MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 78-2016 (YEAR 2 OF 3)
2016 ANNUAL REPORT

Title: Characterization of soybean taproot decline; a new disease in Mississippi soybean production fields

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BACKGROUND

This research addresses the etiology of taproot decline (TRD) associated with soybean plants throughout MS production fields. The symptoms include foliar chlorosis, interveinal necrosis, stained vascular tissues, and signs of black stroma, which is a black matrix of vegetative hyphae observed on the lower stem and roots. The disease is widespread throughout Mississippi and recurs in the same area within a field, particularly if soybean is planted in consecutive years.

A first report of taproot decline has been published in Plant Health Progress through a collaborative effort (taproot decline task force) among plant pathologists from Alabama, Arkansas, Louisiana, and Mississippi. The phylogenetic analyses, initiated in my lab with subsequent sequencing of the fungal genome at the University of Arkansas and final bioinformatics conducted at Louisiana State University, confirms a novel species is the causal organism of this serious soybean disease. Over the summer of 2016, reports of taproot decline were confirmed in Alabama and Missouri, increasing the distribution of the disease.

OBJECTIVES AND PROGRESS/ACTIVITY

1. Confirmation of the taproot decline pathogen

The TRD pathogen was successfully re-isolated from inoculated soybean seedlings grown in the greenhouse at MSU. Pure cultures were obtained from infected plants and the pathogen was confirmed by sequencing the internal transcribed spacer (ITS) region and compared to other TRD isolates in our database at MSU.

2. Characterize the life cycle and disease cycle of the taproot decline pathogen

Initial life/disease cycle characterization of the TRD pathogen was conducted in the summer of 2016 using an ultra-mini rhizotron prototype developed in my laboratory. The plexiglass design allows for the observation of root development with no disturbance. Destructive sampling occurred 4 weeks post-germination. The intent of this preliminary study was to develop a procedure to readily examine the infection process of the pathogen. The hypocotyl appeared to be the site of initial infection and subsequently infected the developing taproot. As infection and colonization advanced on the soybean seedlings, the taproot and lateral roots become colonized, initiating root damage which produces foliar chlorosis and necrotic foliar symptoms. Symptomatic and asymptomatic taproots were divided into eight 1-cm-long sections. The majority of TRD isolations came from the top 1-cm portion of

symptomatic taproots. TRD isolations became less frequent in the distal portion of symptomatic taproots. This may indicate the pathogen's preference for root material closer to the soil surface.

Based on the preliminary study, we observed the hypocotyl may be the initial site of infection, with subsequent infection occurring in the taproot. With advanced infection, extensive colonization of the taproot and lateral roots was observed. The damage incurred to the overall root system leads to subsequent foliar decline presented as foliar chlorosis and necrosis.

Infected root tissues were fixed in paraffin, stained with toluidine blue, and thin-sectioned for microscopic viewing. Bright-field microscopy was used as a tool to facilitate the study of the infection process and the extent of fungal colonization. The results indicate the TRD pathogen forms a layer of stroma which results in the degradation of epidermal cells associated with the taproot and lateral roots. Further evidence from infected root samples of both the tap and lateral roots shows a structural breakdown of the cortical parenchyma and endodermis. Fungal colonization within the xylem and phloem was also observed in infected roots.

3. **Phylogenetic analysis with isolates of the taproot decline pathogen throughout Mississippi soybean production fields**

Collections from soybean fields expressing TRD symptoms were made throughout the growing season of 2016. These samples represent 19 counties in Mississippi where we recovered 38 TRD isolates extracted for genomic DNA sequencing. A phylogenetic analysis based on ITS showed diversity among the Mississippi TRD isolates; however, despite that diversity, a distinctly divergent branch separates the TRD pathogen from its closest taxa, the *Xylaria arbuscular* aggregate (Fig. 1).

Ancillary soybean variety trial located at DREC, Stoneville, MS.

On 22 June 2016, a cultivar trial was initiated at DREC by Dr. Tom Allen and Tessie Wilkerson. Plots were 10 feet long and one row of each plot was inoculated at planting with 1 cc/row ft of corn cob grit inoculum prepared in Tomaso-Peterson's lab at MSU. The second row was non-inoculated. Stand was recorded by counting the entire plant stand in the inoculated and non-inoculated rows prior to harvest on 31 October. Plant height was recorded at approximately R6 by measuring five plants per row for each variety. The inoculated rows of 17 varieties had significantly lower stands when compared to non-inoculated controls, and stand reduction ranged from 0 to 91%. Height reduction in inoculated rows ranged from 0 to 28% and was significantly lower in 11 varieties. These results indicate that commercial sources of resistance may currently be available for soybean producers.

WWW.MSSOY.ORG ⟹ **MSPB WEBSITE WITH UP-TO-DATE SOYBEAN PRODUCTION INFORMATION**

END PRODUCTS

Poster presentation.

Potential Varietal Resistance to Taproot Decline of Soybean. 2017. P. Price, M. Purvis, H. Pruitt, LSU AgCenter, T. Allen, M. Tomaso-Peterson, T. Wilkerson, MSU. Southern Division American Phytopathological Society Meeting. College Station, TX. 18–20 February 2017.

Journal publication.

First Description of the Causal Agent of Taproot Decline of Soybean, an Emerging Disease in the Southern United States. 2017. T. Allen, B. Bluhm, K. Conner, V. Doyle, T. Price, E. Sikora, R. Singh, T. Spurlock, M. Tomaso-Peterson, and T. Wilkerson. Plant Health Progress. 18:35−40. http://dx.doi.org/10.1094/PHP-01-17-0004-RS


Arkansas I5
George 1 I4
SYM 10 20 I2
TP KP2
Tallahatchie I1
TP KP1
Alabama I3
Lamar I1
Lafayette 3 I1
62
Lee I4
NewMadrid 197 16
Perry I1
Monroe 2 I6
Monroe 1 I3
UARKBRR1
67
UARKBRR6
SYM 10 20 I3
LA BLACK ROT
Craighead AR 1 I7
George 2 I2
Lafayette 1 I4
FLD5 I8 XYLARIA
Forrest I2
Clay I2
Franklin I12
63
Hinds I11
Yazoo I15
Craighead AR 2 I9
78
FLD1 I8 XYLARIA
FLD2 I3 XYLARIA
FLD1 I7 XYLARIA
FLD2 I2 XYLARIA
FLD1 I3 XYLARIA
SYM 5 10 I4
62
Yalobusha 2 I4
93
Noxubee BM 15
Lamar I8
FLD1 I6 XYLARIA
Jackson I3
74
ASYMP 5 10 I1
Yalobusha 1 I2
59
MSU 1 Xylariaceae
87
MSU 2 Xylaria
PearlRiver I5
Lafayette 2 I4
53
Panola I1
Covington I14
George 3 I10
62
Leflore I7
Missouri I7
Xylaria arbuscula isolate UFMGCB9667
99
Xylaria venosula isolate 94080508
63
Xylaria arbuscula var.plenofissura
76
Xylaria bambusicola isolate 205
Xylaria striata isolate 304
0.005