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| Project Number:  | 1920-162-0121-A |
| Project Title:  | Development and commercialization of advanced high oleic germplasm lines with natural mutations |
| Organization:  | Michigan State University |
| Principal Investigator Name: | Dr. Dechun Wang |
| **National Soybean Checkoff Research Database** [**https://www.soybeanresearchdata.com/**](https://www.soybeanresearchdata.com/) **(visible to public)****Please choose one option (if no option is selected, this report will be posted to the website):**[x]  I agree to allow the information contained in this report to be published in its entirety.[ ]  I have included, at the end of this report, a brief non-technical report that can be posted to the website.[ ]  I DO NOT agree to allow the information contained in this report to be published. |
| Project Status - What key activities were undertaken and what were the key accomplishments during the life of this project? Please use this field to clearly and concisely report on project progress. The information included should reflect quantifiable results (expand upon the KPIs) that can be used to evaluate and measure project success. Technical reports, no longer than 4 pages, may be included in this section.  |
| Over 1500 high oleic lines were selected from the greenhouse based on near infrared spectroscopy and gas chromatography measurements of their fatty acid profiles. These lines were planted in single row yield plots in June 2019. From the 2018 single row plots, 142 high oleic lines were selected with target maturity and high yield potential. These lines were planted in preliminary yield trials in 2019 with multiple replications in three locations. From the 2018 preliminary yield trials, 49 non-GMO, high oleic soybean lines were selected based on high yield and other agronomic traits. These lines were planted in two advanced yield trials in 2019, one at two locations and the other at four locations across Michigan (We prepared seeds for 7 locations, but we could not plant all 7 locations due to the wet spring weather). Critical high oleic breeding lines were sent to Costa Rica for winter seed increases. These lines were harvested and shipped back to Michigan. This seed was planted in the above trials or planted for additional seed increase at MSU for the 2019 growing season. Three high oleic lines from MSU were increased in a larger scale increase in Argentina. The total acreage for the increases in Argentina was 56.5 acres. Over 2000 bushels of seed was shipped back to the US. These lines were planted on ten commercial farms in Michigan totaling 860 acres. Zeeland Farm Services (ZFS) will not use this as a seed source, but rather as grain to be crushed for a commercial-scale oil extraction. These lines range in maturity from MG2.5 – MG3.0. One of the lines from this increase had the highest yield of any high oleic line from MSU, yielding 100% of the ZFS commercial check. The table below shows the performance of MSU’s non-GMO, high oleic soybean varieties in the two-location advanced yield trial. All the lines in the table except the yield check “ZFS 1420 LS” are non-GMO, high oleic lines. Two high oleic lines E18331 and E18900 had higher yield than the check. Three other lines E18171, E18923N and E17804-01 yielded over 95% of check. These 5 lines showed good yield potential and will be further tested for commercialization (Table 1). **TABLE 1 – Yield Trial for MSU’s non-GMO, high oleic soybean varieties**MSU soybean breeding team also received additional funding to extract, process, and test oil from our non-GMO, high oleic varieties. The grant was jointly funded by Michigan Translational Research and Commercialization, The Michigan Soybean Promotion Committee, and Zeeland Farm Services. The test results are shown below in Figure 1.CBA **Figure 1 Oxidation levels parameters analysis of frying oil**Primary oxidation in oil mainly forms hydroperoxides, which are measured by the PV. In general, the lower the PV, the lower the oxidation state of the oil and the better the quality of the oil. The PV of MSU non-GMO high oleic oil shows lower hydroperoxides than commodity soybean oil, MSU non-GMO high oleic oil also shows no significant differences with the GMO high oleic soybean oil (Figure 1A).Anisidine value is a measure of secondary oxidation and is useful in determining the quality of oil. As the anisidine value increases, the quality of the oil decreases. The anisidine value of MSU high oleic oil is significantly lower than the commodity soybean oil and the canola oil (Figure 1B).We also carried out a frying test by frying 50 batches of French fries with a sensory evaluation of the fries, to evaluate the differences between 5 different types of frying oil. The protocol for producing the fries is the same for all batches including oil temperature, frying time, and variety of potato. A sensory panel of 12-20 persons evaluated the fried samples. The MSU high oleic oil shows no differences in overall liking from other frying oil including the commodity soybean oil (Figure 1C). |
| Did this project meet the intended Key Performance Indicators (KPIs)? List each KPI and describe progress made (or not made) toward addressing it, including metrics where appropriate.  |
| **•At least one non-GMO, high oleic commercial line is ready for commercial production by 2020.**Two high oleic lines were planted on ten commercial farms in Michigan totaling 860 acres. Zeeland Farm Services (ZFS) will crush the seeds for a commercial-scale oil extraction. **•At least five additional non-GMO high oleic lines will be tested in commercial variety trials in 2019 and at least one line will be selected by 2020 for future commercial releases.**Three varieties were tested in commercial trials in 2019. One variety is selected for commercial release.  |
| Expected Outputs/Deliverables - List each deliverable identified in the project, indicate whether or not it was supplied and if not supplied, please provide an explanation as to why. |
| **•1 or 2 high yielding, non-GMO, high oleic MSU germplasm lines (MG II and/or MG III) will be ready for commercial production through ZFS by 2020**We have one variety ready for future commercial production.**•5 non-GMO, high oleic MSU lines will be tested in 2019 commercial variety trials**Three non-GMO, high oleic soybean varieties were tested in commercial variety trials in 2019. Over 40 additional lines were tested against commercial yield checks.**•Over 230 additional non-GMO, high oleic lines will be tested in various pre-commercial yield trials in 2019**This deliverable was exceeded. The total sum of single row yield plots, preliminary yield trial, advanced yield trials, and commercial yield trials exceeds this metric.  |
| Describe any unforeseen events or circumstances that may have affected project timeline, costs, or deliverables (if applicable.) |
| N/A |
| What, if any, follow-up steps are required to capture benefits for all US soybean farmers?Describe in a few sentences how the results of this project will be or should be used. |
| Michigan State University and Zeeland Farm Services need to build a licensing agreement for specific non-GMO, high oleic soybean varieties developed through this grant. The varieties grown commercially in 2018 were grown as part of a research agreement. In the future, this research agreement will be replaced by a licensing agreement. Once the varieties are licensed from MSU, ZFS will be able to contract farmers to grow these varieties and purchase the grain with bushel premiums for the non-GMO, high oleic traits. Further funding can be used to continue developing improved non-GMO, high oleic soybean varieties, as well as speeding up commercialization through winter seed increases in South America.  |
| **List any relevant performance metrics not captured in KPI’s.** |
| MSU soybean breeding team received additional funding to extract, process, and test oil from our non-GMO, high oleic varieties. The grant was jointly funded by Michigan Translational Research and Commercialization, The Michigan Soybean Promotion Committee, and Zeeland Farm Services. In brief summary, oil from our non-GMO, high oleic varieties had significantly slower rate of oxidization than that of commodity soybean oil and had no significant difference in flavor and taste of the fried product compared against commercially available fry oils. |
| **Non-technical report (this information will be posted to website in place of above report):** |