Pennsylvania Soybean On-Farm Network 2018
Final Report[1]

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Summary.

The soybean on-farm network expanded in 2018, with research trials and monitoring efforts across the Commonwealth (Figure 1). Special efforts were made to increase efforts in Western and Northern Pennsylvania.

There were four main research priorities in 2018, including slug monitoring (Project 1), plant populations (Project 2), fungicide seed treatments (Project 3), and yield-limiting factors (Project 4). Supplementary information is provided for several of the trials that shows current results at the farm level. Furthermore, summer field days and winter workshops were conducted to provide to core stakeholders updated information and results on soybean production in the state, regionally, and nationally. We have leverage our efforts with this network to achieve additional funding from the United Soybean Board to conduct surveys for nematodes (especially Soybean cyst nematode), which commenced in 2019.

As indicated in the footnote, due to weather conditions in 2018, we continue to work on different aspects of the project and will be finalizing the main on-farm trial book soon. The 2018 edition will look very different to previous editions given some of the changes that occurred in 2018 in terms of research trial type and corresponding laboratory efforts.

[1] This is a final report for grant purposes. Due to delays in harvest and continued laboratory work, we are still finalizing the overall soybean report of individual trials. We will continue to work on that to publish as soon as possible.

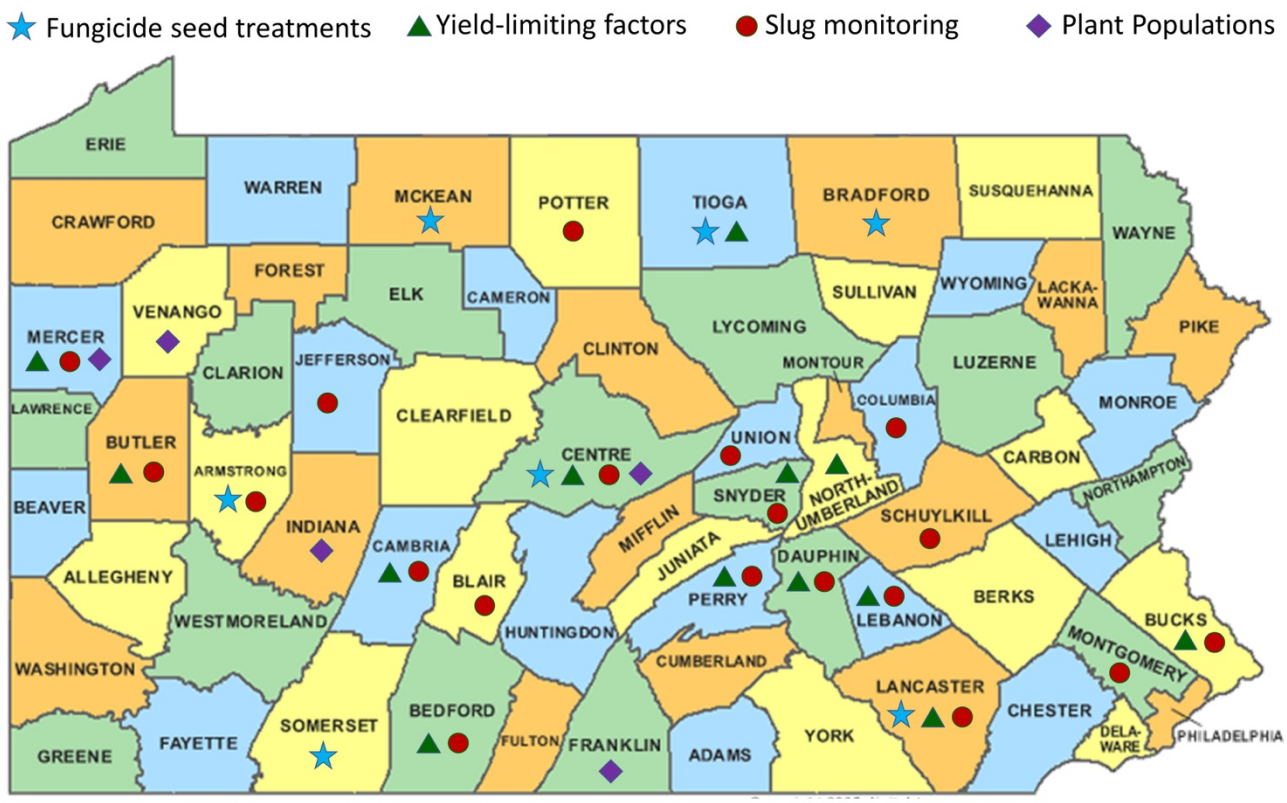


Figure 1: Map of Pennsylvania showing 27 counties where four types of trials were conducted in 2018.

Project 1: Slug monitoring

Project Co-Leaders: Dr. Liz Bosak (Dauphin and Perry Counties) and Anna Busch (Union County)

Counties where monitoring occurred:

Cambria, Bedford, Lebanon, Union, Snyder, Columbia, Mercer, Bucks, Montgomery, Perry, Dauphin, Lancaster, Centre, Butler, Potter, Armstrong, Jefferson

Number of overall sites: 31

Current update:

For the 2018 planting season, slug populations and slug damage were low across the State. Monitoring efforts were temporarily halted twenty-one days after crop emergence at each site and resumed after harvest when possible. Due to the extremely difficult and prolonged harvest season, many fields were not monitored in the fall. Fall egg counts were performed when possible.

The following are preliminary results from this growing season. Efforts are currently in progress to finalize the data set for 2018. Overall, slug populations have been low in the all but a few of the monitored fields. Because of this, it is very difficult to draw any conclusions about slug eggs, juvenile populations, and plant damage. What have we learned so far?

1. Egg counts did not reflect the juvenile and adult numbers for every field. Years 2 and 3 will be very important to establish whether there is any pattern and if this is a viable scouting method.
2. Of all four slug species, gray garden and marsh slugs were found most often in shingle traps.
3. One field accounted for 92% of the gray garden slugs found for the season. With that high gray garden slug field removed from the data set, marsh slugs were by far the most abundant.
4. Most fields experienced little or no plant damage.

Current extension activities include:

- Weekly Field Crop News slug reports during the planting season. No reports were necessary in the fall.
- Three video updates were published on YouTube and incorporated into Field Crop News articles.
- On Twitter and social media: #PAslugproject has been dedicated to our slug monitoring project efforts. Many educators involved in the project have posted updates with images and videos.

- Early project results were reported at numerous winter meetings hosted by local ag retailers in 2019.
- Project update presentations were given by Dr. Bosak at the 2018 Farming for Success event, held at the Southeast Agricultural Research and Extension Center, in Lancaster County, at the Perry County Soybean Management Field Day in July 2018, and the Keystone Crops and Soils Conference in October 2018.

Project 2: Plant populations

Project Lead: Del Voight (Lebanon County)

Background: Some growers have suggested that lower plant stands near 75,000 may actually promote more pod development, reduce the potential for white mold and reduce seed costs, especially with full season soybeans and full season maturity soybeans. Recent research reported in the Agronomy Journal from surrounding States suggests that the full season final stands should be maintained at 100-120,000 plants per acre (ppa). With the advent of fungicide and insecticide seed treatments lower populations may still maintain adequate yields to realize seed cost savings.

Objectives

- To determine the impact of low plant population strategies for soybeans. Specifically, the goal was to assess the ultra-low threshold as well as in field response to 100,000, 140,000, and 180,000 plant populations.

Project Results:

1. Validation plots (Penn State Southeast Agriculture and Experiment Station)

In 2016, 2017 and 2018 Trials were designed using a randomized complete block with 6 replications and data analyzed using Tukey equations and LSD and CV values reported in the *p*=.10 level. Plots were established in Early May using a 15-inch row planter and fully treated seeds with fungicide and insecticide components. Populations were varied by 25,000 ppa increments. Treatments were 25,000, 75,000, 100,000, 125,000, and 150,000 respectively. Plots measured 10 by 50 feet and a small plot combine was utilized to gain yield information as well as lab analysis of test weight and moisture. The correlation of soybean yield to plant stand matches up perfectly with the Agronomy Guide Soybean replant decision guide (Figure 2). Illustrating the impact of low populations on the yield of soybeans. The three years of data suggest 80,000 ppa final stands achieved 90% of yield potential. The main reason lower populations are able to maintain yield is through the plants ability to add pods to the plant and branch to create more pods. This is illustrated is the table correlating pods to plant stand (Figure 3). It appears that perhaps varieties are innately different in their ability to branch and pod and more research is needed in soybean varieties to assess this response to lowering populations.

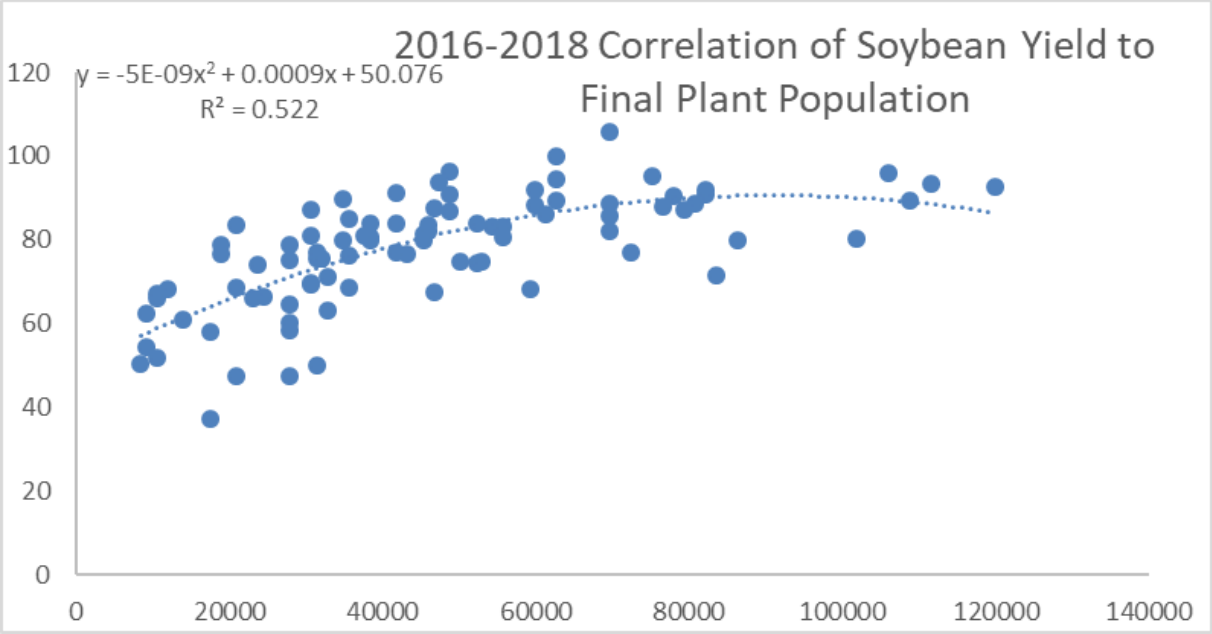


Figure 2. Correlation between soybean yield and final plant population, 2016 to 2018.

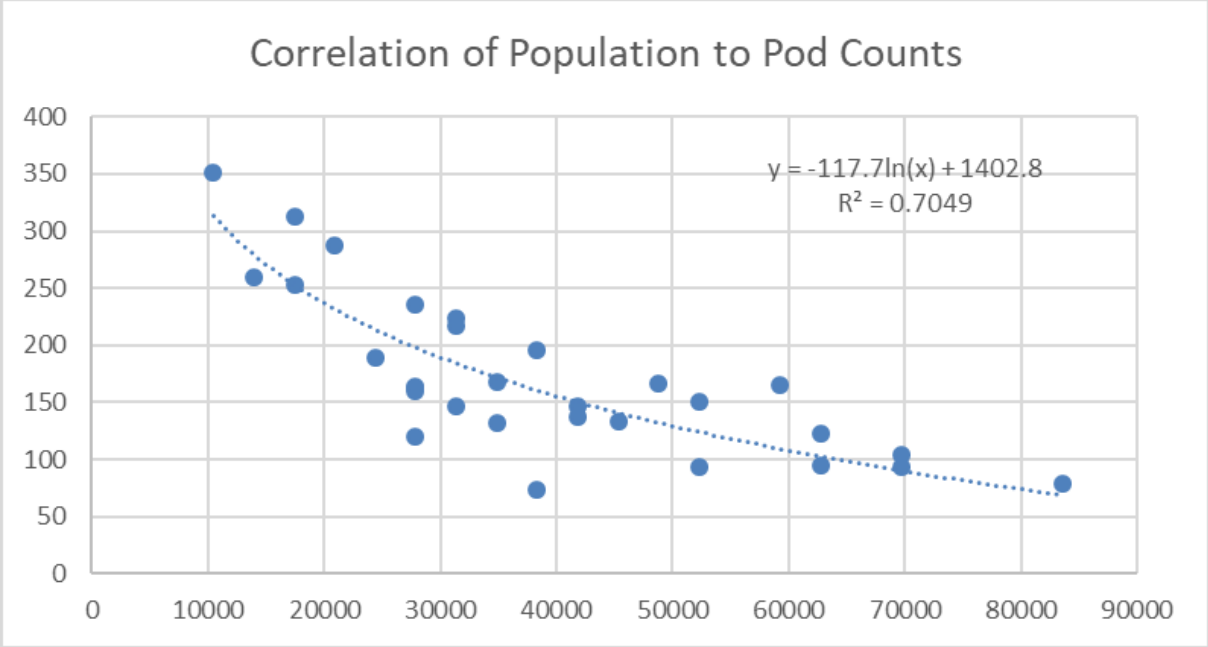


Figure 3. Correlation between final plant population (x-axis) and pod counts (y-axis).

2. Large plot On Farm Experiments: On Farm Projects on network participating growers were utilized to illustrate the effect of lower seed drop practices.

In 2016, 2017 and 2018, 20 growers participated in the soybean response to population trials. Yield differences due to the treatments tended to be small so replication of the treatments is essential to know if the effect we measure is real. It could be possible to program a planter with

these seed drops and then harvest and extract the data from a yield map. Treatments were wider than the combine and configured to avoid wheel tracks from applicators if possible. These are results of large plots more than 2 acres in size, so variability is greater and there is a significant amount of time to supervise harvests.

The 2018 growing season proved to be a challenging year to get harvests completed. This section will be updated once the data is summarized and complete. In 2018, summaries are available for the Franklin County Location at the Leslie Bowman farm. In this trial, there was not a clear correlation to yields (Figure 4). We continue to process data from Centre, West Moreland and Mercer Counties, due to late harvest (including 2019 harvests due to fall 2018 conditions).

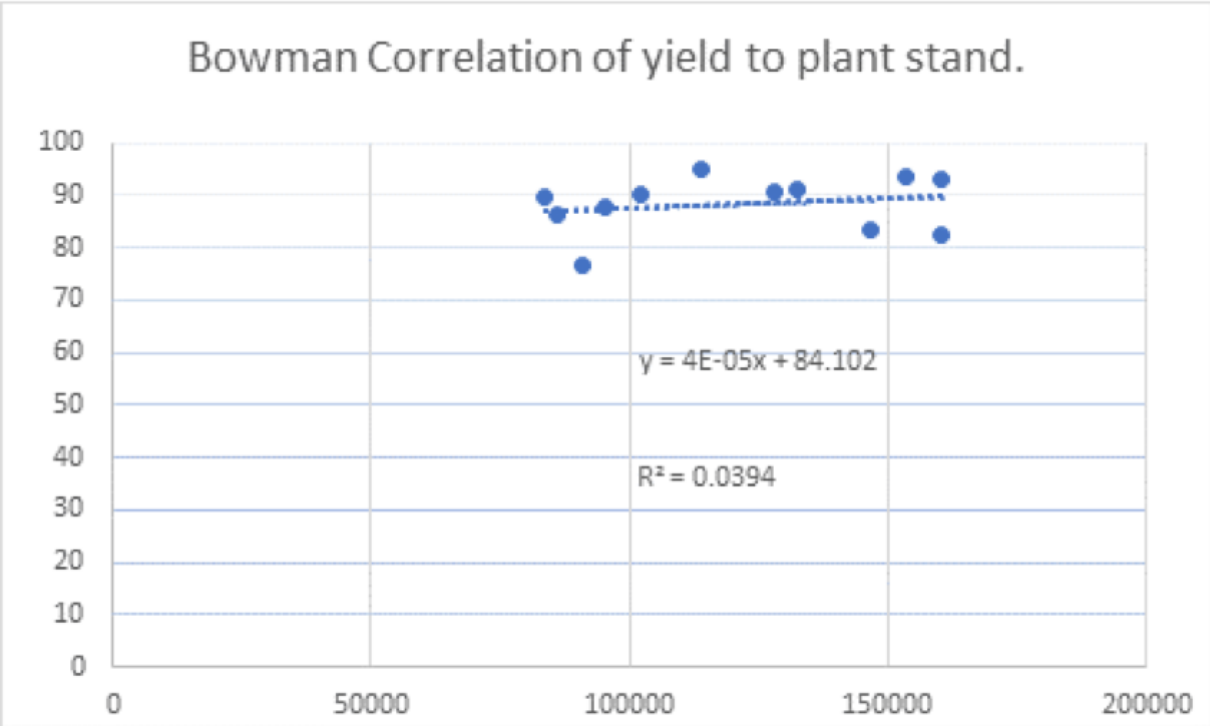


Figure 4. Correlation between plant population and yield at the Leslie Bowman Farm.

Observations: The data suggests growers using seed treatments, early planting, and a soybean variety prone to branching may reduce populations without sacrificing yields to levels around the 100,000 plants per acre drop mark to achieve a final stand of around 80,000 ppa at harvest. Additionally, if replant conditions exist this data would suggest that if populations in the field are 80,000ppa or higher no replant is necessary provided it is even across the field. More work needs to be completed in assessing soybean germplasm to identify responses by variety and by planting date going into the future.

Projects 3 and 4: Soybean Fungicide Seed Treatments and Yield-Limiting Factors

Project Lead: Dr. Paul Esker, Dr. Ananda Bandara, and Dr. Dilooshi Weerasooriya (PSU-UP)

As indicated in Figure 1, trials and monitoring sites were established seven locations (seed treatment) and 13 counties (yield-limiting), respectively. Summary trial information is available in the supplemental information section.

Over the next three sections (including subsections), we summarize the main findings from those efforts. These summaries formed the basis for several professional research abstracts that will be presented at a conference in August 2019. We continue to finalize main results from the work on microbiomes and several papers are already in development based on this work.

1). Effect of Apron Maxx seed treatment on soybean seedling diseases, seedling vigor, and yields.

Though extensively used in PA, fungicide seed treatment-associated positive yield responses are variable in soybean. A study was conducted to look at the impact of Apron Maxx (Mefenoxam + Fludioxonil) on seedling diseases, seedling vigor, and yields of soybean grown in Pennsylvania.

Method.
On-farm field and small plot trials were conducted in seven counties (Ahern, Armstrong, Lancaster, McKean, Centre, Somerset, and Tioga). At each location, plots were arranged in randomized complete block design. At R1 growth stage, 15 seedlings from each plot (Apron or control) were carefully uprooted to quantify the incidence of root rots. Seedling height (SH), tap root length (TRL), root/shoot weight (RW/SW: dry basis) were measured as seedling vigor indicators. Test weight (lbs/bu) and yield (bu/ac) were measured at harvest.

Results.
Root rots were absent in both Apron Maxx and control plots at all locations. Non-significant differences were observed between control and Apron for SH, TRL, RW, or SW at all locations. Apron did not significantly increase test weight or yield compared to control at all locations (Figure 5).

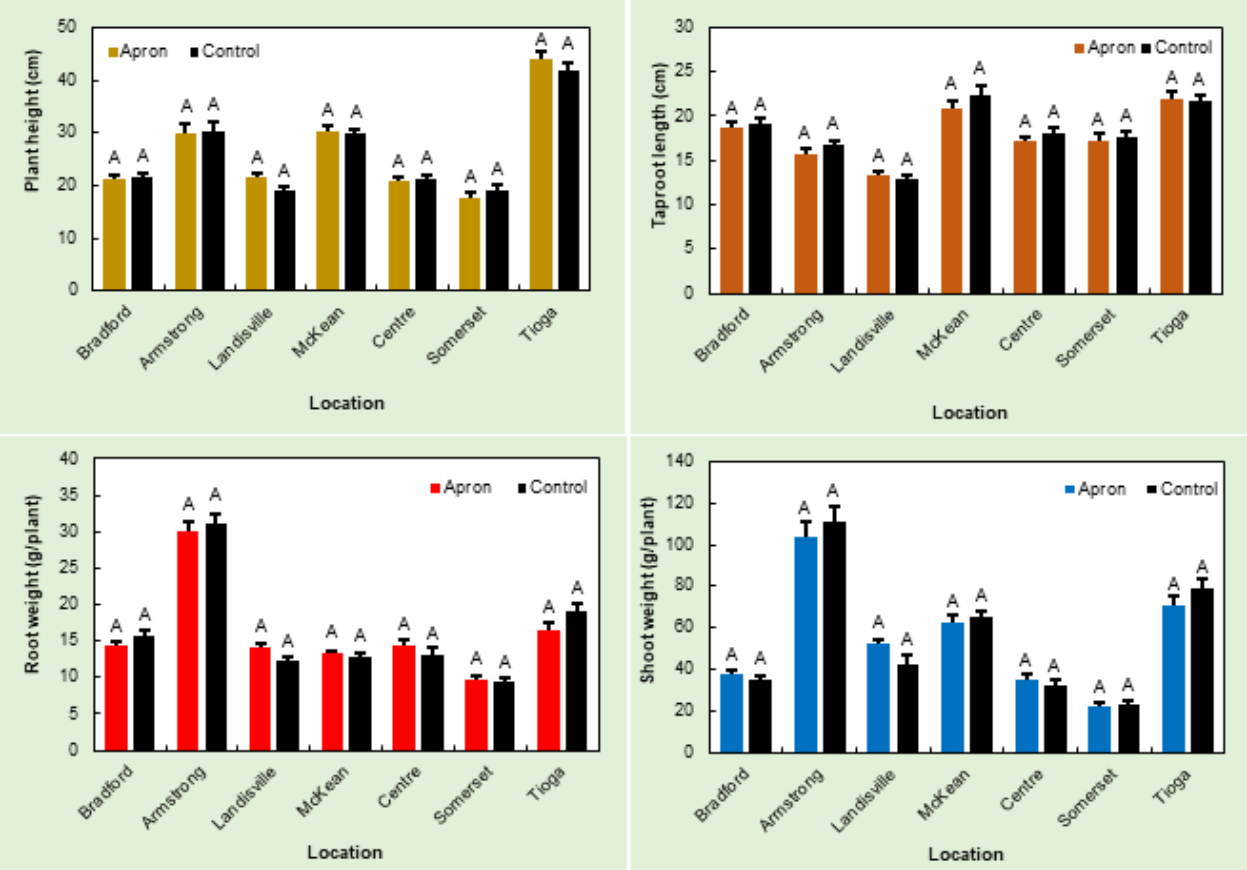


Figure 5. Soybean fungicide seed treatment trial R1 stage disease trait assessment results. "Apron "= Apron Maxx and the "Control" was non-treated soybean seed.

Conclusion.
The study showed that Apron Maxx did not positively impact soybean seedling vigor and yields. Our research continues to focus on an improved understanding of the pathogen profile as linked to the need for seed treatment fungicides to help Pennsylvania soybean farmers make rational decision making on the use of fungicide seed treatments to maximize profits.

2). Yield-limiting factor study addressing the association between soil and root microbiomes and within-farm-spatial-variation (WFSV) of soybean yields.

Within farm spatial variation is a key yield limiting factor in soybean growing states but the drivers of this are yet unknown. Our current microbiome research is built on the hypothesis that potential differences of soil and root associated bacterial and fungal communities contribute to the spatial variation within farms and thus on the soybean yield.

In the current study, the associated microbial communities in plant roots, rhizosphere soil and bulk soil from various soybean farmer fields across PA with high vs. low yield were

explored through analyzing the root and soil microbiomes at different soybean growth stages. The research was conducted using two approaches whereby soil and plant samples were collected at V1 and R8 soybean growth stages for the first approach and at V1, R1, R6 and post-harvest stage for the second approach (Figures 6 and 7).

Figure 6. All soybean sampling stages used for microbiome analysis

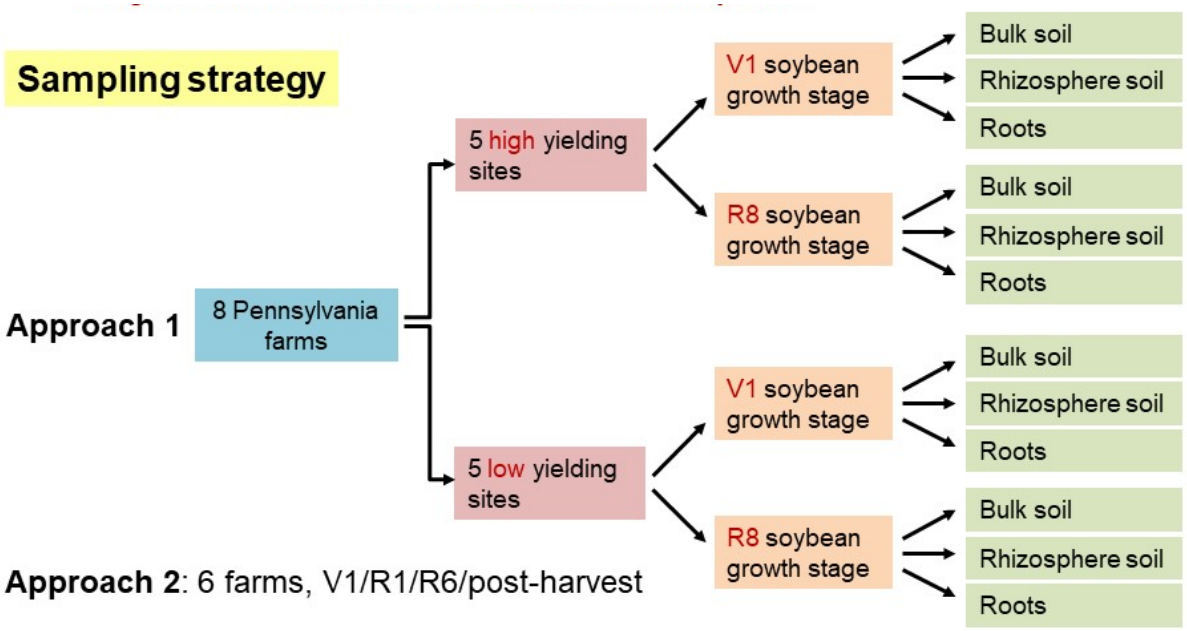


Figure 7: The sampling strategy followed for yield-limiting study.

The samples were processed in the laboratory and DNA extraction was followed by several different steps as shown in Figure 8 before sequencing and data analysis was conducted.

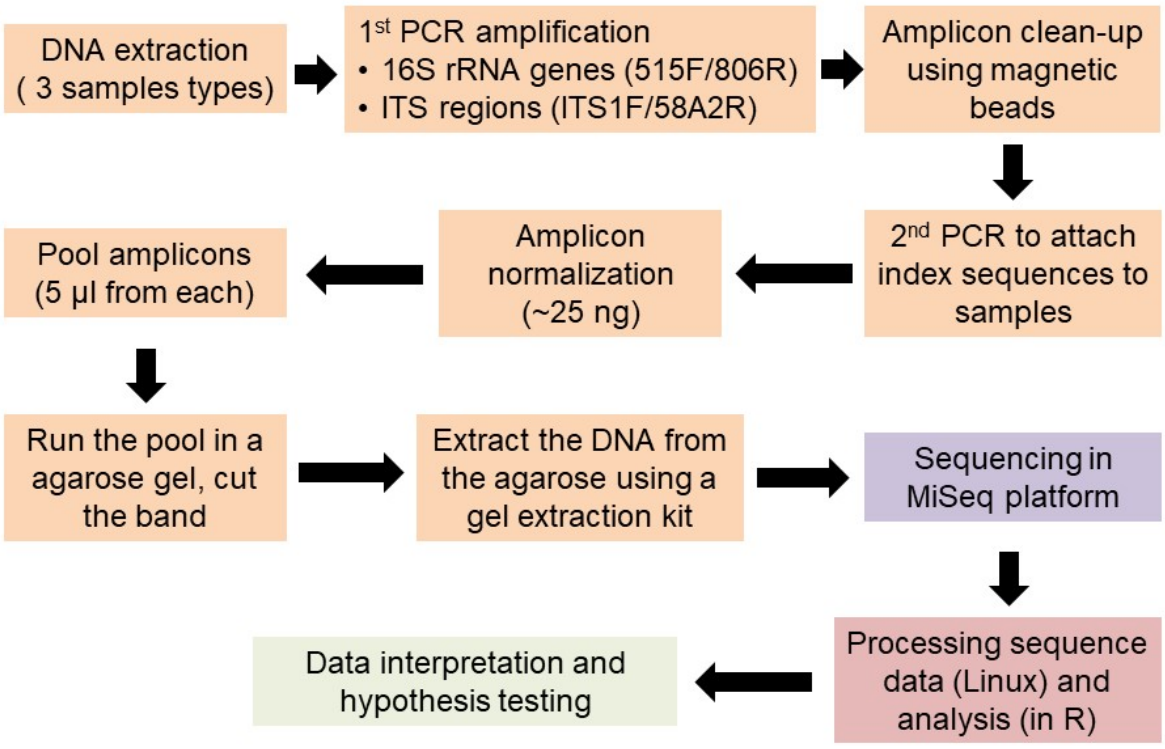


Figure 8. The pipeline for molecular characterization of the soil and root microbiome.

Results.
The relative abundance of Ascomycota and Zygomycota appeared to be different between high and low sites in bulk soil and root samples at R8 while Chytridiomycota, Zygomycota, and Basidiomycota were different between high and low sites in rhizosphere at R8. The global analyses suggested that fungal community differences can potentially contribute to within-farm-spatial-variation of soybean yields in Pennsylvania.
On the bacterial perspective, there were no noticeable differences in relative abundances of bacterial communities at the phyla level across high and low sites at V1 and R8. However, in-depth analysis will be performed to see whether specific bacterial taxa drive within-farm-spatial-variation of soybean yield.

3). Understanding the pathogen profile and their impact on seedling diseases in PA.

Attempts to control of seedling disease without a complete picture of the soilborne pathogen profile is a challenge that requires further research to make more informed management decisions. Proper knowledge on the pathogen profile and composition of a farmer field would therefore better explain the reasons underlying seedling disease and existing yield issues.

To improve our understanding of pathogen profiles in different farms and locations, all soil samples that were collected from soybean farmer fields across Pennsylvania from the

fungicide seed treatment study and yield-limiting factor study were characterized for four important soilborne soybean pathogen groups: *Pythium* spp., *Phytophthora* spp., *Fusarium* spp., and *Rhizoctonia* spp. For each pathogen group, isolations were conducted using selective media in the laboratory.

A total of 551 Pythium spp., 456 *Phytophthora* spp., 635 *Fusarium* spp. and 258 *Rhizoctonia* spp. were isolate from the collected soil samples. On average, 25 *Pythium* spp., 21 *Phytophthora* spp., 29 *Fusarium* spp. and 12 *Rhizoctonia* spp. isolates were found per farmer field. Figure 9 shows selected isolates from each pathogen group found in the current study.

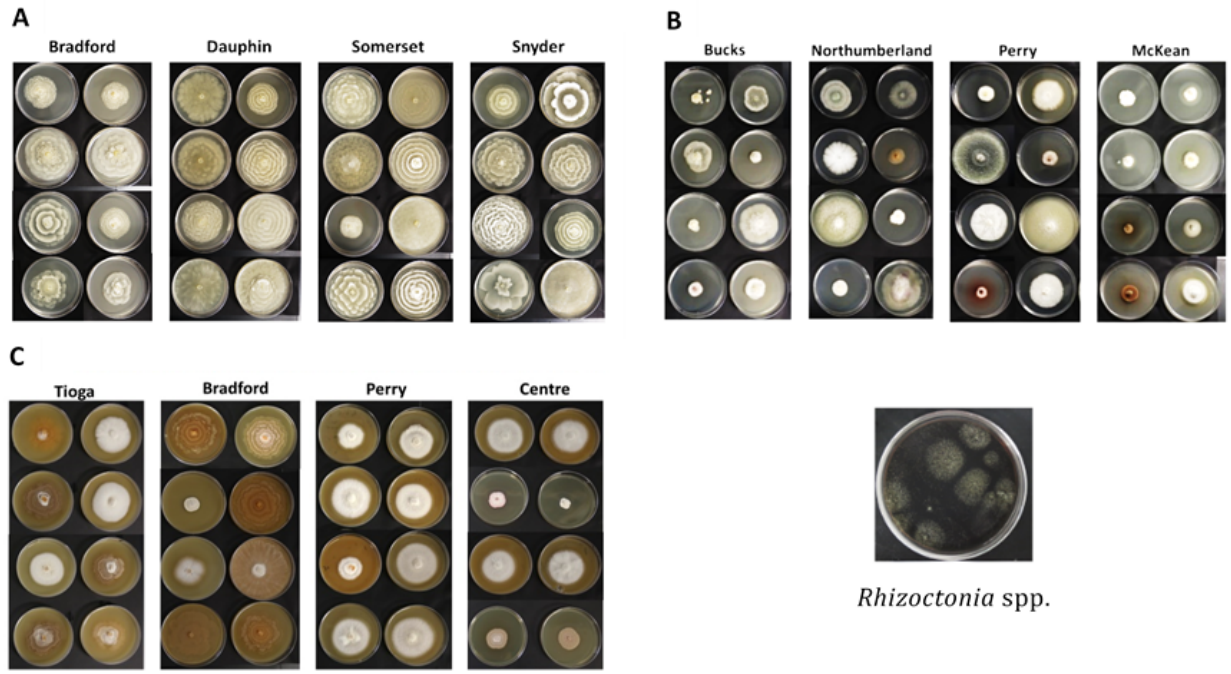


Figure 9. Images of selected pure cultures of A). *Pythium* spp., B) *Phytophthora* spp., C) *Fusarium* spp., isolates and *Rhizoctonia* spp. found in selected counties in PA.
Note: Rhizoctonia is a monotypic genus.

Pure cultures of isolates were characterized in different studies to help decision making and possible manipulation of crop production practices:

3(i). Impact of metalaxyl, ethaboxam, and mefenoxam on in-vitro growth rate of Pythium isolates from Pennsylvania.

The selection of appropriate fungicides with proper concentration is critical for efficient control soil borne pathogens. A study was conducted to determine the efficacy of selected fungicide active ingredients on in-vitro growth of selected *Pythium* isolates that were obtained. Future work will focus on the other pathogen groups.

Method.
A selection of 153 *Pythium* isolates recovered from soil samples collected were grown in PDA amended with 0, 10, 100, and 1000 ppm concentrations of metalaxyl, ethaboxam and mefanoxam. Colony diameter was measured at different time points to compute the colony growth rate.

Figure 10. Example of two selected Pythium fungal isolates tested against four concentrations of ethaboxam in three replicates.

Results.
Statistical analysis indicated that there was a significant isolate × concentration interaction for all tested fungicides. Among the isolates tested, 70.6%, 88.2% and 64.7% were insensitive (non-significant growth rate difference compared to counterpart control = 0 ppm) to Metalaxyl, Ethaboxam and Mefanoxam respectively. Furthermore, only 13.1%, 4.6% and 9.8% of the isolates were sensitive to Metalaxyl, Ethaboxam and Mefanoxam at 1000 ppm.

Conclusions.
Findings showed that the majority of the tested isolates were unaffected by the different fungicide active ingredients even at higher concentrations. Further research is needed to determine if these primary active ingredients used in seed treatments are effective for control of *Pythium* spp. in Pennsylvania soybean fields.

3(ii). The relationship between soil chemical properties and population densities of pathogen groups were investigated.

In this study, we examined the possible links between soil chemical properties and pathogen population densities.

Method.
Enumeration of fungal colonies from soil samples collected from all 22 locations were carried out on selective media (*Fusarium* = Nash and Snyder; *Pythium* = P5ARP; *Phytophthora* = P5ARP + hymexazol; *Rhizoctonia* = Ko and Hora). Organic matter (OM), cation exchange capacity (CEC), pH, and nutrients (P, K, Mg, Ca, Zn, Cu, S) of soil samples were determined.

Results.
Pearson correlation analysis showed a significant relationship between soil *Fusarium* density (CFU/g) and S ($r = 0.74$, $P < 0.0001$). *Pythium* density was significantly correlated with K ($r = 0.71$, $P = 0.0002$) and CEC ($r = 0.58$, $P = 0.0051$). Neither *Rhizoctonia* nor *Phytophthora* densities were significantly correlated with any of the measured properties.

Conclusions.
Despite their importance for enhanced crop production, S and K have the potential to increase inoculum densities of soil borne *Fusarium* and *Pythium* species respectively and could indirectly promote crop's susceptibility to soil borne diseases caused by these fungi.

3(iii). Association of selected biological and chemical properties of soil with within-farm-spatial-variation of soybean yields were investigated.

This study was conducted to investigated to determine if variation in selected biological and chemical properties of soil contribute to spatial heterogeneity of soybean yields.

Method.
Bulk soil samples from 14 locations in PA were collected from five historically high and low yielding sites per location at V1 growth stage of soybean. The plant pathogenic nematode counts (lesion, stunt, spiral, stubby root, dagger, ring, lance, and pin), fungal counts (*Fusarium*, *Pythium*, and *Phytophthora* species and *Rhizoctonia solani*), organic matter, cation exchange capacity, pH, and nutrients (P, K, Mg, Ca, Zn, Cu, S) of soil samples were determined.

Results.
None of the measured variables were significantly different between high and low yielding sites. Using a multivariate statistical procedure (principle component analysis) revealed that first two principle components contribute to 46% of the total observed variation in the data set. However, this variance maximizing data point distribution failed to distinctly cluster high and low yielding sites in the principle component space.

Conclusions.
Findings suggested that the underlying biological and chemical causes behind within-farm spatial-heterogeneity of soybean yields in Pennsylvania is complex. Further research is required to determine which biological and chemical properties are associated with pest and pathogens to determine the impact on yield.

Publications:

Ananda Bandara, Ryan Trexler, Dilooshi Weerasooriya, Terrence Bell, Paul Esker (Abstract) 2019. Association between soil and root microbiomes and within-farm-spatial-variation of soybean yields I: The bacterial perspective. APS Annual Meeting 2019, Cleveland, OH.

Ananda Bandara, Ryan Trexler, Dilooshi Weerasooriya, Terrence Bell, Paul Esker (Abstract) 2019. Association between soil and root microbiomes and within-farm-spatial-variation of soybean yields: II. The fungal perspective. APS Annual Meeting 2019, Cleveland, OH.

Ananda Bandara, Dilooshi Weerasooriya, Brandon Wilt, Alyssa Collins, Paul Esker (Abstract) 2019. Relationship between soil fungal densities and soil chemical properties in Pennsylvania. APS Annual Meeting 2019, Cleveland, OH.

Ananda Bandara, Dilooshi Weerasooriya, Brandon Wilt, Alyssa Collins, Del Voight, Paul Esker (Abstract) 2019. Effect of Apron Maxx seed treatment on soybean seedling diseases, seedling vigor, and yields in Pennsylvania. APS Annual Meeting 2019, Cleveland, OH.

Ananda Bandara, Dilooshi Weerasooriya, Adriana Murillo-Williams, Alyssa Collins, Paul Esker (Abstract) 2019. Association of selected biological and chemical properties of soil with within-farm-spatial-variation of soybean yields in Pennsylvania. APS Annual Meeting 2019, Cleveland, OH.

Brandon Wilt, Ananda Bandara, Dilooshi Weerasooriya, Paul Esker (Abstract) 2019. Impact of metalaxyl, ethaboxam, and mefenoxam on in-vitro growth rate of Pythium isolates from Pennsylvania. APS Annual Meeting 2019, Cleveland, OH.

Paul Esker, Ananda Bandara, and Dilooshi Weersooriya. 2019. Improving knowledge of soilborne pathogens in PA soybean production systems. Field Crop News: https://extension.psu.edu/improving-knowledge-of-soilborne-pathogens-in-pa-soybean-production-systems

Summaries from Several of the Summer Field Days.

Bradford County.

The Soybean Production Field Day in Bradford County involved a group of about a dozen farmers interested in growing soybeans. These producers included both novices to soybean production and those who have grown soybeans for many years. The growers had the opportunity to visit one of the On-Farm Soybean research plots and talk about the soybean research taking place across the state this year. Additionally, they learned about production basics and nuances from Penn State soybean experts and discussed production practices that suit their own operations. It was noted by many that the unseasonably wet weather this summer has certainly had an impact on disease management but has reduced some of the late season stress due to insect pressure. Soybean diseases were a hot topic of discussion. Examples of white mold, frogeye leaf spot, and insect damage were passed around the group for future identification ease. The group discussed the importance of integrated pest management and the timing of pest control sprays, especially in the management of tough broadleaf weeds like marestail. The host field served as a great example of the benefits of preserving predatory insects like lady beetles and soldier bugs. Throughout the workshop, Dr. Roth made his way through a late season "report card" and rated the field on plant population, weed control, pod development, and other factors that influence soybean yield. It is evident that soybean production will continue to gain traction in Bradford County based on the level of engagement found among participants at this field day.

Potter County.

The Soybean Field Day in Potter County drew new and seasoned soybean growers representing 8 operations in a 3-county area. We visited two fields, estimated yields, discussed the Soybean Sentinel Plot results including pressure from white mold, some frog eye leaf spot and the effect of rain and lady beetles on the aphid population this year. Growers were interested in ideal plant population and how to build more soil rhizobia including planting beans on beans. There was significant discussion on when soybeans typically stop flowering, and with good pod development this year, would the beans at the uppermost nodes properly fill or abort. The lowest node with beans seems to be higher off the ground this year, so we were hopeful their won't be much yield loss. Practices, such as rolling the field were discussed as a method to even the field for the combine later in the season. Deer and groundhogs were of concern particularly fields, with wooded borders. This year could potentially be the first year we will see widespread whitemold issues in Potter, so some discussion such as identification and proper treatments. Also, resistant marestail is a new weed to North Central Pennsylvania, so farmers were in need of spray programs to combat that. We discussed that markets are a few hours or more from the North Central, so many growers are selling direct to dairy farms to be roasted on farm.

Extension Winter Workshop Summary.

Three winter workshops were held in Bucks, Centre, and Mercer Counties. The workshop scheduled for Mercer County was cancelled due to low registration and will instead be integrated into a 2019 summer workshop/walking tour.

Results:

Bucks: 15 responses to survey.
Centre: 10 responses to survey.
Dauphin: 12 responses to survey.

44% of responses indicated that they had between 50 and 200 acres, 21% over 500 acres, and 35% indicated this was "not applicable" in their situation.

94% of respondents said that they learned a "moderate" to "a lot" of knowledge by attending the workshop.

74% of respondents indicated they were "moderately" to "extremely" like to adopt two practices as a result of the workshop (16% said this was not applicable in their situation).

74% of respondents indicated that they were likely change or adopt a new practice this (2019) growing season (10% indicated that this was not applicable in their situation).

Overall, this continues a similar trend from previous years that the value of the workshops is substantial. As indicated below, comments provided by participants also provides evidence of the value for the workshops and the desire to continue to have these offerings.

Comments across the different sites (grouped by comments from specific sites):

"Very good information; Good workshop with a lot of useful/practical information with nice conversation between presenters and attendees. Well worth attending. Please keep the workshops going; Thank you; Great workshop and speakers. Good content. Very practical topics and discussions; Great informative program; Great. Del Voight and Dwight very useful info for my bean crop. Excellent program; So much to cover, make it a longer day; These workshops are a great idea; Good meeting; Good workshop, thanks; Good sessions, appreciate information on planting rates, population and row spacing. Would like some information on cover crops and crop diversity, impacts in the different aspects of soybean production; Very well put together, lots of useful information; Very well done and presented. Gave me a couple of good ideas and some new techniques to work with; I teach people who will use these practices, but don't farm myself; Lots of data to review; Good meeting. Lots of information

presented; Very informative and well organized; Very good information; Good information, wish more growers would attend; Very good knowledge and information. Need to advertise more for better attendance; Well done workshop."

"Excellent program; So much to cover, make it a longer day; These workshops are a great idea; Good meeting; Good workshop. Thanks; Good sessions, appreciate information on planting rates population and now spacing. Would like some information on cover crops and crop diversity, impacts in the different aspects of soybean productions."

"Very well put together, lots of useful information; Very well done and presented. Gave me a couple of good ideas and some new techniques to work with; I teach people who will use these practices, but don't farm myself; Lots of data to review; Good meeting, lots of information presented; very informative and well organized; very good information; Good information. Wish more growers would attend"

Seed Treatment Trial – 2018

Field Information

Field code: 5ST
Location/Farm: Butler
Variety: Channel
Replications: 4

County: Tioga
Trial Type: Seed Treatment
Planting Date: 6/6/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Since the field was not harvested, yield components from 5 plants were recorded at maturity.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	40.8	44.9	Not Significant
Taproot length (cm)	21.9	21.9	Not Significant
Root weight (g/plant)	18.7	16.7	Not Significant
Shoot weight (g/plant)	80.2	69.9	Not Significant
Initial plant stand (per 1 meter)	13	11.9	Not Significant
Final plant stand (per 1 meter)	9	7.8	Not Significant
Greenseeker V1	0.57	0.57	Not Significant
Greenseeker R1	0.85	0.86	Not Significant
Greenseeker R6	0.84	0.85	Not Significant
Test Weight (lbs)	49.1	49.8	Not Significant
No. of pods per plant	40.9	42.1	Not Significant
No. of seeds per pod	2.5	2.4	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.6	6.8	6.9
Phosphorus (P) (ppm)	77	112	81
Potassium (K) (ppm)	88	88	93
Magnesium (Mg) (ppm)	165	171	182
Calcium (ppm)	1425	1659	1767
Acidity (meq/100 g)	2	0	0
CEC (meq/100 g)	10.7	9.9	10.6
Organic Matter %	2.3	2.4	2.1
Zinc (ppm)	1.1	1.5	1.4
Copper (ppm)	2.2	2.5	2.6
Sulfur (ppm)	17.8	8.5	10.8
% Saturation of the CEC for:			
K	2.1	2.3	2.3
Mg	12.8	14.3	14.3
Ca	66.4	83.4	83.4

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	50	25	66
Stunt	40	0	66
Spiral	0	0	266
Stubby root	0	0	0
Dagger	0	0	0
Ring	0	0	0
Lance	40	87	100
Pin	0	0	0
Action Code	A	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+

Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Seed Treatment Trial - 2018

Field Information

Field code: 6ST
Location/Farm: Ahern
Variety: Channel
Replications: 6
County: Bradford
Trial Type: Seed Treatment
Planting Date: 5/23/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield and test weight were recorded at harvest.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	21.6	21.3	Not Significant
Taproot length (cm)	19.1	18.6	Not Significant
Root weight (g/plant)	15.7	14.3	Not Significant
Shoot weight (g/plant)	35.5	37.7	Not Significant
Initial plant stand (per 1 meter)	21	22.9	Not Significant
Final plant stand (per 1 meter)	19	20.2	Not Significant
Greenseeker V1	0.66	0.65	Not Significant
Greenseeker R1	0.59	0.59	Not Significant
Greenseeker R6	0.86	0.85	Not Significant
Test Weight (lbs)	50.7	51	Not Significant
Yield (bu/ac)	54.6	53.3	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.9	6.4	6.4
Phosphorus (P) (ppm)	68	69	67

Potassium (K) (ppm)	163	97	96
Magnesium (Mg) (ppm)	116	104	112
Calcium (ppm)	1247	1170	1331
Acidity (meq/100 g)	0	2.2	2.2
CEC (meq/100 g)	7.6	9.2	10
Organic Matter %	2.3	2.1	2.1
Zinc (ppm)	2.4	2.4	2.6
Copper (ppm)	3.1	2.9	3
Sulfur (ppm)	7.9	7.9	8
% Saturation of the CEC for:			
K	5.5	2.7	2.5
Mg	12.7	9.5	9.3
Ca	81.8	63.8	66.3

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	140	290	750
Stunt	80	200	280
Spiral	40	80	240
Stubby root	0	0	0
Dagger	0	20	10
Ring	0	0	0
Lance	10	10	0
Pin	0	0	0
Action Code	D	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+

Damage Threshold	
	Low
	Moderate
	High

Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Seed Treatment Trial - 2018

Field Information

Field code: 8ST
Location/Farm: Huntsburger
Variety: 36T36X
Replications: 6
County: Somerset
Trial Type: Seed Treatment
Planting Date: 6/18/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield and test weight were recorded at harvest.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	19.0	17.8	Not Significant
Taproot length (cm)	17.7	17.3	Not Significant
Root weight (g/plant)	9.3	9.7	Not Significant
Shoot weight (g/plant)	23	22.2	Not Significant
Initial plant stand (per 1 meter)	No Data	No Data	NA
Final plant stand (per 1 meter)	22	23.6	Not Significant
Greenseeker V1	No Data	No Data	NA
Greenseeker R1	0.59	0.71	Not Significant
Greenseeker R6	0.85	0.86	Not Significant
Test Weight (lbs)	55.1	55.4	Not Significant
Yield (bu/ac)	44.2	48.6	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.8	7	7
Phosphorus (P) (ppm)	33	43	46

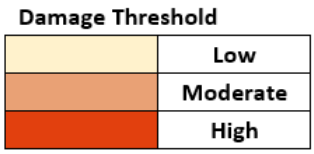
Potassium (K) (ppm)	151	189	200
Magnesium (Mg) (ppm)	274	398	344
Calcium (ppm)	2564	2042	1807
Acidity (meq/100 g)	0	0	0
CEC (meq/100 g)	15.5	14	12.4
Organic Matter %	3.4	4.0	3.7
Zinc (ppm)	3.2	3.4	4
Copper (ppm)	16.2	13.1	137
Sulfur (ppm)	16.2	13.3	11.5
% Saturation of the CEC for:			
K	2.5	3.5	4.1
Mg	14.7	23.7	23.1
Ca	82.8	72.9	72.8

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	0	30	0
Stunt	0	0	0
Spiral	120	1040	360
Stubby root	0	0	0
Dagger	0	0	0
Ring	0	0	0
Lance	10	0	0
Pin	0	0	0
Action Code	A	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+



Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Lesion nematode is the only concern in this field. It can cause damage to soybean.

Seed Treatment Trial - 2018

Field Information

Field code: 4ST
Location/Farm: Crownover
Variety: seedway beans
Replications: 4
County: Armstrong
Trial Type: Seed Treatment
Planting Date: 5/18/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield and test weight were recorded at harvest.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	30.4	29.8	Not Significant
Taproot length (cm)	16.7	15.7	Not Significant
Root weight (g/plant)	31	30	Not Significant
Shoot weight (g/plant)	111	103.9	Not Significant
Initial plant stand (per 1 meter)	12	13.2	Not Significant
Final plant stand (per 1 meter)	8	8.9	Not Significant
Greenseeker V1	0.67	0.75	Not Significant
Greenseeker R1	0.77	0.79	Not Significant
Greenseeker R6	0.83	0.83	Not Significant
Test Weight (lbs)	47.8	48.3	Not Significant
Yield (bu/ac)	58.8	59.1	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.8	6.6	6.6
Phosphorus (P) (ppm)	65	80	75

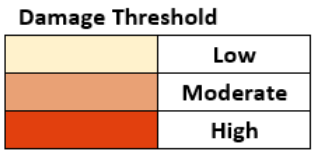
Potassium (K) (ppm)	148	254	211
Magnesium (Mg) (ppm)	108	171	169
Calcium (ppm)	1121	1252	1253
Acidity (meq/100 g)	0	2	2.2
CEC (meq/100 g)	6.9	10.3	10.4
Organic Matter %	2.3	3.27	3.6
Zinc (ppm)	2.2	3.3	3.4
Copper (ppm)	2.9	1.8	2.1
Sulfur (ppm)	6.9	10.7	11.4
% Saturation of the CEC for:			
K	5.5	6.3	5.2
Mg	13.1	13.8	13.5
Ca	81.4	60.6	60.2

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	37	50	130
Stunt	0	0	0
Spiral	100	40	200
Stubby root	0	0	0
Dagger	0	10	0
Ring	0	0	0
Lance	0	0	0
Pin	0	0	0
Action Code	A	A	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+



Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Seed Treatment Trial - 2018

Field Information

Field code: 2ST
Location/Farm: Rock springs
Variety: HS 24A60
Replications: 3
County: Centre
Trial Type: Seed Treatment
Planting Date: 5/15/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield and test weight were recorded at harvest.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	21.3	20.7	Not Significant
Taproot length (cm)	18.1	17.1	Not Significant
Root weight (g/plant)	13.2	14.4	Not Significant
Shoot weight (g/plant)	32.1	35	Not Significant
Initial plant stand (per 1 meter)	25	24.9	Not Significant
Final plant stand (per 1 meter)	24	22.7	Not Significant
Greenseeker V1	0.56	0.55	Not Significant
Greenseeker R1	0.85	0.81	Not Significant
Greenseeker R6	0.81	0.85	Not Significant
Test Weight (lbs)	55.8	56.2	Not Significant
Yield (bu/ac)	59.6	60.8	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.8	6.9	6.6
Phosphorus (P) (ppm)	114	139	104

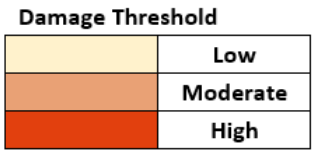
Potassium (K) (ppm)	153	192	139
Magnesium (Mg) (ppm)	54	65	57
Calcium (ppm)	1398	1966	1666
Acidity (meq/100 g)	0	0	2
CEC (meq/100 g)	7.8	10.9	11.2
Organic Matter %	4	3.8	3.3
Zinc (ppm)	3.7	4.2	3
Copper (ppm)	6.5	13.5	11.6
Sulfur (ppm)	9.0	9.8	11.2
% Saturation of the CEC for:			
K	5	4.5	3.2
Mg	5.7	5	4.3
Ca	89.2	90.5	74.6

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	80	120	370
Stunt	0	40	0
Spiral	440	1200	2120
Stubby root	0	0	0
Dagger	0	0	20
Ring	0	0	0
Lance	20	0	10
Pin	0	0	0
Action Code	A	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+



Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Seed Treatment Trial - 2018

Field Information

Field code: 7ST
Location/Farm: Miles
Variety: Channel
Replications: 4

County: McKean
Trial Type: Seed Treatment
Planting Date: 6/9/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Since the field was not harvested, yield components from 5 plants were recorded at maturity.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	29.93	30.4	Not Significant
Taproot length (cm)	22.4	20.8	Not Significant
Root weight (g/plant)	12.9	13.3	Not Significant
Shoot weight (g/plant)	65.3	63	Not Significant
Initial plant stand (per 1 meter)	8	8.1	Not Significant
Final plant stand (per 1 meter)	No Data	No Data	NA
Greenseeker V1	No Data	No Data	NA
Greenseeker R1	0.73	0.73	Not Significant
Greenseeker R6	No Data	No Data	NA
Test Weight (lbs)	52.2	50.7	Not Significant
No. of pods per plant	49.3	69.3	Significant
No. of seeds per pod	2.4	2.5	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA

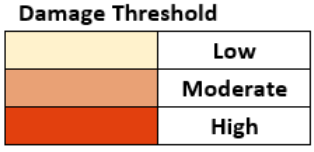
Soil pH	6	5.8	6.5
Phosphorus (P) (ppm)	27	20	18
Potassium (K) (ppm)	35	76	66
Magnesium (Mg) (ppm)	69	114	116
Calcium (ppm)	1408	2302	2284
Acidity (meq/100 g)	3.9	6.9	3.9
CEC (meq/100 g)	11.6	19.6	16.5
Organic Matter %	2.6	3.8	3.7
Zinc (ppm)	0.8	1.3	1
Copper (ppm)	1.8	2	2.1
Sulfur (ppm)	6.7	9.7	9.3
% Saturation of the CEC for:			
K	0.8	1	1
Mg	5	4.9	5.9
Ca	60.7	58.9	69.4

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	160	70	70
Stunt	40	0	0
Spiral	40	0	0
Stubby root	0	0	0
Dagger	10	20	0
Ring	0	0	0
Lance	20	0	0
Pin	0	0	0
Action Code	D	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+



Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Seed Treatment Trial - 2018

Field Information

Field code: 1ST
Location/Farm: Landisville
Variety: Pioneer 33T77
Replications: 6
County: Lancaster
Trial Type: Seed Treatment
Planting Date: 5/3/2018

Treatments

Apron Maxx RTA vs. Untreated Control

Procedures and measurements

- Destructive sampling measures (plant height, taproot length, root and shoot weight) were carried out using 15 plants per plot at R1 growth stage and,
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Using three, 1-meter long sections of each plot, initial and final plant stands were recorded 3 weeks after planting and at harvest, respectively.
- Yield and test weight were recorded at harvest.

Results

Parameter	Untreated control	Apron Maxx RTA	Statistical significance
Plant height (cm)	18.91	21.5	Not Significant
Taproot length (cm)	12.8	13.3	Not Significant
Root weight (g/plant)	12.2	14.1	Significant
Shoot weight (g/plant)	42.9	52.7	Not Significant
Initial plant stand (per 1 meter)	12	12.5	Not Significant
Final plant stand (per 1 meter)	9	9.9	Not Significant
Greenseeker V1	0.77	0.74	Not Significant
Greenseeker R1	0.38	0.35	Not Significant
Greenseeker R6	0.53	0.48	Not Significant
Test Weight (lbs)	56.3	56.7	Not Significant
Yield (bu/ac)	74.8	76	Not Significant

Soil nutrient profile

Parameter	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Soil pH	6.8	6.6	6.9
Phosphorus (P) (ppm)	59	61	55

Potassium (K) (ppm)	185	236	216
Magnesium (Mg) (ppm)	186	247	280
Calcium (ppm)	899	1041	1180
Acidity (meq/100 g)	2	2	0
CEC (meq/100 g)	8.5	9.9	8.8
Organic Matter %	2.7	2.8	3.4
Zinc (ppm)	3	2.9	3.1
Copper (ppm)	1.4	1.7	1.8
Sulfur (ppm)	6.6	7.3	6.8
% Saturation of the CEC for:			
K	5.6	6.1	6.3
Mg	18.2	20.9	26.5
Ca	52.8	52.8	67.2

Soil nematode profile

Nematode	Pre-plant	Post-harvest	
		Untreated control	Apron Maxx RTA
Lesion	50	25	137
Stunt	0	0	0
Spiral	160	1250	1950
Stubby root	0	0	0
Dagger	0	12	0
Ring	0	0	0
Lance	70	50	87
Pin	0	0	0
Action Code	A	A	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---

Damage Threshold	
	Low
	Moderate
	High

Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

- Apron Maxx RTA seed treatment did not show a significant effect on crop health as compared to the untreated control.
- Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 7M
County: Perry
Location/Farm: Elliotsburg
Planting Date: 05/09/2018
Trial-type: Intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.33	0.27
Greenseeker R1 stage	0.75	0.56
Greenseeker R6 stage	0.84	0.84
Yield (bu/ac)	45.4	38.8

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.7	6.9	6.5	6.6
Phosphorus (P) (ppm)	105	73	72	78
Potassium (K) (ppm)	202	200	135	209
Magnesium (Mg) (ppm)	194	164	282	203
Calcium (ppm)	1301	1508	1641	1671
Acidity (meq/100 g)	2	0	2	2
CEC (meq/100 g)	10.6	9.4	12.9	12.6
Organic Matter %	4.2	4	3.8	3.7
Zinc (ppm)	6.1	4.1	2.6	2.6
Copper (ppm)	3	2.2	1.8	1.8
Sulfur (ppm)	10	9.1	14.1	12.6
% Saturation of the CEC for:				
K	4.9	5.4	2.7	4.3
Mg	15	15	18.2	13.4

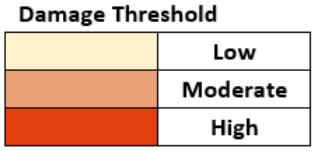
Ca	61.1	80	63.6	66.4

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	50	100	150	237
Stunt	0	0	0	50
Spiral	150	222	50	150
Stubby root	0	0	0	0
Dagger	0	0	0	12
Ring	0	0	0	0
Lance	0	33	0	0
Pin	0	0	0	0
Action Code	A	D	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+



Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments:

Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 31M
County: Dauphin
Location/Farm: Middletown
Planting Date: 6/15/2018
Trial-type: Intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.38	0.38
Greenseeker R1 stage	0.38	0.375
Greenseeker R6 stage	0.86	0.86
Yield (bu/ac)	No Data	No Data

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.5	6.4	6.3	6.7
Phosphorus (P) (ppm)	296	269	205	222
Potassium (K) (ppm)	206	170	78	116
Magnesium (Mg) (ppm)	138	188	140	178
Calcium (ppm)	1315	1636	1267	1630
Acidity (meq/100 g)	2.2	2	2.2	2
CEC (meq/100 g)	10.5	12.2	9.9	11.9
Organic Matter %	3	3.2	3.4	3.5
Zinc (ppm)	11.4	9.3	7.9	9.2
Copper (ppm)	4	2.1	3.8	2.5
Sulfur (ppm)	10.1	10.8	11.6	10.1

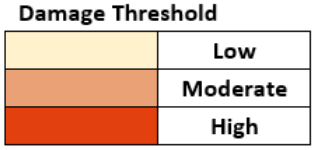
% Saturation of the CEC for:				
K	5.1	3.6	2	2.5
Mg	11	13	11.8	12.4
Ca	62.9	67.1	64	68.3

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	30	136	42	260
Stunt	0	0	0	0
Spiral	0	378	914	720
Stubby root	0	0	0	0
Dagger	0	0	14	10
Ring	0	0	0	0
Lance	0	73	0	70
Pin	0	0	0	0
Action Code	A	D	A	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+



Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 17M
County: Snyder
Location/Farm: Bowersox
Planting Date: 5/18/2018
Trial-type: Intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.24	0.24
Greenseeker R1 stage	0.75	0.74
Greenseeker R6 stage	0.84	0.83
Yield (bu/ac)	52	50

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	7.2	6.9	6.2	6.3
Phosphorus (P) (ppm)	97	106	62	61
Potassium (K) (ppm)	217	316	157	205
Magnesium (Mg) (ppm)	164	155	115	143
Calcium (ppm)	1622	1470	1131	1241
Acidity (meq/100 g)	0	0	2.2	2
CEC (meq/100 g)	10	9.5	9.2	9.9
Organic Matter %	3.4	3.9	3.4	3.6
Zinc (ppm)	14.6	27	9.6	12.8
Copper (ppm)	3.2	3.2	3.2	3.2
Sulfur (ppm)	13.2	12.9	11.2	11.5
% Saturation of the CEC for:				
K	5.5	8.6	4.4	5.3

Mg	14	14	10.4	12
Ca	80.8	77.8	61.4	62.5

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	90	137	150	210
Stunt	0	0	0	0
Spiral	0	50	0	0
Stubby root	0	0	0	0
Dagger	0	0	10	0
Ring	0	0	0	0
Lance	70	112	190	40
Pin	0	0	40	20
Action Code	A	D	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 23M
County: Centre
Location/Farm: Innovation Park
Planting Date: 6/6/2018
Trial-type: Intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Since the field was not harvested, yield components from 5 plants were recorded at maturity.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.35	0.31
Greenseeker R1 stage	0.80	0.81
Greenseeker R6 stage	0.89	0.88
No. of pods per plant	76	56.4
No. of seeds per pod	2.8	2.6

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	7.1	7.2	7.2	7.2
Phosphorus (P) (ppm)	57	43	75	31
Potassium (K) (ppm)	180	212	176	184
Magnesium (Mg) (ppm)	156	154	103	127
Calcium (ppm)	1704	1688	2352	1931
Acidity (meq/100 g)	0	0	0	0
CEC (meq/100 g)	10.3	10.3	13.1	11.2
Organic Matter %	4.3	4.1	4.7	3.9
Zinc (ppm)	3.8	3.6	4	2.88
Copper (ppm)	2.8	3.2	4.4	2.6
Sulfur (ppm)	9	8	12.5	10
% Saturation of the CEC for:				

K	4.5	5.3	3.5	4.2
Mg	13	13	6.6	9.5
Ca	82.9	82.2	90	86.3

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	30	110	260	230
Stunt	0	40	0	0
Spiral	0	80	160	0
Stubby root	0	0	0	0
Dagger	10	60	20	20
Ring	0	0	0	0
Lance	0	40	0	0
Pin	0	0	0	0
Action Code	A	D	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 13M
County: Lebanon
Location/Farm: Krall
Planting Date: 4/23/2018
Trial-type: Intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Yield was recorded at harvest

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.24	0.23
Greenseeker R1 stage	0.56	0.42
Greenseeker R6 stage	No Data	No Data
Yield (bu/ac)	80	76

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.2	6.5	7.2	6.7
Phosphorus (P) (ppm)	131	149	171	149
Potassium (K) (ppm)	299	231	285	228
Magnesium (Mg) (ppm)	180	264	194	145
Calcium (ppm)	1535	2235	2035	1697
Acidity (meq/100 g)	4.5	2.2	0	2
CEC (meq/100 g)	14.4	16.2	12.5	12.3
Organic Matter %	4.2	3.5	3.8	3.5
Zinc (ppm)	7.4	8.3	11.6	9.9
Copper (ppm)	4.4	4.2	7.2	4.7
Sulfur (ppm)	11.4	9.1	9.2	9.4
% Saturation of the CEC for:				
K	5.3	3.7	5.8	4.8

Mg	10	14	12.9	9.8
Ca	53.1	69.1	81.3	69.1

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	0	83	0	10
Stunt	0	0	0	0
Spiral	600	1600	1550	2400
Stubby root	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Lance	0	16	0	0
Pin	0	0	0	0
Action Code	A	A	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion is the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 15M
County: Lebanon
Location/Farm: Grumbine
Planting Date: 5/1/2018
Trial-type: Intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1, R1, R6 and post-harvest stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess the crop heath.
- Yield was recorded at harvest

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.31	0.27
Greenseeker R1 stage	0.57	0.57
Greenseeker R6 stage	No Data	No Data
Yield (bu/ac)	95	87

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.7	5.9	6.2	6.2
Phosphorus (P) (ppm)	103	91	109	120
Potassium (K) (ppm)	403	397	351	311
Magnesium (Mg) (ppm)	201	130	181	153
Calcium (ppm)	1246	996	1283	1273
Acidity (meq/100 g)	2.8	3.9	3.4	3.9
CEC (meq/100 g)	11.7	11	12.2	12.3
Organic Matter %	3.7	4.1	4.96	4.46
Zinc (ppm)	6.5	5.4	8.9	7.8
Copper (ppm)	2	2	2.1	2
Sulfur (ppm)	10.3	13.3	15.8	17.3
% Saturation of the CEC for:				
K	8.8	9.3	7.4	6.5
Mg	14	9.9	12.3	10.3

Ca	53.1	45.4	52.5	51.6

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	525	316	70	90
Stunt	0	133	0	0
Spiral	1600	2600	880	560
Stubby root	0	0	0	0
Dagger	25	0	0	0
Ring	0	0	0	0
Lance	0	0	0	0
Pin	0	0	0	0
Action Code	D	D	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 19M
County: Butler
Location/Farm: Butler
Planting Date: 5/28/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.21	0.21
Greenseeker R1 stage	0.58	0.41
Greenseeker R6 stage	0.8	0.66
Yield (bu/ac)	70.5	65.4

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.5	5.9	6.3	6
Phosphorus (P) (ppm)	96	103	47	97
Potassium (K) (ppm)	193	205	151	197
Magnesium (Mg) (ppm)	226	156	223	137
Calcium (ppm)	1219	946	1264	712
Acidity (meq/100 g)	2.2	3.4	2.2	3.4
CEC (meq/100 g)	10.7	10	10.8	8.6
Organic Matter %	3.7	3.3	3.4	2.79
Zinc (ppm)	5.3	5.4	4	4.9
Copper (ppm)	2	1.5	1.8	2.6
Sulfur (ppm)	15.1	17.8	112	13
% Saturation of the CEC for:				
K	4.6	5.3	3.6	4.9

Mg	18	13	17.3	13.3
Ca	57.1	47.5	58.7	41.4

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	80	450	62	100
Stunt	120	0	0	0
Spiral	1040	600	600	360
Stubby root	0	0	12	0
Dagger	0	0	37	10
Ring	0	0	0	0
Lance	80	225	0	380
Pin	0	0	0	0
Action Code	A	D	A	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management

Yield Limiting Factor Trial - 2018

Field Information

Field code: 5M
County: Northumberland
Location/Farm: Crone
Planting Date: 5/3/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.26	0.25
Greenseeker R1 stage	No Data	No Data
Greenseeker R6 stage	0.37	0.35
Yield (bu/ac)	71	70

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.7	6.9	6.6	7
Phosphorus (P) (ppm)	176	193	174	153
Potassium (K) (ppm)	304	363	324	258
Magnesium (Mg) (ppm)	148	188	249	174
Calcium (ppm)	1150	1320	1805	1884
Acidity (meq/100 g)	2	0	2	0
CEC (meq/100 g)	9.8	901	13.9	11.5
Organic Matter %	4.7	4.2	4.7	4.54
Zinc (ppm)	11	11	12.5	9.3
Copper (ppm)	2.8	2.8	3.4	3.1
Sulfur (ppm)	11.5	11.7	14.2	12.5
% Saturation of the CEC for:				
K	8	10.2	6	5.7

Mg	13	17	14.9	12.6
Ca	58.9	72.5	64.8	81.7

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	150	230	350	450
Stunt	0	0	0	0
Spiral	0	0	0	0
Stubby root	0	10	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Lance	0	0	0	0
Pin	0	0	12	0
Action Code	D	D	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion is the major concern. See action codes for managemen

Yield Limiting Factor Trial - 2018

Field Information

Field code: 3M
County: Mercer
Location/Farm: Rob Glen
Planting Date: 5/8/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.24	0.24
Greenseeker R1 stage	0.86	0.75
Greenseeker R6 stage	0.69	0.63
Yield (bu/ac)	59	52

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.4	6.4	6.4	6.9
Phosphorus (P) (ppm)	46	37	26	29
Potassium (K) (ppm)	133	168	137	123
Magnesium (Mg) (ppm)	123	103	121	168
Calcium (ppm)	1290	1039	1212	1420
Acidity (meq/100 g)	2	2.8	2	0
CEC (meq/100 g)	9.8	9.3	9.4	8.8
Organic Matter %	2.5	2.7	2.46	3.1
Zinc (ppm)	2.2	1.6	2.3	2
Copper (ppm)	2.3	1.6	2.3	2.3
Sulfur (ppm)	8.1	8	8.6	8
% Saturation of the CEC for:				

K	3.5	4.6	3.7	3.6
Mg	10	9.2	10.7	15.9
Ca	65.7	56	64.3	80.5

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	0	16	0	12
Stunt	0	66	50	50
Spiral	133	66	800	600
Stubby root	0	0	0	0
Dagger	0	0	0	12
Ring	0	0	0	0
Lance	0	16	0	0
Pin	0	0	0	0
Action Code	A	A	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management

Yield Limiting Factor Trial - 2018

Field Information

Field code: 11M
County: Bucks
Location/Farm: Beer
Planting Date: 5/7/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.35	0.22
Greenseeker R1 stage	0.83	0.82
Greenseeker R6 stage	No Data	No Data
Yield (bu/ac)	73	60

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6	5.6	5.4	6.6
Phosphorus (P) (ppm)	58	68	48	55
Potassium (K) (ppm)	170	188	138	156
Magnesium (Mg) (ppm)	266	197	285	330
Calcium (ppm)	1083	773	852	1031
Acidity (meq/100 g)	3.9	4.5	5.7	2
CEC (meq/100 g)	12	10.5	12.7	10.3
Organic Matter %	3.7	3.6	3.7	3.4
Zinc (ppm)	6.5	5.3	5.3	5.6
Copper (ppm)	2.8	2.5	2.3	2.8
Sulfur (ppm)	15.1	16.9	13.2	12.9
% Saturation of the CEC for:				

K	3.6	4.6	2.8	3.9
Mg	19	16	18.7	26.7
Ca	45.2	36.9	33.6	50

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	200	33	80	412
Stunt	0	0	40	0
Spiral	200	266	1560	1650
Stubby root	0	0	0	0
Dagger	0	0	0	0
Ring	0	0	0	0
Lance	100	50	180	100
Pin	0	0	0	0
Action Code	D	A	A	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion is the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 1M
County: Lancaster
Location/Farm: Hershey
Planting Date: 5/3/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	No Data	No Data
Greenseeker R1 stage	0.86	0.84
Greenseeker R6 stage	No Data	No Data
Yield (bu/ac)	76	84

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.5	6.5	6.4	6
Phosphorus (P) (ppm)	137	218	154	210
Potassium (K) (ppm)	259	196	218	151
Magnesium (Mg) (ppm)	195	178	212	170
Calcium (ppm)	1051	1471	1194	1586
Acidity (meq/100 g)	2.2	2.8	2	4.5
CEC (meq/100 g)	9.7	12.1	10.3	14.2
Organic Matter %	2.7	3.8	2.6	2.96
Zinc (ppm)	11.3	14.8	9.1	10.8
Copper (ppm)	4.6	6.8	5	7.5
Sulfur (ppm)	7.2	12.7	9.1	13.1
% Saturation of the CEC for:				
K	6.8	4.1	5.4	2.7

Mg	17	12	17.2	10
Ca	53.9	60.6	58	55.7

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	100	93	12	20
Stunt	0	0	0	0
Spiral	1100	640	700	840
Stubby root	0	0	0	0
Dagger	12	13	0	0
Ring	0	0	0	0
Lance	225	0	62	0
Pin	0	0	0	0
Action Code	D	A	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 9M
County: Bedford
Location/Farm: Hernley
Planting Date: 5/3/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	No Data	No Data
Greenseeker R1 stage	0.78	0.71
Greenseeker R6 stage	0.88	0.84
Yield (bu/ac)	72	58.2

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	7.2	7.5	7	6.9
Phosphorus (P) (ppm)	44	331	36	197
Potassium (K) (ppm)	205	238	185	167
Magnesium (Mg) (ppm)	97	177	100	114
Calcium (ppm)	1341	2248	1825	2087
Acidity (meq/100 g)	0	0	0	0
CEC (meq/100 g)	8	13.3	10.4	11.8
Organic Matter %	3.1	7.1	3.4	5.6
Zinc (ppm)	3	9.1	2.9	4.9
Copper (ppm)	8.6	8.9	9.8	9.5
Sulfur (ppm)	8.6	16.3	9.8	13.2
% Saturation of the CEC for:				
K	6.5	4.6	4.5	3.6

Mg	10	11	8	8
Ca	83.4	84.3	87.5	88.3

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	66	55	140	610
Stunt	0	0	0	0
Spiral	0	44	40	80
Stubby root	0	0	0	0
Dagger	0	0	10	0
Ring	0	0	0	0
Lance	16	22	0	0
Pin	0	0	0	0
Action Code	A	A	D	D

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 33M
County: Cambria
Location/Farm: Hite
Planting Date: 5/26/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.26	0.22
Greenseeker R1 stage	0.35	0.27
Greenseeker R6 stage	0.86	0.75
Yield (bu/ac)	49.8	37.4

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.7	6.7	6.8	7
Phosphorus (P) (ppm)	62	48	74	46
Potassium (K) (ppm)	128	170	120	175
Magnesium (Mg) (ppm)	393	505	359	465
Calcium (ppm)	2074	2774	1446	1728
Acidity (meq/100 g)	2.2	2	0	0
CEC (meq/100 g)	16.2	20.5	10.5	13
Organic Matter %	3.1	4	3.2	4.1
Zinc (ppm)	1.7	2.3	1.5	1.6
Copper (ppm)	1.5	2.4	1.9	1.9
Sulfur (ppm)	9.7	28.4	8	10.9
% Saturation of the CEC for:				
K	2	2.11	2.9	3.5

Mg	20	21	28.4	29.9
Ca	64.1	67.6	68.7	66.6

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	70	40	100	10
Stunt	0	0	0	0
Spiral	40	0	0	40
Stubby root	10	0	0	0
Dagger	40	0	25	0
Ring	0	0	0	0
Lance	40	100	37	20
Pin	0	0	0	0
Action Code	A	A	D	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+

Damage Threshold

	Low
	Moderate
	High

Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.

Yield Limiting Factor Trial - 2018

Field Information

Field code: 21M
County: Tioga
Location/Farm: Martin
Planting Date: 5/1/2018
Trial-type: Non-intensive

Procedures and measurements

- Destructive sampling was carried out using 5 plants each (with intact rhizosphere) from high and low yielding areas separately at V1 and R8 stage to obtain soil and root samples for molecular work on pathogens.
- Greenseeker measurements were conducted at V1, R1 and R6 growth stages to assess crop heath.
- Yield was recorded at harvest.

Results

Parameter	High yielding area	Low yielding area
Greenseeker V1 stage	0.19	0.2
Greenseeker R1 stage	0.68	0.66
Greenseeker R6 stage	0.76	0.83
Yield (bu/ac)	67	64

Soil nutrient profile

Parameter	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Soil pH	6.1	6.5	6.5	6.2
Phosphorus (P) (ppm)	140	101	161	118
Potassium (K) (ppm)	209	205	198	209
Magnesium (Mg) (ppm)	110	161	141	190
Calcium (ppm)	1032	1480	1908	1854
Acidity (meq/100 g)	4.5	2.2	2.2	3.4
CEC (meq/100 g)	11.1	11.5	13.4	14.8
Organic Matter %	4.7	6	4.6	6.5
Zinc (ppm)	2.7	2.2	2.5	3
Copper (ppm)	1.3	1.2	1.9	1.6
Sulfur (ppm)	11.1	11.4	13.4	16.1
% Saturation of the CEC for:				

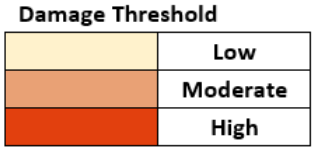
K	4.8	4.6	3.8	3.6
Mg	8.2	12	8.8	10.7
Ca	46.4	64.5	71.1	62.7

Soil nematode profile

Nematode	Pre-plant		Post-harvest	
	High yielding area	Low yielding area	High yielding area	Low yielding area
Lesion	270	100	0	0
Stunt	0	0	0	50
Spiral	0	133	40	100
Stubby root	0	0	10	0
Dagger	10	66	0	12
Ring	0	0	0	0
Lance	0	0	0	0
Pin	0	0	0	0
Action Code	D	D	A	A

Nematode damage thresholds for soybean

CROP HOST: Soybean	Nematodes per 500 cc soil		
Nematode	**Low**	**Moderate**	**High**
Root-knot*	0-40	50-160	170+
Soybean cyst - juveniles	0-10	20-50	60+
Soybean cyst - females	0	0	1+
Lesion	0-90	100-290	300+
Stunt	0-290	300-990	1000+
Spiral	0-990	1000+	---
Lance	0-290	300-490	500+
Ring	0-190	200-690	700+
Stubby root	0-80	90+	---
Sting	0	10	20+
Dagger	0-90	100-290	300+



Action Code(s) (if present)

A: No expected harm to crop production
B: Possible damage; consider chemical treatment
C: Chemical treatment recommended
D: Use of nematode-resistant variety recommended
E: Rotate with nonhost crop(s)

*Soybean is a host for both nothern root-knot (*M. hapla*) and southern root-knot nematode (*M. incognita*). --- = no threshold level for this category. **Source: Mehl. 2018. Nematode Management in Field Crops. Virginia Cooperative Extension, SPES-15NP**

Comments: Several plant parasitic nematode species were found, but lesion and dagger are the major concern. See action codes for management.