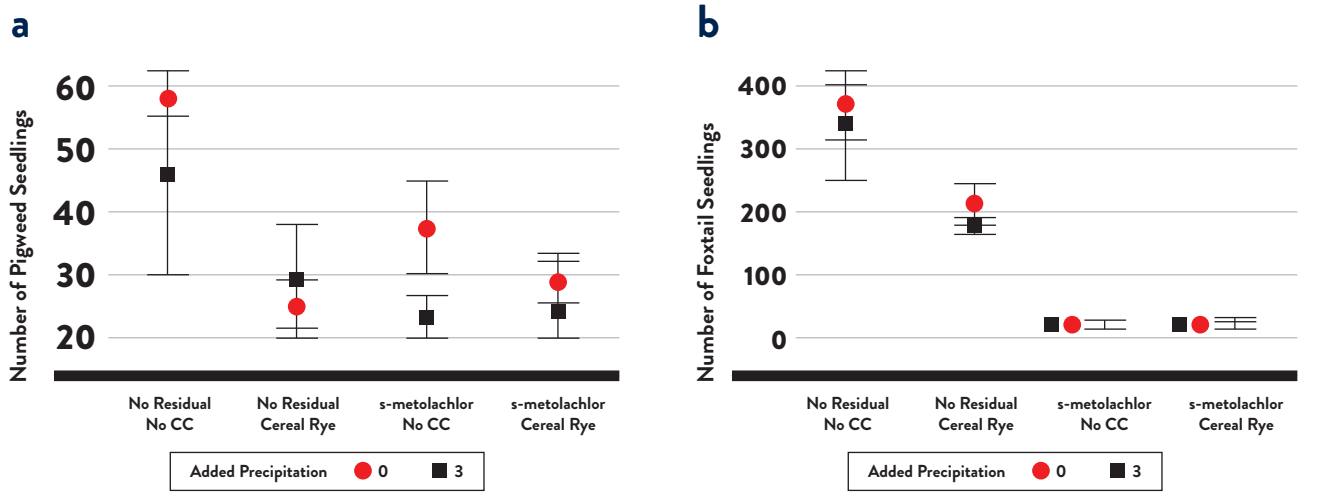
Our findings show that precipitation at the levels included in our study (3 inches of added precipitation, totaling 4 inches in the week after S-metolachlor application) had little effect on weed control efficacy of either S-metolachlor or cereal rye surface residues.

Both S-metolachlor and cereal rye surface residues effectively controlled smooth pigweed regardless of added precipitation. The cereal rye surface residues did not provide any additional weed control of smooth pigweed when S-metolachlor was used.

S-metolachlor effectively controlled giant foxtail, and S-metolachlor efficacy was not dependent on level of precipitation or cereal rye surface residues. Cereal rye surface residues were less effective at controlling giant foxtail compared to smooth pigweed.

Our research findings show that cover crop surface residues are not likely to worsen the potential effects of extreme rainfall on the efficacy of residual herbicides, at least not at the levels of precipitation included in this study.

Future work will examine whether extreme rainfall events and cover crop surface residues affect the efficacy of other pre-emergent residual herbicides, as well as whether these effects vary in other soil types and under greater levels of precipitation.



Mean (+/- standard errors) total number of (a) smooth pigweed and (b) giant foxtail seedlings within treatments including: added precipitation (red=0 and black = 3 inches), cover crop surface residues (No Cover Crop [NoCC] and cereal rye), and residual herbicide (no residual versus S-metolachlor).

Pennsylvania Soybean Yield Contest

2021 turned out to be a pretty good year for Pennsylvania's soybean growers, especially for Bucks County farmer Nathan Crooke, the Commonwealth's top producer in the Pennsylvania Soybean Yield Contest. His winning yield in the 2021 competition was 112.43 bushels per acre, the highest yield recorded in the 28-year history of the contest. Four other farmers also recorded yields of over 100 bushels per acre.

Nathan Crooke (right), with custom combine operator Joe Dise.

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.) Special awards are presented for irrigated bean yield and for oil/protein quality.

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, Pennsylvania
19426-1179
610-489-4315

2021 Pennsylvania Soybean Yield Contest Winners

1ST PLACE STATE OVERALL & SOUTHEAST REGION

Nathan Crooke, Perkasie, Pa. (Bucks County)
112.43 bu./acre

1ST PLACE CENTRAL REGION

Eric Meyers, Mercersburg, Pa. (Franklin County)
84.11 bu./acre

1ST PLACE SOUTH-CENTRAL REGION

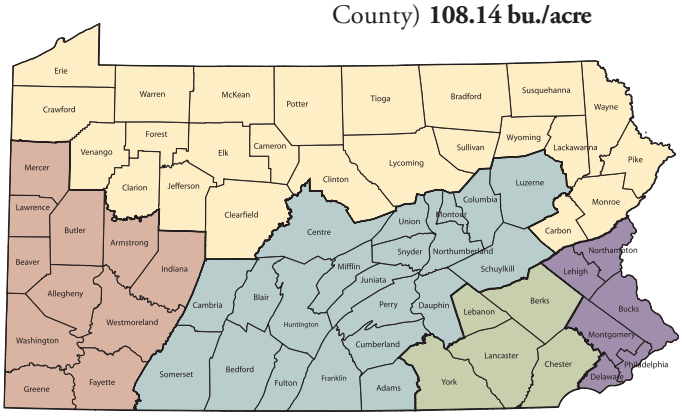
AAA Farming, Lebanon, Pa. (Lebanon County)
105.98 bu./acre

1ST PLACE NORTHERN REGION

Raymond (Jerry) Martin, Wellsboro, Pa. (Tioga County) **73.34 bu./acre**

1ST PLACE WESTERN REGION

Henry Sniezek, New Castle, Pa. (Lawrence County) **108.14 bu./acre**



Scan the QR code to learn about the 2022 Pennsylvania Soybean Yield Contest

pasoybean.org

2021 YIELD CONTEST RESULTS

Soybean Management Practices - Regional Award Winners

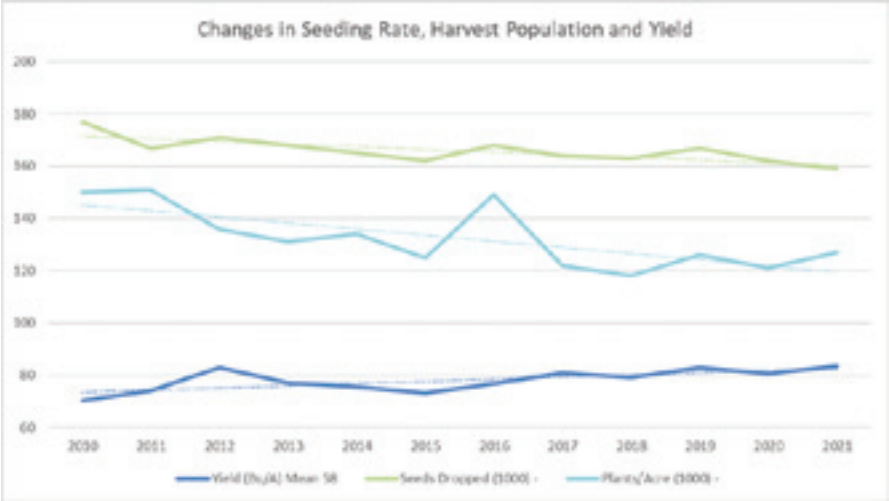
Region	South Central	Central	West	Northern	Southeast
Winner	AAA Farming	Eric Meyers	Henry Sniezek	Raymond (Jerry) Martin	Nathan Crooke
County	Lebanon	Franklin	Lawrence	Tioga	Bucks
Previous Crop	Corn	Corn	Corn	Corn	Grass Hay
Row Width	20”	30”	30”	15”	7.5”
Tillage Type	Min-Till	No-Till	Conventional	No-Till	Conventional
Variety	Stine 37EC20	Pioneer 42A96X	Seed Consultants SC7341E	Pioneer 26A61X	Channel 2918 xtend
Seeding Date	4/8/21	4/28/21	4/26/21	4/28/21	4/28/21
Seeding Rate	160,000	140,000	120,000	158,000	165,000
Final Stand	141,300	54,000	103,000	69,600	139,200
Seed Treatment	Exceleron	Pioneer Premium	None	Pioneer Premium	Fungicide/ Bionematicide
Inoculation	Liquid	Pre	Dry	none	Dry
Fungicide	Approach Prima	Miravis Neo	Approach Prima	Miravis Neo	Delaro
Insecticides	Mustang	Lamcap II	Mustang Maxx	Lambda	None
Pre-Herbicide	Roundup/Sharpen	Thundermaster	Metribuzin/Sonic	Canopy	None
Post-Herbicide	Liberty/Clethodim	Roundup	Glyphosate/Enlist	Roundup	1st Sequence/Engenia 2nd Roundup
Date of Harvest	11/3/21	10/21/21	11/4/21	10/13/21	10/1/21
Yield	105.98	84.11	108.14	74.34	112.43
Moisture %	17.9	14.90	15.6	19.5	12.10
Ave Pod Count	38	160	112	88	53
Harvest Loss	0.5 bu/a	2.25 bu/a	1.5 bu/a	0.3 bu/a	0.5 bu/a
pH	6.8	7.2	5.9	6.5	6.2
P	Optimum	Optimum	Below Optimum	Optimum	Optimum
K	Optimum	Optimum	Below Optimum	Optimum	Below Optimum
Organic Matter		4.8	2.3		2.7
Biostimulant	No	No	No	No	No
Foliar Fertilizer	No	Yes	Yes	No	Yes
Cover Crop	Rye	Wheat for grain	Rye	Wheat	Wheat for grain

Prepared by Delbert G. Voight, Jr., Senior Extension Educator & Andrew Frankenfield, Senior Extension Educator
Supported and directed by the Pennsylvania Soybean Board

PENNSYLVANIA SOYBEAN YIELD CONTEST FINDINGS

SEED RATE

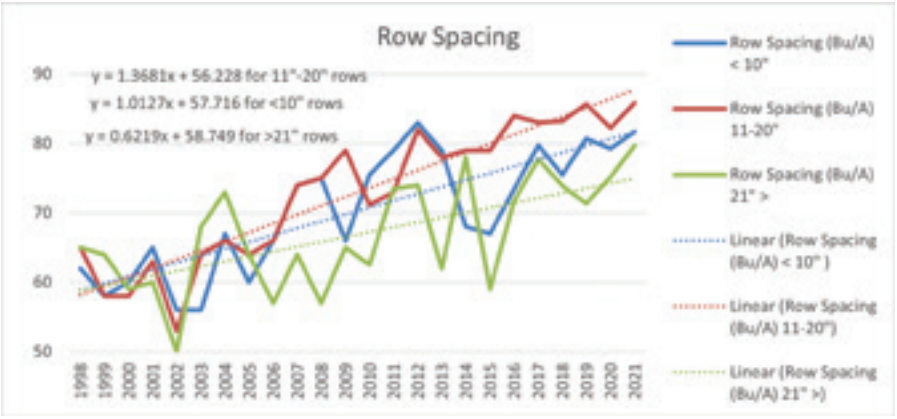
Over a 12-year period, there has been a decrease in seeding rate by approximately 20,000 seeds per acre and a decrease in the harvest population by approximately 25,000 plants per acre, all while increasing yield 10 bushels per acre in the same period.



ROW SPACING

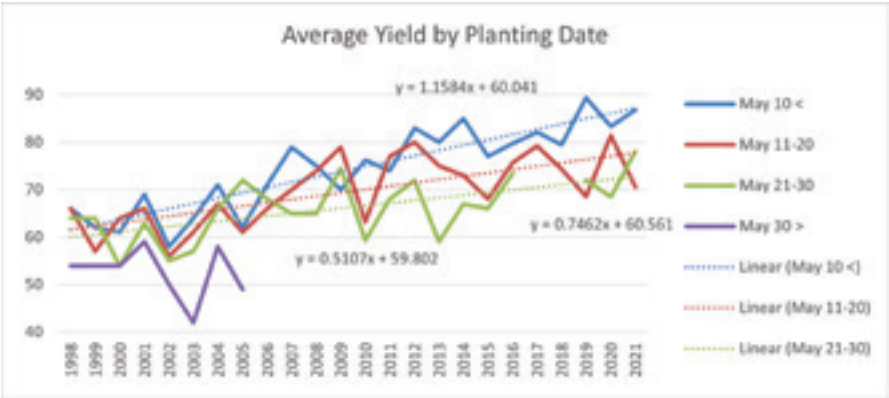
Since 2008 at least 50% of the entries in the contest were planted in 15" rows with a trend of yielding 1.37 bushels more per year compared to drilled soybeans planted in rows less than 10" which are trending up at a rate of 1.01 bushels per year.

Wide row soybeans make up about 15% of the entries and are trending below drilled and 15" soybeans at a rate of 0.62 bushels per year.



PLANTING DATE

Since 1998 the average yield of entries planted before May 10 increased 1.16 bushel per year compared to 0.75 bushels from May 10 – 20 and 0.51 bushels from May 21-30. Since 2005 very few entries were planted after May 30.



To read the complete Pennsylvania Soybean Contest 2021 Report scan the QR code or request a copy from your local Penn State Extension Educator.

pasoybean.org

Enhancing the Nutritional Value of Soybean Meal for Lactating Dairy Cows

Principal researcher: Dr. Alex Hristov, PSU Professor of Dairy Nutrition

FUNDED AMOUNT: $38,862

PROJECT SUMMARY

This project was designed to demonstrate to dairy producers and their consulting nutritionists the advantages of extruded soybean meal (ESBM) over canola meal in terms of milk production and milk components.

We directly compared canola meal with ESBM in a large, long-term experiment with lactating dairy cows. The idea of the trial was to show that ESBM is equal or superior in nutritive value to canola meal, which has been heralded as a better protein supplement for lactating dairy cows, primarily as a result of recent studies funded by the Canola Council of Canada.

In addition, going forward, we will also be continuously monitoring enteric methane production by the cows. Our hypothesis is that the greater fat content of ESBM (compared with canola meal) will result in decreased methane emission, in absolute terms and relative to feed intake and milk production of the cows. Our laboratory has extensive experience with enteric methane mitigation research, and we believe that this study will be an important contribution to the efforts to mitigate the environmental impact of dairy production.

FINDINGS

Our study showed a statistically greater milk fat percentage and yield when the cows were fed the ESBM diet. This resulted in 3.7 lb/d greater 4% fat-corrected milk yield for the ESBM diet vs. the canola diet. Milk protein percentage and yield, however, were not different between the two diets. This may have been due to the relatively low extrusion temperature during preparation of the ESBM.

In an earlier study we showed increased rumen-undegraded protein concentration of SBM extruded at 340°F vs. meal extruded at 300°F, which also resulted in increased blood plasma concentration of histidine, a key amino acid shown by our group to be limiting milk protein synthesis in lactating dairy cows. Collectively, these data led us to the hypothesis that feeding ESBM with a higher rumen-undegraded protein content (i.e., extruded at higher temperature), would result in not only greater milk fat but also greater milk protein percentage and yield in lactating dairy cows when compared on an equal protein supply basis with canola meal.

Scan this QR code to learn more.

soybeanresearchdata.com

Simultaneous Detection of Endemic and Emerging Coronavirus in Pigs

Principal researcher: Dr. Suresh Kuchipudi, PSU Clinical Professor & Associate Director, Animal Diagnostic Lab

FUNDED AMOUNT: $49,076

PROJECT SUMMARY

Coronaviruses have emerged as a major global threat to animal and human health. Coronaviruses exhibit a pronounced propensity for interspecies transmission as illustrated by important emerging viruses in humans such as the recent SARS-CoV-2 that is causing the ongoing COVID-19 pandemic.

Over the past 80 years, several novel coronaviruses have caused extensive outbreaks and economic losses in swine. Currently there are three coronaviruses of concern to pig production globally. These are porcine epidemic diarrhea virus (PEDV), porcine deltacoronavirus (PDCoV), and emerging swine acute diarrhea syndrome coronavirus (SADS-CoV).

Novel PEDV strains emerged in China in 2010 and spread to the United States in 2013. It was estimated that PEDV caused an annual loss of $1.8 billion to US hog farmers.

Outbreaks of SADS-CoV have been recorded in swine herds throughout China. These outbreaks were associated with acute diarrhea and vomiting with 90% mortality rates in piglets less than 5 days of age. While the SADS-CoV has not been identified in the United States, emergence of this virus in the US could cause a devastating impact to the US hog industry.

FINDINGS

Rapid and specific identification tools for emerging swine coronaviruses can help safeguard swine. Many other infections including bacterial diseases cause similar symptoms in pigs. Therefore, laboratory confirmatory diagnosis is essential to identify the cause of diarrheal disease and death in pigs. The goal of this research is to develop a multiplex PCR assay for simultaneous detection of PEDV, PDCoV and SADS-CoV, which will be subsequently offered through the Pennsylvania Animal Diagnostic Laboratory System.

We have completed analysis of genome sequences and designed the PCR assays. The reagents have been ordered and the next steps are going to be assay standardization followed by validation. The project is progressing as per plan.

Scan this QR code to learn more.

soybeanresearchdata.com

Stay Connected with the Penn State Extension Field and Forage Crops Team

Sign up to receive news, upcoming event information, and the weekly Field Crop News newsletter.

Scan this QR code to complete the form to receive the latest news and upcoming event information from Penn State's Field and Forage Crops team. Extension field and forage crop experts provide educational resources including news, articles, videos, events, and demonstrations on topics that matter most. Topics include small grains, cover crops, forages, industrial hemp, soil health, pest and diseases, and more. Sign-up today!

Scan this QR code to sign up.

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

2021 Field Crop News articles from Penn State Extension

NEMATODES

- https://extension.psu.edu/suns-up-soils-dry-lets-sample-for-soybean-cyst-nematode-scn
- https://extension.psu.edu/scout-now-for-soybean-cyst-nematode-scn-the-hidden-enemy

SLUG MONITORING

- https://extension.psu.edu/2021-pennsylvania-slug-monitoring-project

WHITE MOLD

- https://extension.psu.edu/white-mold-in-soybeans-sporecaster-validation-2021-results
- https://extension.psu.edu/time-to-scout-for-white-mold-in-soybeans
- https://extension.psu.edu/white-mold-in-soybeans-sporecaster-forecasts-and-scouting
- https://extension.psu.edu/combating-white-mold-through-sampling-surveys-and-sporecaster

PESTICIDE APPLICATOR RECERTIFICATION WORKBOOK: SOYBEAN DISEASES

- https://extension.psu.edu/pesticide-applicator-recertification-workbook-soybean-diseases

RECENT JOURNAL ARTICLES

- Bandara, A.Y., D.K. Weerasooriya, R.V. Trexler, R. Poudel, T.H. Bell, and P.D. Esker. 2021. Soybean roots and soil from high- and low-yielding field sites are characterized by distinct microbial co-occurrence networks. Frontiers in Microbiology, https://doi.org/10.3389/fmicb.2021.675352.
- Bandara. A., D. Weerasooriya, T. Bell, and P. Esker. 2021. Prospects of alleviating early planting-associated cold susceptibility of soybean using microbes: insights from microbiome analysis. Journal of Agronomy and Crop Science https://doi.org/10.1111/jac.12476.

SCAN the QR code to learn more.

ncsrp.com

North Central Soybean Research Program

FUNDED AMOUNT: $50,000

The Pennsylvania Soybean Board is a member of the North Central Soybean Research Program (NCSRP). This farmer-led organization invests soybean checkoff funds in university research and Extension programs to better understand and manage plant stressors that reduce soybean yield and farmer profitability. Their mission is to maximize producer returns by coordinating regional research efforts, minimizing duplication of research, and assuring that regional research projects are targeted at problems of the soybean producer in member states.

For Pennsylvania soybean producers, participating in the NCSRP provides a tremendous opportunity to leverage their checkoff investment into new areas of research. Most projects are multistate, so results can be compared and integrated from across the region. This research can help farmers improve production and management decisions because they can see how various treatments or factors may perform in different soybean production areas.

The NCSRP is recognized as a leader in multi-state collaborative research and outreach efforts to support soybean farmers and drive the soybean industry forward. NCSRP's emphasis on enhancing and protecting soybean yield through genetics and agronomic practices contributes to soybean farmer success today and tomorrow.

The NCSRP Board approved new and ongoing research projects for funding for soybean diseases, soybean cyst nematode, soybean entomology, genetic studies toward the improvement of host resistance and yield, and outreach. Several of the projects are jointly funded by the United Soybean Board and state checkoff boards.