Kansas Agricultural Experiment Station Research Reports

Volume 1
Issue 2 *Kansas Field Research*

Article 3

January 2015

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Recommended Citation
Adee, E. A. (2015) "Effects of Seed Treatment on Sudden Death Syndrome Symptoms and Soybean Yield," *Kansas Agricultural Experiment Station Research Reports*: Vol. 1: Iss. 2. https://doi.org/10.4148/2378-5977.1006

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Erratum

Soybean variety Stine 42RE02 (Stine Seed Co., Adel, IA) was misidentified in the first version of this report. The error has now been corrected.

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. The presence of soybean cyst nematode (SCN) and saturated soils have been implicated in 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 to avoid saturated soils further complicates efforts to increase productivity with irrigation while still avoiding SDS. A study with seed treatments applied to soybean was conducted at the Kansas River Valley Experiment Field in 2014, with treatments applied to a soybean variety with a high level of tolerance to SDS. The study was irrigated earlier and more often than normal to promote the disease. The most severely infested plots had more than 50% of the leaf area expressing symptoms of SDS by the R6 growth stage. Treatments with ILeVO from Bayer CropScience (Research Triangle Park, NC) reduced foliar symptoms and increased yields up to 12 bu/a, or more than 25%. These results are similar to those in a 2013 study of varieties with SDS tolerance ranging from very susceptible to more tolerant; the yield increase was up to 16 bu/a, or 40% with the ILeVO seed treatment.

Introduction
Soybean SDS is caused by the fungus *Fusarium virguliforme*, 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 also have 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 the 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 at planting. Seed treatments could help protect the roots against initial infection by *F. virguliforme.*

Procedures

Soybean were planted into a field with a history of SDS at the Rossville Unit of the Kansas River Valley Experiment Field in 2014. Seed treatments were applied by Bayer CropScience (Research Triangle Park, NC) to a soybean variety with a high level of tolerance to SDS, Stine 42RE02 (Stine Seed Co., Adel, IA). The treatments included: ILeVO 0.15 mg/seed and ILeVO 0.075 mg/seed in combination with other seed treatment products, a check with Poncho/Votivo or Gaucho, and a test product. Soybean were planted May 6 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 7.81 in., and 21.4 in. of rain was received during the growing season. Preemergence herbicide applied at planting was Authority Maxx (FMC Corporation Agricultural Products Group, Philadelphia, PA) (5 oz) and Cinch (Syngenta Crop Protection, LLC, Greensboro, NC) (1.5 pt). Postemergence herbicide was Roundup PowerMax (Monsanto Company) (22 oz), Assure II (DuPont, Wilmington, DE) (12 oz), and Warrant (Monsanto Company) (1.5 qt). Foliar symptoms of SDS were rated weekly starting August 6, when the soybean were at the R4 (pods full length) to September 3 at the R6 (full seed) 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 growth stage. The NDVI readings are higher when plants have 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 AUDPC and NDVI, correlated with yield (Figures 1 and 2). The figures also show that the more "traditional" ratings with the AUDPC and the NDVI are nearly equal in their relationship with yield. As the AUDPC increased, the yield decreased, with the AUDPC explaining more than 28% of the change in yield. The NDVI readings explained more than 16% of the change in yields, with soybean yields increasing as the NDVI increased.

The seed treatments with ILeVO increased yields from 3 to 12 bu/a, depending on the rate of the product and the additional seed treatments (Table 1). The greatest yields were with the higher rates of ILeVO.

Disease severity ratings show that the environment in which this study was conducted was very favorable for SDS, with nearly 50% of the leaves showing symptoms in the most affected plots with this variety that is highly tolerant to SDS (Table 1). To have a more than 25% yield increase owing to seed treatment with this level of severity is promising. These data are similar to a study with ILeVO conducted in 2013, indicating that this product can consistently decrease soybean yield loss due to SDS. This seed treatment in combination with a variety with a high tolerance to SDS could make soybean more sustainable as a crop in the presence of SDS.

Table 1. Influence of seed treatment for sudden death syndrome (SDS) on yield of soybean on Stine 43RE02, Kansas River Valley Experiment Field, Rossville, 2014

Seed treatments	Yield	SDS severity	SDS severity	NDVI[1]
	bu/a	% leaf area at R6	AUDPC[2]	
Poncho/Votivo check	47.4 g[3]	52 a	696 ab	0.834 bc
ILeVO[4] (0.15 mg)+ Poncho/Votivo	59.6 a	16 bc	146 c	0.846 ab
ILeVO (0.075 mg)+ Poncho/Votivo	57.0 d	31 ab	443 bc	0.835 bc
Gaucho 600 check	54.0 d	25 bc	814 a	0.818 c
ILeVO (0.15 mg)+ Gaucho 600	57.2 c	16 bc	192 c	0.849 ab
ILeVO (0.075 mg)+ Gaucho 600	57.1 d	7 c	153 c	0.864 a
ILeVO (0.15 mg)+ Gaucho 600 + Agriplier	58.3 b	13 bc	148 c	0.858 a
Poncho/Votivo + test compound	50.1 f	21 bc	572 ab	0.830 bc
LSD 0.05	0.06	22.9	354	0.021

[1] Normalized difference vegetation index.
[2] Area under the disease progress curve, a unitless number describing the development of defoliation effects over time.
[3] Values followed with different letters are significantly different at $P < 0.05$.
[4] Bayer CropScience (Research Triangle Park, NC).

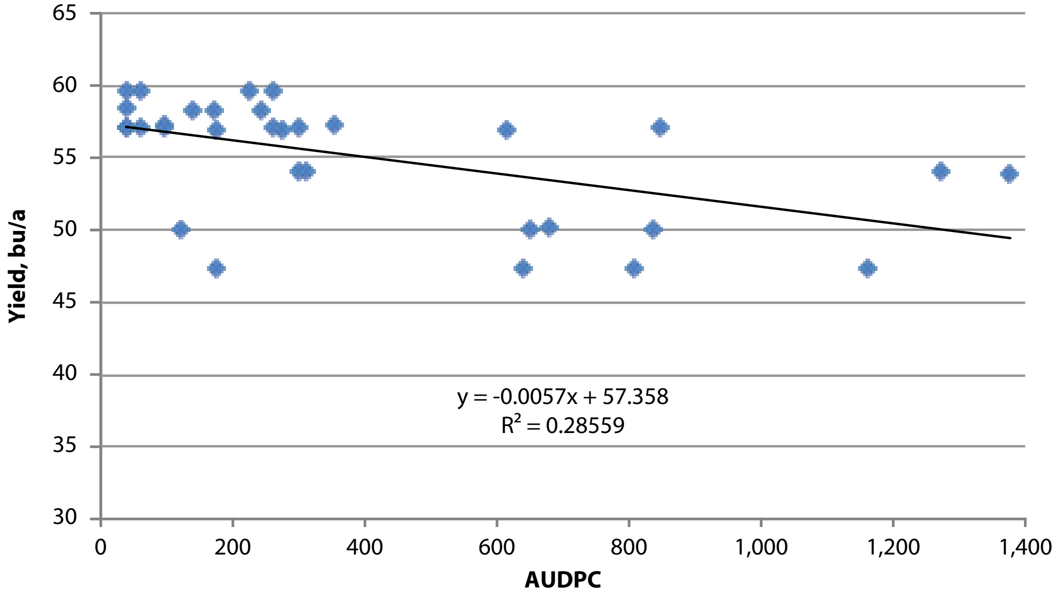

Figure 1. The severity of soybean sudden death syndrome disease ratings as shown by area under the disease progress curve (AUDPC, a unitless number describing the development of defoliation effects over time) correlated with yield, Kansas River Valley Experiment Field, Rossville, 2014.

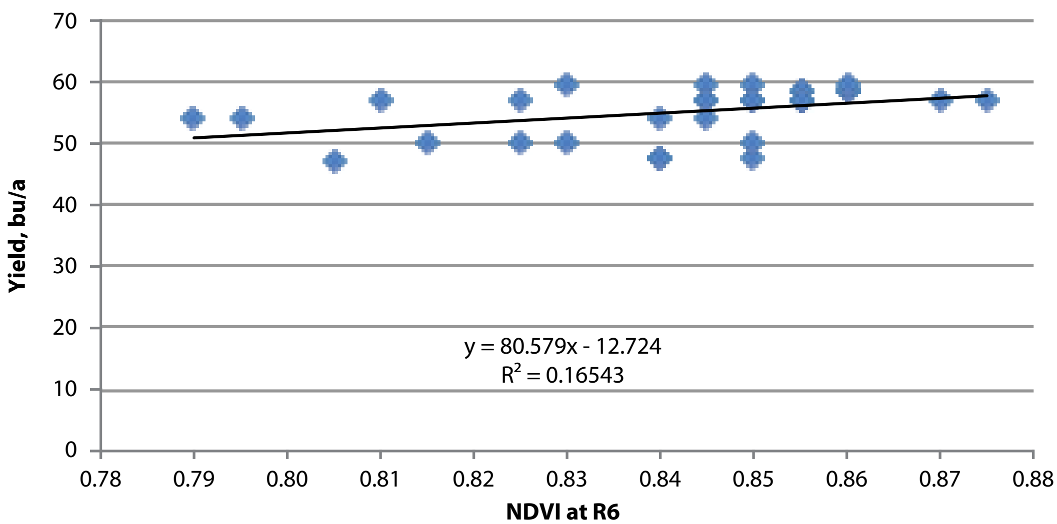

Figure 2. The severity of soybean sudden death syndrome disease ratings as shown by normalized difference vegetation index (NDVI) at growth stage R6 correlated with yield, Kansas River Valley Experiment Field, Rossville, 2014.