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Effects of Seed Treatment on Sudden Death Syndrome Symptoms and Soybean Yield

E.A. Adee

Summary

Sudden death syndrome (SDS) is a soybean disease that perennially limits yields in the Kansas River Valley. Soybean cyst nematode (SCN) and saturated soils have been implicated as contributing to the severity of the disease. Selecting varieties with some degree of tolerance to SDS is the only cultural practice that can potentially reduce the severity of SDS and improve yields. Variety selection alone, however, cannot improve the production of soybeans to make them profitable. The challenge of trying to manage irrigation scheduling and prevent saturated soils has further complicated trying to increase productivity with irrigation while avoiding SDS. A study with seed treatments applied to soybean was conducted at the Kansas River Valley Experiment Field in 2013, with treatments applied to three soybean varieties with different levels of tolerance to SDS. The study was irrigated earlier and more often than normal for soybean to promote the disease. The most severely infested plots had over 80% of the leaf area expressing symptoms of SDS by the R6 growth stage. Treatments with ILeVO from Bayer CropScience (Research Triangle Park, NC) reduced the amount of foliar disease in all varieties and increased yields up to 16 bu/a, or over 40%. Caution should be used in interpreting these data, which are from only one location for one year, but the results show some promising products may be available to help manage SDS.

Introduction

Soybean SDS is caused by the fungus *Fusarium virguiliforme*, which infects plants through the roots, primarily before they start to flower. Foliar symptoms generally begin to show up as interveinal chlorosis and necrosis in the leaves at growth stage R3, after the seed has started to develop in the pods.

An interaction between SDS and SCN has been reported, and SCN is prevalent in the soils of the Kansas River Valley. Saturated soils have also been implicated as contributing to the development of SDS. Depending on how early the symptoms begin to be visible and the symptoms' severity, yield losses can be very significant. In severe cases, plants in which the symptoms begin early (i.e., before seed development stage) can fail to produce any seed.

This disease has been a perennial problem in the Kansas River Valley, causing severe yield reductions in soybean to the point that the crop cannot be profitably produced in some fields. Crop rotations and tillage have had little effect on reducing the severity of the disease and reducing the subsequent yield loss. No soybean varieties are totally resistant to the fungus, but some varieties have varying degrees of tolerance that can reduce yield losses. Irrigating soybean at the wrong time also could increase the severity of SDS, further complicating production in the Kansas River Valley, where irrigation is often necessary to produce a profitable crop.

Another method of trying to increase soybean productivity in fields with a risk of SDS is seed treatment applied to the seeds at planting. Seed treatments could help protect the roots against initial infection by *F. virguiliforme*.

Procedures

Soybean were planted into a field with a history of SDS at the Rossville Unit of the Kansas River Valley Experiment Field in 2013. Three soybean varieties of varying levels of resistance to SDS were provided by Dennis Scott of Bayer Chemical Company. Seed from each variety was treated with three seed treatments: ILeVO at a higher rate, ILeVO at a lower rate, and a competitor's product with an untreated check. The soybean were planted May 17 at 140,000 seeds/a into 10- × 30-ft plots, with four replications in a randomized complete block design. The soil was Eudora silt loam, and the previous crop was soybean. Irrigation with a linear-move sprinkler irrigation system was started on June 24. Total irrigation was 5.13 in., and 14.2 in. of rain was received during the growing season. Preemergent herbicide applied at planting was Authority XL (FMC Corporation Agricultural Products Group, Philadelphia, PA) (5 oz) and Dual II Mag (Syngenta Crop Protection LLC, Greensboro, NC) (1.5 pt). Postemergent herbicide was Roundup PowerMax (Monsanto, St. Louis, MO) (22 oz) and Warrant (Monsanto) (1.5 qt). Foliar symptoms of SDS were rated weekly starting August 12, when soybean were at the R4 (pods full length) to R5 (beginning seed formation) growth stages. Ratings were based on incidence and severity of the symptoms. An area under the disease progress curve (AUDPC), a unitless number describing the development of defoliation effects over time, was derived by plotting periodic measurements of disease over time and integrating the area under the disease curve. A GreenSeeker meter (Trimble Navigation, Ag Division, Westminster, CO) was also used to collect normalized difference vegetation index (NDVI) readings from each plot at the R6 (full seed) growth stage. The NDVI readings are higher when there are abundant, green leaves to absorb the light used in photosynthesis. The plots were harvested September 30.

Results

The severity of the disease ratings, using both the AUDPC and the NDVI, explained much of the yield difference between treatments (Figures 1 and 2). These two graphs also show that the more "traditional" ratings with the AUDPC and the NDVI are nearly equal in relating to yield. As the AUDPC increased, the yield decreased, with the AUDPC explaining more than 50% of the change in yield. The NDVI readings explained more than 60% of the change in yields, with soybean yields increasing as the NDVI increased. The improvement in NDVI explaining more of the yield variation may be a result of what the readings are measuring: NDVI takes into account the amount of foliage as well as the greenness, whereas the AUDPC is looking at the amount of green and diseased leaf tissue in a plot.

The seed treatments with ILeVO increased yields from 5 to 16 bu/a, depending on the rate of the product and the level of resistance in the soybean variety (Table 1). The greatest yields were with the two varieties that had a higher level of resistance.

Yield results show the benefit of planting varieties with some level of tolerance to SDS. In addition, increased tolerance to SDS reduced disease severity (Table 1). Disease severity ratings show that the environment this study was conducted in was very favor-

able for SDS, with nearly 90% of the leaves showing symptoms in the most affected plots (Table 1). To have over a 40% yield increase due to seed treatment with this level of severity is promising. These data are from a single location for one year, however, so further research needs to confirm if this product will be effective in a predictable manner.

Table 1. Influence of variety and seed treatment for sudden death syndrome (SDS) on yield of soybean, Kansas River Valley Experiment Field, Rossville, 2013

Soybean varieties:	Most resistant	Moderately resistant	Susceptible	Most resistant	Moderately resistant	Susceptible
Seed treatments	bu/a			Percentage of leaf area with SDS at R6		
Check	28.6	29.2	21.3	18	44	63
Competitor's product	32.1	33.2	15.4	21	33	88
ILeVO[1] at higher rate	41.6	39.7	37.4	4	28	45
ILeVO at lower rate	42.9	41.0	26.2	5	28	72
LSD 0.05	8.3 bu/a			17.4%		

[1] Bayer CropScience (Research Triangle Park, NC).

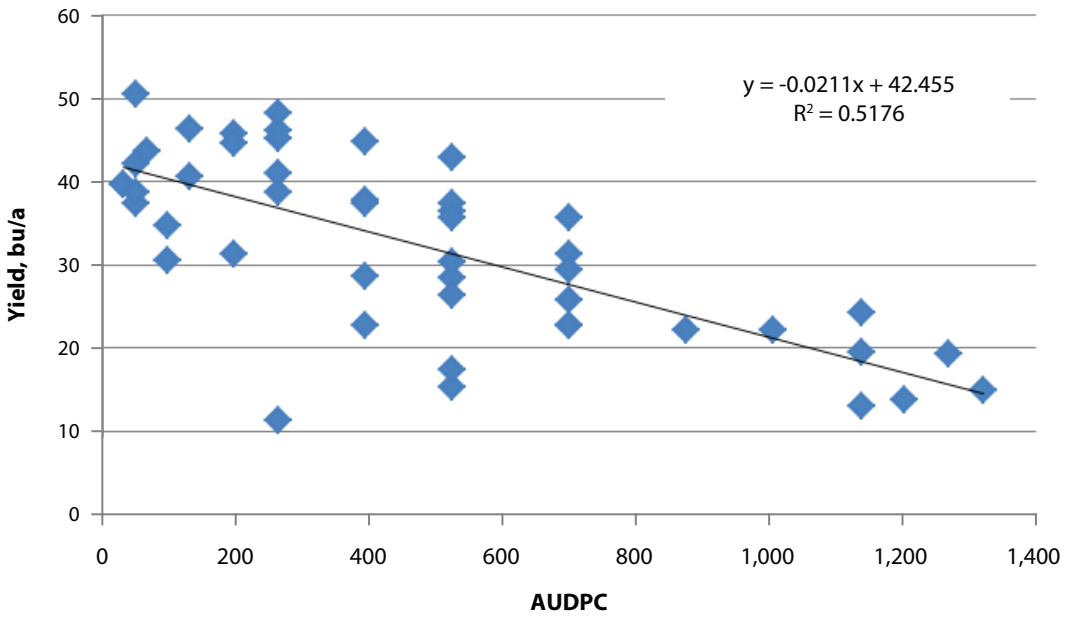

Figure 1. Relationship between area under disease progress curve (AUDPC) for SDS and yield, Kansas River Valley Experiment Field, 2013.

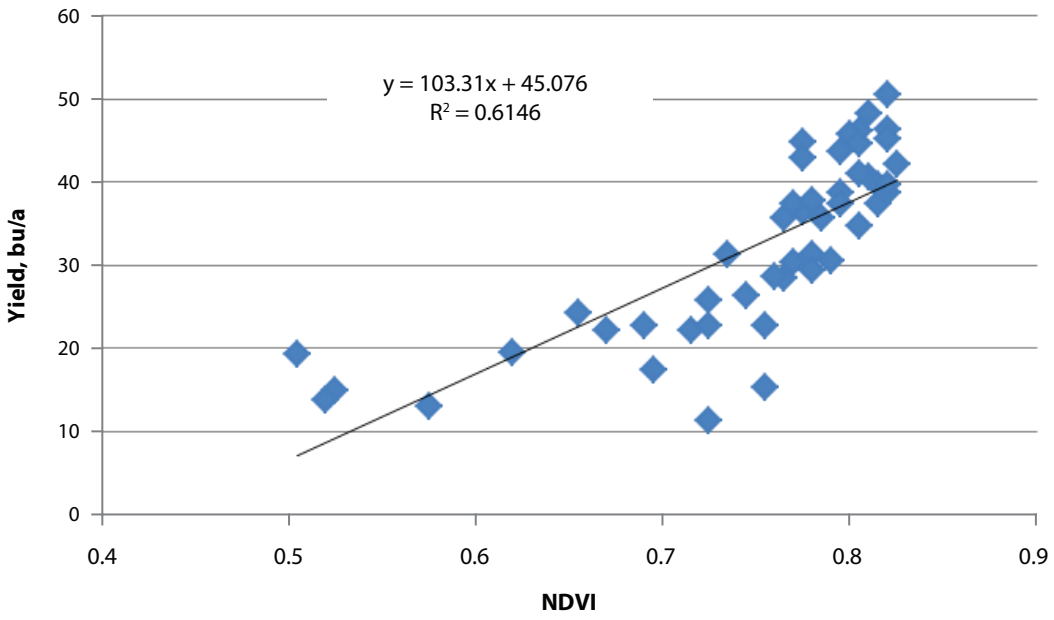

Figure 2. Relationship between normalized difference vegetation index (NDVI) readings taken with a GreenSeeker meter (Trimble Navigation, Ag Division, Westminster, CO) from plots with SDS foliar symptoms at R6 and soybean yield, Kansas River Valley Experiment Field, 2013.