Iowa Soybean Research Center Project Report

Project title: Time of disease onset as an early indicator of soybean resistance to soybean sudden death syndrome (SDS)

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Project Objective: Determine if time of SDS onset is a reliable indicator of soybean resistance against SDS

Field experiments

During the 2021 field season, field trials were planted in two locations in Central Iowa. At each location, 8 commercial soybean varieties were planted (Table 1). The soybean varieties used were obtained from three seed companies and differed in SDS resistance ranking from susceptible to resistant. The field plots were 20 ft. long and 10 ft. wide, with 30 in. spacing, and there were 4 replications per treatment. The field trial in Ames, was located at the ISU Hinds Farm and was artificially inoculated with *Fusarium virguliforme* and irrigated weekly. The field trial in Roland was located at a farmer field that had a history of SDS, and was not irrigated. Plots were monitored for the onset of SDS foliar symptoms. Once first symptoms were detected, the plots were rated for incidence (% plants per plot with symptoms) and severity (% leaf area with symptoms in the symptomatic plants). Plots were harvested at the end of the season.

Table 1. Soybean varieties used in 2021 field trials

Company	Variety	SDS resistance
Pioneer	P22T18E	Susceptible
Pioneer	P25A04X	Resistant
Pioneer	P28T14E	Moderately Susceptible
Pioneer	P25T09E	Moderately Susceptible
Golden Harvest	GH2788X	Resistant
Golden Harvest	GH2279E3	Susceptible
Golden Harvest	GH2610E3	Moderately Resistant
Syngenta - NK	S25-2E3	Moderately Resistant

Results: The 2021 summer was very dry and therefore not conducive to SDS development. Mean disease index and yield for each variety at the Roland and Hinds locations are shown in Tables 2 and 3, respectively. SDS foliar symptoms were first detected at Roland on Aug 3 and at

Hinds on Aug 16. However, SDS incidence and severity remained low throughout the remaining season at both locations, resulting in very low disease index (a combination of severity and incidence). There were no significant differences in SDS or yield among varieties at Roland. Although there were some differences in SDS index and yield at the Hinds location, we found no correlation between SDS index, time of SDS onset, and yield. Due to the low SDS pressure observed this season, we do not think the data is reliable for determining if time of SDS onset is a reliable indicator of soybean resistance against SDS.

Table 2. Mean SDS disease index (DX) and yield for each variety for the Roland location, 2021

Variety	Plants Per Acre	DX1 (Aug 3)	DX2 (Aug 11)	DX3 (Aug 18)	Yield Bu/Ac	Yield Mt/Ha
P22T18E	98072a	0.000a	0.000a	0.332a	72.89a	4.90a
P25A04X	98321a	0.000a	0.000a	2.223a	77.14a	5.18a
P28T14E	95459a	0.000a	0.083a	5.000a	69.16a	4.65a
GH2788X	97201a	0.000a	0.000a	3.333a	74.69a	5.02a
GH2279E3	95708a	0.028a	0.083a	0.168a	79.31a	5.33a
GH2610E3	95210a	0.028a	0.278a	6.945a	75.09a	5.05a
P25T09E	98819a	0.000a	0.000a	1.250a	73.62a	4.95a
P28T14E	94961a	0.000a	0.000a	4.000a	75.21a	5.06a
S25-2E3 (NK)	97948a	0.083a	0.278a	10.833a	69.48a	4.67a

Means within column followed by the same letter(s) are not significantly different from each other at 5% level of significance (P<0.05).

Table 3. Mean SDS disease index (DX) and yield for each variety for the Hinds location, 2021

Variety	DX1 (Aug 6)	DX2 (Aug 16)	DX3 (Aug 20)	DX4 (Aug 27)	Yield Bu/Ac	Yield Mt/Ha
P22T18E	0a	0.08b	0.12b	0.05c	49.06f	3.30f
P25A04X	0a	0.00b	0.00b	0.00c	49.43ef	3.33ef
P28T14E	0a	0.52b	1.39ba	2.18a	61.14ba	4011ba
GH2788X	0a	0.13b	0.34b	0.43bc	58.48bdc	3.93bdc
GH2279E3	0a	0.05b	0.13b	0.10bc	46.09d	3.77d
GH2610E3	0a	0.65b	1.06b	0.33bc	54.78d	3.68d
P25T09E	0a	0.39b	1.42ba	0.74bac	65.05a	4.37a
P28T14E	0a	0.21b	0.69b	0.72bac	60.16bac	4.05bac
S25-2E3 (NK)	0a	1.73a	2.72a	1.74ba	54.06ed	3.64ed

Means within column followed by the same letter(s) are not significantly different from each other at 5% level of significance (P<0.05).

Greenhouse experiments

In addition to the field trials, we also conducted five greenhouse experiments. Soybeans were planted in pots, into soil infested by the SDS pathogen. After emergence, plants were assessed every two days for foliar SDS onset and disease severity; root rot and plant growth parameters were measured at the end of the experiments. In the first two experiments, we compared six soybean genotypes that are well characterized for their levels of SDS resistance and often used as checks in SDS research. However, some of these checks did not behave as expected, with resistant genotypes acting as susceptible and vice versa. These genotypes had been stored for different periods of time and had variable vigor, which may have affected their relative resistance to SDS. We now have a new batch of seed from the same genotypes that were increased in the same field in 2021, and we plan to repeat the experiment with this new seed.

We also conducted three greenhouse experiments using the same commercial varieties that were used in the field trials. In these experiments we observed that time of onset is very similar among the varieties, varying only by 2-3 days within an experiment (Fig 1). Our data to date suggests that time of onset may not be a valuable indicator of resistance in soybean seedlings. However, we will try to improve the current protocol by reducing inoculum levels or changing light intensity to determine if those factors affect time of onset.

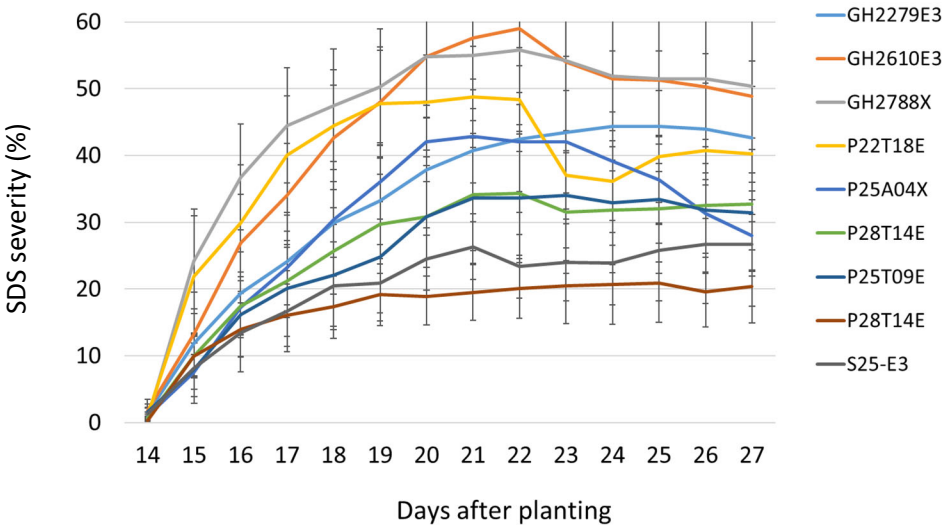

Figure 1. Progress of SDS foliar severity on commercial soybean varieties grown in greenhouse conditions. All soybean varieties started showing symptoms 14 to 15 days after planting, despite having different levels of resistance to SDS.

Future plans

With additional funding generously provided by the ISRC, we plan to establish field trials at more locations (four to six) throughout Iowa in both the 2022 and 2023 seasons. This increase in locations will increase our chances to collect data from high disease environments, so we can reliably test our hypothesis. We plan to establish trials at ISU research stations and reach out to ISRC partners and council members who have offered to help us find locations for the trials and seed sources. Due to the intense labor required to detect time of onset at multiple locations, we will investigate the possibility of using remote sensing to detect initial changes in soybean canopy health that would be indicative of SDS onset. We will work in collaboration with statisticians at ISU to explore different approaches to analyze the data, possibly using thresholds to define onset and reduce variability in the data.

For the greenhouse component of this project, we plan to conduct additional experiments, using both the commercial varieties planted in the field and a new batch of seed from genotypes with well-characterized resistance levels to SDS. We will also try to optimize our protocols by reducing inoculum levels in an attempt to spread out the SDS onset time among resistance levels.