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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: | Dec 15 to Mar 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. (Faske and Watson)*** A time-course nematode development study was conducted with 3 newly identified maturity group 4 resistant lines (PI 567516C, PI438489B, NIL-PI), a resistant control (Forrest), and two susceptible controls (Magellan, NIL-Mag). Overall, preliminary results from this time-course nematode development study suggest that newly identified maturity group 4 resistant lines may suppress nematodes by delaying the progression of nematode development from an infective J2-stage nematode to a J3/J4 nematode. Data analysis continues and the experiment will be repeated in April 2023. (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. The experiment will be repeated in the next quarter. (Faske)

**Obj. 2: Genetic characterization and development of functional markers for new sources of resistance to SRKN. (Nguyen)*** We processed the harvested seeds from the important resistant donor lines such as PI 567516C, PI 438489B, Forrest, Magellan, and near-isogenic lines (NIL) derived from the crosses of Magellan and PI 438489B at University of Missouri during this season. These seeds are packaged for the shipping to University of Arkansas and Louisiana State University for re-confirmation of resistant phenotypes in these lines.
* In addition to marker developed from the major QTL loci on Chr. 10, we are developing markers from minor QTL on Chr. 13. Currently, we are continuing the validation of these markers which can distinguish the SRKN resistant lines from the susceptible lines.
* We selected RILs containing Chr. 13 QTL for NIL development from SRKN populations including Magellan X PI 567516 and Magellan X PI 438489B.

**Obj. 3: Development of breeding populations and MG4 soybean varieties with resistance to SRKN.** University of Arkansas: Caio Vieira* Two high-yielding advanced lines will be evaluated in our 2023 pre-commercial yield trials. Trials will be replicated in four locations in Arkansas, one each in Missouri and Louisiana. These were screened for SRKN resistance in 2022 in field and greenhouse conditions and have shown higher levels of resistance.

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| Name | Pedigree | Yieldbu/ac | Relative Yield% Check | Galling(0-5) | Root Galling Score(%) |
| R18-10919 | R11-2282/R12-3684 | 64 | 85 | 1.2 | 3.8 |
| R19C-1081 | S09-13635/R11-328:82 | 63 | 98 | 1 | 11.4 |

* Ten new cross combinations between SRKN-tolerant and high-yielding parental lines were completed in 2022. Eight combinations (80 F1 seeds) were sent to an off-season nursery for generation advancement. Molecular marker evaluation is underway to identify true hybrids. Selected materials will be advanced until F4 in the off-season nursery.
* Twenty EG1populations were advanced in Puerto Rico in the 2021-2022 off-season. During the summer of 2022, EG2populations were planted in 61 rows in Fayetteville, AR. Nineteen populations were selected for generation advancement. In total, 2,989 individual plants were tagged and harvested individually. Tissue sampling was taken during the growing season, and molecular analysis to confirm genetic resistance is currently underway.
* Four EG3 populations were planted in Fayetteville, AR, during the 2022 summer. Individual plants were visually selected based on pod load, uniformity, and desired agronomic traits and harvested using the modified pod pick method for EG3:EG4 generation advancement in 2023.
* Southern root-knot nematode marker screening is currently ongoing in 43 of our pre-commercial materials (PCMs). Results are 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.  |