Project No: 23-XXXX

Optimizing Potassium Fertilization Management in Almond and Pistachio Orchards

Project Leader: Patrick Brown
University of California, Davis
phbrown@ucdavis.edu

Abstract

Potassium (K) is one of the most important nutrients for almond and pistachio production. However, studies conducted on almonds have demonstrated extreme leaf K variability between samples, across dates, and across the field in orchards of apparently uniform soil type. This high degree of variability is not understood but results in growers and commercial testing labs adopting critical values (CV) for K of >2.2% even though research has demonstrated that the CV is 1.4% K leaf. The use of higher than recommended critical values is necessary to minimize the chance that any tree in the orchard falls below the 1.4% CV. Thus, high in-field variability complicates leaf and soil sampling and interpretation and hence compromises fertilizer decision-making. This research seeks to understand the patterns and causes of soil and plant K variability in the context of fertigated almond and pistachio production. The project will also develop a rapid, cost-effective mechanism to identify regions of differential K demand to improve grower decision-making and quantify potential returns and methodology for site-specific management. The final product will be the development and calibration of novel soil and aerial methodologies for K variability mapping, a greatly improved understanding of the causes of this variability, and guidance on the management practices needed to optimize fertilizer practices.

Project Objectives

- Identify the extent and causes of in-field K-variability
- Develop an improved cost-effective methodology to identify areas of differential K demand
- Develop online training resources and extend outcomes through talks and publications

Project No: 23-XXXX

Estimating Mineralization and Nitrogen Utilization from Banded Compost Applications in Drip Irrigated Sweetpotatoes and Processing Tomatoes

Project Leader: Daniel Geisseler
University of California, Davis
djgeisseler@ucdavis.edu

Abstract

Based on results from an ongoing FREP-funded project, an online calculator was developed that allows users to estimate the nitrogen (N) availability from a number of organic amendments. This calculator estimates that less than 30% of the total N applied with poultry manure compost is mineralized within six months when incorporated in early April under typical climatic conditions of the San Joaquin Valley. Observations in sweetpotato fields, however, reveal that very high decomposition and N mineralization rates occur, which suggests that the calculator may underestimate N availability from the poultry manure compost. Consequently, the application rate for poultry manure compost and in-season N fertilizer may be overestimated, increasing the risk of excess N being leached. Both organic and conventional sweetpotato and processing tomato growers frequently apply a band of composted poultry manure either below surface or above buried drip tape, then supplement fertilizer N through the drip tape during the growing season. However, sweetpotatoes are typically grown on sands and loamy sands using fall-applied compost, while processing tomatoes are grown on clay loam soils using spring-applied compost. This project will develop N budgets for sweetpotato and processing tomato production using field trials and a litter bag study to validate N mineralization from organic amendments in fields under similar climatic conditions, but with different soil types and drip irrigation systems. These studies will be complemented with a laboratory incubation study, which will be used to isolate the effect of soil type on N mineralization from different organic amendments.

Project Objectives

The objective of the project is to develop N budgets for sweetpotato and processing tomato production in Merced County. Specific objectives include:

- Determining N release of commonly used poultry manure composts and other organic fertilizers in field trials
- Investigating the effects of soil texture on N mineralization
- Determining the accumulation of N in the vines and storage roots of sweetpotato plants throughout the growing season
- Conducting outreach and developing user-friendly tools for growers and consultants

Project No: 23-XXXX

Improving Nitrogen and Potassium Management in Almond Orchards with Hulls and Shells as a Soil Amendment and Offground Harvest

Project Leader: Sat Darshan Khalsa
University of California, Davis
sdskhalsa@ucdavis.edu

Abstract

Almond (*Prunus dulcis*) production has a potentially large impact on groundwater quality in the Central Valley of California due to the large size of the industry and the high rates of nitrogen (N) used. Recycling almond hulls and shells as an organic matter amendment by California growers is a sustainable orchard practice that can increase soil organic matter, increase efficiency of N and potassium (K) fertilizer inputs, and maintain economically viable cropping systems. The management of N and K in almond orchards is made more difficult by current harvest practices that limit the ability to manage orchard floors to enhance soil organic matter. In addition, despite the value of hulls and shells as a K source, research is needed to understand the N dynamics from applied fertilizer in combination with the high carbon to N ratio (C:N) of hulls and shells. This project aims to understand how recycled hulls and shells will influence N, K and carbon cycling in almond orchards and the subsequent effects on N and K productivity, soil health and N availability following fertigation events. We will use an orchard field experimental design and monitoring techniques to investigate these effects across a range of management practices.

Project Objectives

- Characterize N release and absorption dynamics from amended hulls and shells and tradeoff between K release from hulls and shells and calcium, magnesium and sodium at plant and soil over the period of hulls/shells decomposition

- Integrate hulls and shells as a soil amendment with semi offground harvest to identify synergistic benefits including the continued buildup of an undisturbed mulch layer on the tree berm and study nutrient release, soil properties, and water and nutrient use efficiency

- Demonstrate the effects of hull and shell application on tree growth, physiology, and yield

- Enable the adoption of improved orchard management techniques and optimize hull and shell amendments based on nutrient supplementation, nutrient and water use, and economics by conducting field days and outreach events and evaluating the economic and environmental tradeoffs

Project No: 23-XXXX

Nitrogen Movement Out of Root-Zones in Central Valley Irrigated Lands: A Multi-Scale Management, Monitoring, Modeling, and Outreach Project

Project Leader: Isaya Kisekka
University of California, Davis
ikisekka@ucdavis.edu

Abstract

The Central Valley (CV) Irrigated Lands Regulatory Program (ILRP) regulates discharge of nitrate and other soluble constituents from irrigated cropland. To comply with this program, growers utilize precision irrigation and fertigation practices that are increasingly informed by decision support tools like CropManage (CM) to recover more applied fertilizer and minimize nitrate leaching. ILRP coalitions assess efficacy of these practices using the Soil Water Assessment Tool (SWAT), which is adapted to estimate nitrate transport and fate within the root-zone. CV-SWAT employs a suite of physically-based submodels to calculate daily water movement and nitrate transport over long time periods, however; uncertainty exists around the seldom-measured parameters of percolation and nitrate leaching. This project will apply CM and CV-SWAT to three already instrumented almond, orange, and processing tomato sites to assess and enhance the benefit of CM and validate the CV-SWAT model. The research seeks to validate the CV-SWAT model simulations to ensure solute losses are not under- or over-estimated, to demonstrate the performance benefits of using decision support tools like CM and expand their applications, and to study how these changes are reflected in CV-SWAT.

Project Objectives

- Evaluate and enhance the performance of CV-SWAT in quantifying the effects of irrigation and nutrient management practices on rates of nitrate leaching
- Evaluate uncertainty in predicted nutrient leaching through inter-model comparisons (CV-SWAT and HYDRUS) and comparisons with field measurements
- Expand application of CM by adding data and algorithms for orange, lemon, and mandarin crop types
- Integrate results from monitoring, management, and modelling efforts to inform outreach to water quality stakeholders at multiple in-person and/or virtual events

Project No: 23-XXXX

No-till planting of Rice to Conserve Water and Ensure the Sustainability of Rice Systems

Project Leader: Bruce Linquist
University of California, Davis
balinquist@ucdavis.edu

Abstract

The sustainability of California rice systems is being threatened by on-going droughts. Rice systems use a significant amount of water, but there are limited options for reducing water use in rice systems in California while maintaining an economically viable crop. One option is to plant rice by dry-seeding into a field that has not been tilled (no-till, NT). With NT, soil moisture in the soil is conserved and can be used to support plant growth early in the season. The benefits from NT include saving water, early planting, no additional tillage costs, and less weed pressure. However, challenges include fertility management, stand establishment in heavy clay soils, and identifying the optimal planting time to take advantage of soil moisture without rutting up the field. This project will test and develop the practice of NT planting in rice systems. Replicated field trials will be set up that compare three varying NT seedbed systems fertilized with urea at different N rates and timings. The field trials will also be used to optimize stand establishment, monitor weed populations and develop weed control methods, and quantify water inputs to develop a water budget and estimate evapotranspiration losses. Field days at the Rice Experimental Station and participating farm locations will be conducted and outreach materials will be developed that provide guidelines for farmers to more confidently adopt this practice on a wider scale.

Project Objectives

- Develop economically and environmentally viable NT practices that lead to the conservation of water for the various field conditions farmers may encounter through on-station and on-farm research. This will be accomplished by ensuring good crop establishment, developing a good weed management plan and developing best management practices for fertility management

- Disseminate information to growers that will allow for successful adoption of this practice. Outreach will involve interaction between researchers and growers and the dissemination of research findings

Project No: 23-XXXX

Facilitating Grower Adoption of Cover Crop Nitrogen Scavenging to Minimize Residual Nitrogen Loss and Comply with the Irrigated Lands Water Quality Protection Program (Ag Order 4.0) on the Central Coast of CA

Project Leader: Sacha Lozano
Resource Conservation District of Santa Cruz County
slozano@rcdsantacruz.org

Abstract

Intensive specialty crop rotations in the central coast region depend on abundant and costly nitrogen (N) inputs and often leave a considerable amount of residual N in the soil, which is highly susceptible to leaching below the root zone, especially during winter rains. Losing residual N is a missed cost-savings opportunity and can also cause water quality impairment, affecting environmental and human health. Cover cropping is a soil management practice that can help to recover and recycle N from crop residue mineralization and excessive fertilizer application through a process known as 'N scavenging'. This practice has been incorporated as a valid 'removal' strategy, or credit, in the context of balancing 'applied' and 'removed' N within Ag Order 4.0. This outreach project will implement 20-30 field-scale demonstrations annually on commercial fields during winter. Participating growers will be trained on how to collect measurements to demonstrate that the shoot biomass and carbon to N ratio (C:N) meet the criteria to receive the full cover crop N scavenging credit. Findings from field trials will be shared with growers and certified crop advisors through field days and guidance documents. The project goal is to facilitate grower adoption of winter cover cropping and demonstrate research-backed methods to estimate cover crop biomass, C:N ratio, and associated N uptake, helping growers to receive the cover crop N scavenging credit in Ag Order 4.0.

Project Objectives

- Educate central coast growers on the practical application of a validated, field-based method to estimate the biomass and C:N ratio of a winter cereal cover crop

- Facilitate and guide grower adoption of winter cereal cover cropping and the proposed N scavenging verification method to reduce residual N loss and receive full credit for 'N removal'

- Demonstrate and disseminate the proposed methodology and lessons learned to a broader community of growers through outreach events and print materials in multiple languages