Delaware SOYBEAN BOARD

FISCAL YEAR 2021

RESEARCH REPORT

ADVANCING RESEARCH

Delaware Soybean Board Approves Research Funding to Increase Farmer Profitability

In fiscal year 2021, the Delaware Soybean Board (DSB) approved funding for six research projects that aim to improve yields and control weeds and pests affecting Delaware soybean farmers.

These grants, totaling $38,847, are funded through the soybean checkoff program, where farmers collectively invest in research, promotion, and consumer and industry information to benefit all soybean farmers.

"These projects will study genetic improvements and yield protection methods in order to provide farmers with the information they need to deal with the most immediate threats to their crops. The end result is to find the best production practices that will increase efficiency and bottom-lines."

CORY ATKINS, DSB CHAIR

New Projects for 2021

- **Cover Crop Selection and Termination Implications for Slugs**, David Owens and Joseph Deidesheimer, University of Delaware
- **Evaluation of Aggressiveness among Diaporthe Species isolated from Mid-Atlantic Soybeans**, Alyssa Koehler, University of Delaware
- **Getting the Most Out of Enlist Soybeans for Weed Control in Delaware**, Mark VanGessel, University of Delaware
- **Exchangeable Cation Uptake by Irrigated and Rainfed Soybeans**, Jarrod Miller, Amy Shober, and Jake Jones, University of Delaware
- **Soybean Yield Response to Planting Populations in Delaware**, Jarrod Miller, Corey Whaley, James Adkins, and Jake Jones, University of Delaware

SUMMARIES IN THIS ISSUE

Two Approaches for Palmer Amaranth Control: We Need Multiple Approaches

Mark VanGessel, University of Delaware
Photo Credit: Jake Jones, University of Delaware

Palmer amaranth is a recent problem species in the region and has become one of the "driver weeds", a species that needs control strategies targeted specifically for it.

Palmer amaranth can grow rapidly and outcompete soybeans. This project investigated the management of large Palmer amaranth including the impact on yield and weed seed production, and the utility of late-terminated cereal rye for reducing herbicide inputs.

Results of this project found that when treating large Palmer amaranth plants, a single herbicide application is unlikely to provide acceptable control or eliminate seed production.

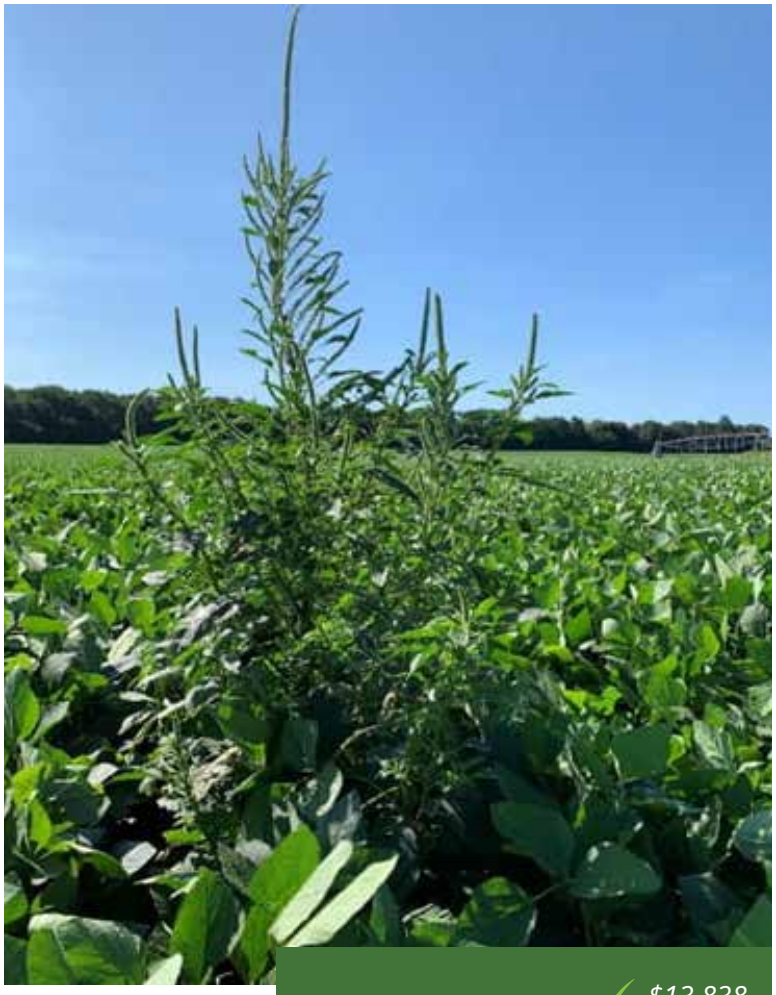
While two applications is not desirable, no one herbicide consistently provided excellent control and prevented seed production. Avoid the temptation to add additional products with the postemergence application, since they have not provided additional control.

Effective Palmer amaranth management should focus on timely postemergence applications while Palmer amaranth plants are small and most susceptible to herbicides. This timing is typically 3 to 4 weeks after soybean planting.

When using cereal rye to improve weed control, terminating as close to planting as possible often improves overall control.

While cereal rye can improve weed control, it often is not sufficient to provide season long control and should be used in combination with other effective weed management options, notably timely herbicide applications.

Effective Palmer amaranth management should focus on timely postemergence applications while Palmer amaranth plants are small and most susceptible to herbicides.



✓ *$13,838*

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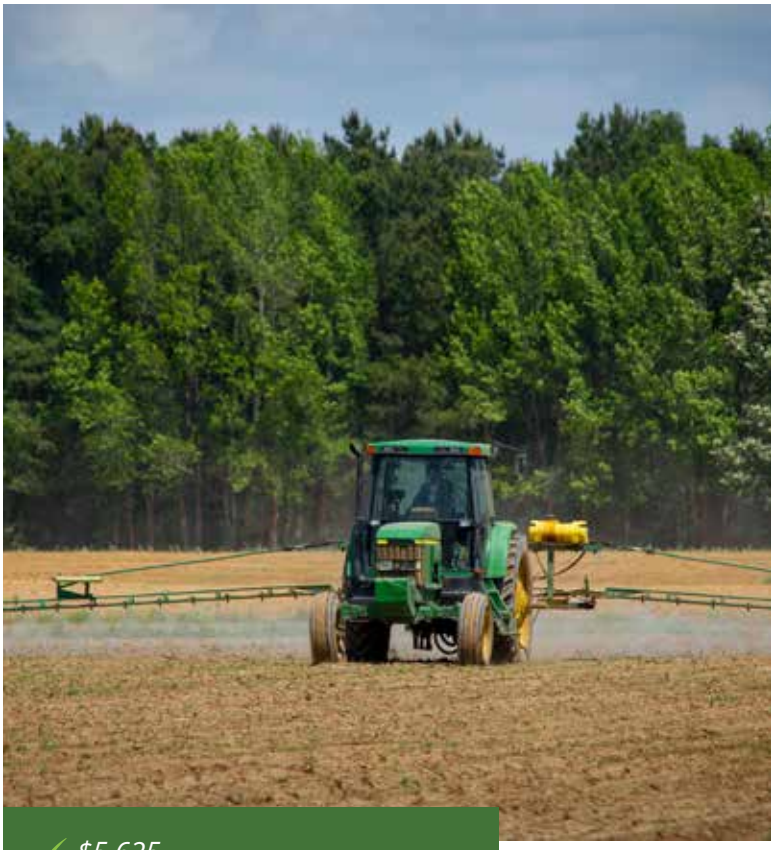
Potassium Sidedress on Soybeans

Jarrod Miller, University of Delaware
Stock Image: Mark Stebnicki, Pexels



✓ *$5,625*

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Split applications of K are not recommended in Delaware soils when optimal levels are present.

As an essential plant nutrient, potassium (K) is easier to manage when compared to nitrogen (N) or phosphorus (P). In the soil, K exists as a monovalent cation and is held on the soil cation exchange capacity (CEC).

Soils with finer textures and greater CEC can hold a larger amount of total K to supply crop production. Sandier soils with lower CEC will not retain the same amount of K, and while it may not leach from the soil, it could possibly move below the root zone.

Dr. Miller hypothesized in this project that split applications of K may improve soybean yields on sandy soils, similar to sidedressing N for corn. If applied during a more rapid uptake period for soybeans, the plant may have access to a greater portion of K fertilizer before it moves below the root zone. This has the potential to improve soybean yields, while also improving the efficient use of K fertilizer.

At the end of the growing season, he found that splitting K applications did not result in subsequent yield increases; however, there are some trends in K uptake with fertilizer applications. Post season soil K levels had a positive relationship with yield, so yield was higher as post-season K was higher.

This indicates that maintaining good soil K values can help maintain yield. However, losses of K were greater in treatments receiving fertilizers. These soils were at optimum levels, so that K recommendations are based on plant uptake. It is possible that split applications would perform better on low CEC soils with medium to low fertility index values.

At this time, he would not recommend split application of K in Delaware soils when optimal levels are present. It could also be considered to skip K applications all together.

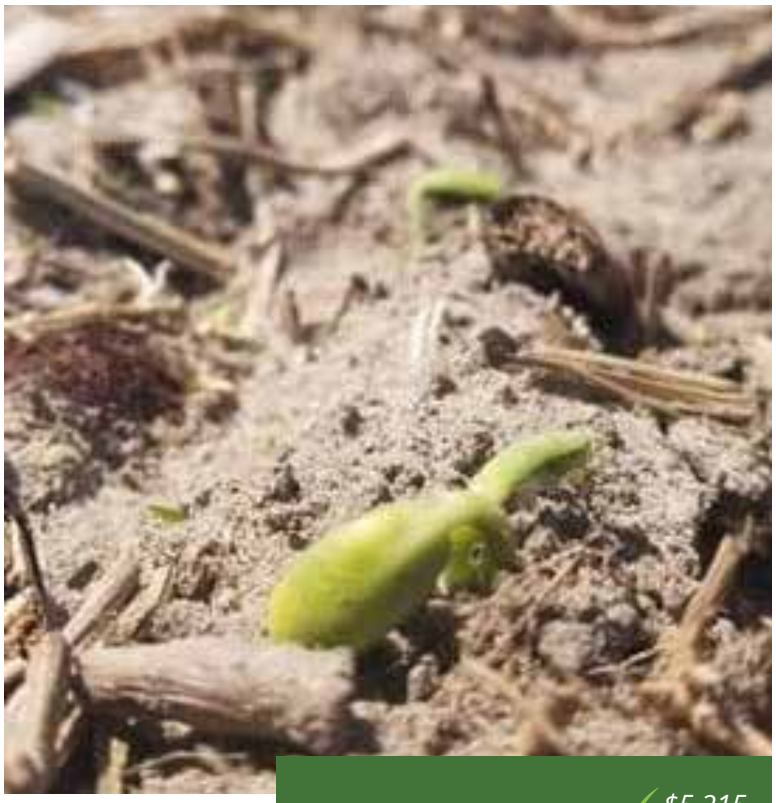
Evaluating Earlier Planting Dates for Increased Soybean Yields

Jarrod Miller, University of Delaware
Photo Credit: Jarrod Miller, University of Delaware

Drone imagery found differences in growth within all three planting dates. Early and Mid-May were similar for leaf area (NDVI) throughout the growing season, while the June planting was always behind.

The start of indeterminate soybean reproductive stages depends on the detection of the length of night. As nights become longer, soybeans are triggered to begin the reproductive or "R" stages of maturity. Due to this, later planted beans do not have as much time to develop biomass, or leafy growth. Additional photosynthesis from leaves and nodes for pod production can mean additional yield with more time to grow.

However, issues with earlier planting have occurred where cooler, wetter soils slow germination. This may cause seeds to rot in the ground. Additionally, sudden death syndrome (SDS) infects soybean roots of earlier planted varieties, but won't be noticed until later in the season.



This project aimed to evaluate full season soybean plats planted on three different dates (early, mid, and late) for deficiencies and disorders, and compare the tissue and soil contents to yield at the end of the season.

For the 2020 growing season, the earliest planting was the first week of May, which missed some of the cooler weather that may have caused disease or damage to growth. The drought conditions in the early summer may have also had an effect across all three plantings, although this field was irrigated. Regardless, there were no observable differences in yield by planting from early May to early June in 2020.

There were differences in nutrient uptake, with interesting patterns in macro and micronutrients based on planting timing. This had no effect on yield in this study, but does raise the question about nutrient uptake where there is low or excessive concentrations.

The optimum levels in this study may not have affected yield as they may in a field with wider variability in nutrient contents. That Al uptake, a toxic non-essential nutrient, dropped off in uptake with later plantings, is an interesting path to explore. It was obviously

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✓ *$5,215*

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✓ *$5,625*

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The strongest relationships in Delaware for soybean yield remain to be soil type and access to adequate moisture.

NUTRIENT MANAGEMENT

A Survey of Delaware Soybean Variety Tissue

Jarrod Miller, University of Delaware
Stock Image: United Soybean Board

Research in soybean fertility is difficult due to limitation in the number of variables that can be compared. Any study may uncover the relationship with one nutrient under that year's environmental conditions. A survey of soybean fields across different soils and seed varieties can reveal a different picture.

In this project, the University of Delaware soybean variety trials were sampled at two locations (Georgetown, Middletown) to observe soil and tissue nutrient levels at the R1 soybean stage. Yields were collected at the end of the season to be compared to tissue nutrient contents to observe statewide trends. Critical nutrient contents were also evaluated versus the yields of modern hybrids and whether any updates in values are necessary.

Strong relationships between maturity group and nutrient uptake were not observed in this study, but potential herbicide damage, drought, and other environmental conditions may have contaminated the study. Instead the strongest relationships in Delaware for soybean yield remain to be soil type and access to adequate moisture. Soil nutrient concentrations varied by site, which is not unusual considering variation in management and natural soil variability.

However, there were some interesting relationships for nutrient uptake and sufficiency ranges. The only nutrient that did not meet the sufficiency range was leaf concentrations of Ca. When compared to yield, higher Ca levels had a weak, but significantly negative relationship with yield. Whether this means Ca sufficiency levels are high, or nutrient imbalances needed corrected is not known. A more confusing observation is that Middletown had the lowest Mg, Cu, and Fe in the soil, but the highest in the whole plant tissue. Middletown also had the lowest P concentration, but a higher leaf P, but lowest whole plant P concentration.

Some of the strongest correlations to yield included Mg, S, and Cu, which all increased in the plant with higher yield.

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PLANT DISEASE

Continued Survey and Characterization of Fungal Pathogens in Mid-Atlantic Soybean Production

Alyssa Koehler, University of Delaware

Photo Credit: Alyssa Koehler, University of Delaware

Fungal pathogens can be very damaging to soybean production reducing both yield and quality. Environmental conditions can increase disease severity and favor the spread of certain pathogens. In the Mid-Atlantic, we continue to observe extreme weather events and periods of prolonged rainfall that can lead to widespread fungal infection and reduced seed quality.

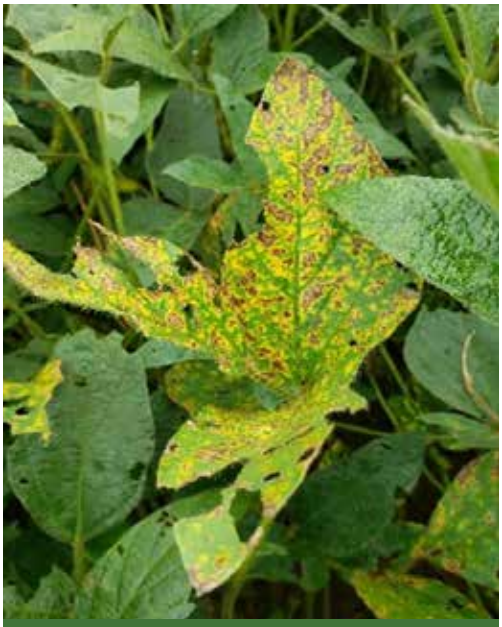
A survey was established in 2019 to document which soilborne pathogens are most commonly observed across the region. This research identified numerous fields with Charcoal rot caused by Macrophomina phaseolina and fields with various diseases caused by the Phomopsis/Diaporthe complex.

This project continued efforts from the 2019 survey by targeting Mid-Atlantic soybean farms with history of disease based on surveys and correspondence facilitated by the 2019 research. Certain fungal species can be difficult to separate by morphology alone and molecular tools offer a way to confirm proper identification.

Knowing the correct identity of a pathogen is important for management recommendations regarding variety selection or fungicide program. Pathogens isolated from this project were analyzed using molecular techniques to increase understanding of soilborne fungal pathogen distribution across Delaware fields.

In 2020, twenty-eight field sites were surveyed. Diaporthe longicolla was the dominant pathogen identified in 2020. From this trial, an isolate collection was established that will be used in greenhouse and field screening trials in 2021.

Knowing the correct identity of a pathogen is important for management recommendations regarding variety selection or fungicide program.



✓ *$7,895*

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Planting Dates Continued

not high enough in the earlier planting to effect yield though.

Drone imagery found differences in growth within all three planting dates. Early and Mid-May were similar for leaf area (NDVI) throughout the growing season, while the June planting was always behind. In a year with freeze damage or drought in May, we may see a separation in early and mid-May plantings. This supports multiple years to study a question on soybean growth and improving yields. Plant heights had similar patterns, but the mid-May plantings were higher in August, which may be important, or an artifact of the 2020 study. Future replications of this study across the mid-Atlantic will improve our understanding of planting timing, soybean growth, and nutrient uptake.

✓ *$7,186*

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It has been suggested in the literature that recently hatched juvenile slugs are the most injurious to the crop and if a bait were applied when eggs hatch, slug populations can be controlled satisfactorily.

Can Slug Egg Hatch be Predicted?

David Owens, University of Delaware
Photo Credit: David Owens, University of Delaware

Slug damage to germinating field crops is a significant problem of no-till or conservation-till fields in the Mid-Atlantic. Cover crops also provide a favorable microclimate. All of these management practices are being widely adopted and encouraged by farmers and various agencies for their agronomic, nutrient management, and soil management benefits.

Slug damage is difficult to predict. Sampling can be difficult because they hide during the day in soil cracks. Rescue treatments are expensive ($20 – 30/acre) and sometimes not satisfactory, and, in soybean, the field will often require replanting by the time a problem is noticed.

It has been suggested in the literature that recently hatched juvenile slugs are the most injurious to the crop and if a bait were applied when eggs hatch, slug populations can be controlled satisfactorily. If weather conditions are forecast that would favor slugs at time when eggs were expected to hatch, planting timing could be changed to lessen slug risk to the crop.

The winter of 2020-2021 was colder than the previous year. In many of the sampled fields, grey garden slugs that were present in the Fall had much reduced populations in the spring.

One exception was a field near Lewes, DE with extremely high slug counts. The farmer elected to plant soybean at the end of May after a prolonged dry spell and very warm soil; the soybean exhibited very little slug feeding. Another field site with a large number of marsh slugs was worked with a land awl, reducing slug feeding to the crop.

Once again, all life stages of marsh slugs were active during most of the sampling period. Dry weather in May also likely contributed to low slug populations in most of the sampled fields. Gray garden slug activity was much lower even in fields with historically high populations. In only 1 field were hatchlings observed on March 30.

Temperature data has not yet been correlated with slug activity as this research is still ongoing.

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Variety Tissue Continued

These three nutrients were also correlated to each other by plant tissue concentrations. Higher potassium in leaf samples was actually related to lower yield though, which may indicate some kind of stress or competitive uptake with Mg or Ca.

Sodium tissue levels were similar to the 2019 statewide survey, which was also the only plant nutrient which correlated to yield. In 2019 we assumed this to be a corollary to irrigation, with higher plant levels related to irrigation water salt concentrations. In the 2020 variety trial study, Na had a negative correlation to yield as well as Mg, S, and Cu. As a monovalent cation, it would also be expected that Na would have a negative relationship with K uptake, but this was not the case. With tissue levels similar to 2019, it can be assumed that Na uptake was either in competition with other nutrients, or the result of some kind of environmental stressor. As this study was not controlling for any nutrient or variable, that cannot be known.

This study leads us to conclude that Mg uptake, and its relationship to soil and nutrient characteristics, needs further study for soybeans in Delaware. Whether it is important for increasing yields or is a corollary to other abiotic controls on soybean growth warrants further investigation.