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| Project Title:  | **Evaluation of a novel drought-tolerant inoculant on soybean yield in the Mid-South (Year 3)** |
| Organization:  | **University of Texas at Arlington** |
| Principal Investigator Name: | **Woo-Suk Chang** |
| Collaborators | **James Grichar (TX), Pengyin Chen (MO), Leandro Mozzoni (AR), Trey Price (LA), Avat Shekoofa (TN), Tessie Wilkerson (MS)** |
| Report Period: | **March 16, 2021 – June 15, 2021** |
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| The objective of this project is to evaluate the effects of the TXVA strain (a drought-tolerant inoculant) on soybean nodulation and yield in comparison to the commercial inoculant Cell-Tech™ and a non-inoculated control under non-irrigated conditions. For the 3rd year trial (Year 2021), we has set up the field trials in 6 states including TX, TN, MO, LA, MS, and AR. As of June 15, 2021, we finished planting all states except AR. Field trial set-up has been delayed in AR due to the weather condition. However, we will do it before the end of June, assuming the field condition is good. Detailed plot design and experimental conditions are described in the Technical Report attached.It has been well established that the microorganism *Bradyrhizobium japonicum* has a beneficial impact on soybean plants. Previously, we isolated the TXVA strain that showed outstanding performance in nodulation, nitrogen fixation, and enhancing plant growth and production. To improve the inoculants’ performance and optimize the benefits of biological nitrogen fixation in the Mid-South, we set up field trials to evaluate the effects of the drought-tolerant inoculant on soybean yield at drought-prone sites. For the 1st year trial (year 2019), three inoculation treatments (drought-tolerant inoculant TXVA, commercial inoculant Cell-Tech, and no inoculation) were compared under irrigated vs. non-irrigated conditions at drought prone sties in the Mid-South. For the 2nd year trial (year 2020), we tested the same three inoculation treatments, but with more soybean cultivars including a drought-tolerant variety. At the first sampling, the number of nodules per plant were counted and nodule size was measured. A second harvest of plants was performed to evaluate final soybean seed production. The climate and weather factors (e.g., precipitation, temperature, and humidity) for each location were also monitored.At the completion of the proposed research, we expect to provide positive effects of the drought-tolerant inoculant on soybean profitability and aid Mid-South producers in better understanding of the potential benefits for biological nitrogen fixation. We believe that providing such information will allow soybean producers to advance the management of soybean plants and inoculants for economical and ecological benefits. |

**Technical Report**

**Texas A&M AgriLife Research Plot – Yoakum, Texas.**

This site is in collaboration with Dr. James Grichar, a senior research scientist at Texas A&M AgriLife research. This was the first plant this year (March 18th). The plot layout that we designed here has 3 treatments, 3 cultivars, and 4 replicates (Fig. 1). The cultivars used here were last year’s variety TN16-520R1, drought-tolerant S11-20242C, and drought-sensitive S14-9017R. Each block contains 2 rows, and each row is 20’ with a 5’ spacer row between blocks and has 38” row spacing. The planter used was set at 10 seeds/foot. Due to an abundance of rain, mid-harvest sampling has yet to occur.

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**Figure 1.** Plot layout in Yoakum, TX (2021).

**Tennessee Agricultural Experiment Station – Jackson, Tennessee.**

This site is in collaboration with Dr. Avat Shekoofa at the University of Tennessee. This was the second plant this year (May 19th) which puts the mid-harvest sampling date at mid-July, depending on growth progression. This research station is on Iuka fine loamy sand, which is moderately well drained and permeable. This station is the only in our trials that uses a no-till management system. The plot layout for TN (Fig. 2) contains 2 cultivars, 3 treatments, and 4 replicates. The cultivars used here were TN16-520R1 and the drought-sensitive USG-7496XTS line. Here, each block contains 4 rows, and each row is 20’ with a 3’ spacer and 30” row spacing. The planter was set at 8 seeds/foot.

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**Figure 2.** Plot layout in Jackson, TN (2021).

**T.E. “Jake” Fisher Delta Research Center – Portageville, Missouri.**

This site is in collaboration with Dr. Pengyin Chen at the University of Missouri. This was the third plant this year (May 19th) which puts the mid-harvest sampling date at mid-July, depending on growth progression. The plot layout contains 3 inoculant treatments, 3 cultivars, and 6 replicates (Fig. 3). The cultivars used here remained the same as last year’s; TN16-520R1, drought-tolerant S11-20242C, and drought-sensitive S14-9017R. Each block has 4 rows of 12’ with a 4’ spacer row with 30” row width. The planter was set at 10 seeds/foot.



**Figure 3.** Plot layout in Portageville, MO (2021).

**Macon Ridge Research Station – Winnsboro, Louisiana.**

This site is in collaboration with Dr. Trey Price at Louisiana State University AgCenter. This was our fourth site to plant (May 26th) which puts the mid-harvest sampling date around the end of July, depending on growth stage. The soil type at the Macon Ridge research station is Jigger-Gilbert silt loam, which is a very deep slowly draining soil with very slow permeability. The plot layout for Winnsboro is shown below (Fig. 4) and has 3 inoculant treatments, 3 cultivars, and 4 replicates. The cultivars used here were TN16-520R1, drought-sensitive S14-9017R, and drought-sensitive USG-7496XTS. Each block has 4 rows of 20’ with a 3.5’ spacer row with 40” row width. The planter was set to 11 seeds/foot.



**Figure 4.** Plot layout in Winnsboro, LA (2021).

**Stoneville USDA-ARS – Leland, Mississippi.**

This site is in collaboration with Dr. Tessie Wilkerson at Mississippi State University. This site was planted on June 3rd. The soil type at the Stoneville research station is Commerce silty clay loam, which are somewhat poorly drained soils with moderately slow permeability but a constant soil saturation in lower layers. The plot layout for our MS plot is shown below (Fig. 5) and reflects 3 cultivars, 3 treatments, and 6 replicates. The cultivars used here were TN16-520R1, a drought-sensitive S14-9017R, and a drought-tolerant S11-20242C. Each block contains 4 rows of 12’ with a 5’ spacer row between blocks and a 38” row width. The planter was set at 11 seeds/foot.

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**Figure 5.** Plot layout in Leland, MS (2021).

In summary, we have planted the soybean cultivars at the research sites in 5 states (TX, TN, MO, LA, and MS), testing our novel Texas-native drought-tolerant *Bradyrhizobium* inoculant with drought-tolerant and sensitive cultivars under the non-irrigated condition across drought prone regions. Planting in Stuttgart, AR has been delayed due to the weather condition, but we plan to plant soybeans in AR before the end of June. Below is a summary of general site specifics, planting date, and cultivar information (Table 1).

**Table 1.** Summary of each field site and soybean cultivars planted in 2021.

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| **Location** | **Planting date** | **Field** | **Cultivars used** |
| **Yoakum, TX** | **3/18/21** | Grichar Farm | TN16-520R1, S14-9017R\*, S11-20242C\*\* |
| **Jackson, TN** | **5/19/21** | West TN AgResearch | TN16-520R1, USG-7496XTS\* |
| **Portageville, MO** | **5/20/21** | Lee Farm | TN16-520R1, S14-9017R\*, S11-20242C\*\* |
| **Winnsboro, LA** | **5/26/21** | Macon Ridge | TN16-520R1, S14-9017R\*, USG-7496XTS\* |
| **Leland, MS** | **6/3/21** | Stoneville USDA | TN16-520R1, S14-9017R\*, S11-20242C\*\* |
| **Stuttgart, AR** | **N/A** | Stuttgart | TN16-520R1, S14-9017R\*, S11-20242C\*\* |

\* Drought-sensitive cultivar

\*\* Drought-tolerant cultivar