Maryland Soybean Board

Soybean Sampler

FY20 RESEARCH REPORT

Soy Checkoff Provides Strong Return on Farmer Investments

According to an independent economic study, the soy checkoff continues to translate farmer investments into significant benefits for U.S. soybean farmers, even in recent down-market times. The results of the 2019 return-on-investment (ROI) study, which is required by the U.S. Department of Agriculture, found that U.S. soybean farmers received $12.34 in added value for every dollar they invested in the soy checkoff.

"These have been some of the toughest years to be a soybean farmer," said USB Chair Jim Carroll. "We have to be wise and careful with our investments in this business, and I'm proud that our soy checkoff continuously adds value to our industry."

The ROI study analyzed the demand- and supply-enhancing activities funded by the soy checkoff between 2014 and 2018.

Key findings included:

U.S. soybean farmers received $12.34 in added value for every dollar they invested in the soy checkoff over the last five years.

Every dollar U.S. soybean farmers invested in international promotion activities produced $17.95 in return value.

Soy checkoff investments made toward demand-enhancing research and promotion returned an average value of $18.18.

Collaborative soy checkoff investments in production research that leverage industry and academic partners continue to provide promising returns to U.S. soybean farmers, returning an average value of $9.42.

"The study finds that USB's activities have had a positive and significant impact on soybean demand between 2014 and 2018," said Dr. Harry Kaiser, author of the study and leading research expert at Cornell University in agricultural economics and its application to commodity checkoff programs.

These estimates were reached using econometric models of domestic and international soybean markets that allowed the research team to net out the impacts of other important factors, such as other crops, substitute commodities, income, exchange rates and economic conditions in importing countries, to determine the estimated impact of the soy checkoff's work and investments.

Local Research Investments Focus on Yield and Soil Health

The Maryland Soybean Board awarded 17 research project grants in spring 2020 totaling an investment of $185,387 that best met research priorities to benefit Maryland soybean growers.

"The Board is entrusted with investing checkoff dollars in projects that will directly contribute to the success of our growers," stated Brian Johnson, MSB chair. "The grants were selected based on research priority, cost effectiveness and positive impact to farmers."

University of Delaware new research project:

- ✓ Efficacy of Seed Treatments to Manage Soilborne Pathogens of Soybean, Alyssa Koehler and Jake Jones, $5,878

University of Maryland new research projects:

- ✓ Aerial Application of Pesticides & Cover Crop Seeding Using Drones, Andrew Kness and Erika Crowl, $3,186
- ✓ Developing an interactive web app for calculating soybean crop budgets, Alan Leslie, Benjamin Beale and Shannon Dill, $8,067
- ✓ Evaluating Novel Herbicide Tolerant Traits in MD Soybean Systems, Benjamin Beale and Alan Leslie, $7,850
- ✓ Fertilizing Cover Crops - Do You Have to Put Some In to Get More Out? Ray Weil and Jim Lewis, $22,570
- ✓ Novel Resistance to Cercospora Leaf Blight & Purple Seed Stain of Soybean, Behnam Khatabi and Burt Bluhm, $14,700
- ✓ Strategies for Reduced Herbicide Input and Herbicide Resistant Weed Control in Soybean, Kurt Vollmer, $8,361

University of Maryland ongoing research, summaries in this issue:

- ✓ Effects of Planting Population on Yield in Full Season Soybeans, Kelly Nichols and Matt Morris, $5,635
- ✓ Evaluation of Growth-Promoting Products for Soybean Production in Maryland, Andrew Kness, $6,000
- ✓ Evaluation of Miravis Neo for Soybean Production in Maryland, Andrew Kness, $4,823
- ✓ Identification of New Sources of Resistance/Tolerance to Sclerotinia sclerotiorum among Soybean Germplasm Showing Resistance to Phytophthora sojae, Kathryne Everts and Benham Khatabi, $19,488
- ✓ Managing Herbicide Resistant Common Ragweed Emergence and Growth in Soybeans, Sarah Hirsh, $9,413
- ✓ Phosphorus Runoff from No-Till Soils: Do Cover Crops Make It Better or Worse? Ray Weil, $20,072
- ✓ Planting Green – Extend the Green to Get More from Cover Crops, Ray Weil, $23,208
- ✓ Reducing Deer Damage to Corn Using Forage Soybean as Biological Fencing, Jason Wight and Bo Zhang, $16,466
- ✓ State Soybean Variety Testing: Benchmark Varieties, Jason Wight, $2,250
- ✓ Study the Occurrence and Distribution of Virus Infecting Soybean from Delmarva, Behnam Khatabi, $7,420

Phosphorus Runoff from No-Till Soils: Do Cover Crops Make It Better or Worse?

✓*University of Maryland, $18,219, Ray Weil, rwell@umd.edu*

Water quality in the Chesapeake Bay is related to both nitrogen and phosphorus, but much less is known about the impacts of cover crops on phosphorus losses than on nitrogen losses. This research looks at how cover crops impact phosphorus losses. The main pathway for phosphorus transport from croplands to bodies of water is via surface runoff during intense rainstorms or heavy snow melt. A secondary pathway in areas of poorly drained sandy soils is leaching of phosphorus to drainage ditches. Cover crop mechanisms that cycle P and make soil P more soluble and plant–available may allow high productivity on Maryland farms with lower levels P fertilization. This could be part of a long-term strategy to make farming more sustainable both economically and environmentally.

The results of this year's research are best summarized by the data which show the cumulative amounts of runoff water, sediment loss and phosphate-P loss in runoff for all the samples analyzed to date. Between October 18, 2019 and February 24, 2020, an average of 12.8% to 30.2% of the rainfall was lost as runoff during eight runoff-generating events totaling 250 mm of precipitation. This is not counting several rain events that were too light to cause any runoff from any of the plots. Cumulative sediment losses from the first three events were very modest, ranging from 32 to 53 kg sediment per hectare. To put these values in perspective, since they were from only three storms over two months, these losses can be multiplied by 6 times to estimate annual rates of sediment loss between 192 and 315 kg/ha. These figures can be compared to the 2-4,000 kg/ha annual loss that is considered "tolerable" (T-value) for similar soils by the USDA/NRCS. The amount of dissolved phosphate-P lost in the runoff from the first five events over 4.5 months ranged from 8 to 36 grams of P per hectare (0.1 to 0.5 ounces/acre). Assuming a similar rate of P loss through the year, the annual loss of dissolved phosphate-P would range from 21 to 107 g P/ha.

While other forms of P (organic and sediment bound) in the runoff remain to be analyzed, these very low levels of dissolved phosphate-P loss in runoff from moderately high P fertility soils under no-till management with crop residue cover should be encouraging.

Quantifying the Incidence of Yield Reducing Soilborne Pathogens in Soybean Production

✓*University of Delaware, $5,423, Alyssa Koehler, akoehler@udel.edu*

Soilborne pathogens can reduce soybean yield and quality. Limited research has been conducted to quantify and characterize nematode populations or to identify problematic fungal species. This project sought to update knowledge on nematode distribution and molecularly identify soybean fungal pathogens to species for the first time in the region. Project objectives included: 1) Determine which nematode species are present in soybean acreage across Mid-Atlantic farms, 2) Survey farmers regarding field history of SCN damage and use of host resistance, and 3) Use molecular tools for species identification of soilborne fungi to inform future foliar and seed treatment fungicide efficacy research and improve variety selection.

Sixty field sites were surveyed for nematode soil samples and soilborne fungi. Results showed that over 60% of fields sampled had soybean cyst nematode (SCN), with 30% at population levels that warrant management. Other economically relevant nematodes included lesion, root knot, and lance.

Many growers are not aware of the loss of effectiveness in the PI88788 resistance gene for management of SCN. Spread of this knowledge will allow growers to stay informed as they select soybean seed and make management decisions. Three species of the fungus Diaporthe were isolated from stem and root tissue across 17% of fields, along with Macrophomina phaseolina, the causal agent of charcoal rot, isolated from 18% of fields. From this trial, a field was identified that will be used for soybean seed treatment efficacy trials in 2020.

Evaluation of Miravis Neo for Soybean Production

✓*University of Maryland, $4,869, Andrew Kness, akness@umd.edu*

Adepidyn is a new fungicide from Syngenta, marketed under Miravis Neo and Miravis Top for soybeans, and combines active ingredients from FRAC groups 3, 7 and 11. The product is touted for having superior management of foliar diseases of soybean, reduced risk of fungicide resistance, and plant health benefits to bump yields (mainly stay-green/green stem properties) even in the absence of disease. In this project, the effect of adepidyn on foliar fungal disease and yield on full-season soybeans in Maryland has been evaluated.

Based on this one year of research, Miravis has the potential to be an effective fungicide for full-season soybean production in Maryland. A single application of Miravis at R1 significantly increased yields at both trial locations; as did Priaxor, which was included as a benchmark for comparison. The Miravis Top label allows two applications of the fungicide; treatment at R1 and 14 A B D C six days after provided an even greater yield boost at Western Maryland Research and Education Center (WMREC) but not the Wye Research Center. This is likely due to the fact that there was more disease pressure at WMREC than the Wye, and plots were planted much earlier at WMREC than Wye. Interestingly, even at the Wye, which had little-to-no disease, the double Miravis treatment and the Priaxor treatment yielded significantly greater than the untreated control (P=0.0902). At WMREC, where there was good infection of frogeye leaf spot, all fungicide treatments significantly reduced disease severity and incidence. Regarding plant "greenness", which manufacturers often attribute to "plant health", no significant difference in normalized difference vegetative index (NDVI) at WMREC (P=0.7365) was observed; however, at the Wye location, plots treated with Miravis Top at R1 + 14 days after were greener for longer. A significant difference was seen in green stem ratings at both trial locations where all fungicide treatments led to an increase in percent green stem plants at harvest. These green stem plants can be potentially problematic to cut at harvest. Even though there was no significant difference in grain moisture between treatments, the data does suggest a weak but significant correlation (R2=0.15, P=0.0210) between green stem at maturity and grain moisture, where plots with greater green stem tended to have higher grain moisture. These green stem observations are consistent with other similar fungicide trials conducted on soybeans.

Extending the Growing Season to Get More Payback from Cover Crops

✓*University of Maryland, $19,287, Ray Weil, rwell@umd.edu*

Maryland has some of the highest proportions in the U.S. of cropland acres cover cropped. However, farmers enrolled in the state cover crop program typically plant cover crops after cash crop harvest, which research shows may be too late to effectively capture the large pool of soluble nitrogen (N) left deep in the soil or provide enough cover to adequately control overwinter erosion. Using aerial or ground-based interseeding into standing crops, choosing earlier-maturing corn and soybean cultivars, and other adjustments may allow earlier cover crop establishment. Delaying spring cover crop termination until optimal cash crop planting time could allow both timely cash crop planting and extended cover crop growth. Potential benefits of greater cover crop biomass growth include greater nutrient cycling, better weed-suppression, and more effective water-conservation in summer, in addition to increased soil organic matter and biological activity. Planting into living cover crops may save time, improve stands and gain extra weed suppression advantages.

This is particularly relevant to soybean production. First, soybeans tend to leave a large amount of soluble N in the profile at the end of the season, and soybeans tend to be harvested later than corn. These factors combine to make early cover crop establishment in fall especially important for soybean systems. Second, soybeans, unlike corn, do not tend to respond adversely to the early shading and N immobilization that may be associated with planting into certain living high-biomass cover crops after extended growth in spring. Soybeans therefore stand to benefit from water-conservation, nutrient-cycling (P, K, S, Ca, Zn, B) and compaction-alleviation effects of high springtime biomass cover crops.

Using replicated experiments on coastal plain soils at the research farm and collaborating commercial farms, dramatic increases were found in N capture and reductions in nitrate leaching in both winter and spring from planting cover crops just two weeks earlier in September. Biomass carbon added to soil and N fixed by legumes was four times greater with early May instead of early April termination. There was no drag on yields with either practice when using a multi-species cover crop that included a brassica, a legume, and a cereal.

This 3-species mixed cover crop in mid-July was no-till interseeded in mid-June into corn and soybeans. A no-till drill with clearance for 30 inch crop rows was used.

Overall, from three years (some 18 site-years) of experience, researchers concluded that flying seed onto a standing crop canopy in September is likely to be advantageous compared to drilling after harvest with regard to biomass fall production and nitrogen capture. However, stands tend to be less even and establishment is more variable with aerial seeding. In all cases, substantial suppression of weed biomass was observed with cover crops established.

Data collected is transforming the way researchers look at the nutrient capture/water quality function of winter cover crops. The new view of how cover crops impact leaching of nitrate during the winter focuses on activity during the fall when the cover crop can utilize the growing degree days remaining before winter to send roots deep into the profile and clean up most of the soluble nitrogen shown to be present in the soil towards the end of the summer cropping season. This leaves a relatively nitrate-free soil profile exposed to the leaching water that percolates down through the profile during the winter when precipitation greatly exceeds evapotranspiration. If the cover crops are planted a few weeks later in fall, often after summer crop harvest is completed, there may not be sufficient growing degree days remaining before the onset of winter dormancy to achieve this purpose. The result is that where cover crops are planted late the soil is full of soluble nitrate throughout the profile and that nitrate can leach away with the percolating water during the winter.

Effects of Planting Population on Yield in Full Season Soybeans

✓*University of Maryland, $1,840 , Kelly Nichols, kellyn@umd.edu, with Matt Morris*

The current soybean planting population recommendation for full season soybeans in Maryland is 140,000 plants per acre (ppa), based on research conducted in the early 2000s on initial Roundup Ready® varieties in minimum tillage systems. Today, farmers have switched to no-till soybean production and have access to the second generation of Roundup Ready® soybeans as well as many newer varieties. This research evaluated recommendation options using current management practices and products.

Soybean population plots were planted at 80, 100, 120, 140, and 160 thousand ppa on two farms in Frederick County. The Thurmont plots were planted on 30-inch spacing with three replications. The Tuscarora plots were drilled on 7.5-inch spacing with four replications. Initial population counts taken showed consistency with the germination percentage of the seed. At harvest, yield ranged from 61 to 70 bu/A. There were no significant differences in yield between any of the planting populations on either farm, indicating that lower populations did not adversely affect yield. Also, those lower planting populations would have resulted in reduced seed costs.

At Thurmont (Pioneer P37A69), the 100,000 planting population had the highest net per acre at $598.19, while the 140,000 and 160,000 populations had the lowest net, around $581/A. At Tuscarora (Hubner 38-27R2X), the 120,000 planting population had the highest net per acre at $560.13, while the 160,000 population had the lowest net at $515.76/A.

Stem diameter measurements were taken before harvest. At higher populations, stems tend to be thinner because plants are closer together and there is more competition between plants. At lower populations, plants can branch out, resulting in thicker stems. The Dectes stem borer (DSB) is a pest of soybeans; after the eggs hatch, the larvae bore into the stem and feed from the inside. Soybeans with thicker stems are theorized to be a more favorable environment for DSB larvae. The average stem diameters for the two fields shows the trend that as population increases, stem diameter decreases, indicating that higher populations with thinner stems may be less favorable for DSB larvae.

In summary, lower soybean populations may still result in optimum yield while reducing seed costs. For fields that have a history of DSB, a balance may need to be found between lowering planting population and creating a less suitable environment for Dectes.

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BATTLING BILLION-DOLLAR YIELD ROBBERS?

DON'T WORRY. WE'RE ON IT.

Deer damage, Dectes Stem Borer, Palmer Aamaranth, Soybean Cyst Nematodes, Sudden Death Syndrome, and many other yield-robbing diseases, weeds, pests and wildlife. Fortunately, your state soybean checkoff is on the job with research projects to develop effective traits and practices to get back as much of your yield as possible. **Visit soybeanresearchinfo.com to learn more.**

The Soybean Research & Information Network provides you with information to work smarter and more efficiently. **Visit soybeanresearchinfo.com and check out the hard work behind your hard work.**

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ADDITIONAL FUNDING WITH SOYBEAN CHECKOFF DOLLARS THROUGH THE UNITED SOYBEAN BOARD AND NORTH CENTRAL SOYBEAN RESEARCH PROGRAM

Managing Herbicide Resistant Common Ragweed Emergence and Growth in Soybeans

✓*University of Maryland, $9,323, Sarah Hirsh, shirsh@umd.edu*

Herbicide resistant common ragweed (Ambrosia artemisiifolia L.) continues to be a problematic weed in Maryland. Because 95% of common ragweed is expected to emerge by early May, delaying cover crop termination in the spring in order to increase biomass and competition with weeds to reduce ragweed emergence and growth was researched. As later emerging common ragweed escapes can be difficult to control post-soybean planting, effectiveness of applying residual herbicides, pre-soybean planting to reduce ragweed prevalence during the soybean growing season was evaluated.

Common ragweed samples from St. Mary's, Charles, Somerset, Worcester, and Wicomico counties were tested and found to be resistant to glyphosate (group 9) and cloransulam (Firstrate; group 2 "ALS Inhibitors") herbicides. Furthermore, three-way resistance to glyphosate, Firstrate, and fomesafen (Reflex, group 14 "PPO Inhibitors") was found for two samples from Dorchester county, MD and Kent county, DE. Because common ragweed populations can be resistant to glyphosate and other herbicides, pre-planting and residual herbicide control are particularly important.

Preliminary results show that the best actions against common ragweed are:

1. **Delay cover crop burn down**. In addition to providing other agronomic benefits, cover crops may provide competition with spring weeds, including ragweed, and reduce emergence and growth. When spring growing conditions are good, terminating a cover crop would leave an open window for weeds to proliferate.
2. **Plan to apply something other than, or in addition to, glyphosate at pre-planting burndown.** Research trials in 2019 indicated that a herbicide burndown of glyphosate plus Liberty at soybean planting effectively eliminated common ragweed. The addition of 2,4-D or Banvel is another glyphosate tank mix option, and paraquat or paraquat + metribuzin is another option for smaller ragweed plants.
3. **Apply a residual herbicide at soybean planting**. Research trials indicated that it was important to apply a residual herbicide at burndown to control post-planting common ragweed escapes. Applying the residual herbicide at soybean planting provided better common ragweed control than applying the residual herbicide at an earlier (April 4) burndown date. A second research trial comparing residual herbicide products found that Command, Linex, Dimetric, or combinations of Command + Dimetric, and Linex + Dimetric all reduced common ragweed prevalence in soybean.

Evaluation of Growth-Promoting Products for Soybean Production

✓*University of Maryland, $5,426, Andrew Kness, akness@umd.edu*

New products have come on the market touted as growth-promoting products intended to attain high-yielding soybeans. Many of these products contain plant growth regulators, hormones, humic acids, carbon, sugars, and/or fertilizer. Research has been completed with these products to assess their application and utility in Maryland's unique climate and growing conditions. Results showed that all treatments with Take Off treated seed significantly improved soybean emergence over untreated seed at the Western Maryland Research and Education Center trial location, but not the Wye Research Center. This is likely a function of the earlier planting date at WMREC. Cooler, wetter soils can inhibit germination; this data suggest that Take Off seed treatment may help soybeans germinate and emerge better in these conditions vs. warmer, drier soils at the Wye. A bivariate fit of yield by emergence did reveal a weak but significant positive correlation between emergence and yield, meaning higher yields were influenced by greater emergence. However, these differences in emergence were not significant enough to cause a significant difference in yield between any of the treatments at either location. NDVI and canopy height were used as indicators to estimate "plant health"; in which none of the treatments affected either metric. a b NS 8. Additional research is needed under these early field season conditions to confirm or refute this hypothesis.

Having a Bitter Bite? The Use of Cover Crop to Manage Slugs

✓*University of Delaware, $9,230, Ivan Hiltpold, hiltpold@udel.edu with Bill Cissel*

Cover crops are used to promote soil health and prevent erosion, though little is known about their potential for pest management. Slugs are a challenging pest of soybeans that are capable of causing significant stand and yield losses. Planting a cover crop that slugs prefer could favor the slugs and result in increased slug survival. Planting a cover crop that slugs dislike has the potential to reduce slug survivorship. This project explores slug feeding preferences to various cover crop species. Planting the right cover crop could then have the dual benefit of protecting soils and reducing slug injury on soybeans.

Preliminary data from laboratory trials suggest that slugs may not perform well on all cover crop species. Slugs (grey garden slug) were enclosed on five cover crop species and their mass gain measured. After only seven days on the plants, differences in mass gain were measured between the tested plants, with barley being the most sustainable cover crop for slugs whereas annual ryegrass was not supporting slug growth well.

Twelve species of cover crops were tested. Plants were grown in pots in a greenhouse for about four weeks, then transferred to the laboratory and infested with one slug each. Prior to the infestation, the slugs were starved for 24 hours and weighed to record its mass prior to the experiment. The cover crops were then covered with transparent plastic pot to prevent slugs from escaping while allowing for direct observations. Slugs were weighed weekly and their survival was monitored until the individual died.

The feeding trials demonstrated that certain family of cover crop species significantly negatively impacted the survival of slugs. It was expected that Brassicacae would be a less suitable host because of its high content in glucosinolates (highly effective chemical defensive compounds natural produced by the members of this family), but surprisingly slugs survived significantly shorter (max 28 days) on Fabacae than on Brassicacae and Poacea.

In addition to being a source of nitrogen for the cash crop, using cover crop species from the Fabaceae family can offer an ecological sound alternative to synthetic pesticides against mollusks and especially slugs.

Reducing Deer Damage Using Forage Soybean as Biological Fencing

✓*University of Maryland, $15,280, Jason Wight*

Deer damage has become a national, natural hazard to crop producers. It has been estimated that a total of $100 million loss on agricultural crops is caused by deer annually in the U.S. Mid-Atlantic farmers report fields cannot be used to grow soybean anymore because of recurring deer damage. Hunting, fencing and repellent are the three main management strategies to reduce deer damage; while using a combination of these methods may be the most efficient to reduce deer damage. However, the potential use of a protective biological fence may be a more cost-effective solution.

"Big Fellow" forage soybean was favored by deer in early testing of biological fencing.

Six large scale fields were planted using a partial perimeter of forage soybean vs. non-forage soybean. Four were planted in Delaware while three were planted in Maryland. Eagle Brand "Big Fellow" forage soybean was used.

Results in reducing deer damage for 2019 was lower than in 2018. To test higher deer pressure, the 2019 trials were placed in areas of known high deer populations. The forage fence beans were eaten at emergence and could not even begin to grow. Another possible factor in the difference was that all of the trials in 2019 were planted earlier then in 2018. Because of the disappointing results in 2019, a demonstration project on double crop beans using deer repellant is being explored to try to give the beans time to put on growth.

Maximizing Yield and Quality of Mid-Atlantic Soybean Production with Soil Sulfur Management

✓*University of Maryland, $20,866, Ray Weil, rwell@umd.edu*

Sulfur (S) is an essential macronutrient and a key component in the essential amino acids methionine and cysteine (METH+CYST) that are the building blocks of protein. The nutritional value of protein from soybeans, like that from most grain legumes, is limited by relatively low levels of METH+CYST. Sulfur deficiencies are becoming more widespread as soil reserves of S are depleted with removal in high yielding crops and much lower inadvertent S input. Sulfur deficiencies are most common on sandy soils that are low in organic matter and anion exchange capacity.

To compare two common sulfate sources of sulfur and determine whether sulfur fertilization could enhance the amino acid make-up of soybean protein, a series of eight field experiments were conducted. Soybean yield, seed S concentration, and seed S yield were measured on all plots to determine the effects of sulfur fertilization. In addition, selected samples were analyzed for contents of amino acids. Results of this experiment show that applied sulfur, on low available S soils, can produce significant yield increases (up to 35%) and stimulate dramatic increases (up to 90%) in the METH+CYST content the seed. This research demonstrated that managing sulfur fertility can indeed enhance the value of soybeans as a source of protein.

The exploration of sulfur soil test protocols was only partially successful. As with any nutrient, significant responses to sulfur application are expected only where the soil S availability is limiting to plant growth or function. Therefore, more work is needed to improve soil testing methods that can reliably identify S-responsive soils.

Identification of New Sources of Resistance/Tolerance to Sclerotinia sclerotiorum among Soybean Germplasm showing Resistance to Phytophthora sojae

✓*University of Maryland, $24,000, Kathryne Everts, keverts@umd.edu, with Benham Khatabi*

One of the most practical and reliable methods for controlling plant disease is to use disease-resistant varieties since crop rotation and chemical controls usually provide incomplete protection from this pathogen. However, only limited sources of natural tolerance have been reported showing moderate resistance against the Sclerotinia stem rot in soybeans. The goal of this research is to identify new sources of Sclerotinia stem rot resistance in soybean, and provide soybean-breeding programs germplasm that has Sclerotinia stem rot resistance.

Approximately 200 seeds of each of the requested germplasm lines were obtained from Virginia Tech, including several Phytophthora sojae resistant lines and several other elite cultivars used as controlled comparison lines for a total of 65 lines. Seeds were planted in the field at the University of Maryland's Lower Eastern Shore Research and Education Center and UMES research farm. The selected fields have a history of a moderate population of Rhizoctonia solani to allow evaluation of these lines for this soil-borne disease. Most of the cultivated seeds germinated well, and the field plots were successfully protected from deer damage with deterrent soap. The soybean cultivars were evaluated against natural infection including foliar and root disease. Pathogen isolation and identification from these trials is ongoing at the UMES plant pathology research laboratory. At the end of the growing season, the soybean susceptibility or resistance to pathogen infections under natural environments is recorded.

A parallel experiment is also being conducted in the greenhouse at University of Maryland College Park. The lines, growing in the research greenhouse, in controlled conditions, will be inoculated with S. sclerotiorum when they reach the appropriate growth stage. In addition, an extra 30 soybean accessions were requested from the USDA Soybean Germplasm Collection through the Germplasm Resources Information Network (GRIN) website. These lines will be used to score the lines against Sclerotinia sclorotiorum infections. Upon selection of the best soybean germplasm, it will be made available to other researchers and private companies for future soybean improvement. Seed of selected cultivars will be increased and available on request for five years.

Improving Detection of Dectes Stem Borer for Developing Spray Recommendations in Soybeans

✓University of Maryland, $16,895, Alan Leslie, aleslie@umd.edu, with Edwin Afful, Kelly Hamby, Cerruti Hooks, and Emily Zobel

Dectes stem borer (DSB) is a native species of beetle that causes damage to soybeans by feeding as a larva inside of stems, causing lodging to prevent harvest by combine. Chemical control is only feasible while adults are active in fields and before eggs are laid in soybean plants. Determining the peak period of DSB adult emergence allows better timing of insecticide sprays to target adult DSB populations.

After three years of studying DSB biology and behavior, results showed that spraying to reduce feeding pressure by DSB will not result in economic returns if lodging losses can be minimized by timely harvest. Yield loss from feeding alone averaged approximately 6%, and the highest recorded infestation rates were still less than 50% across entire fields. Given that adults emerge over a period of 5-6 weeks from overwintering sites where they are protected from insecticidal sprays, repeated insecticide application would be needed to provide adequate control, which not warranted for at best a 3% yield increase. Priority should be given to scouting fields during the growing season for infestation levels, and scheduling harvest of heavily infested fields first to prevent lodging losses. Sampling has shown that sweep net captures do not accurately predict infestation levels, so sampling larvae should be performed either in-season by splitting stems of living plants or between seasons by examining stubble from the previous crop.

DSB infested soybean stubble being planted in tilled ground to be covered with emergence cage to monitor emergence.

Anecdotal observations suggest that even a single season of rotation to other grain crops can dramatically reduce infestation levels during the following cropping season. For example, the field with the highest levels of infestation during the first year of study (~38%) reduced infestation levels to ~11% after a single year of rotation to corn. In 2019 sampling, the highest infestation rates were measured from fields that have been in continuous soybeans for decades. Corn and sorghum are non-hosts for DSB, which would force existing populations to move out of fields to find suitable hosts if those crops are planted in rotation. Multiple sources of plant stress are likely contributing to yield loss in continuous crop fields, including overall low fertility/yield potential, build-up of disease and other pest species, as well as the buildup of DSB populations. Maximum infestation levels measured in fields across Maryland's Eastern Shore (28-47%) are well below levels reported from other areas of the country (80-100%). Lodging losses from DSB infestation may be the most obvious symptoms in fields with multiple underlying problems. This hypothesis is supported by other anecdotal observations. Several fields were sampled with no history of major losses to lodging from DSB, and these fields often showed infestation levels comparable to fields where DSB was reported as a problem. Given these results, rotation and timely harvest of infested fields are more likely to reduce losses to DSB by suppressing populations in the long term and promoting soybean plant health than insecticide application.

Incidences, Densities, Races, and Virulence of Soybean Nematodes in Maryland

✓University of Maryland, $21,608, Nidhi Rawat, nidhirwt@umd.edu

More than 100 nematode species, comprising 50 genera, have been associated with soybeans. To effectively manage nematode populations, growers need information and best management practices on all major nematodes in their soybean fields. Surveys were conducted of soybean farms in Wicomico, Caroline, Dorchester and Worcester counties. It was found that Root-knots had the highest densities and frequencies in the fields. The major type of nematodes found were root knots, cysts, lesion, stunt and dagger in their respective order of densities. Other types of nematodes found were dagger, stubby-root, lance, needle and spiral. Project findings and recommendations are under development.

Evaluating Germination Patterns of Horseweed in the Mid-Atlantic Region

✓University of Maryland, $2,937, Matt Morris, mjmorris@umd.edu, with Mark Van Gessel, University of Delaware

Horseweed is a native species common to the Mid-Atlantic region It has been a problematic weed in no-till soybean production for years. In recent years, horseweed has become more of an issue due to its resistance to multiple herbicide sites of action. Resistance to glyphosate in glyphosate-tolerant soybeans was first confirmed in Delaware in 2000. Since then, horseweed biotypes resistant to paraquat and ALS-inhibiting herbicides have also been discovered in the Mid-Atlantic region. Horseweed infests fields where no spring tillage is used, including winter cereals, cover crops, forages and perennial fruit crops. Horseweed's resistance to multiple herbicides, competitiveness, and its extremely prolific seed production (200,000 seeds/ plant) makes it a tough-to-control weed. Currently, there are few post-emergence herbicide options for horseweed in soybeans.

While horseweed is classified as a winter annual species, seedlings will emerge in all but the winter months. Previous research at the University of Delaware found that the majority of the horseweed population was emerging in the fall, which guided control recommendations, however, an increase in spring emergence has been seen. This research is investigating the timing of horseweed germination across various sites in the Mid-Atlantic region. Two years of data on horseweed germination patterns has been collected. Plots were maintained over the 2018 and 2019 seasons at three locations and final horseweed population counts have been conducted. Data is undergoing statistical analysis.

Study the Occurrence and Distribution of Virus Infecting Soybean from Delmarva

✓University of Maryland, $15,000, Behnam Khatabi, bkhatabi@umes.edu

Research is underway to isolate and characterize soybean viruses from Delmarva region, evaluate soybean germplasm against virus isolates from Delmarva, and contribute to regional outreach activity to improve soybean virus management. The permit has been received to allow collection and work with soybean-infecting viruses isolates obtained within the contiguous soybean.

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Integrated Approaches to Manage Herbicide Resistance

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Twenty treatments were evaluated in the Palmer Amaranth Herbicide trials utilizing various pre-emergent and post-emergent chemistries and timing patterns at two locations. Both sites had a heavy infestation of glyphosate and ALS resistant Palmer Amaranth the preceding crop year. The Charles County site was planted with mid-4 maturity Asgrow Xtend soybeans and the St. Mary's site planted with mid-4 maturity Northrup King Xtend soybeans. At both sites a cover crop was terminated in mid-March with an application of 16 oz. 2,4-D and 32 oz. glyphosate. Immediately prior to planting, all vegetation was terminated with an application of Paraquat and plots monitored to ensure a clean field seed bed prior to soybean emergence. Both sites exhibited excellent emergence and early growth, with heavy Palmer pressure across six blocks and medium pressure across the remaining two.

2019 trials indicate significantly better control of Palmer Amaranth with the use of any residual product when compared to a non-treated control. Utilizing an effective pre-emergent residual product applied to clean fields in combination with a timely application of a post-emergent product provided 100% control in nearly all treatment regimens, regardless of post-emergent product utilized.

One exception was the use of 4oz Authority XL + 4oz Metribuzin pre followed by 3.5oz Anthem Maxx 24 days post-emergent, which resulted in a small number of escapes at one location. Pre-emergence products containing either sulfentrazone or flumioxazin in combination with either metribuzin, pyroxasulfone, or s-metolachlor provided excellent control for the first three weeks. When used in combination with either post-emergent product Xtendimax or Reflex, Palmer was effectively controlled. Delaying the post-emergent application from 24 to 40 days resulted in Palmer escapes in both locations. The treatments containing pre-sulfentrazone had higher numbers of Palmer present than the pre-flumioxazin treatments. The use of residual products provided a longer timeframe for the timely and thus effective application of post-emergent herbicides.

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