North Central Soybean Research Program

Breeding to improve resistance to SDS in soybean as a means to protect yield: Delivering resistant varieties and lines

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Sudden death syndrome (SDS), caused by the fungus *Fusarium virguliforme,* is one of the diseases that migrated from the southern area of soybean production regions. Depending on environmental conditions, SDS can cause yield losses from 10 to 50%. Planting the most resistant varieties available is the foundation of an SDS management program. There is no completely resistant soybean variety to date, but planting partially resistant varieties will minimize yield loss.

Project objective

To develop high-yielding, SDS-resistant soybean cultivars for farmers and germplasm lines for the seed industry for maturity groups I to VI.

Results

Releases: 6 releases of SDS-resistant germplasm lines

Detailed work by researcher/institution:

P. Chen (UA). NCSRP SDS Variety Trial. A total of 13 conventional and one RR-Y2 advanced lines were entered in 2016 NCSRP SDS Variety Trail MG 4. A total of 16 conventional, three RR, and two RR-Y2 advanced lines were entered in the 2016 NCSRP SDS Variety Trial MG 5. SDS reaction and yield of these lines will be used to make release decisions in the future. Among the MG 4 and 5 lines entered NCSRP SDS Trial, two MG 4 and one MG 5 high-yielding lines are derived from 5002T (resistant parent), while one MG 4 and two MG 5 high-yielding lines are derived from LS03-4294 as a source of SDS resistance (Table 1).

Promising Lines in the USDA Uniform Tests. Three advanced lines with potential resistance to SDS were entered in the 2016 USDA Uniform Test and additional two advanced lines were entered in the 2016 USDA Preliminary Test. When evaluated in 2015 USDA Uniform Test MG 6 across 11 locations, R11-171 exhibited good yield potential (60.8 bu/ac) compared to the commercial check AG6534 (55.8bu/ac) and low DX for SDS (DX=10). R11-171 is being re-evaluated in the 2016 USDA Uniform Test MG 6.

S.R. Cianzio (ISU). Will be released: 1 line highly resistant to SDS and to SCN,

currently under evaluation on the Soybean Uniform Regional Tests. Releases of 3 experimental lines highly resistant to SDS and to SCN are in preparation.

B. Diers (UI). The University of Illinois breeding program develops and release experimental lines with SDS resistance. During the summer of 2016, new experimental lines were developed and evaluated for yield and agronomic traits. Based on the performance of lines in 2016 tests, new lines will be considered for release with winter.

S. K. Kantartzi (SIU). Will be released: 1 line highly resistant to SDS. Research work: it is expected that the new genetic populations developed (LS07 3131 x Forrest; LS03-4294 x Ripley; and LS03-4294 x LS05-3229), will identify new QTL for resistance to SDS. A manuscript is in preparation.

J. Orf (UM-St Paul). Work in progress to release new advanced germplasm SDS resistant lines.

D. Wang (UM). 1 SDS resistant variety was released in the spring of 2016. Eighteen lines with SDS resistance were entered in the 2016 regional SDS test. Seventy three advanced breeding lines were evaluated in our Decatur SDS disease nursery and new lines with strong SDS resistance were identified.

Identification of new sources of resistance accomplishments

J. Bond (SIU). Regional germplasm testing and coordination. In 2016, 11 testing locations across 6 states and Canada were planted. This was a good symptomatic year for the regional trials. The level of resistance established for most entries is valuable information for germplasm development and germplasm releases to the seed industry. During the summer of 2016, new experimental lines were developed and evaluated for yield and agronomic traits. Based on the performance of lines in 2016 tests, new lines will be considered for release with winter.

G.L. Hartman (USDA-ARS at the University of Illinois. Greenhouse germplasm evaluations: Several tests were completed during this period for evaluation of both foliar and root resistance in a set of 350 accessions of soybean and 81 wild soybean (G. soja). The phenotype information will be used for genome-wide association studies. For the field evaluations we provided SIU with SDS data for the North Central Regional Trials (maturity groups II, III, and IV) and USDA Trials (maturity group I and II) that were planted in three replicated experiments in Urbana, IL. All entries were inoculated at planting, irrigated through the season, and notes recorded for SDS. Also, the USDA Trial (two replicated experiments, MG I and II) were planted in western Illinois at the University of Illinois Monmouth Research Station. All entries were inoculated at planting. Notes on SDS were recorded by a cooperator that lives near the Monmouth Research Station.

The check stocks, partially resistant and susceptible based on foliar symptoms, did not show great differences in root assays. There has been an on-going effort to discover better sources of root resistance to this fungus, and so far, we have not found any new sources of root resistance. Over 10,000 plant introductions are

being assembled with a draft manuscript completed with one additional repeat of an experiment needed to complete the study. In addition, several other manuscripts were published and/or accepted for publication during this reporting period.

Publications

Cianzio, S.R., P. Lundeen, M.K. Bhattacharyya, S. Swaminathan, G. Gebhart, and N. Rivera-Velez. 2016. Registration of AR11SDS soybean germplasm Resistant to Sudden Death Syndrome, soybean Cyst Nematode, and with Moderate Iron Deficiency Chlorosis Scores. J. Plant Registrations 10: 177-188.

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Chang, H.-X., Lipka, A., Domier, L. L., and Hartman, G. L. 2016. Characterization of disease resistance loci in the USDA Soybean Germplasm collection using genome-wide associations. Phytopathology 106:http://dx.doi.org/10.1094/PHYTO-1001-1016-0042-FI.

Chang, H.-X., Yendrek, C. R., Caetano-Anollés, G., and Hartman, G. 2016. Genomic characterization of plant cell wall degrading enzymes and in silico analysis of xylanses and polygalacturonases of Fusarium virguliforme. BMC Microbiology 16:147 DOI 10.1186/s12866-12016-10761-12860.

Swaminathan, S., Abeysekara N.S., Lin, M., Cianizo S.R., and Bhattacharyya, M.K. 2015. Identification of quantitative trait loci underlying the sensitivity of soybean to the Fusarium virguliforme that induce foliar soybean sudden death syndrome in soybean. Thero. Appl. Genet. DOI.10.1007/s00122-015-2643-5.

Xiang Y., Scandiani M.M., Herman T.K., Hartman G.L. (2015) Optimizing conditions of a cell-free toxic filtrate stem cutting assay to evaluate soybean genotype responses to Fusarium species that cause sudden death syndrome. Plant Disease 99:502-507.