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| Project Number:  | 2020-152-0104 |
| Project Title:  | Effect of cultural practices on soybean seed quality: A review and research studies |
| Organization:  | Kansas State University |
| Project Lead Name: | Dr. Ignacio Ciampitti |
| **Proceeds:** Please indicate if any proceeds have been or may be generated pursuant to this project that are subject to be paid to USB. | [ ]  YES[x]  NO |
| **National Soybean Checkoff Research Database** [**https://www.soybeanresearchdata.com/**](https://www.soybeanresearchdata.com/) **(public website funded by USB). Please include a non-technical summary along with your project status. The non-technical summary will be published to the website. If a non-technical summary is not provided, the contents of this entire report will 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.  |
| The overall objective is to identify factors affecting soybean seed protein and its composition and to identify best management practices (BMPs) for increasing soybean seed quality.1. Meta-analysis of current and past scientific data
2. Multi-state research studies focused on exploring management practices to characterize treatment impacts on seed protein and amino acid composition
3. Field surveys will be conducted in winter 2020 and 2021 to gain a better understanding of the initial and final status of knowledge of soybean seed quality

Item 1: Completed compiling available scientific data on the factors that impact seed protein and composition.* Publication: <https://www.frontiersin.org/articles/10.3389/fpls.2019.00298/full>
* Publication: <https://www.nature.com/articles/s41598-018-32895-0?segid=43b8a013-cecb-40dd-9466-c5e125b85693>
* Publication: <https://www.nature.com/articles/s41598-020-74734-1>

 Item 2:  Multi-state research studies focused on exploring management practices to characterize treatment impacts on seed protein and amino acid composition.* Publication: <https://www.nature.com/articles/s41598-019-56465-0>
* Publication: <https://www.frontiersin.org/articles/10.3389/fpls.2021.725767/full>
* Publication: <https://doi.org/10.1016/j.eja.2021.126285>
* Publication: Seed inoculation with Azospirillum brasilense in the U.S. soybean systems (under review in Field Crops Research)

 Item 3: Field surveys were conducted remotely during winter 2020 and winter 2021 to gain a better understanding of the initial and final status of knowledge of soybean seed quality.* Publication: Soybean management for seed composition: The perspective of US farmers. The manuscript will be submitted for review.

The total number of publications completed for this project to date was eight. |
| 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.  |
| KPIs1. Best management practices (BMPs) for improving soybean seed quality – 25% of farmers are aware of the BMPs for increasing seed quality.* We have made substantial progress on this KPI, across our Extension team units, more than 25 presentations have been executed during the last 4 years to disseminate the knowledge across all the states represented on this project. In addition to meetings with NCSRP and USB boards (e.g., board meeting and soybean breeder conference) to promote our work and increase awareness of seed quality.
* We acknowledge there is still a long way to go on this aspect and more educational efforts (projects funded to promote and transfer knowledge) are needed. This point has been well reflected in our survey instrument with only 12.5% of farmers aware of their oil and protein concentrations and its importance. Therefore, we did make progress on moving forward knowledge on this concept but there is still a long-path forward to increased awareness of soybean seed quality, oil and protein concentrations and well as practices to improve it.

2. At least five agronomists and growers per state adopt practices that can improve soybean protein and focus on quality considering the amino acids composition.* We have working with many soybean specialists and state area agronomists to start focusing on quality. In addition, we have collaborated with seed industry contacts across all states (e.g., Corteva, Bayer, BASF) as they have provided in-kind support for seed supply for all our field trials. Therefore, we have reached more than five agronomists/growers per state to disseminate our work.
* In addition we have provided presentations in winter and summer on these concepts reaching out more than 100 people every year.

3. At least 5% of soybean farmers are evaluating late-season N needs (e.g., ureide test) and testing soybean seeds for amino acids composition.* We are currently working with farmers using ureide test and collecting seed data for quality. Thus far, in the last 3-4 years we have collected samples from more than 50 farmer fields and working with more than 20 farmers across states to create awareness about seed quality variation within fields and testing the N needs towards the end of the season.
* This on-going collaboration with farmers has created a high level of awareness among soybean farmers on the overall changes in seed quality within their fields.
* Still more work is needed to achieve higher levels, i.e. greater than 20-30% of farmers,with awareness on soybean seed quality. Our recent survey shows that more than 10% of the farmers are now more aware of changes of soybean seed quality on their fields.
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| 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. |
| Summary across all US statesMore than 50 field studies were completed in the last 4 years.Several thousands of seed samples were analyzed for seed quality, oil, protein, and amino acids.As for the final outputs1) Final Database is available to collaborators: This has been completed and the database has been disseminated. Our main goal is to publish the database as an open access dataset.2) Information for amino acids composition is processed and new insights are obtained: Outcomes on variation of soybean seed amino acids has been published in five publications and new insights, extension article, has been published in several outlets, below are a few examples:<https://www.ksre.k-state.edu/news/stories/2021/03/soybean-study-protein-content.html> <https://soybeanresearchinfo.com/research-highlight/achieving-soybean-seed-quality-is-a-combination-of-nature-and-nurture/> <https://www.unitedsoybean.org/hopper/study-builds-on-existing-data-to-confirm-strategic-priorities/><https://www.soybeanresearchdata.com/download.aspx?file=Progress5File&name=52890_1920-152-0108_(Year_2_of_1820-152-0108)_SC_Final_Report-Non-technical_version.pdf> |
| Describe any unforeseen events or circumstances that may have affected project timeline, costs, or deliverables (if applicable.) |
| Not applicable – although COVID complicated the possibility to do more in-person meetings. |
| 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. |
| Next steps are to move this information closer to farmers and focus on identifying seed quality variation within the farmer fields, work with industry to create awareness of potential markets and open opportunities to gain value for improving quality at the farm-scale. Future regional specialization of soybean production could be relevant to expand opportunities and increased overall value of US soybean markets. Lastly, the tireless pursuit of adding value is a complex endeavor but a desirable one to increase US soybean competitiveness in the future international market. |
| **List any relevant performance metrics not captured in KPI’s.** |
| Our survey project was able to capture great outcomes relevant to move forward future research initiatives on this project:* Crop management linked to seed compositional quality are already carried out in soybean systems.
* Farmers relate improvement of seed composition mainly with crop nutrition.
* Less than 13% of the participants are aware of their levels of protein and oil.
* Premium prices over seed quality can stimulate adoption of new technologies.
* A $0.50 bushel premium would justify on-farm investments targeting quality.
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| **Non-technical summary:** |
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