A. Cover Page

Project Title
Developing tools and information to enhance water-nitrogen use efficiency and sustainability of avocado production systems

Key Personnel

Role	Name	Affiliation	Contact Information
Project leader (PI)	Ali Montazar	Irrigation and Water Management Advisor, UCCE San Diego, Riverside, and Imperial Counties	(442) 265-7707 amontazar@ucanr.edu
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Project Location
Commercial Avocado Orchards in San Diego, Riverside, Orange, and Ventura Counties

Requested Funding Amount
$300,000

Project Duration
Three years (January 2026 through December 2028)

Funding Category
☐ Outreach, Education, and Demonstration
☒ Research and Demonstration

Funding Priority Area(s)
☐ Outreach -1 ☐ Research -1B ☒ Research -1D ☐ Research -2B
☐ Research -1A ☐ Research -1C ☐ Research -2A

B. Project Summary (400)

Problem
Avocados are shallow-rooted trees and therefore, careful water and nitrogen management is critical to ensure optimal yield and high-quality fruits. This is even more important under avocado crop production systems in southern California due to uncertain water supplies, mandatory reductions of water use, the rising cost of water,

increasing salinity in water sources and the importance of appropriate leaching practices, and water quality issues and complying with the ILRP requirements. The PI of this proposal has conducted extensive data collection and analysis in 12 avocado commercial sites under various environments and conditions over the past three years to develop crop water use information and crop coefficient curves for the CA avocado production systems. This data demonstrates a wide range of water-nitrogen management practices, soil types and conditions, water qualities, row orientation and slopes, and plant densities in avocado production systems. With the low tolerance of avocado trees to chloride and salinity, the need to carefully manage salt in the shallow root zone by leaching causes some growers to leach out nitrate, losing expensive fertilizer and contaminating groundwater. Optimizing N applications along with appropriate irrigation management practices to reduce N leaching is extremely important but needs to be managed in relation to salt leaching. The PI's research and extension activities, working closely with the CA Avocado Commission (CAC) and several farms in different parts of the state, shows that there is an immediate need for tools and information on irrigation and nitrogen best management practices in avocado, as one of the under-studied crops. The CAC is very supportive of this study.

Impact

This project will provide more accurate information on avocado N uptake and removal values under different conditions and farming practices which can assist local/regional growers determine the optimal amount of water and N fertilizer applications. New management tools will be evaluated and adopted in avocados that could provide solutions to enhance the competitiveness of the industry though greater capacity of sustainable practices resulting in reduced inputs (N and water), and increased efficiency, yield, and economic return. A long-term impact of the project will be achieving a higher ratio of harvested N to cropland N inputs which may contribute significantly to reduced nitrate contamination and water quality improvement.

Audience

The target audiences for the project are avocado growers and stakeholders (e.g., local irrigated lands collations, RCDs, and GSAs) in southern California.

C. Project Objectives (100)

The specific objectives of this study are:

1. to assess the impact of water-nitrogen grower practices in avocado trees growth and fruit quality, N removal, N soil availability and leaching.
2. to develop N-removal crop coefficient value/s in California avocado production systems.
3. to assess the usefulness and economic feasibility of Soil Solution Access Tubes in conjunction with leaf analysis as a tool for N and salt management in avocados orchards.
4. to provide data and demonstration trials and adapt the CropManage (CM) web-based tool for water and N management in avocados.
5. to disseminate tools and information developed by the project to avocado growers and stakeholders.

D. Approach (500)

Methods

(1) Two avocado sites will be selected from our current collaborating farms (McMillan Farms in Riverside County and Grangetto Ranches in San Diego County). In each site, three N application strategies, all under grower irrigation practice, will be assessed. The experiments will be arranged in CRB design with 6 replications (6 trees per N strategy). The N strategies will be grower practice, 30% less and 30% more than grower practice. Soil Solution Access Tubes (SSATs) will be set up in four experimental trees per each N strategy to take pore water samples from five different depths (6”-30”). ECe, nitrate-N, and chloride contents will be measured 20 times per year over a two-year period. Soil samples will be collected from these depths three times per year for more comprehensive laboratory analysis. Water and N applied, foliar and fruit nutrient content along with dry matters, and avocado harvested yield will be measured. The effectiveness and economic feasibility of the SSATs in combination with leaf analysis for N and salt management will be evaluated. (2) crop N-removal coefficient values will be developed sampling from 15 commercial avocado sites (from the farms above and 4 other avocado cooperating farms including Barr Ranch, Irvine Ranch, Lloyd-Butler Ranch, and Pine Tree Ranch). The sites will be in San Diego, Riverside, Ventura, and Orange Counties. The measurements (protocol used by the PI’s ongoing study) will be conducted over a three-year period. (3) we will develop information (canopy cover % estimated from high-resolution multi-spectral/thermal images taken by UAV; N uptake data from this study and the Kc curves developed by the earlier PI’s study) to adopt *CropManage*. A new CM module will be developed for avocados. (4) we will conduct demonstration trials adopting the CM in the two experimental avocado sites during the third year of the project. (5) in addition, a web-based survey will be developed and employed to collect information on N-water and salinity management practices, water quality, average marketable fruit yield from at least 80 avocado orchards.

Evaluation

Project success will be measured using an integrated approach consisting of: (1) the outcomes of the project will be disseminated to growers and stakeholders through a robust outreach program. Project staff will document the numbers of training meetings, growers who attend and gain knowledge-based information, and extension publications, and number of growers who adopt practices developed by the project. (2) water and fertilizer used, fruit yield, and dollar net return of the avocado sites will be documented. The reduced resources used and net benefit resulting from better management will be evaluated.

Outreach

A robust outreach program will be developed to disseminate project findings to growers and stakeholders. We will hold three training workshops. The findings will also be presented at the grower meetings of the CAC and at the Avocado Café. Results will be published as extension publications in *Topics in Subtropics* and *Extension Connection* newsletters, CAC- *from the Grove Magazine*, and UC blogs and as scientific articles in peer-reviewed journals.