Project No: 20-0250

Assessment of Nitrogen Content of the Harvested Portion of Specialty Crops to Estimate Crop Nitrogen Removal and Improve Nitrogen Management in Crops

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Abstract

The Irrigated Lands Regulatory Program (ILRP) has issued waste discharge requirements (WDRs) that affect agricultural operations throughout California. The WDRs are intended to improve water quality by affecting grower implementation of more efficient nitrogen (N) management practices. One metric to assess grower progress in improving N management is the ratio of applied (A) to removed (R) nitrogen in harvested crop biomass (A/R). Reliable coefficients to convert measured crop yields into representative rates of N removal (R, in pounds of N/acre/crop) are needed. Refined coefficients for a group of 35 commodities proposed here would provide the information needed to reliably determine R for most of the commodities identified by the Central Coast Regional Water Quality Control Board.

Project Objectives

1. Assess N removed in harvested product for 35 commodities identified in the special request for proposals over three growing seasons

2. Develop N removal coefficients that can be multiplied by grower yield data to provide an estimate of N removed (R) in the harvested crop

3. Expand knowledge and promote appropriate use of N-removal coefficients (as part of routine N-management planning, and evaluation) by growers, advisors, and consultants

Project No: 20-0877

“Crop Nutrient Minute” Video Series

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Abstract

The Irrigated Lands Regulatory Program mandates that producers of irrigated crops minimize or eliminate excessive nitrate movement beyond the root zone where the crop nutrient can pose a risk to groundwater quality. Minimizing nitrate movement is best accomplished by following the 4Rs, a concept based on using nutrients in a way that optimizes crop uptake of the nutrient while minimizing environmental impacts. Each crop has a specific “recipe” of the 4Rs (Right time, Right place, Right amount and Right product) that is unique to that crop. This project would expand the method of communicating to the media, in particular the use of YouTube-type video productions. As the name implies, a “Crop Nutrient Minute” would be a succinct video production that describes the 4R’s for a specific crop. This video series would be made up of seven to eight videos, each focusing on one specific major acreage crop. Additionally, videos would include information on basic soil function and health management, crop rotation, and efficient irrigation practices and their impact on the specific components of the 4Rs.

Project Objectives

The objective of this project is to make available in the contemporary medium of web-based video the information that has been developed and/or is in the process of being developed for the major irrigated crops in the Central Valley and Central Coast. While five minutes is a relatively short duration to cover these subjects, the assumption is that many growers and crop advisors understand the basic principles of crop nutrient management. These five-minute segments will focus briefly on the fundamentals and will cover tips and techniques specific to each crop that have been developed and are in use to properly implement the 4Rs. The objective of these short, crop-specific videos is to enable someone on a busy schedule to watch a video and gain exposure to information that has taken years to develop and already has real-life use in producing crops.

Project No: 20-0878

Ventura County Nitrogen Management Training Program

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Abstract

Approximately 60% of the agricultural acreage in Ventura County is located in Responsibility Areas associated with nutrient water quality exceedances, or Total Maximum Daily Load (TMDL) specific requirements. Growers in these areas are required to develop certified Nitrogen Management Plans (NMPs) for their farms. To provide local growers with the tools and training they needed to implement these requirements, the Ventura County Agricultural Irrigated Lands Group (VCAILG, administered by the Farm Bureau of Ventura County) worked collaboratively with the California Department of Food and Agriculture Fertilizer Research and Education Program and the University of California Cooperative Extension (UCCE) to develop a customized version of the Central Valley self-certification training program for growers in Ventura County. Funding requested for this project is also needed to serve Spanish-speaking audiences by translating the presentation materials and providing active translation during the workshops.

Project Objectives

1. Provide growers with the information and credentials needed to develop site-specific Irrigation and N Management Plans (INMPs) and NMPs for their farms

2. Improve surface and groundwater quality through an education program focused on the principles of crop-specific irrigation and nutrient management

3. Increase awareness of grower resources and research-based fertilization recommendations, including crop-specific nitrogen demand/removal factors

Project No: 20-0879

Assessment of Harvested and Sequestered Nitrogen Content to Improve Nitrogen Management in Crops, Phase 2

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Abstract

Through the Irrigated Lands Regulatory Program (ILRP), the CV Regional Water Quality Control Board (CV Water Board) now requires producers in the CV to implement management practices that are protective of groundwater quality and to document the effectiveness of those practices by providing, among other things, information on field nitrogen (N) balances. To do this, producers and their coalitions need accurate coefficients to convert yield information into amounts of N removed from fields in harvested crop materials. The importance of these coefficients for nutrient management planning was underscored by the Agricultural Expert Panel convened by the State Water Resources Control Board, which recommended the ratio of N applied (A) to N removed (R) as a simple metric to gauge program progress in reducing the mass of leachable N.

Project Objectives

1. Assess N concentration of harvested material removed from fields (N removed, or R) for approximately 33 crops over several growing seasons, and N sequestration rates for 8 perennial crops (which are included among the 33 total crops), by working with grower/packer/shipper partners to obtain samples, and UC Davis to analyze samples and interpret results

2. Refine crop yield (Y)-to-R conversion factors, and add N-sequestration rate estimates, for use by growers and grower advisors during nutrient management planning and by coalitions for large-scale performance assessment

3. Promote and enable expanded knowledge and appropriate use of N-removal coefficients and N-sequestration rates (as part of routine N-management planning and evaluation) by growers, grower advisors, and coalitions

Project No: 20-0880

Development of Site-Specific Nitrogen Fertilization Recommendations for Annual Crops

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Abstract

To minimize nitrate leaching to groundwater while maintaining high yields, growers need reliable tools to determine optimal rates and timing of nitrogen (N) applications. These tools should be based on field-specific information, including availability of N from non-fertilizer sources, such as residual soil nitrate, nitrate in irrigation water, and N mineralization from soil organic matter (SOM). Our research has shown that combining measures of soil texture as well as SOM content and quality can provide accurate site-specific N mineralization estimates. In soils with a high SOM content, particulate organic matter was a good measure for SOM quality, while in soils with a low SOM content, fluorescein diacetate (FDA) hydrolysis, a measure for microbial activity, was a better predictor. In this research, field trials will be conducted to validate these estimates in commercial fields in the Central Valley, Delta and Tulelake basin regions. The project will generate models for in-season N mineralization and seasonal N uptake data that will be used to develop online calculators that estimate site-specific in-season N mineralization rates and N fertilizer requirements.

Project Objectives

The proposed project will develop robust site-specific estimates of the contribution of N mineralization to the plant-available N pool and incorporate them into user-friendly online N fertilization calculators. Specific objectives are to:

1. Validate N mineralization estimates in field trials in the Central Valley, Delta and Tulelake basin

2. Characterize the chemical composition of SOM using Fourier transform infrared spectroscopy (FTIR) and correlate it to soil quality

3. Develop user-friendly and site-specific online N fertilization calculators for different crops

Project No: 20-0960

Enhancing Nitrogen and Water Use Efficiency in California Carrot Production Through Management Tools and Practices

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Abstract

California fresh market and processing carrots comprise an area of 68,000 acres with gross sales of nearly 702 million dollars per year (California Agricultural Statistics Review 2016-2017, CDFA, data associated with crop season 2016). One of the biggest needs of the carrot industry from the scientific community is data on nitrogen (N) uptake and removal rates and N uptake curves for various soil types and carrot crops in major crop production regions. There is not enough research on N management to free farm managers/growers of the worry associated with underapplication, causing a loss in profitability. Utilizing more accurate estimates of crop water use and N uptake may have a significant impact on water quality issues and on soil water and N availability, which potentially increases the economic sustainability of carrot production as water resources become less available or more expensive and N fertilizer prices rise in the future.

Project Objectives

The project aims to develop knowledge and information on improving and promoting adaptation of management practices that optimize N and irrigation water use efficiency in California carrot production systems. Specific objectives are to:

1. Provide data and information on crop water use

2. Provide data and information on crop N uptake curve, net N removal, and recommendations on N applications

3. Develop recommendation on best N and water management

4. Develop knowledge base information and data to adapt the CropManage tool for water and N management

5. Disseminate the project outcomes by developing an effective outreach program

Project No: 20-0961

Certification and Distance Learning for Fertigation

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Abstract

This proposal addresses 2020 Priority Funding Area (2) Improving Input Management (C) Education and Outreach (Technical Education). The specific problem addressed is the need to apply nitrogen and other fertilizers with a high efficiency. California has over 4.1 million acres with intensively farmed drip/micro irrigation, and about 1 million more acres with sprinklers, almost all of which apply fertilizer through irrigation water (fertigation). The lack of readily available pragmatic information and training related to fertigation is a major stumbling block to improving nitrogen fertilizer efficiency.

Project Objectives

1. Develop twenty-one excellent distance-learning modules for various aspects of fertigation including nitrogen processes and management. These modules will utilize information available in the ITRC/FREP book Fertigation (2018) that was developed under FREP Grant Agreement 15-0393-SA

2. Make fourteen of the basic modules available in both English and Spanish for free on YouTube

3. Make the remaining seven modules in English, available for free on YouTube

Project No: 20-0962

Outreach and Revenue Generation for sustaining CropManage Irrigation and Nutrient Management Decision Support Tool

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Abstract

CropManage (CM) is an online decision support tool developed by University of California Agriculture and Natural Resources for assisting growers with efficiently managing water and nitrogen (N) fertilizer to match the site-specific needs of their crops. CM also allows growers to track fertilizer and water applications on each of their fields. This recordkeeping capability of the software allows multiple users to share and review water and N applications on each field of their ranch, and for growers to maintain data required to comply with water quality regulations. With financial support of FREP, CM was originally developed in 2011 to help farmers estimate irrigation schedules in lettuce using California Irrigation Management Information System (CIMIS) reference evapotranspiration (Eto) data and determine fertilizer N needs using the soil nitrate quick test and models of N uptake. Later CM was expanded to include other coastal crops, including baby salad greens, spinach, celery, broccoli, cabbage, cauliflower, and strawberries. Funding from FREP and the CA Department of Water Resources facilitated adapting CM for central valley crops including alfalfa, almonds, and processing tomato. This project will address both increasing outreach and training on CM to growers, consultants, technical support providers, and UC farm advisors as well as explore and implement a strategy to continue funding software development.

Project Objectives

1. Target outreach on irrigation and N management using the CM decision support tool for growers and industry groups producing commodities recently added to the software or are unfamiliar with the decision support tool

2. Develop and implement a plan that would generate funding to sustain CM software into the future.

Project No: 20-0964

Nitrogen Response of Industrial Hemp Cultivars Grown for CBD, Essential Oils

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Abstract

In 2019 there were numerous growers producing industrial hemp throughout California, but many of these growers had limited knowledge of the best management practices for this novel crop. This lack of knowledge is because of the dearth of agronomic data (fertilizer, pest management) for industrial hemp in the Mediterranean climate of California. Nitrogen (N) management studies with industrial hemp have focused on hemp fiber and grain types in rain-fed or partially-irrigated environments, not fully-irrigated production regions. When growing hemp cultivars for essential oils production, in particular cannabidiol (CBD), concerns with impacts of management practices are not only with yield responses to inputs such as irrigation water amount or applied N fertilizer, but also with interactive effects on CBD and (tetrahydrocannabinol) THC concentrations in harvestable portions of plants. Our opinion is that additional information from studying N fertilizer effects on biomass yields, CBD productivity and THC levels will be of significant interest to farmers who wish to grow this crop.

Project Objectives

1. Evaluate for two biotypes of industrial hemp the impacts of N application amount and variety/growth habit/plant type on plant N uptake, harvest removal, yield response

2. Assess impacts of N management approach on THC and CBD tissue content, including partitioning to harvested portions of plants

3. As information is developed in the study, provide information to appropriate grower groups, consultants and industry to give opportunities for feedback and to refine concepts of workable changes in N management approaches

Project No: 20-1019

Techniques to Minimize Nitrate Loss from the Root Zone During Managed Aquifer Recharge

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Abstract

The managed application of floodwaters (Flood-MAR) on agricultural fields is gaining a great deal of interest in California as a technique to offset groundwater overdraft (Department of Water Resources, 2018). Despite its promising possibilities, there are significant challenges that need to be addressed before this practice can be widely implemented. One concern is the potential for groundwater contamination by nitrate. Place-based guidance is needed to optimize Flood-MAR strategies in ways that capitalize on natural mechanisms of the nitrogen cycle to remove nitrate through denitrification, immobilization, and plant uptake so that deep percolation is clean.

Project Objectives

To encourage wider adoption of Flood-MAR among growers and to gain the confidence of regulating institutions such as the State Water Resources Control Board, there is a need for crop and soil-specific strategies to reduce the risk of nitrate contamination of groundwater. We will develop and validate a modeling process where the effect of amount, timing, and duration of Flood-MAR on nitrogen transformations and translocations are evaluated over a range of soil types and different residual nitrate levels via hydrologic-biogeochemical simulations using HYDRUS-1D coupled with a reactive transport module, PHREEQC. Our goal is to quantify nitrate losses under different treatments and create place-based guidelines that minimize nitrate leaching during Flood-MAR. The proposed modeling will be validated with data from six Flood-MAR locations, three of which are agricultural fields with detailed measurements of soil and pore water N to determine N losses and transformations. The other three agricultural sites have had deep cores sampled before and after Flood-MAR experiments. Thus, we are leveraging existing funding to conduct field trials of Flood-MAR strategies and associated hydrological and biogeochemical monitoring at these sites.