College of Agriculture, Food and Environment

2022 Soybean Science Research Report

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2022 Soybean Science Research Report

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SUNFLOWERS MAY HAVE A POSITIVE IMPACT ON SOYBEANS: THE INTERACTION OF COCKLEBUR WEEVIL WITH DECTES STEM BORER

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OBJECTIVE

The soybean stem borer *Dectes texanus* (Coleoptera: Cerambycidae) is a native long horned beetle that feeds on soybeans (Fig. 1A). This species can cause losses to soybean production across North America. The feeding larvae debilitate the plant causing lodging. Previous works proposed the use of sunflower as a trap crop to reduce the attacks of Dectes (Michaud et al. 2007). However, this interaction can be disrupted if another insect arrives first to the host plant: the red cocklebur weevil (RCW) *Rhodobaenus quinquepunctatus* (Coleoptera: Curculionidae) (Fig. 1B). Here, we evaluated the feasibility of using sunflower as a trap crop in soybeans in KY considering the interac- tion with the RCW within the same host plant.

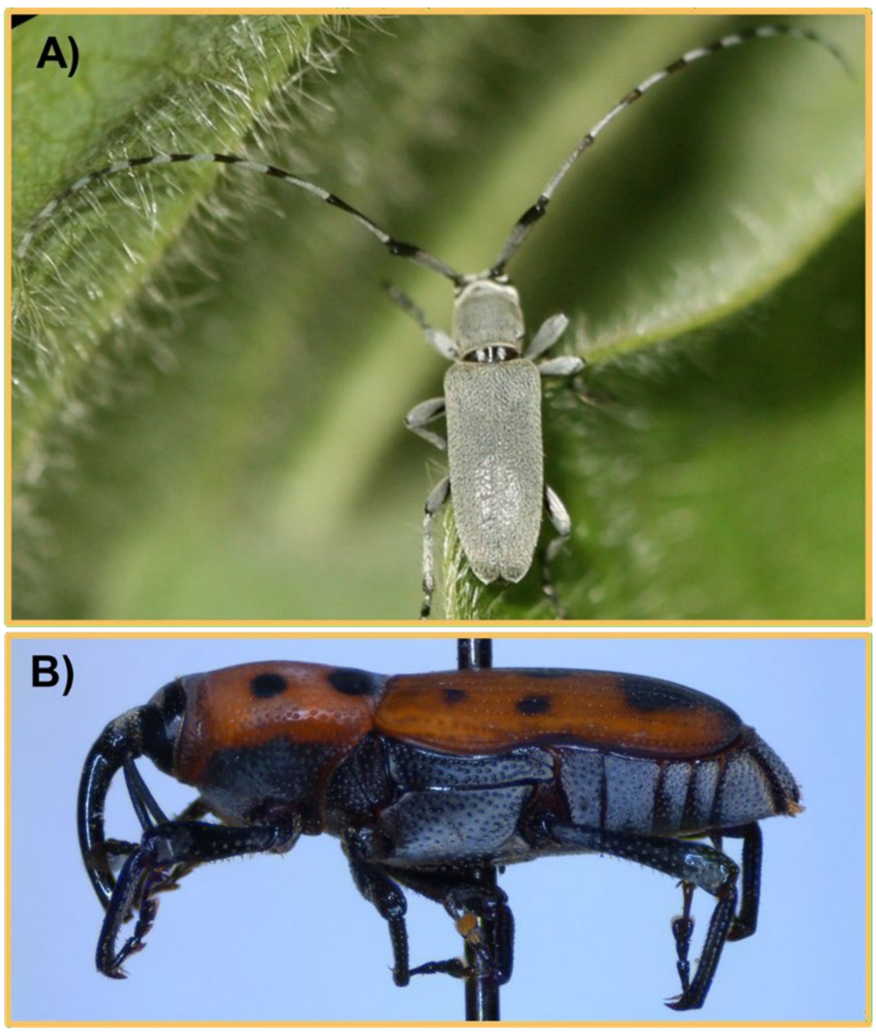

Figure 1. *Dectes texanus* **(A)** and *Rhodobaenus quinquepunctatus* **(B)**. Photos: A. Falcon-Brindis.

MATERIALS & METHODS

During two consecutive years (2021-2022), the attack incidence of *D. texanus* on soybean and sunflower was evaluated in Lyon County and Caldwell County, western Kentucky.

Sampling was conducted every 2 weeks from August to September. Ten plants were randomly removed from a sunflower plot, while soybeans were randomly chosen from rows at 0, 5, 10, 20, 50, 100 and 200 m away from the sunflowers. Both sunflower and soybean plants were taken to the laboratory for further inspection. Then the larvae of Dectes and RCW were recorded from each host plant (Fig. 2A-B).

Figure 2. Larva of *D. texanus* **(A)** in soybean a soybean stem and R. *quinquepunctatus* **(B)** in a sunflower stalk. Photos: A. Falcon-Brindis.

RESULTS AND DISCUSSION

Overall, the highest numbers of Dectes were found in soybean plants 0.5 and 10 m away from the sunflowers in 2021 and 2022, respectively (Fig. 3A-B). In 2021, the number of Dectes significantly decreased as the distance to sunflower increased, but in 2022, Dectes larvae were concentrated at one single distance. The lowest incidence of Dectes in soybean stalks was found 200 m away from the sunflowers. The highest proportion of soybean plants infested with Dectes were found at 10 and 20 m (Fig. 4A-B).

The red cocklebur weevil (RCW) was only found feeding on sunflower stalks (n=75). We observed the RCW larva colonized sunflowers earlier than Dectes, Dectes colonizes soybeans by early July to mid-August whereas, adult RCW were observed since mid-April. The RCW was found in larger proportions (80%) than Dectes on sunflower plants in 2021 and 2022. The galleries of RCW were found mainly in the lower half of the sunflowers. Pupation occurred at the root and then adults chewed their way out of the plants (Fig. 5).

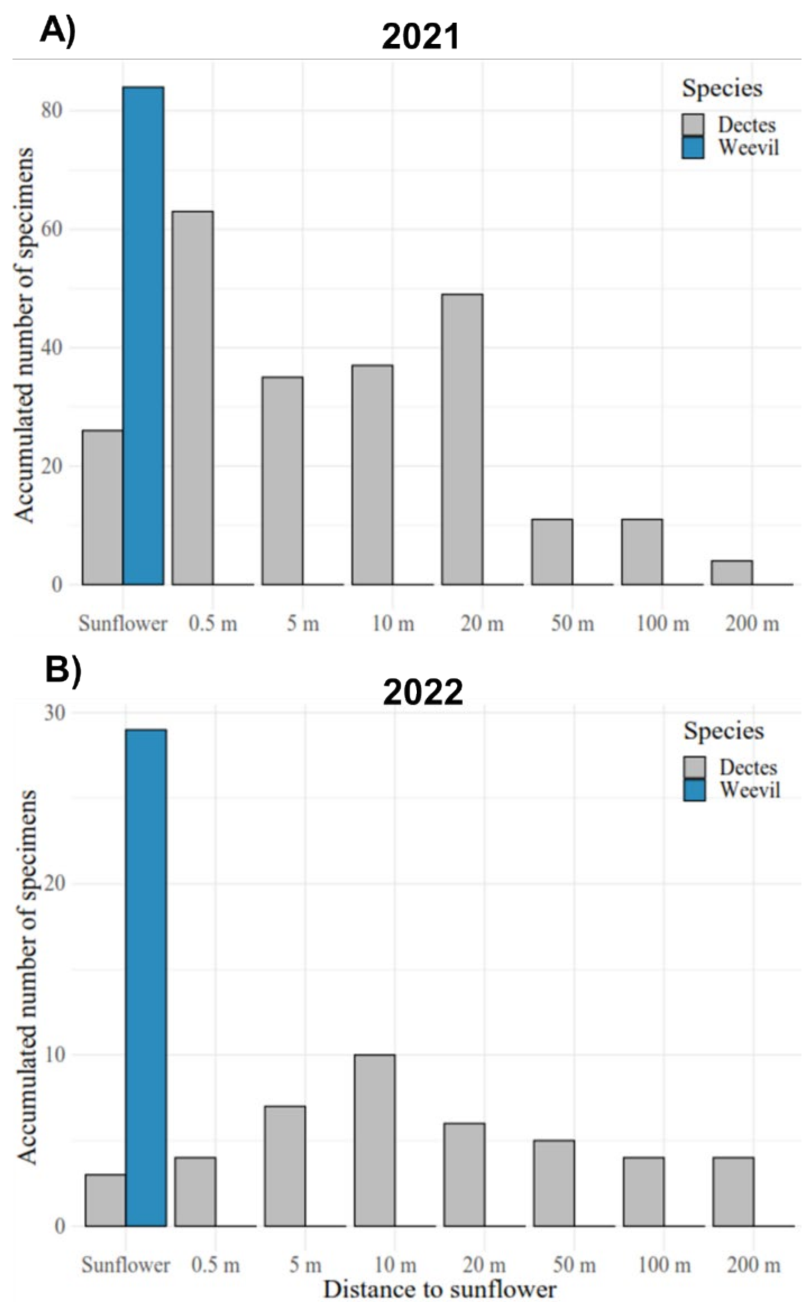

Figure 3. Accumulated numbers of Dectes and red cocklebur weevil (RCW) per host plant across different distance categories and years.

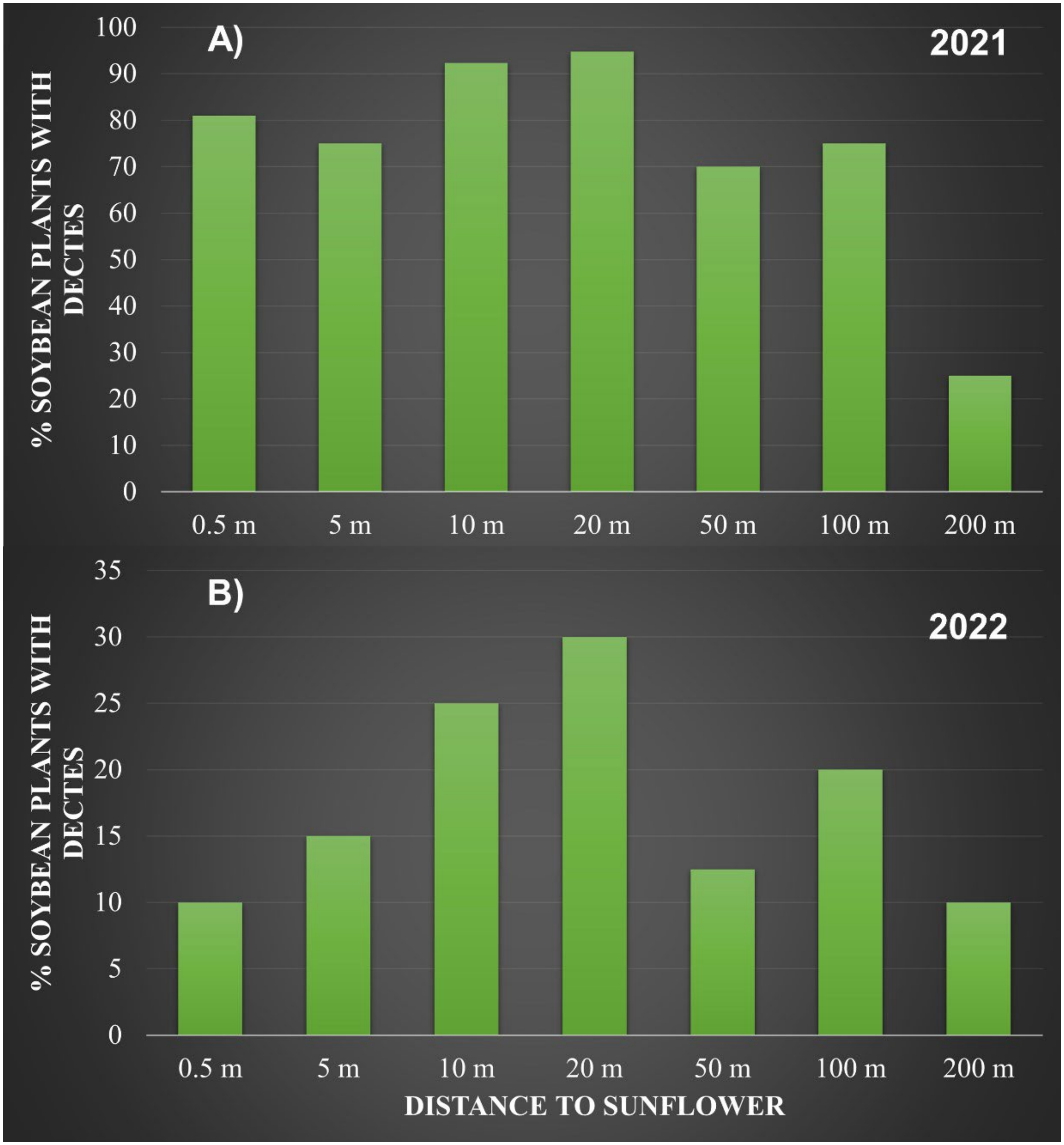

Figure 4. Percentages of soybean plants infested with Dectes at different distances from sunflower in 2021 and 2022.

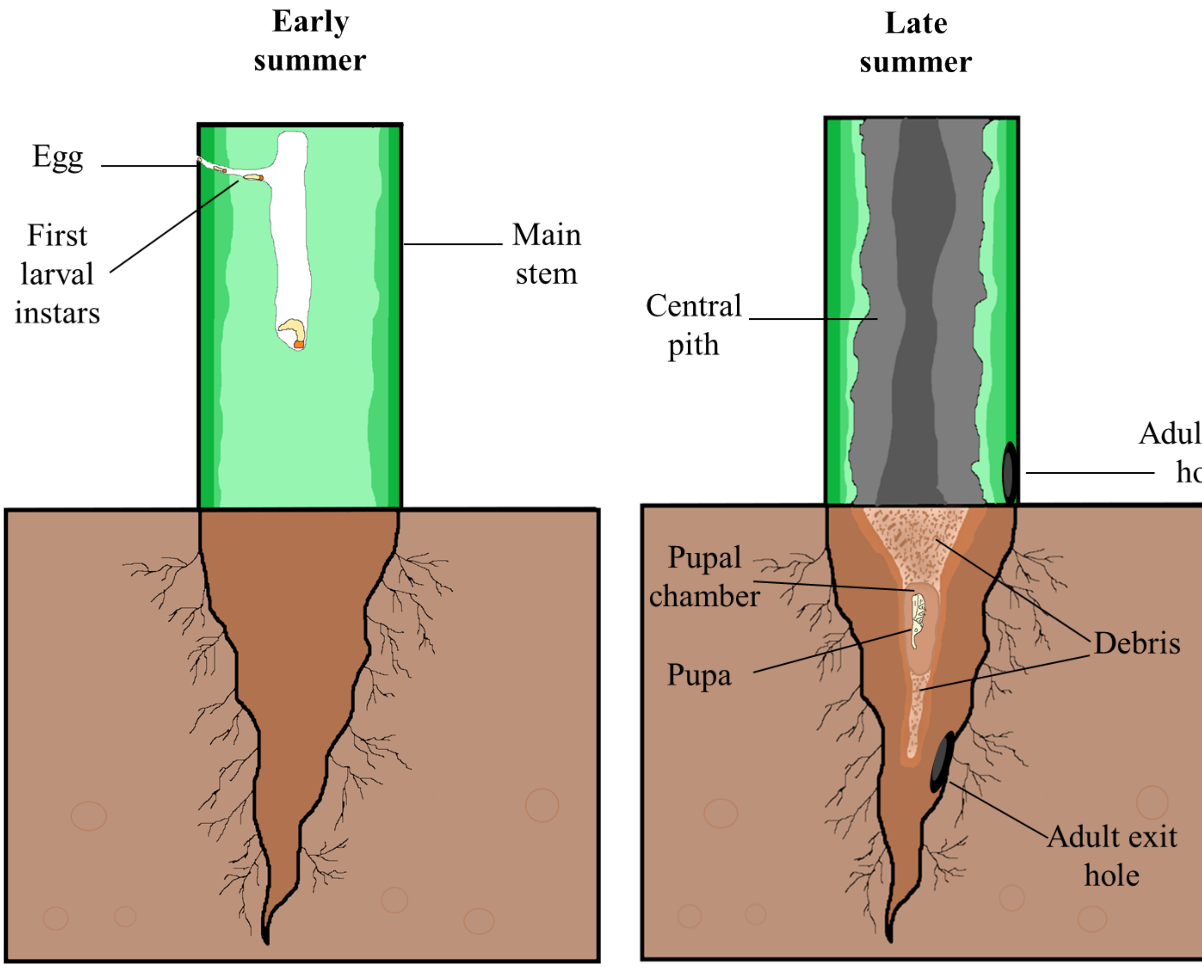

Figure 5. Diagram of the life cycle of the red cocklebur weevil in sunflowers observed in western Kentucky. Longitudinal section of the host plant. There is usually one larva per plant. Then the larva feeds on the central main. Eventually, the tissue of central pith dies and is no longer occupied by the larva. The pupal chamber is surrounded by debris. Finally, the adult escape from either the root or the base of the main stem. Figure credit: A. Falcon-Brindis.

CONCLUSION

The interaction between Dectes and RCW was previously unknown and is apparently restricting the success of Dectes larva in sunflowers. Therefore, the use of sunflower as a trap crop may be disrupted by this competitive relationship in KY.

Although sunflower is an attractive host for Dectes, the cocklebur weevil infested these plants earlier than Dectes, thus restraining Dectes to complete its life cycle and might be causing mortalities that were not recorded in this study. Low Dectes and RCW populations in 2022 were related to a severe drought that occurred in western KY. More research needs to be done to understand the interaction between the RCW and Dectes in sunflowers; and its use as trap crop in soybean systems.

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CHANGES ON STINK BUG SPECIES COMPOSITION IN SOYBEANS ACROSS CENTRAL AND WESTERN KENTUCKY

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OBJECTIVE

Stink bugs comprise several species considered major pests in soybeans in southern United States; however, spe- cies are moving north, and westward as global temperatures continue to increase. Soybean growers in Kentucky usually face the attacks of endemic common stink bugs: the green stink bug (*Chinavia hilaris*) and the complex of brown stink bugs (*Euschistus* spp.--i.e., *E. variolarius, E. servus*), but during the last decade, the invasive brown mar- morated stink bug (BMSB, *Halyomorpha halys*) has successfully increased in crop fields (Figures. 1A-C). These spe- cies are highly mobile and known to damage soybeans during summer and fall. Their damage on pods can cause aborted seeds and reduced economic value. Here, we evaluate the dispersion trends of the brown, brown marmo- rated and green stink bugs in soybeans across west and central Kentucky. We compared the proportion of the three most common stink bugs in soybeans: green, brown, and BMSB.

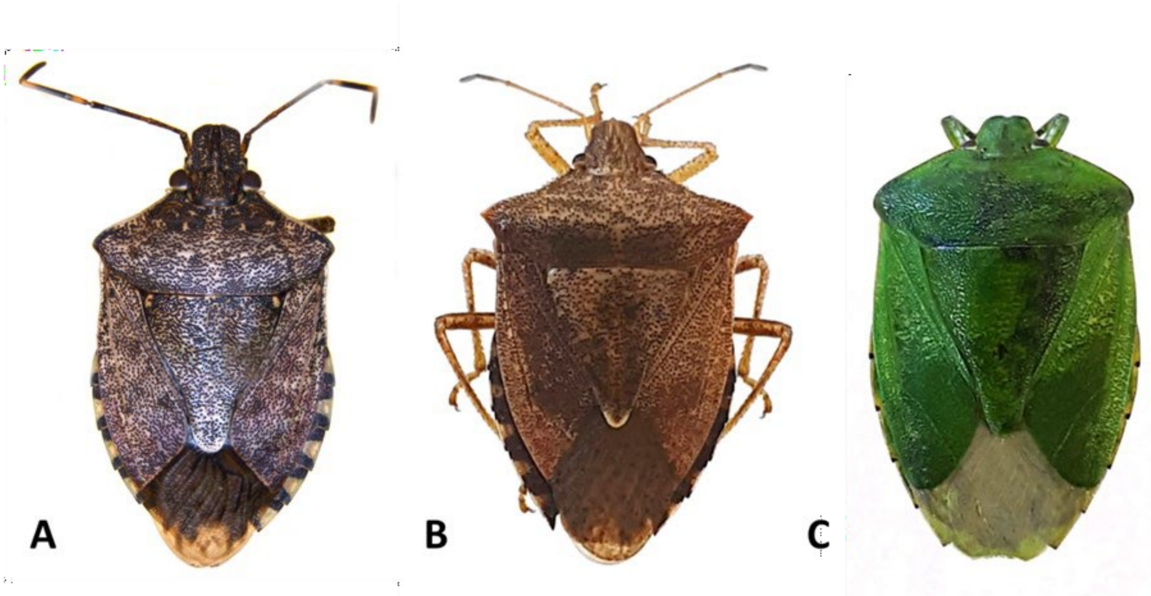

Figure 1. Common stink bugs found in soybean fields from west and central Kentucky. Adults of brown marmorated stink bugs (A), brown stink bug (B) and green stink bugs (C) (Photos: Armando Falcon-Brindis, UK).

METHODS & MATERIALS

Since our first report of the expansion of the brown marmorated stink bug (BMSB) towards western Kentucky in 2020, farmers and County Extension agents have been reporting increasing numbers of them in the western coun- ties of Kentucky.

We conducted standardized sampling (100 sweeps/field) in 66 commercial soybean fields from 22 counties in west- ern and central Kentucky. In the western region the counties sampled were in Fulton, Hickman, Carlisle, Ballard, McCracken, Graves, Calloway, Livingston, Lyon, Caldwell, Christian, Trigg, and McLean, whereas in the central re- gion we sampled in Henderson, Daviess, Hancock, Breckenridge, Hardin, Warren, Nelson, Muhlenberg, and Fayette counties. Tallies were conducted using sweep nets during August and September in 2020, 2021 and 2022.

RESULTS AND DISCUSSION

We collected 2,223 stink bugs from Central and Western counties from 2020 to 2022 (Figure 2). Compared to our preliminary data of 2020 and 2021, the total number of stink bugs collected in 2022 dramatically decreased in more than 50%. The proportion between the green, brown, and BMSB has been statistically different in all years. Although the most abundant species is the green stink bug in soybeans, the proportion of brown marmorated stink bug has increased since 2020.

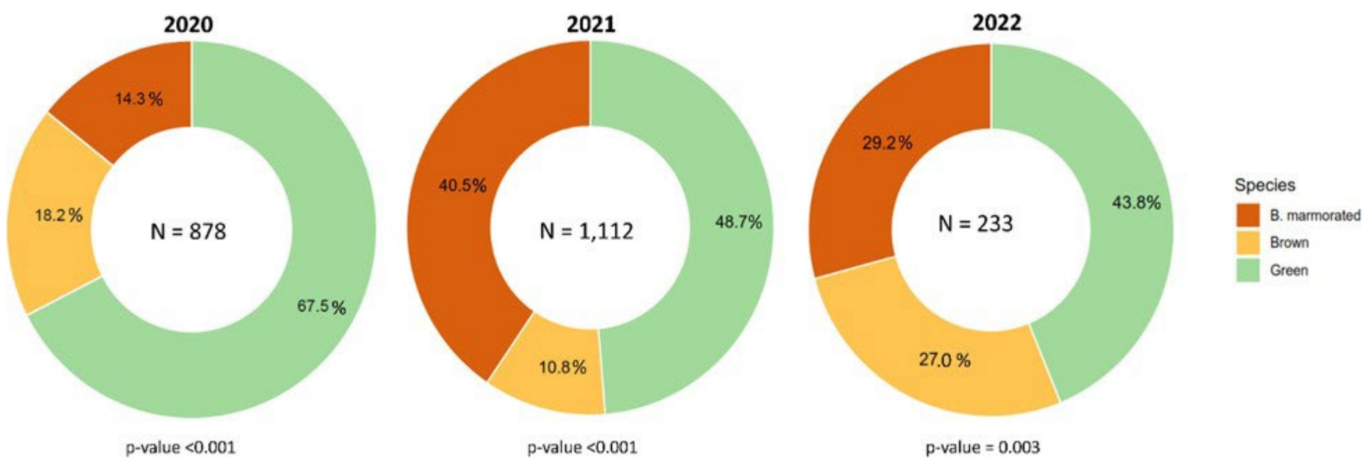

Figure 2. Changes in the proportion of common stink bugs from 2020 to 2022 in Western and Central Kentucky. N = total stink bugs collected. P-value of $\chi2$ goodness of fit is shown. (Figure by Armando Falcon-Brindis, UK).

The mean number of stink bugs per 100 sweeps varied significantly in both western and central counties during 2021 and 2022 (Figure 3). In 2022, there were no stink bugs recorded in 28% of the sampled fields and in 9% of the sampled locations we found one single stink bug/100 sweeps. This could be attributed to the **severe drought** documented in the Midwest during this growing season, especially in western Kentucky (Figure 4). In fact, there was a moderate to exceptional drought intensity covering between 37% to 45% of the United States from July to September (NOAA, 2022). Interestingly, despite the drought conditions during 2022, the proportion of brown marmorated stink bugs are still higher compared to that in 2020. This may suggest that the populations of BMSB would be increasing in upcoming years.

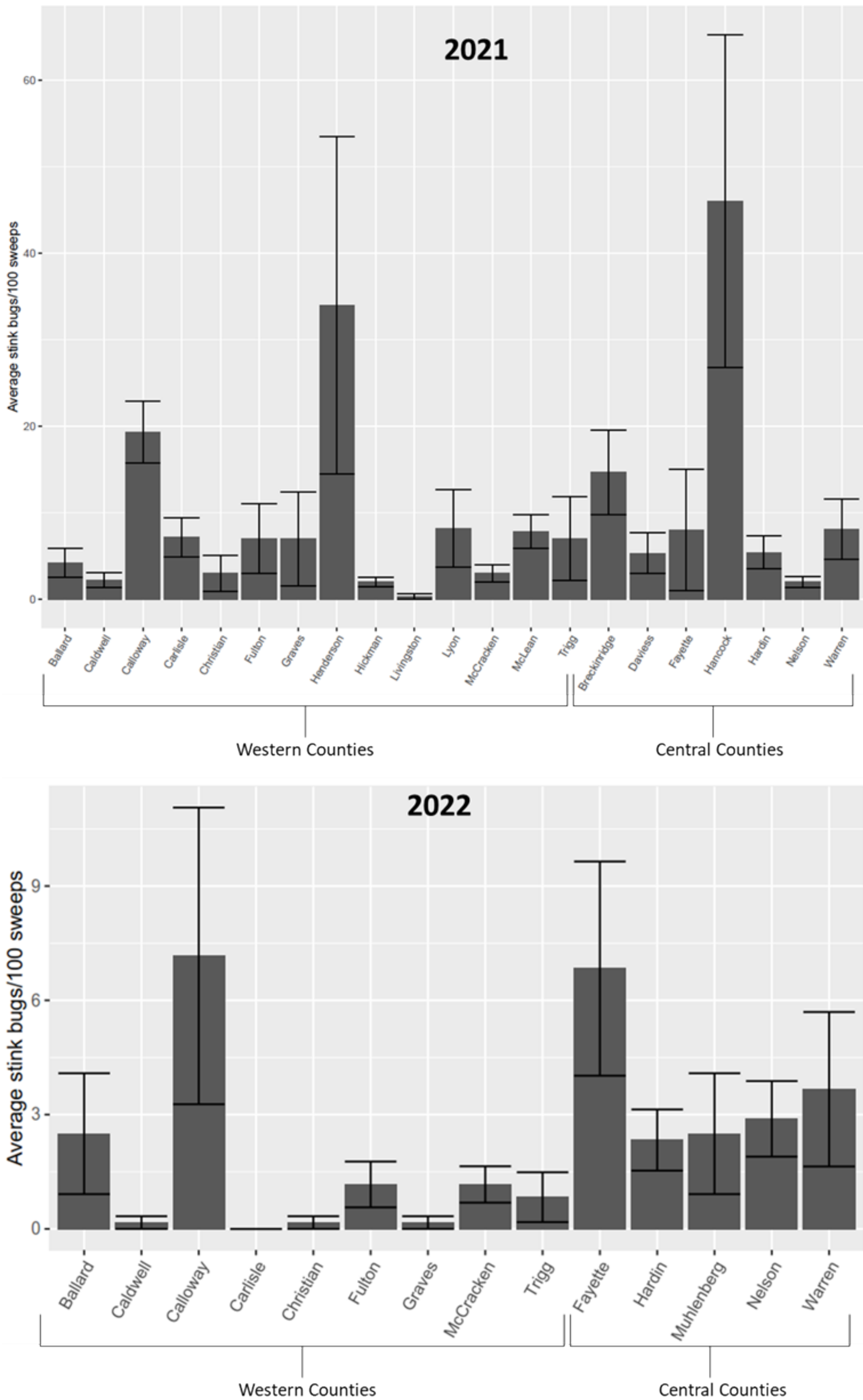

Figure 3. Mean numbers ±(SEM)of stink bugs across 66 commercial soybean fields in 22 counties. Note: the Y-axis is different for both years, in 2022 the severe drought in KY may have impacted stink bug populations.

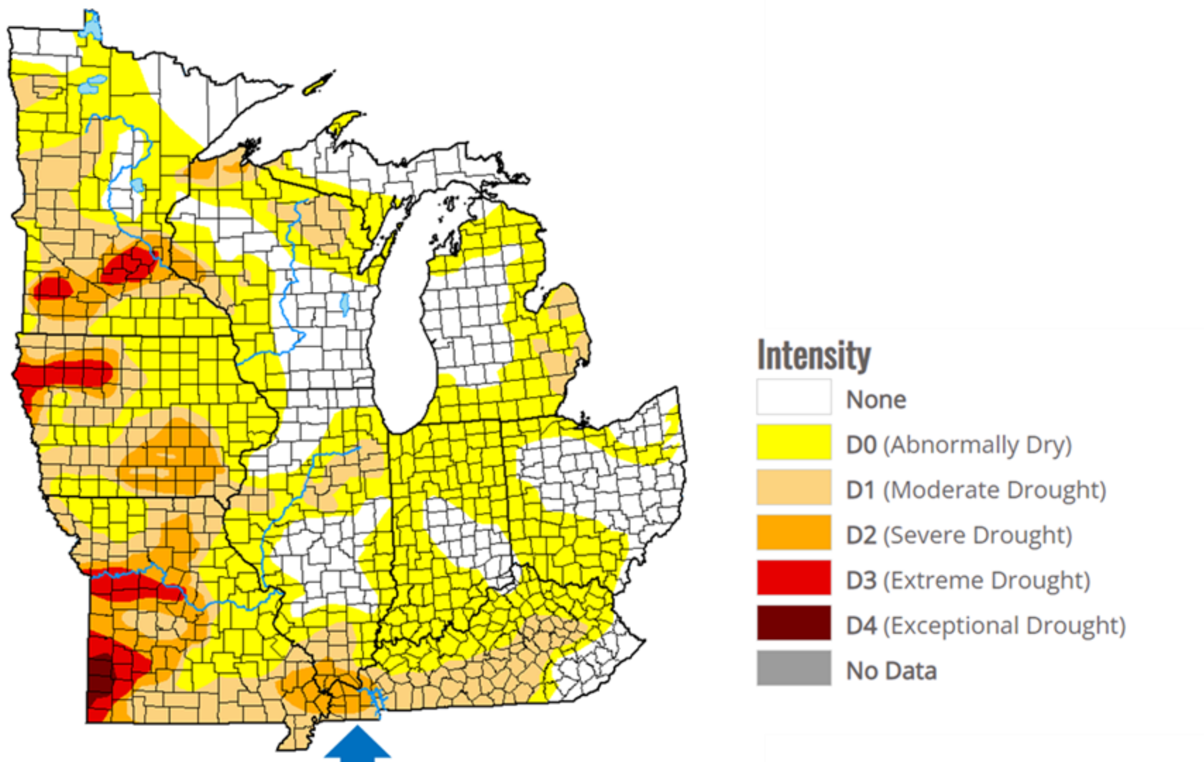

Figure 4. Drought intensity in the Midwest region. In Kentucky, the driest conditions have been present in the western region (blue arrow). Average values from January to October 13th, 2022. Data retrieved from U.S. Drought Monitor (https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?Midwest).

According to previous research, these highly mobile polyphagous pests depend on weather conditions, the location of host plants, and human infrastructure. In this regard, the expansion of BMSB may bring new problems for soybean and vegetable growers in western Kentucky as well as nuisances for human shelters as they move into barns or houses to overwinter staining walls or producing allergies. Furthermore, each stink species can respond to different factors which may allow/restrict their dispersion. For instance, the brown stink bug (*E. servus*) often responds to the crop type and food availability of the surrounding habitat, whereas the establishment of BMSBs is strongly associated to human development (i.e., railroads and urban areas). In contrast, the green stink bug (*C. hilaris*) has generalist habits and is found in both crop fields and non-crop habitats. Other species such as the dusky stink bug (*Euschistus tristigmus*) is primarily associated with forest habitats, and only occasionally in crop fields.

CONCLUSION

Soybean growers should be aware of the imminent dispersion of BMSB from the east to the west. The effect of increasing numbers of BMSB in soybeans yield of Kentucky is still unknown, but it could have negative implications for local growers as the population balance within native species (i.e., brown and green stink bugs) is disrupted. Moreover, as the mean yearly temperatures continue to increase, other stink bug species might move from the south in the following years.

ACKNOWLEDGEMENTS

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EVALUATING YIELD RESPONSE TO AND RETURN ON INVESTMENT TO BIOLOGICAL SEED TREATMENTS IN SOYBEAN IN KENTUCKY

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Project Purpose

There are a large number of biological seed treatments containing fungi, amino acids, and/or bacteria marketed to growers under the premise that these treatments will produce a positive return on investment (ROI) by promoting plant health. Growers often purchase these products with the intention of maximizing yield to gain a competitive advantage. The effect of these products on yield, however, is largely undocumented. We evaluated commonly-marketed biological seed treatment products in Kentucky and colleagues across the U.S. evaluated these products as well. We intend to report yield effects and hope to identify soil properties or other factors that may affect the im- pact of these biological seed treatments. Note: This purpose paragraph was developed by colleagues from 17 land grant universities across the country and will be similar to the Project Purpose in their reports as well. The Project Objectives are similar across the studies as well.

Project Objectives

The objectives of this project are to:

1) Identify yield response in soybean to biological seed treatments (commonly-marketed products);

2) Conduct economic analyses on the value of these products; and,

3) extend results to soybean growers through extension networks.

Methods and Materials

Two planting dates of soybeans were established at Spindletop Farm, Lexington, KY in a no-tilled Bluegrass-Maury Silt Loam soil rotated from corn the previous year. The site has grown successful soybean crops in previous rotations over the last two decades.

Soil test results were adequate for all nutrients, except potash (Table 1). Muriate of potash fertilizer was applied to remedy to low soil test values.

Table 1. **Soil test results for the research field. Soil test report from the University of Kentucky Regulatory Services.**

Soil Component	Soil Test Value
Soil-water pH	6.08
Sikora Buffer pH	6.59
P_2O_5, lb/A	328
K_2O, lb/A	179
Zn, lb/A	3.4
SOM, %	2.72

Asgrow variety 'AG40XF1' was seeded on May 2, 2022 and June 1, 2022 in attempt to have soybean growth and development occur with different weather conditions in 2022.
Biological seed treatments are listed in Table 2

Table 2. Products used in the biological seed treatment study.

Treatment No.	Company	Product Name	Microorganism(s)
1	Sunrise	**BioBuild™ Soy Bio ST + R**	*Azospirillum brasiliensi, Bacillus licheniformis, B. amyloliquefaciens, B. subtillis, Pseudomonas fluorescens, Rhizobium*
2	ABM	**SabrEx® Soybeans PB**	*Trichoderma virens*
3	ABM	**Graph-Ex®**	*Rhizobium*
4	BASF	**Vault® IP Plus**	*Bacillus subtillis, Bacillus amyloliquefaciens, Bradyrhizobium japonicum*
5	3Bar Biologicals	**Bio-YIELD® ST**	*Pantoea agglomerans*
6	3Bar Biologicals	**Bio-YIELD®**	*Pseudomonas brassicacerum*
7	Lallemand	**LAL FIX Proyield + LAL RISE Start SC**	*Bradyrhizobium elkanii; Delfia acidourarus; Bacillus velenzensis*
8	Lallemand + Agrilead	**Rise & Shine**	*Bacillus velenzensis*
9	Valent	**MycoApply EndoFuse**	*Glomus intraradices, G. mosseae, G. aggregatum, G. etunicatum*
10	Control	**none**	Control (Not treated with a biological seed treatment)

Distilled water was used to apply each of these seed treatments to soybean seed lots of the same variety. These applications were conducted in an air-conditioned room set to 72 F (22 C). All seed treatments were applied in the morning and planting was completed later that same day for each of the two planting dates. These methods were used to ensure maximum survival and activity from each of the biological seed treatments.

The uppermost trifoliolate leaves were harvested from R2 growth stage soybeans on July 14 and August 3 for the May and June plantings, respectively. Soybeans were harvested on October 7, 2022 for both planting dates. Seeds from each plot were bagged, tagged and mailed to colleagues at Ohio State for additional analyses on oil and pro- tein.

Results

The 2022 season was wet early, dry in parts of July and August, and extremely dry in September through harvest. The timing of dry weather is evident in the soybean yields from the two planting dates. Soybeans from the May planting averaged 41.9 bushels per acre while soybeans from the June planting averaged 64.8 bushels per acre. The soybeans experienced stress from the weather this summer. If biological seed treatments help mitigate stress, we should have observed that this summer.

Yields were not significantly different for any of the seed treatments on soybeans planted May 2, 2022 (Table 3, Figure 1) or for soybeans planted June 1, 2022 (Table 3, Figure 2). The table displays averages for each treatment. To better visualize the variability of those averages, box and whisker plots were created (Figures 1 and 2). The box represents 50% of the data for each treatment. The 'x' represents the average yield. For the May planting date, BioBuild Soy, SabrEx and Bio-YIELD ST resulted in less variability than the Control (Figure 1). For the June planting, Graph-Ex resulted in less yield variability than the Control (Figure 2).

Table 3. Soybean grain yield, test weight, and grain moisture in response to soybean biological seed treatments at two planting dates in Lexington, KY 2022.

Planting Date	Treatment	Grain Moisture, %	Test Weight, lb/ bu	Yield, bu/A
May 2, 2022	BioBuild Soy	9.3	62.3	43.3
	Bio-YIELD	9.6	62.0	43.8
	Bio-YIELD ST	9.2	62.4	42.7
	Graph-Ex	9.2	62.4	41.5
	LAL FIX PY + LAL RISE	9.4	62.2	38.0
	MycoApply EndoFuse	9.5	62.1	42.3
	Rise & Shine	9.5	62.0	42.3
	SabrEx	9.6	62.1	42.6
	Vault IP Plus	9.2	62.3	40.3
	Control	10.3	61.7	42.7
	Average	*9.5*	*62.1*	*41.9*
	LSD (0.10)	*0.7*	*0.8*	*6.6*
	p value	*0.6967*	*0.6145*	*0.9277*
June 1, 2022	BioBuild Soy	8.4	63.1	67.5
	Bio-YIELD	8.4	63.0	66.8
	Bio-YIELD ST	8.3	63.1	65.8
	Graph-Ex	8.3	63.1	63.0
	LAL FIX PY + LAL RISE	8.4	63.0	64.7
	MycoApply EndoFuse	8.5	63.0	65.0
	Rise & Shine	8.3	63.1	62.0
	SabrEx	8.3	63.1	64.0
	Vault IP Plus	8.5	62.9	63.0
	Control	8.4	63.0	66.5
	Average	*8.4*	*63.0*	*64.8*
	LSD (0.10)	*0.1*	*0.1*	*5.6*
	p value	*0.1880*	*0.2020*	*0.7760*

Figure 1. Soybean yield response to biological seed treatments on soybeans planted May 2, 2022 at Lexington, KY.

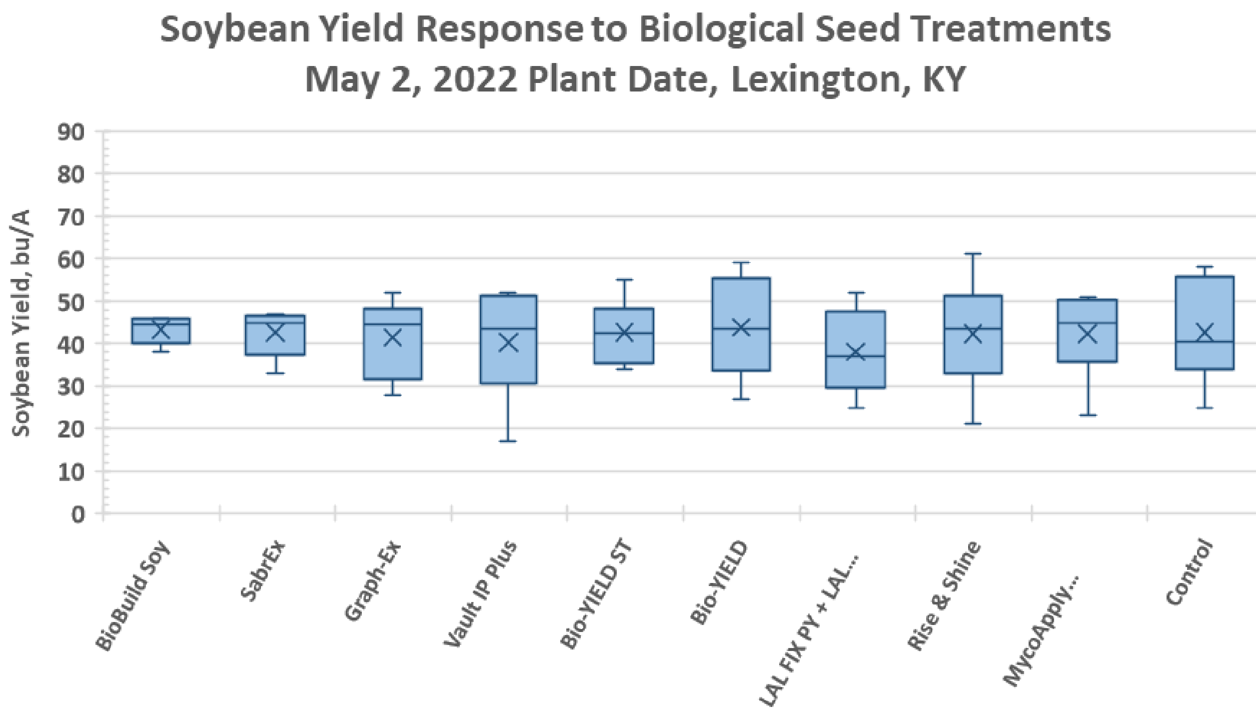
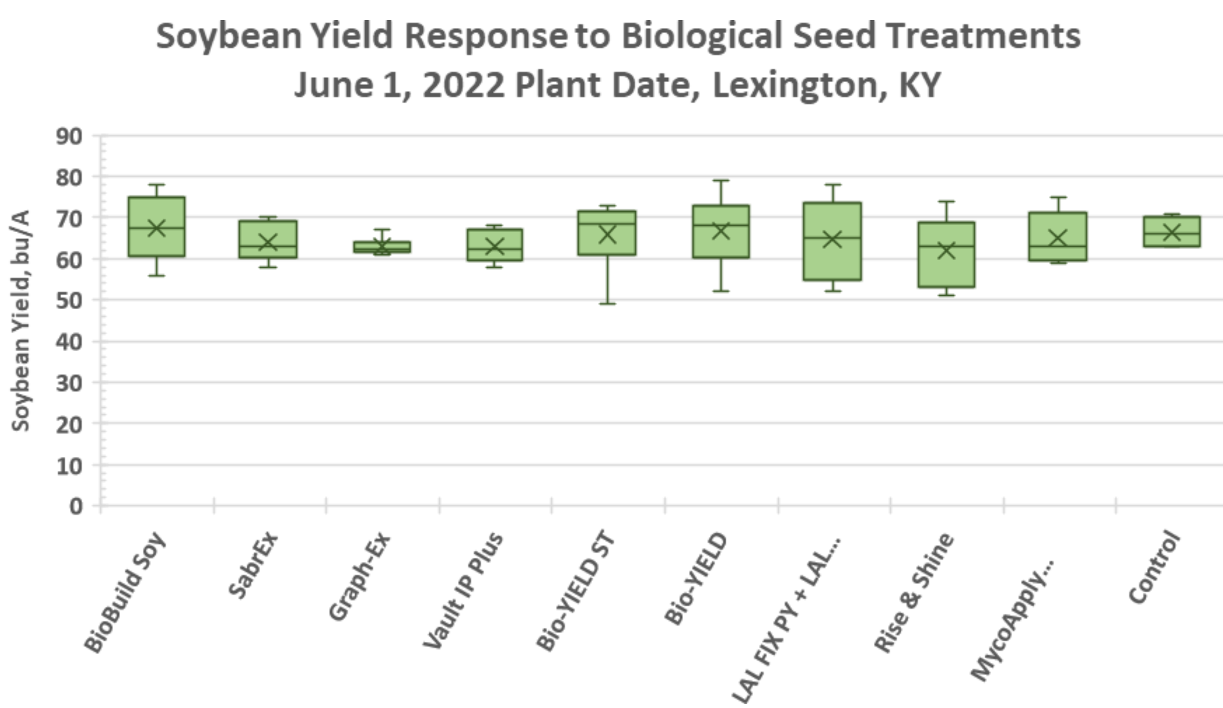


Figure 2. Soybean yield response to biological seed treatments on soybeans planted June 1, 2022 at Lexington, KY.



Discussion

Soybeans planted in June yielded about 24 bu/acre greater than soybeans planted in May on average. Soybeans planted in May experienced more water stress than soybeans planted in June. There were no yield differences from the biological seed treatments, but three treatments resulted in less variability. Data from these two planting dates will be combined with data from across the country to help us gain a better understanding of how these biological seed treatments may affect yields.

Acknowledgements

We thank Kentucky Soybean Board for funding the project. We thank Ashley Hadley, undergraduate student, for her help in this project. We are pleased that she was able to use this project as part of an undergraduate re- search project.

SNAIL OUTBREAK DURING DROUGHT AFFECTING SOYBEANS

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OBJECTIVE

Sporadic outbreaks of slugs had been reported in the USA in the past. However, during the last 40 years, there had been several occurrences of mollusk feeding on vegetable and field crops in several US states. These incidents have been occurring in many areas from the Gulf coast to northern states; and from west to east after the adoptions of conservation practices such as no-till and cover crops. It is reported that slugs thrive in low disturbance fields compared to conventional tillage areas. Several studies reported the presence of more slugs in no till, or conservation tillage compared with conventional tillage. Indeed, Tonhaska (1994) showed this trend in soybeans fields in Ohio. Hammond (1985) reported an important feeding episode by slugs in soybean fields in Ohio in 1983, but prior to this there were no reports of slugs even as secondary or even minor pest in Ohio, and Villanueva (2017) reported high presence of slugs in non-till soybean fields. Raudenbush et al. (2021) also reported the increased presence of these pests in crop fields. Because mollusks attack plants during the early stages of development, their impact can be devastating; they can reduce plant densities or destroy entire fields overnight and increase costs when replanting is conducted. These types of events are happening in the soybean fields of Kentucky.

In 2022, there were reports on presence of snail in two commercial soybean farms, one on each in Caldwell and Lyon counties. Snails differ from slugs by the presence of the spiral shell that is carried on its back. The shell is a hard structure composed of calcium carbonate, which protects their soft body and internal organs. Slugs and snails do not have legs. Snail and slugs have a “foot” that allows them to move and slide along easily with the help of the mu- cus it secretes. Also, snails can live up to 3 years.

Figure 1. Commercial soybean where snails reduced plant densities in by mid-June in Lyon Co. Ky in 2022. (Photo: Raul T. Villanueva, UK).

In Caldwell the attacks were detected on early May and the farmer was able to make an application of metaldehyde (10 lb/A). This application successfully controlled this pest. In Lyon Co. the event was different, and snail reduced severely plant densities (Figure 1). The objective of this report is to describe the snail outbreak in Lyon Co. and the results of an application of metaldehyde to control snails.

Figure 2. Between 1 to 106 snails per 5-foot row lengths were found under stalks, husk, and cobs of corn planted the previous season. (Photo: Raul T. Villanueva, UK).

METHODS & MATERIALS

At the Lyon County soybean commercial farm, the presence of a slope, a creek at the bottom of the field, and accumulation of moisture and organic matter from the previous crop (corn) in the lower part of the field may have provided proper conditions for the outbreak of snails. The soybean plants were at the V2 to V4 developmental stage. In this field, there were areas where entire plants were consumed and some areas where plants were standing with some damages (Figures 1, 2 and 3).

Tallies of snails were conducted removing all the organic matter residue between two rows of plant using a 5-ft long PVC pipe to measure the length to be evaluated (Figure 2). The application of 10 lbs/A of metaldehyde (DEADLINE® M-Ps™ Mini-Pellets molluscicide AMVAC Chem. Corp.) was conducted on June 24, and tallies were completed on June 22, 23,25, and 27, 2022. In areas where plants were absent and plants present the depth of organic matter residues were measured.

Figure 3. Tallies of snails were conducted using a 5 -ft PVC pipe, notice the V2 to V4 grow stage of the soybean plants (Photo: Raul T. Villanueva, UK).

RESULTS AND DISCUSSION

In areas where all the soybean foliage and stem were completely consumed (naked surface, see Figure 1) by snails; the number of snails numbers ranged from 1 to 106 snails/5 ft-row lengths whereas the areas where there were plants (mean ± SEM = 14.6 ± 1.3) the ranges were from 1 to 20, two and one day before the application (dba) of the molluscicide (Figure 4). In addition, in these same locations the mean depth of the organic matter were 4.2 and 2.5 inches (Figure 5), the air temperatures were 108.0 ±1.0^{o} F and 97.7 ± 0.6^{o} F, and temperatures under the organic matter were 79.4 ± 0.8^{o} F and 77.3^{o} ± 0.5^{o} F, in areas with and without plants, respectively.

One and two days after the application (daa) of molluscicides, the numbers of snail were reduced, Figure 5 shows the mean numbers (±SEM) of snail alive and dead. In this case (Figure 6) this single application of 10 lbs/of metal-dehyde was an effectively management tool for controlling this pest. After repeated visits to this field, we ob- served dead snails and felt the foul smell produced by dead corpses.

By the end of June, the farmer proceeded to replant soybeans. These new plants were not subsequently affected by snails (Figure 7).

In this event is interesting to notice that soybean plants had two to four true leaves (V2 to V4), and this is one difference observed on snail attacks from a slug attack; the latter usually affects and causes reduction of popula-tions on soybean seedlings that are between the VE to V2 grow stage. Also, it was hard to believe that mollusks could be the cause of this damage, especially when the area has been experiencing a drought period and warmer temperatures; however, they were sheltered under abundant organic matter presented in this field. Snail in great numbers were found under stalks, husk and cobs of corn planted the previous season (Figures 2 and 3)

In this case, it seems that the abundant organic matter left from the previous crop provided a refuge for the snails. I visited other locations with this type of abundant organic matter, but snails were not present. At the Lyon County farm, the presence of a slope, a creek at the bottom of the field, and accumulation of moisture in the lower part of the field may have provided proper conditions for the outbreak of snails, including temperature that were 29^{o} and 20^{o} F for areas without and with vegetation as explained above.

Although, for this snail outbreak this field was not a previous cover crop, and cover is important for soil conservation, prevents soil erosion and protects water quality, keep soils moist, reduces soil compaction with fewer trips and less tillage, saves fuel, labor, and time with reduced field operations, and sequesters carbon in the soil; farmer for planting full season or double crop soybeans, should consider some type of residue management from previous crop. Mollusks (snails and slugs) were observed causing severe injuries to several soybean fields, even when environmental conditions were not feasible for their development. Mollusk found very good environmental conditions under residues from the previous crop (corn, wheat, or cover crops), these conditions are conducive to cause outbreaks that affect farmers if residues are not properly managed.

Another important issue in this event was the abundant presence of snails and absence of slugs under the drought conditions observed in 2022 (Figure 8A and 8B). It seems that snail shell main provide some major conditions to survive during the absence of rains and lower %RH registered in 2022 compared with 2021.

Previous report in snail affected soybeans has been described in Argentina, the snail *Bulimulus bonariensis bonariensis* is a native species of South America and caused heavy damages in Argentina, (Frana and Masoni 2011), this species has been reported in several areas of the US and can be a potential pest of soybeans (Borrero, personal communication). In this case the snail causing damages here need further identification, and it is not the species reported in Argentina

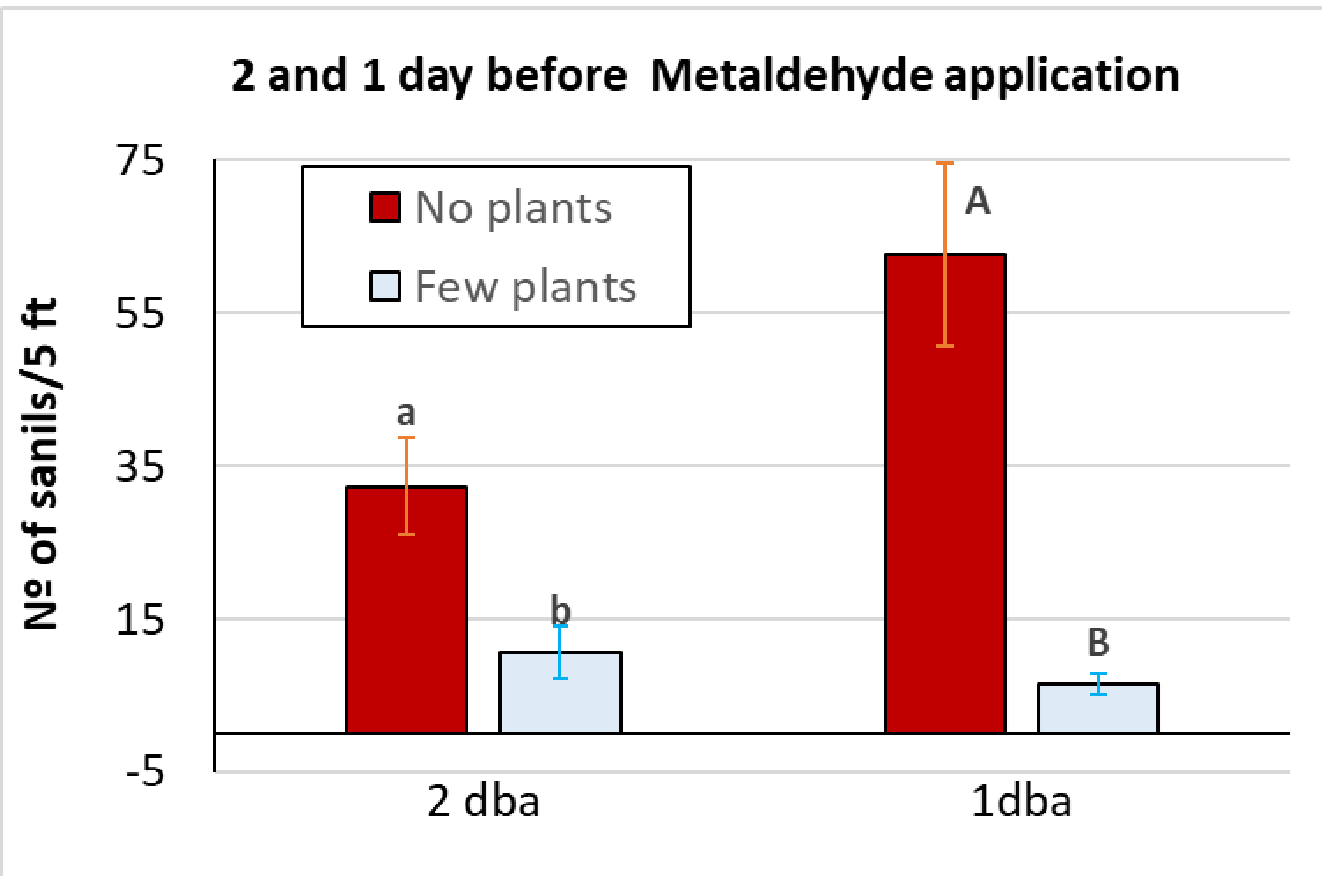

Figure 4. Mean numbers of snails (±SEM) two and one day before the application of 10 Lbs/A of the metaldehyde bait in 2022. Significant differences differences(p<0.05) between are shown by different letters on each date.

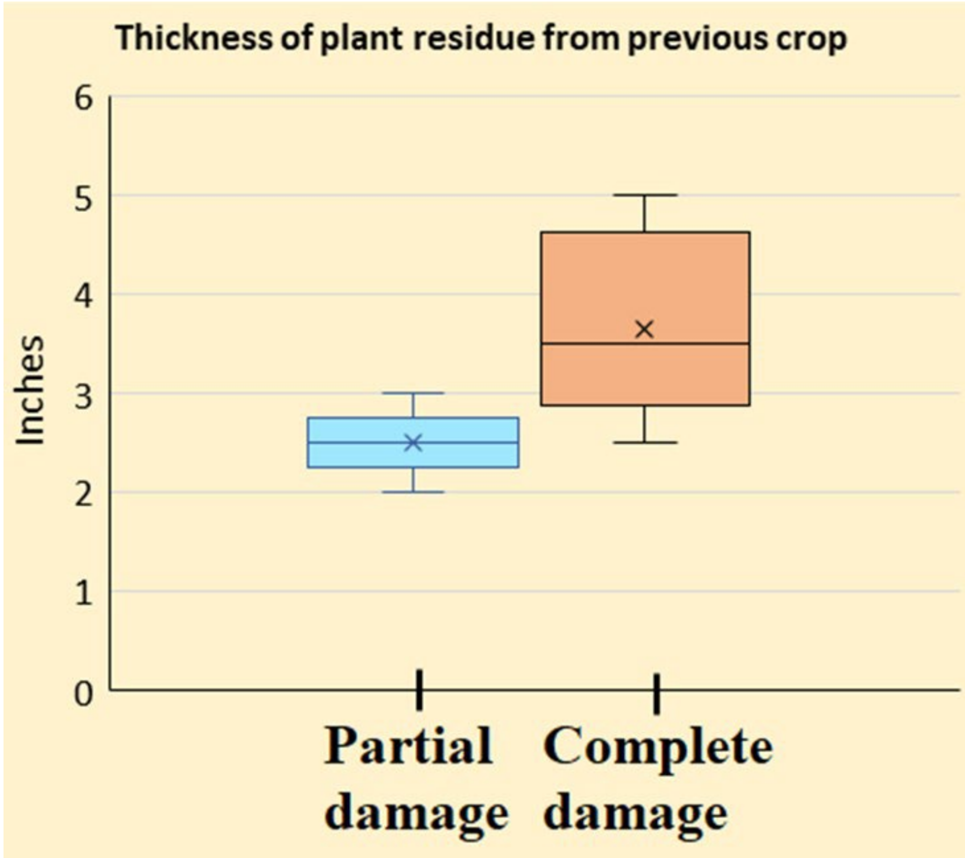

Figure 5. Depth of organic matter in areas of soybean field that had partial and complete damage of plants. (Photo: Raul T. Villanueva, UK).

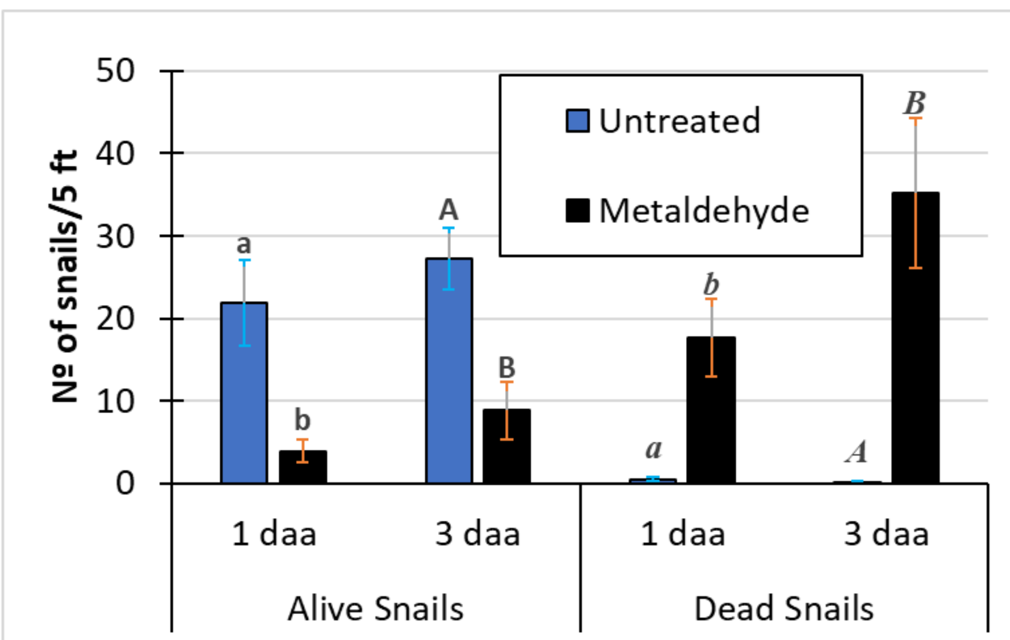

Figure 6. Mean numbers of snail (±SEM) on untreated and metaldehyde treated areas of a commercial soybean field in Lyon Co. KY. Significant differences(p<0.05) between treatments are shown by different letters on each date (Photo: Raul T. Villanueva, UK).

Figure 7. Soybean field where snail attack occurred by mid-June and replanted by the end of June 2022. You can see the replanted (dark green) and plants that were not affected by this snail attack (light green- senescing) on this photography taken on 20 September 2022. (Photo: Raul T. Villanueva, UK).

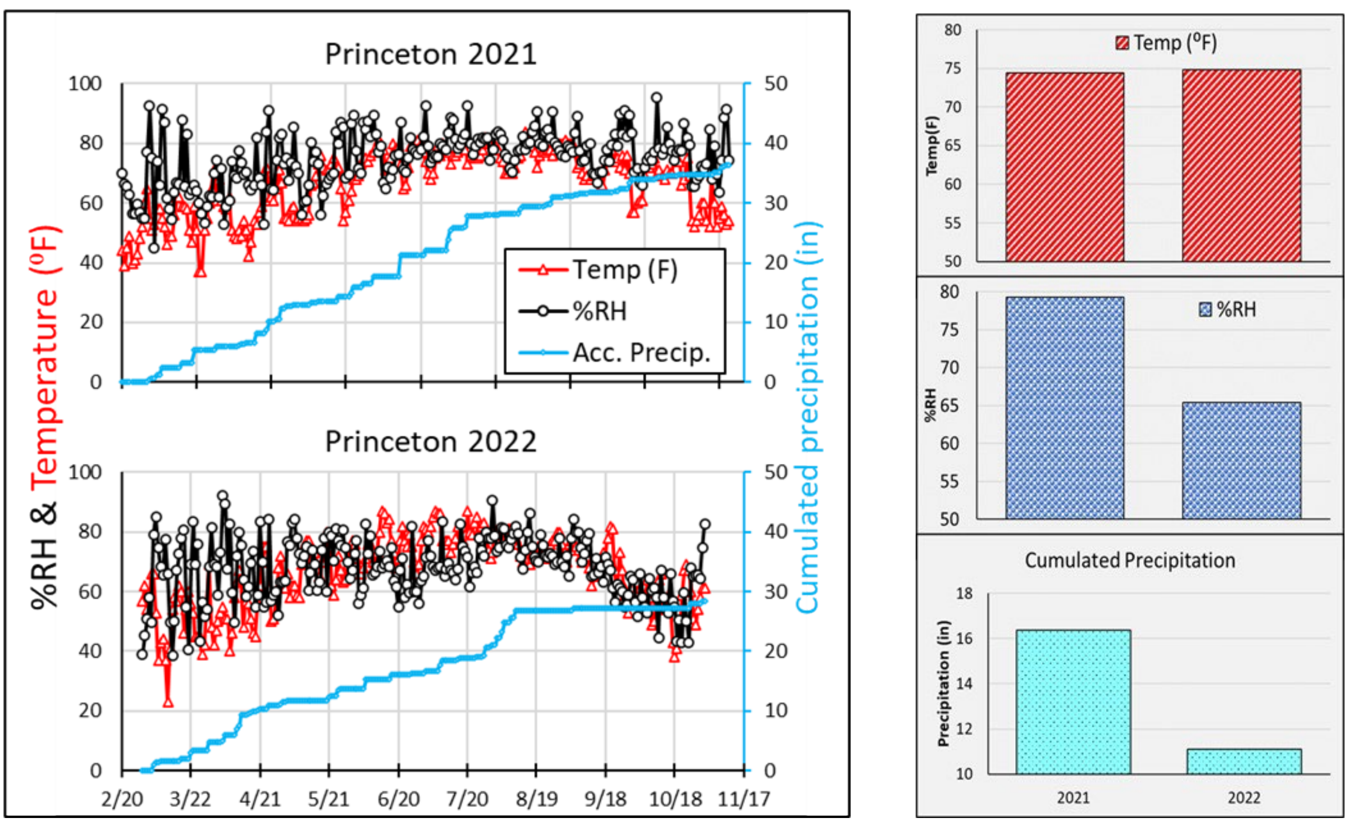

Figure 8. (A) Percentages of relative humidity, temperature, and cumulated precipitation registered at Princeton from 1 March to October 31, 2022 and (B) mean Temperature, %RH and cumulated precipitation registered at Princeton during the duration of this study, from 1 June 1 to 30 October 2022

CONCLUSION

Although snail damages on soybeans are not as frequent as slugs, here we report one that caused severe injuries to soybeans under very particular situations, heavy organic matter from the previous crop that provided good environmental conditions for the snails, the survival of the snails under severe drought conditions presented in KY in 2022. There is no curative control for slugs or snail damage however, there are molluscicides used for the management of mollusks. In this particular case the use of the metaldehyde bait mini pellets at 10 Lbs/A was successful. The price of soybeans are relatively good nowadays compared to previous years, and in this occasion the grower was able to pay the $20/A fee to proceed with a preventative tactic to replant soybeans. Further studies need to be conducted to understand the presence of slugs and snail, the abundance of cover crops and organic matter in soybean fields, as well the evaluations of molluscicides with different formulations, different active ingredients, and costs for this management tactic.

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EVALUATION OF FOLIAR FUNGICIDES ON SOYBEAN, PRINCETON, KY, 2022

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OBJECTIVE

The objective of this research was to determine which fungicide product(s) has the best efficacy against foliar diseases of soybean and the best yield response relative to a non-treated check.

METHODS & MATERIALS

A field trial was conducted at the University of Kentucky Research & Education Center (UKREC) in Princeton, KY in 2022. Soybean cultivar ‘Asgrow 47XF0’ was planted on May 24, 2022, at 135,000 seeds/A. Plots were no-till planted into soybean stubble from the previous crop. Plots were 4 rows wide (on 30 inch row spacings) and 20 ft long. Each treatment was replicated four times in a randomized complete block design. Foliar fungicide treatments were applied to plots at the R3 soybean development stage (beginning pod stage) using a backpack sprayer calibrated to deliver 20 gal/A. Severity of frogeye leaf spot (caused by *Cercospora sojina*) was rated multiple times starting 2 weeks after treatment application, and then every two weeks after that. Disease severity was rated by evaluating leaves in the upper canopy and estimating the percentage of leaf area affected by frogeye leaf spot. Final disease ratings are reported below. Plots were harvested with a small plot combine equipped with a grain moisture and weigh system, and yields were calculated and standardized to bushels per acre at 13% moisture.

RESULTS AND DISCUSSION

Final disease severity in the nontreated check was relatively high (60%) (Table 1.). All treatments significantly reduced disease severity compared to the nontreated check. Lucento treated plots had the lowest frogeye leaf spot severity, but were not statistically different than all other fungicide treatments except Quadris. There were no significant differences among treatments for grain moisture. Yields that were significantly better than the nontreated check were achieved by Topguard EQ, Lucento, Initiate 720 + Monsoon + Topsin 4.5 FL, Miravis Top, and Approach Prima.

ACKNOWLEDGEMENTS

The authors thank the United Soybean Board for funding and the UKREC Farm Crew for their assistance with conducting the trial.

TABLE 1. EFFECT OF FOLIAR FUNGICIDE TREATMENTS ON FROGEYE LEAF SPOT SEVERITY, SOYBEAN GRAIN MOISTURE, AND YIELD AT PRINCETON, KY IN 2022.

Product	**Rate (fl oz/A)**	**Frogeye leaf spot severity (%)**	**Grain moisture (%)**	**Yield (bu/A)**
Nontreated check		60	10.8	61
Topguard EQ	5	7	10.8	68
Lucento	5	4	10.8	70
Trivapro	13.7	13	10.8	65
Quadris	6	33	10.8	61
Veltyma	7	10	10.8	62
Revytek	8	7	10.8	67
Initiate 720 + Monsoon + Topsin 4.5 FL	36 + 4 + 20	11	10.8	69
Delaro Complete	8	10	10.8	63
Miravis Neo	13.7	15	10.8	64
Topsin 4.5 FL	20	9	10.8	64
Miravis Top	13.7	8	10.8	68
Approach Prima	6.8	16	10.8	69
	LSD 0.05*	**18**	**NS****	**7**

***Fisher's least significant difference with alpha = 0.05.**

****No significant differences detected.**

MAXIMIZING PROFITABILITY OF EARLY PLANTED SOYBEAN

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OBJECTIVE

It has been well established that planting soybean early will generally result in the greatest yield potential. However, in recent years the question has become "How early is too early"? Several producers in western Kentucky are now targeting late-February to early-April soybean planting dates. Even with a spring freeze in May 2020, the majority of early-planted soybean survived. This has increased interest in very early planting dates for soybean. But it also leads to the question of "Should management practices be changed for these very early planting dates?"

METHODS & MATERIALS

In 2020, a trial examined the impact of sulfur and nitrogen on early planted soybeans. A nitrogen only check was included to compensate for the nitrogen provided by the sulfur fertilizers: gypsum and ammonium sulfate. In addition, the soybean were planted April 22. There was an 11 bushel per acre increase for the treatment that provided 9 lbs of nitrogen per acre (Table 1) suggesting that early planted soybean could benefit from additional management practices.

In 2021, the number of treatments was reduced to the two fertilizer treatments that had the greatest seed yield in 2020 and an untreated control (UTC). Three planting dates were implemented: March 10, April 13 and May 12. With aid from a fall burndown herbicide application, field conditions were right for planting in early March but soil temperatures remained around 42°F. Due to these cold soil temperatures, March planted soybeans did not emerge until April 8. Another issue encountered was a large infestation of slugs for the March planting date. Early season plants population was measured as well as harvest populations. All three planting dates were harvested at 13% to 15% moisture on September 30th.

RESULTS AND DISCUSSION

Average yields of each treatment are shown in Table 2. In 2021 no statistical differences were found between fertilizer treatments within their planting dates. At harvest seed and intact plants were collected to determine seed quality and pods per plant. Unfortunately, seed and plant samples were lost in the December 10th tornado.

When data from 2020 and 2021 are considered, it is apparent that response to starter fertilizer in early planted soybean are inconsistent. Understanding why this is the case is important to allow recommendations for early planted soybean to be most profitable.

TABLES

Table 1. Soybean seed yield for various fertilizer treatments. Each treatment was broadcast after planting, but before soybean emergence, at Princeton, KY 2020.

Product	Lbs of product applied per acre	Lbs of N per acre	Lbs of S per acre	Seed Yield (bu/a)
UTC[1]	N/A	N/A	N/A	68 b[2]
AMS	42	9	10	75 ab
AMS	83	18	20	70 b
AMS	125	26	30	76 ab
CaSO4	59	0	10	73 ab
CaSO4	117	0	20	73 ab
CaSO4	176	0	30	69 b
Urea	20	9	0	79 a
Urea	39	18	0	70 b
Urea	57	26	0	74 ab
Pr > F				0.0052

[1] UTC refers to untreated control that received no broadcast fertilizer treatment; AMS is Ammonium sulfate (21-0-0-24S); CaSO4 is Calcium Sulfate; N/A is not applicable.

[2]Seed Yield followed by different letters are statistically different (P<0.05).

Table 2. Soybean seed yield for various fertilizer treatments. Each treatment was broadcast after planting, but before soybean emergence. Princeton, KY 2021.

Product	Planting Date	Seed Yield (bu/A)
UTC	1	65
AMS	1	69
Urea	1	68
P > F		0.2842
UTC	2	73
AMS	2	70
Urea	2	73
P > F		0.4949
UTC	3	66
AMS	3	62
Urea	3	72
P > F		0.1259

[1] UTC refers to untreated control that received no broadcast fertilizer treatment; AMS is Ammonium sulfate (21-0-0-24S); CaSO4 is Calcium Sulfate.

Table 3. Fertilizer product and amount of product applied per treatment in 2021.

Product	Lbs of product applied per acre	Lbs of N per acre	Lbs of S per acre
UTC	N/A	N/A	N/A
AMS	42	9	10
Urea	20	9	0

[1] UTC refers to untreated control that received no broadcast fertilizer treatment; AMS is Ammonium sulfate (21-0-0-24S); CaSO4 is Calcium Sulfate; N/A is not applicable.