Nebraska Soybean Board
FINAL Research Report Form

DS VB 11/8/2019

Note: Submit this report no later than 90 days after the NSB-funded project officially terminates.
This post-project 90-day time-frame will allow the Lead PI time to complete any final data analysis and a final technical report, plus the drafting of any articles for submission to scientific journals. Note that this completed report will be provided to the National Soybean Checkoff Research Database, (soybeanresearchdata.com).

Project # and Title: Combining producer data and remote sensing to identify management practices that maximize light and seed harvest

Principal Investigator: PI#1: Patricio Grassini

Co-PI's & Institutions: Juan I. Rattalino Edreira

Project Date (Including Extension): 10/01/2019 ***to*** 09/30/2019 ***(For example: mm/dd/yyyy to mm/dd/yyyy)***

Total Budget for Project: $ 45,000.00

1. Briefly State the Rational for the Research:

Future soybean yield increases will require us to combine the best genetics with the best possible agronomic management. Soybean yield ultimately depends on the amount of light 'harvested' during the season. The capture of light can be manipulated by producers via agronomic practices, such as planting date, in-season application of fungicide and insecticides, and tillage methods. However, little is known about the interactive effects of these practices on soybean producer yield when influenced by seasonal variation in water availability. This is especially relevant for NE, where rainfed and irrigated production are equally important. Evaluating these interactions following a typical experimental approach is difficult because of the large number of plots and site-years that would be required. In this project, we propose to use a combination of (existing) producer field data, remote sensing, and crop modeling to understand the influence of key management practices (e.g., planting date, foliar fungicide and insecticide, tillage) on seasonal light capture and seed yield across environments with different water availability. Identification of the 'suite' of management practices that leads to highest yield in each environment will help NE soybean producers to further close the gap between current on-farm yield and the attainable yield potential of modern soybean varieties.

2. Research Objectives: (copy from project, but keep in a brief bullet format)

The goal of this project is to understand how key management practices (e.g., planting date, row spacing, tillage) influence light capture and seed yield across soybean producer fields with contrasting water availability. Identification of the "suite" of management practices that leads to highest yield in each environment will help NE soybean producers to close the existing gap between current on-farm yield and the attainable yield potential.

3. General Approach Used and (if applicable) the Nebraska Test Locations:

We developed a novel approach consisting of producer data, satellite imagery, and crop modeling to understand mechanisms limits to soybean productivity across the US North Central (US-NC) region and identify management option for increasing yield and crop efficiencies in the use of inputs and resources. The approach was evaluated using producer data on yield and management collected from 5291 soybean fields sown across the US North Central region during 2014-2016, with >30% of data belonging to irrigated and rainfed soybean fields in Nebraska. Producer data were grouped into regions with similar soil, climate, and water regime to provide region-specific results that can be used by famers to adjust their current management practices and improve their yields.

4. Describe Deliverables & Significance Attained for Each Research Objective:

We developed a novel approach consisting of producer data, satellite imagery, and crop modeling to understand the upper limits to soybean productivity across the US North central region (US-NC) and identify management option for increasing yield. We found that attainable efficiency at capturing solar radiation (ea) represented 65% of total incident radiation, while attainable conversion of captured radiation into seed yield (ec) ranged from 0.6 to 1.2 g seed MJ −1 depending upon the amount of absorbed photosynthetically active radiation (APAR). Average producer ea and ec were 14 and 29% below their attainable effificiencies, indicating that there are still room for improvement. Our results also reveled that yield increase due to early sowing was attributable to longer crop cycle length and APAR during the entire crop cycle and during the critical stages for yield determination during the reproductive phase. In the case of fields treated with foliar fungicide and/or insecticide, yield increase was related by greater ec, and to a lesser extent, by higher ea and APAR. In contrast, higher yield in tilled fields was attributable to higher ea and APAR levels. The developed approach can complement traditional field experiments used to evaluate the effect of management practices on yield and be used to understand the underlying drivers behind the yield gains over time as a result of changes in the production environment due to agronomic improvement.

Our approach can be used to benchmark current soybean productivity level in individual farmer fields and for the entire state and NC-US region, providing realistic goals for farmers, and also promoting good agronomic practices. It can also serve as an educational tool that can assist researchers and extension educators in explaining producer, for example, why early planting is a 'must' if the goal is to achieve high yields. Similarly, results from this study provide strong evidence about the importance of keeping supporting current and future projects that explicitly aim to increase farmer yield and profit through better agronomic practices.

4. Describe Deliverables & Significance Attained for Each Research Objective (continued)

Our findings have been shared through a peer-review publication in an international high-profile scientific journal (see appended file):

Rattalino Edreira JI, Mourtzinis S, Azzari G, Andrade JF, Conley SP, Lobell D, Specht JE, Grassini P (2019) From sunlight to seed: Assessing limits to solar radiation capture and conversion inagro-ecosystems. Agricultural and Forest Meteorology (In Press).

Simlarly, results have been presented at several conferences international and national conferences. We are about to submit a second manuscript in another well-known international journal (Field Crop Research). To further disseminate our findings, we are planning to write extension articles targeting NE and US soybean farmers, once this second paper is published.

Finally, we note that the project leveraged funding from the North-Central Soybean Research Program (NCSRP) for a multi-year, multi-state project funded at a total level of 1.5 million USD.

5. List where the Project Research Results/Findings were Publicized:

-Rattalino Edreira, J.I., Mourtzinis S, Azzari G, Andrade JF, Conley S, Lobell D, Specht, J.E., Grassini P, 2020. From sunlight to seed: assessing limits to solar radiation capture and conversion in agro-ecosystems. Agriculture and Forest Meteorology, 260: 107775.

-Rattalino Edreira JI, Mourtzinis S, Azzari G, Andrade JF, Conley S, Lobell D, Grassini P, 2018. Exploring limits to soybean productivity using producer data and remote sensing. Paper 192-8. 2018 ASA-CSSA meeting, Baltimore, MD, USA.

-Rattalino Edreira, J.I., Mourtzinis S, Azzari G, Andrade JF, Conley S, Lobell D, Specht, J.E., Grassini P, 2020. Combining field-level data and remote sensing to understand the impact of management practices on producer yields (Under final preparation)

Note: The above boxes will automatically accomodate for your text inputs; HOWEVER, the Final Report comprised of the above listed items must be kept to THREE PAGES. A Technical Report of no more than TEN PAGES (preferably fewer) can be appended to this report.
Submit both reports as a single PDF with this file name format: #XXX > FINAL > Project Title > PI last name

Please email this completed form to the Agriculture Research Division (jmonaghan2@unl.edu) based on the reporting schedule given to you. If you have any questions, please call the ARD at 2-2045 or Victor Bohuslavsky at the Nebraska Soybean Board Office at (402) 432-5720.