ANNUAL REPORT

GRANT CODE: AW3652

TITLE: Factors affecting cadmium uptake by wheat from Idaho soils

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ACCOMPLISHMENTS:

In FY 2020, we advanced the meta-data analysis of paired soil and grain from Idaho samples collected from 2013 through 2017. Data from the 2019 growing season was added. This will allow for a predictive model on potential Cd uptake in grain based on soil properties. We have over 200 soil samples and over 900 grain samples from all grain growing regions in Idaho to conduct the meta-analysis. We are also developing a region-specific model for prediction of Cd grain uptake from southern and northern Idaho to meet the low Cd grain-supply chain. To support the region-specific analysis, we collected grain and soil samples from Parma Idaho, Cassia County and Minidoka County.

In 2019, we continued our QTL mapping research and planted the mapping population in one high-Cd and one low-Cd locations. Upon completion of the Cd test in spring 2020, we will do a comprehensive analysis to develop manuscripts for publication and develop molecular markers for new cultivar development. In 2019, we also harvested large amount of seed for two low Cd hard white spring wheat lines and will test them in multiple yield trials in 2020. This project provided training for one Ph.D student. Results from this study will not only allow for new wheat production strategies to provide baby food producers with a source of low Cd wheat, but also help us to understand genes underlying the low Cd. We are planning to submit one manuscript and apply a NIFA grant to identify candidate genes controlling low Cd in 2020.

We collected soil and grain samples from 24 plots (6 spring wheat genotypes * 4 replicates) from Aberdeen, Soda Springs, and Ashton; soil and grain samples from 2 spring wheat genotypes from Kimberly (2 replicates) and Rupert (4 replicates); soil and grain samples (2 winter wheat genotypes * 4 replicates) from Kimberly and Rupert. We also collected soils from Soda Springs that will be used in a greenhouse experiment on evaluating grain Cd accumulation affected by biochar application in acidic soil. The experiment is expected to be accomplished in the spring of 2020.

In July 2018, we submitted entitled, "Seed Grant to Integrate Variety Selection and Soil Properties to Reduce Cadmium in Wheat." This effort resulted in new synergy between the plant breeding and soil programs, with support from IWC and Ardent Mills. The project will investigate how the genome and phenome is related to the environment (e.g., soil properties). The grant was awarded $176,000 and sampling efforts in FY2020 will be used as input to the overall modeling effort to predict grain Cd uptake using soil and wheat variety as predictor variables. A new MS graduate student began working on this effort in Fall 2019.

PROJECTIONS:

We are completing the grain-soil data for select regions to develop a strong predictive model. The goal is to have a regional-specific predictive model so that growers can plan their planting in coordination with grain buyers.

We are proposing that a soil-genome-phenome relationship exists for Cd uptake in wheat grain, and we are in the initial stages of research effort to test this hypothesis. Our USDA proposal was

funded, which will enable us to make great strides in this effort. Once we prove that there is relationship between plant variety and soil properties for Cd uptake, we will seek support for further development of plant genome-soil relationships in grain Cd concentration by coupling QTL gene discovery with data on grain and soil properties. We anticipate a full proposal to USDA in 2021 to support this effort.

PUBLICATIONS:

PRESENTATIONS:

Daniel G. Strawn, Jianli Chen, Xi Liang. 2019. Relationship between Plant Variety and Soil Properties to Reduce Cadmium in wheat. Annual meetings of the Soil Science Society of America. Nov 2019, San Antonio, TX.

Jianli Chen, Ling Qiao, Justin Wheeler, Natalie Klassen, Kyle Isham and Rui Wang. 2019. QTL Mapping of Grain Cadmium and Other Related Metal in Spring Wheat. Annual meetings of the American Society of Agronomy. Nov 2019, San Antonio, TX.