

## Soybean Sudden Death Syndrome Overview

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Among the top four loss causing diseases of soybean [*Glycine max* (L.) Merrill.], worldwide were the root rot and leaf scorch called Sudden Death Syndrome (SDS; Wrather et al. 1996; 2003). Over a five year period 1999-2004 average losses around 1% or 0.9 million Mg per harvest, worth \$190 million a year, were reported. The syndrome was accurately predicted to intensify and spread over the next 20 years over the whole north central region (Scherer and Yang, 1996). SDS starts in field as hotspots associated with low areas and over 3-5 years become established throughout the field. There is no means to stop its spread. Agronomic solutions are costly and often ineffective (late planting, deep tilling etc). Therefore, improved genetic resistance in germplasm releases will be key to containing soybean losses to SDS (Gibson et al. 1994; Kazi et al, 2008). SDS was shown to be caused by the blue-pigmented soil borne fungus *Fusarium virguliforme* (Aoki et al. 2003; ex. *Fusarium solani* (Mart.) Sacc. f. sp. *glycines*; Fsg; Roy 1997). *F. virguliforme* is a member of an evolutionary group known as the “*F. solani* complex” that colonize a wide variety of habitats and hosts (Gray et al. 1999; O’Donnell, 2000). They are serious pathogens of many crops. Analysis in North America showed that only *F. virguliforme* prompted the symptoms of SDS on soybean but in South America two separate species, *F. tucumaniae* and *F. virguliforme*, were both responsible for SDS (Aoki et al. 2003; Covert et al. 2007). The genetics of resistance to SDS is complex. Stephens et al. (1993) reported that a single dominant gene, *Rfs* controls SDS resistance in ‘Ripley’ soybean in greenhouse conditions. In contrast, the ‘Essex’ by ‘Forrest’ (ExF) population (Hnetkovsky et al. 1996; Chang et al. 1996; Kassem et al. 2006) showed that the SDS resistance was conditioned by several quantitative trait loci (QTL). By 2007, more than twenty detections of QTL for resistance to SDS have been reported among eight different recombinant inbred line (RIL) populations. Soybean [*Glycine max* (L.) Merr.] cultivars show differences in their resistance to both the leaf scorch and root rot of sudden death syndrome (SDS). Root susceptibility combined with reduced leaf scorch resistance has been associated with resistance to *H. glycines* HG Type 1.3.6.7 (race 14) of the soybean cyst nematode (SCN). In contrast, the *rhg1* locus underlying resistance to Hg Type 0 was found clustered with three loci for resistance to SDS leaf scorch and one for root infection. Interactions with SCN are currently a topic of intense research.

### Bibliography

- Aoki T, O'Donnell K, Homma Y, Lattanzi AR (2003) Sudden-death syndrome of soybean is caused by two morphologically and phylogenetically distinct species within the *Fusarium solani* species complex - *F. virguliforme* in North America and *F. tucumaniae* in South America. *Mycologia* 95: 660-684
- Chang SJC, Doubler TW, Kilo V, Suttner RJ, Klein JH, Schmidt ME, Gibson PT and Lightfoot DA (1996) Two additional loci underlying durable field resistance to soybean sudden-death syndrome (SDS). *Crop Sci* 36:1624-1628
- Gibson PT, Shenaut MA, Njiti VN, Suttner RJ, Myers Jr O (1994) Soybean varietal response to sudden death syndrome. p. 436-446. In D. Wilkinson (ed.) Proc. Twenty-fourth Soybean Seed Res. Conf., Chicago, IL. 6-7 Dec. 1994. Am Seed Trade Assoc Washington DC.
- Hnetkovsky N, Chang SJC, Doubler TW, Gibson PT, Lightfoot DA (1996) Genetic mapping of loci underlying field resistance to soybean sudden death syndrome (SDS). *Crop Sci* 36:393-400
- Kassem MA, Shultz J, Meksem K, Cho Y, Wood AJ, Iqbal MJ, Lightfoot DA (2006) An updated ‘Essex’ by ‘Forrest’ linkage map and first composite interval map of QTL underlying six soybean traits. *Theor Appl Genet* 113:1015-1026
- Kazi S., Shultz J, Bashir, R., Afzal J, Njiti V, Lightfoot D.A. 2008. Separate loci underlie resistance to soybean sudden death syndrome in ‘Hartwig’ by ‘Flyer’. *Theoretical and Applied Genetics* 116: 967-977

Lightfoot DA, Meksem K, Gibson PT (2001) Soybean Sudden Death Syndrome resistant soybeans, soybean cyst nematode resistant soybeans and methods of breeding and identifying resistant plants: DNA markers. US Patent # 6,300,541

Lightfoot DA, Meksem K, Gibson PT (2007) Method of determining soybean sudden death syndrome resistance in a soybean plant. US Patent #7,288,386

Scherm H, Yang XB (1996) Development of sudden death syndrome of soybean in relation to soil temperature and soil water potential. *Phytopathology* 86:642-649

Wrather JA, Anderson TR, Arsyad DM, Gai J, Ploper DL, Portapuglia A, Ram HH, Yorinori JT (1996) Soybean disease loss estimates for the top ten producing countries during. *Plant Disease* 79:107-110

Wrather JA, Koenning SR, Anderson TR (2003) Effect of diseases on soybean yields in the United States and Ontario (1999 to 2002). *Plant Health Progr* (online Doi 10.1049)