2019 FREP Concept Proposal

Project Title: Yield Prediction for Seasonal N Fertilization Strategies in California's Almond Orchards

Project Leaders:

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Project Location: UC Davis and commercial farms in the major producing regions of almonds in California.

Project Duration: Three years.

Summary of Problem to be Addressed:
New legislatively mandated N management strategies for Almond requires growers to develop a pre-season N use program based on a Feb yield potential estimate and to update the estimate in May to establish seasonal N fertilization strategies. Accurately predicting yield in the early season is the missing link in the current N management plan and growers desperately need this capability. With preliminary funding from SCBG we have now demonstrated that we can achieve yield prediction accuracy of +/-310 lbs in mature almond yielding 2100 through 3,300 lbs across a diverse range of almond production environments in both February and in May (in Press Zhou, Chen, Jin and Brown, 2019). While this is an impressive accomplishment, further refinement, demonstration and outreach is required to achieve widespread adoption of this critical tool. Here we propose the ongoing development of a block-level yield prediction model and tools to assist growers in their adaptive nutrient management practices. Almond will be used as a model crop for this project as it is the largest tree industry with the best available database, however, this approach can be extended to other tree crops in California.

Target Audience:
All almond producers, consultants, water coalitions, CCAs, PCAs, extension, and other agricultural professionals that make nutrient recommendations for Almond in California.

Objective:
This project directly addresses the priority area "Improving Input Management", by (1) developing a robust and improved block-specific almond yield prediction strategy and creating an interactive Yield Calculator app to provide end users with timely block-level almond yield estimate, (2) demonstrating and promoting the use of these models to better manage nitrogen inputs at the right time in Almond, and (3) developing an effective outreach program to collect feedback and disseminate the outcomes.

General Approach:
This project uses historic yield data and geospatial biophysical, climate, and remote

sensing-based predictors in concert with knowledge of tree biology and bee behavior to build statistical models and easy-to-use tools for early-season yield projection and mid-season yield updates to determine fertilization rates. This project leverages the team's experience on N management, tree biology and chilling models (Brown, Pope), remote sensing and modeling (Jin), and bee modeling (Nino). Historically, attempts to develop yield models have been limited by the inability of researchers to gain access to the needed historic block level yield data sets, archived and real time aerial imagery and the computer algorithms needed to develop these models. Through on-going collaborations with major growers, we have been given access to multi-year yield data on 1,000's of individual orchards covering 70,000 acres of diverse orchard conditions representing a significant proportion of the acreage in the SJV. In addition, we have obtained an agreement from CERES imaging to provide free historic imaging of all almond locations they have imaged (80,000 acres) and low-cost imaging of all blocks included in this project. Further, we have access to historic and current environmental data from the CIMIS network and have access to the data in the SoilWeb database which will be used as a component of the yield model. In addition to achieving an early season yield prediction model with +/-310 lbs accuracy our investigations have provided insight into the geographic, orchard composition and environmental determinants of yield.

While our preliminary models are impressive, we believe that there is considerable room for improvement and we recognize a substantial need to demonstrate and extend this approach to the industry at large. In this proposal we will further refine and optimize the yield prediction tool and develop a grower interface for N management and integrate the tool into CropManage, ABC-CASP and CDFA-FREP website. The final model will be designed to allow users to contrast predicted with realized yield so that the model will be iteratively improved and growers can query results to better interpret the impact of their management decisions. While primarily a tool for improved nitrogen management, the ability to predict block level (and by inference a regional and statewide) yield, will be of tremendous value for many and the model can be used to test novel theories and determinants of yield.

Plans for outreach and measurable outcomes:
The monitoring and modeling tools developed here will be demonstrated throughout California in collaboration with farm advisors and the ABC through regular meetings, workshops, and field days. The project outcomes will be also communicated to the Almond Board and disseminated through UC extension and scientific publications. Measurable outcomes include the N reduction to achieve the same yield per acre. This tool will be of considerable value to fertilizer providers who will benefit from the ability to predict demand and manage distribution. The model is also of value to consultants in the development of fertilization schedules for growers and will contribute to the efficient utilization of nitrogen fertilizers to achieve the dual goal of profitable and environmentally sensitive nitrogen management.

Estimated funding that will be requested:
$225,000 to support research staffing on statistical analysis and modeling and to conduct demonstration and outreach activities.