Project No: 19-TBA

Development of Nutrient Budget and Nutrient Demand Model for Nitrogen Management in Cherry

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Abstract

The development of fertilizer decision support tools for the growers which guide the rate and time of fertilizer application as well as in season monitoring to adjust fertilizer rate is important to optimize yield and reduce leaching of nitrate to ground waters. This project aims to develop demand curves for nitrogen and other nutrients which will guide the quantity and time of fertilizer application thus enable growers to match fertilizer supply with crop demand. It also aims to provide a sound and practical “early-warning” and monitoring tool for cherry growers to optimize N management in Cherry groves. This tool will improve plant tissue sampling protocols to diagnose excessive, sufficient, and deficient nitrogen levels early in the season. Efficient and responsive fertilizer strategies are essential if we are to protect the Californian environment from non-point fertilizer pollution and are an economic imperative as consumers increasingly demand sustainability and responsible production techniques.

Project Objectives

1. Develop nutrient demand curves to guide the quantity and time of fertilizer application in cherry. Repeat for most representative cultivars and production systems.
2. Develop and extend nutrient Best Management Practices (BMP) for cherry cultivars.

Co-Project Leaders and Cooperators: Douglas Amaral and Pedro Lima, Department of Plant Sciences, University of California, Davis; Tyler Rood, California Cherry Board; Kari Arnold and Anthony Fulford, University of California Cooperative Extension

Project No: 19-TBA

Irrigation and Nitrogen Management, Monitoring, and Assessment to Improve Nut Production While Minimizing Nitrate Leaching to Groundwater

Project Leader: Thomas Harter
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Abstract

In the Central Valley and Central Coast regions, the Irrigated Lands Regulatory Program (ILRP) and Agricultural Order, respectively, were developed by Regional Water Boards (RWBs). Growers and their agricultural coalitions are charged with assessing, controlling, and regulating nitrate leaching from irrigated crops. For compliance, growers implement nitrogen (N) management plans and report their N mass balance, improve N use efficiency, and reduce N leaching to groundwater. Under the ILRP, agricultural coalitions – on behalf of their growers - must develop and demonstrate practices that are protective of groundwater. Among those practices, our research is showing that high frequency low concentration (HFLC) fertigation can improve production through higher nitrogen use efficiency, potentially reducing impacts to groundwater. However, commercial orchard scale implementation with direct measurements of resulting groundwater quality improvements immediately underneath the orchard is lacking. The overarching goal of our work is to demonstrate the efficacy of HFLC under real world conditions as both, an economically and environmentally promising practice, while also comparing and contrasting three monitoring approaches for regulatory compliance in a scientifically rigorous systems approach.

Project Objectives

1. Using an adaptive management approach, fine-tune the HFLC approach and demonstrate, in a commercial scale almond orchard, that HFLC fertigation practices increase water and nutrient use efficiency while successfully producing high yields and reducing groundwater quality impacts; perform education and outreach.
2. Perform, compare, and systematically assess three independent monitoring approaches to estimate groundwater nitrate contribution from an orchard to guide growers, agricultural coalitions, and regulatory agencies on the compliance process: 1. Water and nitrogen mass balance (WUE, NUE), 2. High resolution water and nitrogen flux monitoring within and immediately below the root zone, and 3. High resolution on-site groundwater monitoring; collaborate with and perform education and outreach to growers, agricultural coalitions, regulators, NGOs, and other stakeholders.

Co-Project Leaders and Cooperators: Patrick Brown, Department of Plant Sciences, University of California, Davis; Isaya Kisekka, Department of Land, Air and Water Resources, University of California, Davis; Gabriele Ludwig, Almond Board of California

Project No: 19-TBA

Achieving Efficient Nitrogen Fertilizer Management in California Wheat

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Abstract

Of the 450,000 - 750,000 acres of wheat planted annually in California, a large majority are fall-sown and grown in interaction with winter precipitation. Patterns of precipitation are highly variable across the state, as well as within and between seasons. This variability, combined with the extremely diverse set of agroecosystems where small grains are produced, results in a wide range of nitrogen (N) fertilization and irrigation management practices and heterogeneous yield potential across space and time—making efficient management of N fertilizer in wheat challenging to achieve. Achieving high fertilizer use efficiency is particularly important for these fall-sown crops because variable winter precipitation patterns can create conditions for N losses from the system through leaching and other loss pathways.

Project Objectives

1. Establish 14-16 field-scale demonstrations of the use of N reference zones in combination with site-specific measurements of the soil, plant and canopy environments to guide real-time N management decisions.
2. Measure crop productivity and quality outcomes of management actions taken/not taken in response to real-time information.
3. Host 9 field days at demonstration sites during the growing season.
4. Produce case-studies documenting agronomic conditions, specific measurements, interpretations of measurements in the decision support framework, management responses, and the associated crop productivity/profitability outcomes.
5. Develop generalized summaries and guidelines for implementing N rich reference strips, taking site-specific measurements, interpreting results, and making responsive farming decisions.
6. Beta-test, improve, and extend a dynamic, web-based decision support tool that provides customized information based on site- and time-specific environmental conditions and California-specific models of wheat growth and development.

Co-Project Leaders and Cooperators: Taylor Nelsen, University of California, Davis; Nicholas Clark, Giuliano Galdi, Thomas Getts, Michelle Leinfelder-Miles, Sarah Light, Konrad Mathesius, and Lynn Sosnoskie, University of California Cooperative Extension; Kimberly Gallagher, Erdman Farms; Derek Azevedo, Bowles Farming Company

Project No: 19-TBA

Developing a Nitrogen Mineralization Model for Organically Managed Vegetable Farms on the Central Coast

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Abstract

Given the high value of organic vegetables, there is resistance to taking risks with reducing N applications to these crops. The proposed study shall provide a practical and easy-to-use method of estimating N mineralization from organic material, in order to help reduce N application rates without affecting yield. The information generated from this project will also assist growers in accurately estimating the portion of applied N from organic fertilizers and amendments that was available to their crop. These estimates are needed for organic growers to accurately report applied N rates to the regional water quality control boards. The overall goal of this proposal is to develop a simple N mineralization model that can be integrated into CM for organic vegetable production in coastal California. Building upon the existing FREP project and other work, we will take a deeper look at mineralization of N in organic vegetable production systems to help clarify N mineralization patterns in soils under organic management and provide tools that growers can use to estimate mineralized N.

Project Objectives

1. Create a N mineralization database for organic fertilizers and amendments, crop residues, and soil organic matter (SOM)
2. Develop a simple N mineralization model using the existing data
3. Evaluate and improve the simple model by field trials and incubation studies
4. Integrate the selected model with CropManage (CM) to simulate N mineralization in organic vegetable production in Coastal California
5. Conduct outreach to organic vegetable growers in Coastal California

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Co-Project Leaders and Cooperators: Daniel Geisseler, Richard Smith, and Michael Cahn, University of California Cooperative Extension; Dan Sullivan, Oregon State University

Project No: 19-TBA

Next Generation N Management Training for Certified Crop Advisors

Project Leader: Doug Parker
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Abstract

The enactment of the Irrigated Lands Regulatory Program (ILRP) now mandates grower reporting of nitrogen (N) use efficiency (applied N from all sources/N removed in the harvested crop) and legislates a reduction in nitrate leaching to groundwater. This represents a challenge to farming communities as implementation of these rules will undoubtedly reduce the amount of applied N and thereby require an increase in the efficiency of the remaining applied N. Current regulations require growers to develop an annual N management plan in consultation with a certified crop advisor (CCA) at the beginning of the growing season, followed by reporting actual N use the following year. As the mandate of the ILRP widens, our reliance on an educated and informed CCA workforce becomes more important. Our current CCA N management program resulted in 11 workshops and multiple UC ANR publications. However, these efforts have yet to translate into a long-term sustainable solution for training the next generation of CCAs to be proficient in N management. This project will build on our previous work by offering one CCA workshop in 2020, developing a study curriculum delivered in an online video series, authoring a suite of exam questions for use by our partners responsible for testing, and evaluating the efficacy of the overall program after the first set of examinations.

Project Objectives

1. Deliver one CCA workshop;
2. Organize key information sources that CCAs use for making recommendations to growers into a study curriculum;
3. Curate study materials in the form of a video series;
4. Develop exam questions in collaboration with our project supporters and;
5. Analyze exam responses and update study and exam materials accordingly.

Co-Project Leaders and Cooperators: Amanda Crump, Sat Darshan S. Khalsa, Patrick Brown, Department of Plant Sciences, University of California, Davis; Daniel Geisseler, Sarah Light, Mae Culumber, Khaled Bali, Dan Munk, Ben Faber, Allan Fulton, Katherine Jarvis-Shean, Andre Biscaro, George Zhuang, Michelle Leinfelder-Miles, Phoebe Gordon, Nicholas Clark, Sonia Rios, Michael Cahn, Luke Milliron, and Jairo Diaz, University of California Cooperative Extension

Project No: 19-TBA

Immobilization of Nitrate in Winter-Fallow Vegetable Production Beds to Reduce Nitrate Leaching

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Abstract

Another way that leaching of residual soil nitrate can be reduced is by immobilization. Immobilization occurs when soil amendments with a carbon: nitrogen ratio (C:N) greater than 40 are applied. Growers routinely make fall application of compost (Tourte et al, 2017). The goal of the proposed project is to test whether adding high C:N soil amendments, such as high C:N compost) could immobilize nitrate in the winter beds and thereby reduce nitrate leaching during this critical time of the year. Chaves (2007) observed that green waste with a high C:N ratio was effective at reducing nitrate leaching loss from N rich crop residues. Green waste from Central Coast cities as well as from the Silicon Valley is the most common feedstock available for making compost on the Central Coast because manures generally are more costly due to transportation costs from the Central Valley. Therefore, the goal of this project is to evaluate the potential of locally-sourced high C:N ratio green waste compost to sequester residual soil nitrate. If successful, the use of this material would be a practical and economical practice that growers could readily adopt as a best management practice (BMP) to improve water quality.

Project Objectives

1. Identify and select locally-sourced high C:N ratio green waste materials and conduct laboratory incubations of them at different particle sizes.
2. Conduct large scale field trials with cooperating growers in commercial vegetable production fields evaluating the impact of materials identified in objective 1 on nitrate leaching during the winter fallow.
3. Evaluate the magnitude and longevity of the impact of the high C:N materials on subsequent crop production.
4. Develop algorithms for CropManage that can provide estimates of immobilization based on C:N ratio of the amendment and the quantity added to the soil
5. Conduct economic analysis of the cost of the use of high C:N amendments
6. Conduct grower outreach through blogs, trade journal articles and grower meetings.

Co-Project Leaders: Michael Cahn, University of California Cooperative Extension, Monterey County; Joji Muramoto, University of California Cooperative Extension, Organic Specialist; Daniel Geissler, University of California Cooperative Extension, Nutrient Management Specialist

Project No: 19-TBA

Promoting the adoption of CropManage to optimize nitrogen and irrigation use through low-cost data loggers and cellular modems for Spanish-speaking growers in Santa Cruz and Monterey Counties

Project Leader: Gerry Spinelli
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Abstract

CropManage is an online decision-support tool developed by the UC Cooperative Extension (https://cropmanage.ucanr.edu/) that assists growers with water and nitrogen management and record keeping. The adoption of CropManage as a management practice has great potential for improving water and nitrogen application efficiency, particularly in vegetable and berry production, by reducing over-irrigation and thus leaching of nitrogen to the groundwater and by producing nitrogen application recommendations based on soil sampling. However, barriers to the adoption of CropManage have been the high cost of equipment needed to collect irrigation data in the field (Campbell Scientific data loggers and modems, about $3500) and to upload them to CropManage enabling the software to produce recommendations. The RCD of Santa Cruz County, in collaboration with interns from UC Santa Cruz Baskin School of Engineering, recently developed a low-cost (<$300) data logger with cellular modem communication that mimics the output from Campbell Scientific data loggers and produces the same file format automatically uploadable into CropManage. This project aims to increase the adoption of CropManage by eliminating the financial barrier to buying equipment, thus making its use more affordable.

Project Objectives

1. Identify a flowmeter capable of pulse output and field test low-cost Arduino data loggers for use with CropManage.
2. Improve the current Arduino prototype data logger software for cellular communication.
3. Increase adoption of CropManage and implementation of recommendations among growers and irrigators.
4. Assess effectiveness and impact of CropManage adoption among growers and irrigators

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Co-Project Leaders: Michael Cahn, University of California Cooperative Extension, Monterey County; Whitney Haraguchi, United States Department of Agriculture, Natural Resources Conservation Service; Zachary Gottesman, University of California, Santa Cruz, Software Engineer