Don't Delay Soybean Planting to Manage Sudden Death Syndrome (SDS): Yield Loss Can Result

David A. Marburger, Department of Plant and Soil Sciences, Oklahoma State University; Damon L. Smith, Department of Plant Pathology, University of Wisconsin-Madison; Shawn P. Conley, Department of Agronomy, University of Wisconsin-Madison

In a bean pod…

- Wisconsin soybean growers should not sacrifice early-May planting dates that maximize yield in order to reduce SDS development and subsequent yield loss.
- Highest amount of SDS symptoms occurred in early-May planting dates. Despite this, highest yields also occurred in the early-May planting dates.
- Careful attention should be given to selecting cultivars with high-yield potential as the first priority, and then focus cultivar selection using company SDS ratings.

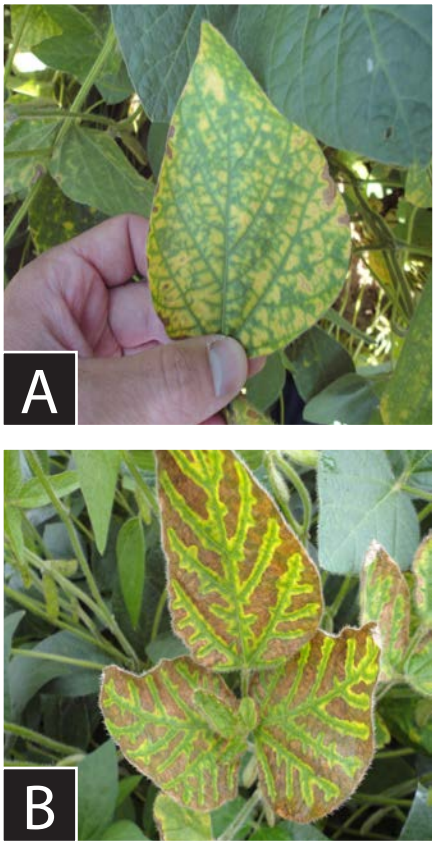


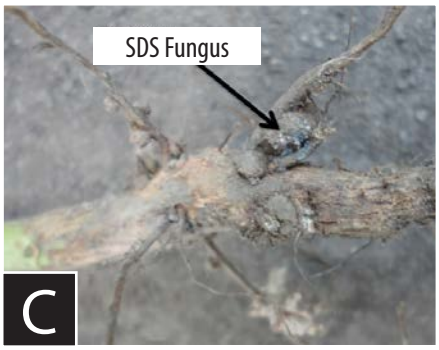
Figure 1. SDS foliar symptoms begin as yellowing between the veins of the leaflets (A). As symptoms quickly progress, the yellowing tissue quickly dies, and the veins of symptomatic leaves will remain green (B). Sometimes you can see the blue to purple colored spores of the SDS fungus on the roots of symptomatic plants (C). The tissue inside the stem of an infected plant will remain a healthy white color (D). *Photos courtesy of David Marburger, Damon Smith and Craig Grau.*

INTRODUCTION

Sudden death syndrome (SDS) is a disease of soybean caused by the soil-borne fungus, *Fusarium virguliforme*. Although SDS was first discovered in Wisconsin in 2006 (Bernstein et al. 2007), further work has shown that the SDS fungus has been found 28 soybean-producing counties in the state (Marburger et al. 2015).

SDS SYMPTOMS AND YIELD LOSS

The SDS fungus infects soybean very early in the growing season, as early as 14 days after planting, with cool and wet soil conditions favoring infection. While the fungus infects early in the growing season, foliar symptoms are not typically observed until the mid-reproductive growth stages [R3 (beginning pod development) to R5 (beginning seed development)]. Foliar symptoms are the result of phytotoxins secreted by the fungus and translocated through the water-conducting organs (xylem) from the roots to the leaves (Brar et al. 2011). Foliar symptoms begin as yellowing between the veins of the leaflets (Figure 1a). The yellow areas of the leaf quickly die, but the veins of symptomatic leaves will remain green (Figure 1b). In severe situations, leaflets will curl or shrivel and drop off with only the petiole remaining. With severe infections, symptoms appearing in the early reproductive growth stages typically reduce seed number by inducing flowering and pod abortion. Symptoms appearing during the pod-filling stages typically reduce yield through decreased seed size. Yield loss up to 80% in



individual fields has been attributed to SDS, but yield loss of 5 to 15% is more common (Roy et al. 1997).

MANAGEMENT

Cultivar selection is considered the best management practice for controlling SDS. Therefore, SDS-resistant cultivars should be chosen whenever possible. If SDS and SCN are both problems in a field, choosing a variety with the best resistance/tolerance to both will be beneficial. Improving soil drainage and reducing compaction can help reduce levels of SDS. Foliar fungicide applications will not control this pathogen. Unfortunately, using crop rotation and tillage to manage SDS have provided inconsistent results. Both of these practices can be useful to manage other disease of soybean; however, research has demonstrated that crop rotation, for example, does not significantly reduce levels of the SDS fungus in the soil. Even after several years of planting corn in a field, the SDS fungus can survive on corn plants and corn kernels can harbor the pathogen. In addition, the SDS fungus can survive in soil for long periods of time as specialized, thick-walled spores. For more information about SDS, consult the Crop Protection Network fact sheet *Sudden Death Syndrome (CPN-1011)*.

Because cool and wet soil conditions typically observed early in the season can favor infection by the SDS fungus, research from the late 1980s and early 1990s showed that delaying planting can reduce the risk of infection and subsequent symptom development (Hershman et al. 1990; Wrather et al. 1995). It is important to remember though that yield loss in Wisconsin will occur from delaying planting after mid-May. However, the impact of currently recommended planting dates (late-April to mid-May) on SDS foliar symptom development and soybean yield loss have not yet been examined. Therefore, the objective of this study was to quantify planting date and cultivar effects on SDS foliar symptom development and soybean yield loss in Wisconsin.

EXPERIMENT METHODS

This experiment was conducted at the Hancock Agricultural Research Station near Hancock, Wisconsin during the 2013 and 2014 growing seasons. The experiment consisted of three planting dates (early-May, late-May, and mid-June), ten soybean cultivars ranging in SDS foliar symptom reaction according to the respective companies (Table 1), and two inoculation treatments (non-inoculated and inoculated). Plots were inoculated by placing oat seed infested with the SDS fungus in-furrow next to the soybean seed at the time of planting.

Foliar SDS symptom ratings were recorded weekly beginning with the first visual symptoms at the R5 growth stage (beginning seed), and continued up to the R7 growth stage (beginning maturity). Symptoms were rated by visually determining disease incidence and severity from each plot. These two numbers were used to calculate a disease index (DX) score (0 to 100).

SDS SYMPTOM RESULTS

Disease index values were greatest for each cultivar in the early-May planting date (Figure 2). Delaying planting to late-May showed reduced symptoms, and little symptom development was found in the mid-June planting date. The two cultivars which had the best SDS ratings provided by their respective companies (CH2105R2 and P92Y51) were the only two cultivars consistently exhibiting the lowest DX values within the first and second planting dates. Three cultivars (CH2305R2, P92Y11, and P92Y32) were those that consistently showed the highest DX values within the first and second planting dates; however, only one of these cultivars (P92Y11) was consistent with having the most susceptible SDS rating provided by its respective company.

Table 1. Soybean cultivar information including brand, maturity group, and sudden death syndrome (SDS) ratings.

		SDS rating		
Brand	**Cultivar**	**Maturitygroup**	**Brand rating[y]**	**Current study rating[z]**
Asgrow	AG1931	1.9	6	A
Channel	CH2105R2	2.1	2	L
Pioneer	P92Y11	2.1	4	H
Pioneer	P92Y12	2.1	4	A
Channel	CH2305R2	2.3	5	H
Pioneer	P92Y32	2.3	6	H
Asgrow	AG2431	2.4	6	A
Asgrow	AG2531	2.5	4	A
Pioneer	P92Y51	2.5	7	L
Pioneer	P92Y53	2.5	6	A

[y] Reported SDS rating by the brand. Asgrow and Channel cultivars on a 1-to-9 scale, with 1 = most resistant. Pioneer cultivars on a 1-to-9 scale, with 1 = most susceptible.

[z] Current study rating was determined based on the amount of foliar SDS symptom development observed in this study in both 2013 and 2014; H = highest level of foliar symptom development; L = lowest level of foliar symptom development; A = average foliar symptom development.

YIELD RESULTS

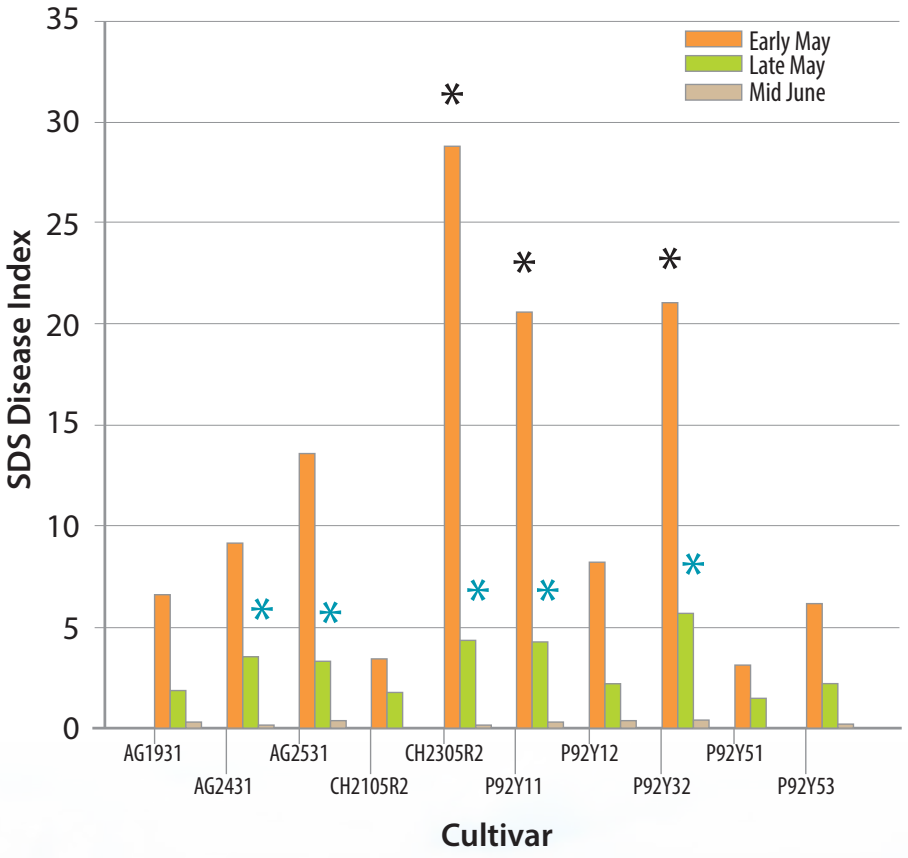
PLANTING DATE

The yield difference between non-inoculated and inoculated plots in the early-May planting date was 8.3 bu/a (15%) (Figure 3). In the late-May planting date, this difference was 7.7 bu/a (15%); however, average yield in the early-May planting date was 5.1 bu/a (9%) greater than the late-May planting date. For the June 17 date, inoculated plots yielded 3.1 bu/a (7%) less than non-inoculated plots, despite little foliar symptom development. Average yield in the June 17 planting date was 9.5 bu/a (21%) less than the late-May.

CULTIVARS

Nine of the ten cultivars used in this experiment showed significantly lower yields in the inoculated plots, with the yield differences between non-inoculated and inoculated plots ranging from 4.5 to 8.5 bu/a (8 to 16%) (Figure 4). The cultivar CH2105R2 was the one that did not show a significant difference. Within the non-inoculated plots, two cultivars (AG2531 and P92Y51) yielded similar to the highest-yielding cultivar (CH2305R2). For the inoculated plots, the cultivar P92Y51 was the highest-yielding, and cultivars CH2105R2 and CH2305R2 yielded statistically similar. The yield results from the inoculated plots demonstrated the two cultivars that consistently had the lowest amount of SDS symptom development (CH2105R2 and P92Y51) were also among the highest-yielding. In spite of displaying some of the greatest amount of SDS symptoms, the cultivar CH2305R2 was also among the highest-yielding under inoculated conditions.

Figure 2. SDS disease index values (i.e., amount of foliar symptom development) for soybean cultivars inoculated with the SDS fungus *(Fusarium virguliforme)* within each planting date in Wisconsin during 2013 to 2014. (*) indicates not statistically different from the cultivar with the highest index value within the first planting date. (*) indicates not statistically different from the cultivar with the highest index value within the second planting date.



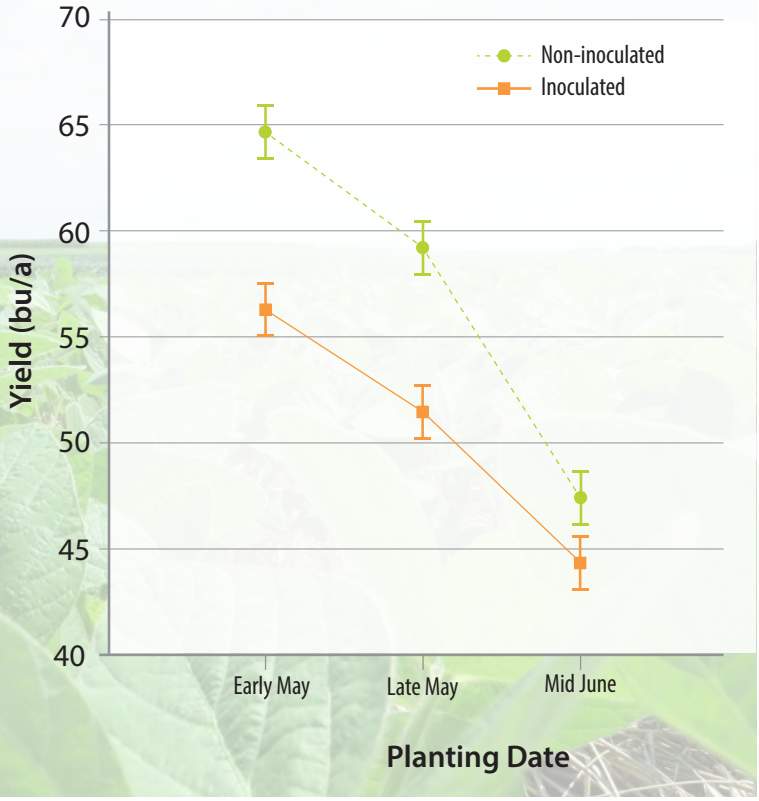


Figure 3. Soybean yield for each planting date in plots inoculated with the SDS fungus (*Fusarium virguliforme*) and not inoculated in Wisconsin during 2013 to 2014.

CONCLUSIONS AND RECOMMENDATIONS

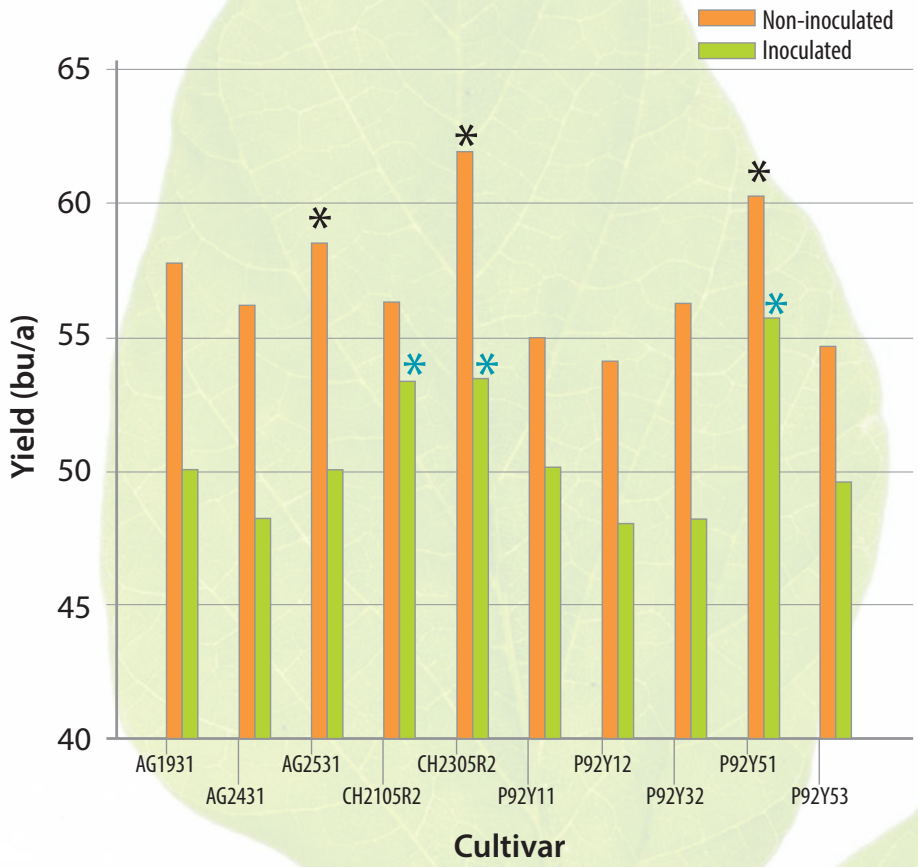
Our results support previous reports that foliar SDS symptom development is greater in early- versus late-planted soybean. Although SDS symptoms and yield loss were greatest in the early-May planting date, average yield was also greatest in the early-May planting date.

Although the two cultivars used in this study which had the most resistant ratings by their respective companies (CH2105R2 and P92Y51) exhibited the lowest symptom development within high SDS environments (i.e., the early-May planting date), the cultivars with the most susceptible disease ratings did not necessarily exhibit the greatest amount of symptom development. While CH2105R2 and P92Y51 were among the highest-yielding cultivars, especially when SDS symptoms were observed, the cultivar CH2305R2 was also among the highest-yielding in spite of being one of the cultivars expressing the greatest amount of symptom development.

Results presented here suggest growers in Wisconsin should not sacrifice planting dates that maximize yield in order to reduce SDS development. Careful attention should be given to selecting cultivars with high yield potential as the first priority, and then focus cultivar selection using company SDS ratings to maximize yield potential and profitability.

A fungicide seed treatment labeled for controlling the SDS fungus, fluopyram (marketed as ILeVO), has recently become commercially available. Recent research has shown that using this fungicide seed treatment resulted in less SDS foliar symptom development and reduced soybean yield loss (Kandel et al. 2016). Therefore, using this fungicide seed treatment in a field with known SDS history and utilizing early-May planting dates along with other SDS management recommendations in Wisconsin has the potential to reduce SDS foliar symptoms and maintain soybean yield potential.

Figure 4. Yield for soybean cultivars inoculated with the SDS fungus (Fusarium virguliforme) and not inoculated in Wisconsin during 2013 to 2014. (*) indicates not statistically different from the highest-yielding cultivar within the non-inoculated plots. (*) indicates not statistically different from the highest-yielding cultivar within the inoculated plots.



Data from: Marburger, D.A., Smith, D.L., and Conley, S.P. 2016. Revisiting planting date and cultivar effects on soybean sudden death syndrome development and yield loss. Plant Dis. (in press).

LITERATURE CITED

Bernstein, E.R., Atallah, Z.K., Koval, N.C., Hudelson, B.D., and Grau, C.R. 2007. First report of sudden death syndrome of soybean in Wisconsin. Plant Dis. 91:1201–1201.

Brar, H.K., Swaminathan, S., and Bhattacharyya, M.K. 2011. The Fusarium virguliforme toxin FvTox1 causes foliar sudden death syndrom-like symptoms in soybean. Mol. Plant Microbe In. 24:1179-1188.

Hershman, D.E., Hendrix, J.W., Stuckey, R.E., Bachi, P.R., and Henson, G. 1990. Influence of planting date and cultivar on soybean sudden death syndrome in Kentucky. Plant Dis. 74:761-766.

Kandel, Y.R., Wise, K.A., Bradley, C.A., Tenuta, A.U., and Mueller, D.S. 2016. Effect of planting date, seed treatment, and cultivar on plant population, sudden death syndrome, and yield of soybean. Plant Dis. 100: 1735-1743.

Marburger, D., Conley, S., Gaska, J., Gerber, L., MacGuidwin, A., and Smith, D. 2015. The relationship between the causal agent of SDS and SCN in Wisconsin. University of Wisconsin-Madison Extension. Online publication. Available at: http://coolbean.info/library/documents/SCN_SDS_2015_FINAL.pdfdoi:10.1094/PHP-RS-13-0107.

Roy, K.W., Rupe, J.C., Hershman, D.E., and Abney, T.S. 1997. Sudden death syndrome of soybean. Plant Dis. 81:1100-1111.

Wrather, J.A., Kendig, S.R., Anand, S.C., Niblack, T.L., and Smith, G.S. 1995. Effects of tillage, cultivar, and planting date on percentage of soybean leaves with symptoms of sudden death syndrome. Plant Dis. 79:560-562.