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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. |
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| Project Title:  | Breeding Maturity Group 4 Soybean with Enhanced Resistance to Southern Root-knot Nematode by Reducing Galling and Nematode Reproduction |
| Organization:  | University of Arkansas |
| Principal Investigator Name: | Caio Canella Vieira |
| Report Period: | March – June, 2025 |
| Project Status: |
| **Objective 1 - Characterization of the mechanism of resistance (Faske, Nguyen)***Characterize the response of lines carrying different combinations of the resistance regions on chromosomes 10 and 13 as well as genetically diverse accessions for nematode reproduction and root galling.***Faske, University of Arkansas:**As noted in the March report, a set of sixteen recombinant lines, each with distinct genetic compositions related to resistance to root-knot nematode (RKN) across different genomic regions, were selected for resistance characterization. The objective is to identify resistant genetic materials and associate resistance with specific genomic regions on chromosome 10, chromosome 13, or both. Each line will be evaluated for nematode reproduction levels and galling. In addition, materials with known resistance to RKN, along with susceptible checks, will be evaluated under the same conditions. Seeds for all entries have been received and will be planted and inoculated under greenhouse conditions at Lonoke, AR, during this quarter.**Nguyen, University of Missouri:**Building on previous work, we identified sixteen contrasting recombinant inbred lines (RILs) derived from a cross between Magellan and PI 438489B. These RILs represent different combinations of QTLs for root-knot nematode (SRKN) resistance: both QTLs on chromosomes 10 and 13, only the major QTL on chromosome 10, or only the minor QTL on chromosome 13. Faske’s group at the University of Arkansas is currently evaluating these lines under greenhouse conditions for galling and reproduction index to assess the individual and combined effects of these QTLs on SRKN resistance. In parallel, the same set of RILs has been planted in Stuttgart, AR, by Vieira’s group to assess yield response and other agronomic traits, including but not limited to maturity, lodging, and seed composition. We anticipate that phenotypic results will reveal the impact of different resistance combinations on overall soybean performance, which will then guide future breeding applications of these novel genomic resources.**Objective 2 – Development of SRKN-resistant breeding populations (Vieira, Lin)***Develop MG 4 breeding populations and varieties with SRKN resistance suitable for production in the Mid-South.***Vieira, University of Arkansas:**Yield trials were established across all our experimental stations by April 28th, ahead of the heavy rains that persisted throughout May. SRKN yield trials, seed increases, and progeny rows were completed by June 6th. Pre-foundation seed increases were planted in Kibler, AR, on June 9th. Planting activities across the southern part of the state have concluded, while pure seed plots in Fayetteville are being planted as weather permits, with all activities expected to be completed by the week of June 16th.**2025 Potential Release:** Progress continues toward the advancement of two promising SRKN-resistant soybean lines. Pre-foundation seed of R19-45980, a candidate for potential release later this year, has been planted in Stuttgart, AR, where it will be closely monitored throughout the season. Introgression of herbicide traits, Enlist E3® and XtendFlex®, continues to make steady progress at our Puerto Rico winter nursery. R21KB-05522, another SRKN-resistant line, has entered its second year of evaluation in both the Arkansas Variety Testing (ARVT) program and the USDA Southern Uniform Trials, following a successful first-year performance.**2025 Pre-Commercial Stage:** A total of 37 advanced breeding lines have been planted this season for evaluation in pre-commercial yield trials across ten experimental locations. These include five sites in Arkansas (Jonesboro, Marianna, Pine Tree, Stuttgart, and Rohwer), as well as collaborative locations in Mississippi (3), Tennessee (1), and Louisiana (1). In parallel, three SRKN-resistant lines are being evaluated through internal pre-commercial trials, the USDA Uniform Preliminary (UP) trials, and/or the Arkansas Variety Testing (ARVT) program.**2025 Preliminary Stage:** As previously reported, over 1,043 lines have been planted and will be evaluated in replicated preliminary yield trials at three Arkansas locations: Pine Tree, Stuttgart, and Rohwer. In parallel, the same set of lines was planted in the greenhouse, with tissue samples collected, lyophilized, and processed for DNA extraction. DNA isolation has been completed, and samples are scheduled to be sent by mid-June to the USDA Soybean Genomics and Improvement Laboratory at the Beltsville Agricultural Research Center in Maryland. Additionally, these lines have been prepared for shipment to undergo screening with a proprietary disease and abiotic stress panel, which includes evaluation for SRKN resistance.**2025 Progeny Rows:** A total of 18,938 progeny rows, representing 181 breeding populations, were planted in Stuttgart, AR, for evaluation during the 2025 season. Notably, more than 50% of these populations include at least one parent with confirmed resistance to root-knot nematode (RKN), providing a strong foundation for identifying new resistant lines. This effort reflects the continued emphasis on integrating nematode resistance into elite breeding material while advancing selection within diverse genetic backgrounds.**2025 Crossing Block:** Cross development for the 2025 breeding cycle is actively progressing, with a focus on integrating molecular data to guide parent selection. A total of 16 SRKN-resistant parents were included in this year’s crossing block, of which around 80 populations will be developed by including at least one SRKN-resistant parent.**2025 SRKN Yield Trials and Seed Increases**: Sixteen RILs and nine key genotypes will be planted in Stuttgart, AR, for seed increase and yield testing during the 2025 growing season. Throughout the season, agronomic traits such as maturity, lodging, plant height, and seed composition will be recorded, followed by post-harvest evaluations.**Lin, University of Missouri:****2025 Screening for Resistance**: A total of 121 lines from the Advanced Yield Trials (AYT) were submitted for phenotypic screening to assess galling scores. These lines will also undergo molecular marker analysis for the major SRKN resistance gene located on chromosome 10.**2025 Crossing Block:** The crossing plan for the 2025 season includes at least 80 crosses incorporating SRKN-resistant parental lines. Two planting dates for the crossing block have been completed, and a third planting is scheduled soon.**2025 Breeding Population Advancement:** Crosses made during the 2024 season were sent to the winter nursery for generation advancement. These materials are expected to return in April 2026, at which point they will be planted as progeny rows and evaluated for agronomic traits and yield potential.**2025 Progeny Rows**: More than 160 progeny row populations were received from the winter nursery for planting in 2025. At least 30% of these populations include one parent with confirmed SRKN resistance. Planting will begin soon, though progress has been delayed due to persistent rainfall.**2025 Preliminary Yield Trials:** A total of 1,500 progeny rows have been successfully planted as part of the 2025 preliminary yield trials. These lines will be evaluated for agronomic performance and yield potential, with several derived from SRKN-resistant parents.**2025 Advanced Yield Trials**: A set of 121 lines from maturity groups 3L to 4L were selected for the 2025 AYT and have been successfully planted. These lines will be evaluated across multiple locations for yield potential and as mentioned above materials will be assessed both phenotypically and genotypically for SRKN resistance.**USDA Trials:** For the 2025 USDA Preliminary Uniform Trial, 12 lines from the 2024 AYT were selected based on strong SRKN resistance and high yield performance, with maturity groups ranging from 3L to 4L. Among them, two lines carry Enlist® herbicide technology. Additionally, two SRKN-resistant, high-yielding lines have been included in the USDA Uniform Trial (UT) and are under consideration for potential release in 2026. |