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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: | December to March, 2025 |
| Project Status: | |
| **Objective 1 - Characterization of the mechanism of resistance**  **Faske – University of Arkansas:**  The characterization of resistance associated with specific QTL linked to SRKN resistance will be investigated this spring under greenhouse conditions. Sixteen recombinant inbred lines (RILs) were identified and selected by project investigators for greenhouse screening (Table 1). These lines represent different genetic compositions, containing resistance on chromosome 10, chromosome 13, both, or neither. The study will assess the extent of nematode reproduction and galling in each entry, categorizing them based on specific QTL marker traits. Additionally, nine key genotypes (Magellan, PI 438489B, PI 567516C, Hutcheson, PI 88788, PI 437654, Peking, PI 567305, and Forrest) will be evaluated under the same conditions.   |  |  |  | | --- | --- | --- | | **Table 1.** RILs selected for galling, reproduction screening and yield trials. | | | | **RILs** | **Chr. 13 Marker\*** | **Chr. 10 Marker\*** | | MPB0001 | (-) | (+) | | MPB0021 | (-) | (+) | | MPB0104 | (-) | (+) | | MPB0127 | (-) | (+) | | MPB0002 | (-) | (-) | | MPB0005 | (-) | (-) | | MPB0011 | (-) | (-) | | MPB0218 | (-) | (-) | | MPB0101 | (+) | (+) | | MPB0154 | (+) | (+) | | MPB0213 | (+) | (+) | | MPB0452 | (+) | (+) | | MPB0131 | (+) | (-) | | MPB0520 | (+) | (-) | | MPB0551 | (+) | (-) | | MPB0700 | (+) | (-) | | \*Indicates SRKN resistance trait; (+) present, (-) absent. | | |   **Nguyen - University of Missouri:**  We identified 25 recombinant inbred lines (RILs) derived from a cross between Magellan and PI 438489B using markers from chromosome 10 and chromosome 13. These RILs represent different genetic combinations, including QTL on both chromosomes, only on chromosome 10, or only on chromosome 13. Based on seed availability, 16 RILs with varying SRKN-resistant QTL combinations were selected and shared with Faske's group at the University of Arkansas for SRKN galling and reproduction index screening. The same set of RILs will also be evaluated in yield trials in Stuttgart, AR, by Vieira's group (Table 1). This study will help investigate nematode reproduction, galling numbers, and the impact of different QTL backgrounds and combinations on SRKN resistance.  **Objective 2 – Development of SRKN-resistant breeding populations**  **Vieira – University of Arkansas:**  Full-scale preparations for the 2025 planting season are underway. Experimental designs, field mapping, seed sorting, cleaning, and packaging for the preliminary yield trials have been completed, with final and pre-commercial trials to follow. Simultaneously, fields at various experimental locations are being prepared, aiming to begin planting by April 15, weather permitting. Additionally, Progeny rows cleaning and crossing combination design are in progress.  **2025 Potential Release**: As noted in the previous report, the SRKN-resistant line R19-45980 has demonstrated outstanding performance over the past two years in the Arkansas Variety Testing (ARVT). In preparation for its potential release at the end of the year, pre-foundation seed will be planted in Stuttgart, AR. Similarly, introgression of herbicide traits Enlist-E3® and XtendFlex® into the line R19-45980 continues in our Puerto Rico nursery.  **2025 Pre-Commercial Stage**: A total of 37 advanced breeding lines have been selected for pre-commercial yield trials, including 15 from MG 4E, 13 from MG 4L, and 9 from MG 5E. These lines will undergo replicated testing across nine experimental locations this season. Three promising SRKN-resistant lines will be evaluated in our internal pre-commercial trials, USDA Uniform Preliminary (UP) trials, and/or ARVT testing (Table 2). Additionally, the SRKN-resistant line R20-1429, identified as flood-tolerant in our 2024 flood screening trials, will be utilized as a parent in the 2025 crossing block.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Table 2. Advanced SRKN- resistant lines | | | | | | Line | *MG* | *RKN* | *% Check* | *2025 Trials* | | R22KB-16609 | 4E | R | 86 | PCM | | R20-1429 | 5E | R | 92 | PARENT / PCM / FLD | | R21KB-03720 | 5E | R | 100 | UP / ARVT |   **2025 Preliminary Stage**: Over 1,000 lines will be evaluated in replicated yield trials across three Arkansas locations (Pine Tree, Stuttgart, and Rohwer) as part of our preliminary yield testing. Additionally, these lines will be planted in the greenhouse, and DNA will be isolated and sent for genotyping at the USDA Soybean Genomics and Improvement Laboratory in the Beltsville Agricultural Research Center, Maryland. Furthermore, all lines will undergo screening using proprietary disease and abiotic stress panel, which includes the SRKN resistance trait.  **2025 Progeny Rows**: Two years ago, the University of Arkansas soybean breeding program began a continuous effort to introduce the SRKN-resistant trait into all our materials. The 2025 progeny rows reflect this commitment and our progress in integrating SRKN resistance into our breeding lines. This year, 69 out of 124 populations (56%) being evaluated have at least one parent carrying the resistant trait, marking the highest number of SRKN-resistant populations assessed in our program since the initiative began.  **2025 Crossing Block**: The development of 2025 cross combinations are currently underway, incorporating molecular data and leveraging diverse lines from the Germplasm Resources Information Network (GRIN) and other breeding programs to identify the most promising crosses and in combination with our elite lines in advance yield trials. Efforts are ongoing to identify materials carrying SRKN-resistant genes, and the final selection of crosses and parent lines with the SRKN trait will be presented in the next report.  **2025 Introducing New Genetic Diversity:** To expand our capacity for testing and identifying SRKN-resistant materials, a new screening protocol is being implemented under growth chamber and greenhouse conditions at the University of Arkansas, Fayetteville campus. This protocol will allow for in-house testing of a greater number of lines throughout the growing season. The growth chamber setup enables off-season screening, eliminating weather-related limitations. Initially, 20 lines, including previously identified resistant and susceptible checks, are being grown, with the first nematode inoculation already completed. Plants will be evaluated 30 to 45 days after inoculation, and the protocol will be standardized over the next few months. In parallel, tomato plants are being cultivated to serve as a continuous nematode propagation source for future screenings.  Lin – University of Missouri:  **2025 Crossing Block**: Parental selection and cross combination designs for the 2025 season are currently in progress.  **2025 Breeding Population Advancement**: Successful crosses from 2024 were sent to the winter nursery for generation advancement. These crosses are expected to return in April 2026, when they will be planted as progeny rows and evaluated for agronomic traits and yield potential.  **2025 Progeny Rows:** Materials advanced in the winter nursery will be evaluated this year as progeny rows in our MO experimental station. In total, we will receive more than 160 populations that were crossed in 2023 and sent to the winter nursery. Approximately 30% of these populations have one parent resistant to SRKN.  **2025 Preliminary Yield Trials**: A total of 1,500 progeny rows were selected for testing in the preliminary yield trials for the 2025 growing season based on agronomic performance and yield potential. Most of these selections have at least one SRKN-resistant parent.  **2025 Advanced Yield Trials:** A total of 120 lines from maturity groups 3L to 4L were selected for the 2025 AYT. These lines will be evaluated across multiple locations for yield potential and assessed both phenotypically and genotypically for SRKN resistance.  **USDA Trials:** To assemble the 2025 Preliminary Uniform Trial for USDA (UP), eight SRKN-resistant lines from AYT 2024 were selected from maturity groups 3L to 4L. These lines were tested for yield at six external locations in Illinois, Arkansas, Missouri, and Tennessee, as well as two university farm locations with clay and loam soils (Table 3).   |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Table 3. Yield in Bushel/acre and percentage (%) compared to the checks for the SRKN-resistant lines selected from AYT24 to be part of the USDA Uniform trials | | | | | | | | | | | | | | |  |  |  |  | ***Portageville, MO*** | | | | | ***Outside locations*** | | | | | | **Line** | ***RM*** | ***MG*** | ***RKN*** | ***Bu/ac*** | ***% XT*** | ***% E*** | ***% C*** | ***% CK*** | ***Bu/ac*** | ***% XT*** | ***% E*** | ***% C*** | ***% CK*** | | **S22PR-260E3** | 3.6 | 3L | R | 60.8 | 98 | 96 | 92 | 95 | 61.1 | 84 | 86 | 92 | 87 | | **S22PR-205E3** | 3.9 | 3L | R | 78.8 | 127 | 100 | 91 | 106 | 52.5 | 76 | 71 | 80 | 75 | | **S22-24366** | 4.3 | 4E | R | 71.6 | 115 | 91 | 83 | 96 | 69.3 | 100 | 93 | 105 | 99 | | **S22-16004** | 4.4 | 4E | R | 64.2 | 104 | 81 | 75 | 86 | 70.6 | 102 | 95 | 107 | 101 | | **S22-24401** | 4.4 | 4E | R | 59.7 | 96 | 75 | 69 | 80 | 70.5 | 101 | 95 | 107 | 101 | | **S22-24339** | 4.6 | 4L | R | 77.3 | 107 | 105 | 107 | 106 | 66.1 | 98 | 97 | 105 | 100 | | **S22-8718HP** | 4.8 | 4L | R | 71.8 | 99 | 97 | 99 | 99 | 66.0 | 98 | 97 | 104 | 100 | | **S22-15639** | 4.6 | 4L | R | 63.2 | 87 | 86 | 87 | 87 | 53.6 | 80 | 79 | 85 | 81 | | XT :XtendFlex, E: Enlist, and C: conventional. | | | | | | | | | | | | | | | |