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| Please use this form to clearly and concisely report on project progress. The information included should reflect quantifiable results that can be used to evaluate and measure project success. Comments should be limited to the designated boxes. Technical reports, no longer than 4 pages, may be attached to this summary report. |
| Project Number:  |  |
| Project Title:  | Southern Root-Knot Nematode in Maturity Group 4 Soybean: Characterization of Resistance Mechanisms and Breeding for Resistance |
| Organization:  | University of Arkansas |
| Project Lead Name: | Travis Faske |
| Report Date: | Sep 15 to Dec 15 |
| **National Soybean Checkoff Research Database** [**https://www.soybeanresearchdata.com/**](https://www.soybeanresearchdata.com/) **(public website funded by USB). Please include a non-technical project status along with your project status. The non-technical project status will be published to the website. If a non-technical project status is not provided, the contents of this entire report will be published.** |
| Project Status: |
| **Obj. 1: Characterization of the mechanism of resistance to SRKN.** * In a preliminary study, *M. incognita* established a feeding site on the susceptible cultivar ‘Magellan’ at 7 days after inoculation (DAI) and matured to females at 14 DAI, whereas J2 did not establish a feeding site or mature in the moderately resistant cultivar ‘Forrest’. (Watson)
* In a preliminary study, the susceptible cultivar ‘Anand’ and MR cultivar ‘Forrest’ were inoculated with 2 J2/cm3 soil. M. incognita developed a feeding site in both cultivars and by 14 DAI, females were observed in both cultivars. (Faske)
* Full experiments with 3 newly identified maturity group 4 resistant lines (PI 567516C, PI438489B, NIL-PI) and a susceptible line (NIL-Mag) will be conducted in the spring in both labs.

**Obj. 2: Genetic characterization and development of functional markers for new sources of resistance to SRKN.*** Resistant donor lines including Forrest, PI 567516C, PI 438489B, Magellan, and near-isogenic lines (NIL) derived from the crosses of a MG4 susceptible cultivar (Magellan) and resistant PI 438489B were harvested and threshing is in progress.
* The genomic DNA was extracted using plant leaf tissues from the above-mentioned lines for marker development. We have successfully developed DNA marker for the major QTL on chromosome 10 associated with RKN resistance. This marker efficiently distinguished resistant and susceptible lines which could be used for marker-assisted breeding program for southern root knot nematode.
* Additionally, minor QTL region on chromosome 13 was screened to develop functional markers for this locus. We developed 10 KASP markers from 2 MB genomic region of Chromosome 13 associated with RKN resistance, and currently we are validating these markers using diverse RKN genotypes. (Nguyen)

**Obj. 3: Development of breeding populations and MG4 soybean varieties with resistance to SRKN.** University of Arkansas: Acuna-Galindo* Ten new cross combinations between SRKN tolerant and high-yielding soybean varieties were developed during the summer of 2022. Eight combinations (80 plants) were sent to the winter nursery for off-season EG1 to EG2 generation advancement.
* Twenty EG1populations were advanced in Puerto Rico 2021-2022 off-season and EG2 planted in 2022 in Fayetteville. Nineteen were selected for generation advancement and SRKN molecular screening.
* Four EG3 populations were planted in Fayetteville, AR, during the 2022 summer. Individual plants were visually selected for performance and desired agronomic traits and harvested using the modified pod pick method for EG3:EG4 generation advancement in 2023.
* Some 44 pre-commercial lines were sent for screening in a field in Kerr, AR. The gall rating severity ranged from 4 to 15%, with the susceptible control rating at 11% and the resistant control at 3% of root system galled. Molecular markers screening of these entries is pending.

Grover Shannon, University of Missouri* **Promising lines in regional tests:** We evaluated 19 high-yielding breeding lines in the 2022 USDA Southern Trials with resistance to southern root-knot nematode (SRKN). The local yield data has been analyzed but data from the 2022 USDA Southern Trials data will not be available until late January. Based on the satisfactory yield in regional trials in 2022, selected lines may be proposed for release in 2023.
* **Advanced yield trials:**260 advanced breeding lines of which many are derived from SRKN-resistant parents were tested in our 2022 advanced yield trials (AYT). These were grown at Portageville, MO (3 environments) and dicamba injury from adjacent farmer fields severely suppressed yields. Our breeding lines lack tolerance to the herbicide. We also tested these lines across locations in AR, IL, LA, MS, MO, TN, and VA (6-8 environments) where damage from Dicamba was minimal. The breeding lines were phenotypically screened for SRKN and genotypically characterized using molecular markers tightly linked to genes conferring resistance to SRKN. Based on the genotypic and phenotypic data (SRKN- resistant) as well as satisfactory multi-environment yield performance, the best performing lines will be put in regional Uniform tests in 2023.
* **Preliminary yield trials: I**n 2022 preliminary yield trials (PYT), we tested 1,070 breeding lines in Portageville, MO (3 environments), but plots yields were reduced from off-target Dicamba. The lines were tested in two additional environments in AR and MO where damage from Dicamba was minimal. Many of the lines are derived from SRKN-resistant pedigrees. Based on the visual phenotypic selection and satisfactory multi-environment yield performance, approximately 150 soybean breeding lines will be advanced to the 2023 AYT and will be phenotypically and genotypically screened for SRKN.
* **Breeding populations advancements:** 246 bi-parental populations (~24,600 F4:5 lines) were grown in progeny rows during 2022. Most of these populations are derived from SRKN-resistant pedigrees. A total of 1,125 soybean late III to late IV breeding lines were visually selected based on yield potential and desired agronomic traits at maturity. They will be advanced to 2023 preliminary yield tests (PYT).
* **New Crosses in 2022 season:** We had 49 high-yielding SRKN-resistant parents in our crossing block. We developed 76 new breeding populations. F1 seeds were sent in off-season nurseries in Puerto Rico and Costa Rica and will return as F4:5 progeny rows during the 2024 season.
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| **Non-technical project status:** |
| The southern root-knot nematode (SRKN) is an important, yield-limiting pathogen of soybean in the Mid-Southern U.S. This project was designed to determine how different SRKN-resistance sources affect nematode maturity, reproduction, and galling and develop SRKN-resistant MG4 soybean varieties. Currently, breeding programs in MO and AR have selected advanced germplasm derived from SRKN-resistant pedigrees. These entries will be screened with molecular markers and in the field in AR and MO. Different sources of SRKN-resistant parents identified by molecular markers will be assayed for SRKN maturity.  |