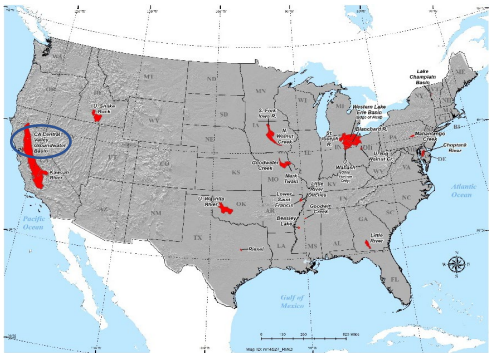
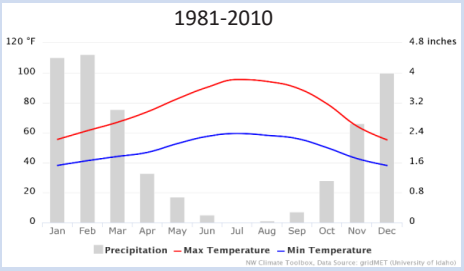
California Central Valley Groundwater Basin: Nitrate Leaching Field Scale Assessment Tools



Location

The 90-acre field is located in Yolo County, California.

Temperature and Precipitation



Major land uses

Cropland: Processing tomato rotation with hybrid seed production.

Data collection

Ten boreholes were drilled and the profiles characterized by soil texture, water content, ammonia, nitrate, total N and C contents, chloride, and sulfate in November 2019.

Historic water and nitrogen mass balances were performed using grower information, remote sensing, meteorological data, and nitrogen uptake coefficients.

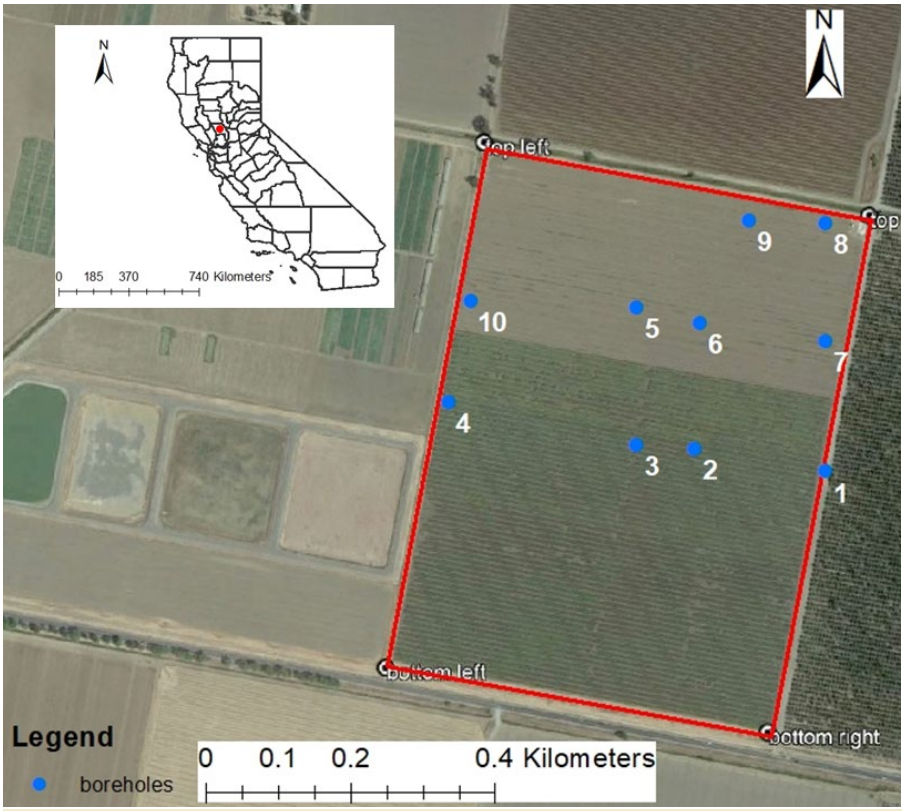
Water and nitrogen inputs will be continuously measured.

Evapotranspiration will be monitored with remote sensing and soil water mass balance techniques.

Nitrate leaching will be monitored using a deep vadose zone monitoring system. Plant nitrogen removal from the field will be measured.

Groundwater level and quality will be intensively monitored with a high resolution well network.

A Conservation Effects Assessment Project (CEAP) Watershed Assessment Study: A collaboration between the University of California–Davis, the Natural Resources Conservation Service, and the Agricultural Research Service



Field location in Yolo County, California. Sampling locations and field delineation.

Issues

Most California drinking water suppliers depend partially or entirely on clean groundwater. Nitrate continues to be the most widespread contaminant, and nitrate levels are trending higher in agricultural regions. Domestic wells, common in rural areas, are also widely affected by nitrate contamination.

Excess nitrogen from agricultural activities is one of the most prominent sources of groundwater nitrate. Nitrogen not used by plants is leached with excess irrigation water or precipitation recharge to groundwater as nitrate.

Main conservation practices used

Irrigation and nitrogen are applied jointly and more accurately to specifically meet plant demands, at the right time, place, and amount.

Nitrogen is injected into irrigation water ("fertigation"), which increases uptake efficiency.

Winter cover crops prevent nutrient losses during California's rainy season (November – April).

Soil tests are performed before planting, and initial mineral nitrogen in the soil is accounted for in fertilizer applications.

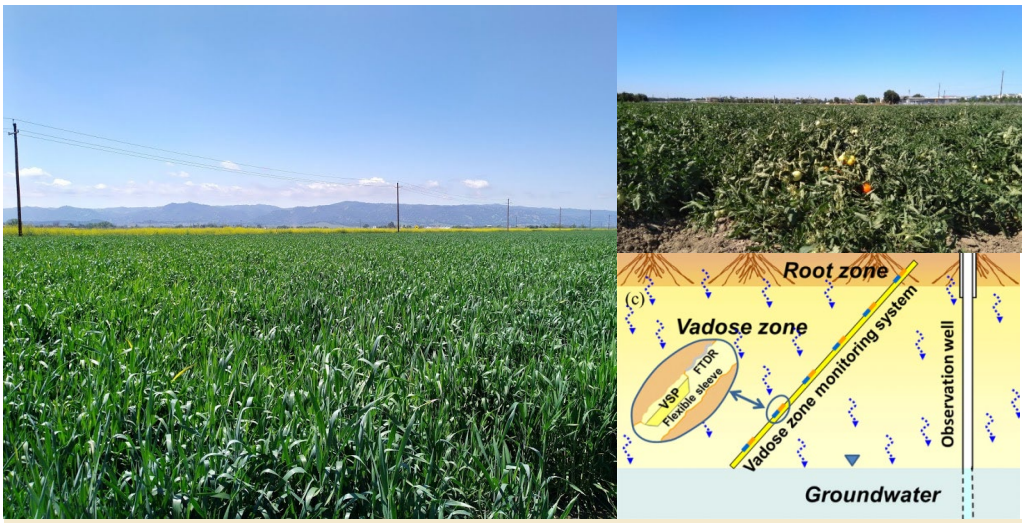
Nitrate concentrations in irrigation water from a groundwater source are accounted for as part of the fertilization budget.

Central Valley Nitrate Leaching Field Assessment

Outcomes/Findings

Watershed scale

- The USDA SWAT model and other modeling tools will be evaluated against field-measured data.
- The models will allow us to simulate nitrogen leaching from other agricultural lands in the Central Valley, CA, with different soils, management, and climate.
- Nitrogen mass balance at the field level will be compared to vadose zone measurements of nitrogen leaching to confirm robustness of this approach.

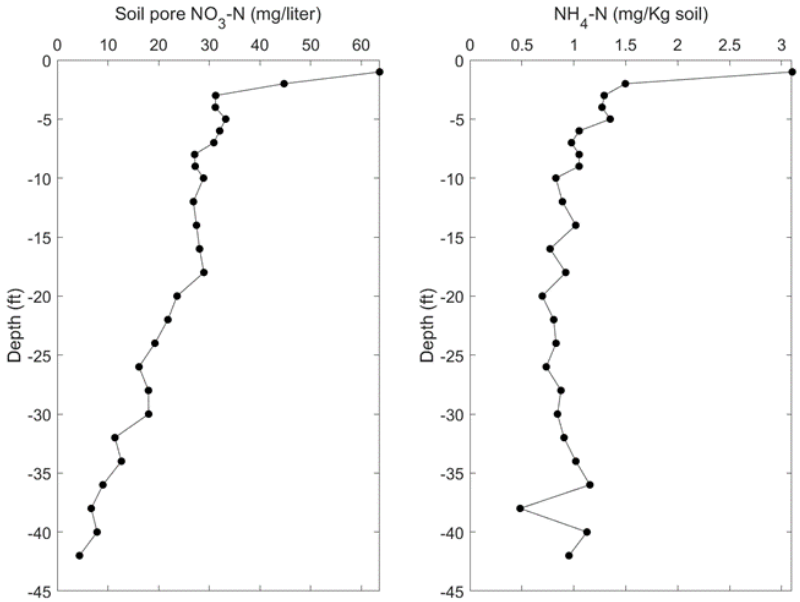


On the left: field in Spring 2020. Triticale was seeded in November 2019 as a winter cover crop, after processing tomato harvest. On the right: deep vadose-zone monitoring system to be installed in March 2020. This system will measure soil water content and will allow for soil pore water sampling from the root zone and up to the groundwater table. Nitrate concentrations will be measured all year round in two profiles.

Plot and field scale

- Nitrate concentrations in the soil pore water exceeded the maximum contaminant level (MCL) (10 ppm NO_3-N) to a depth of 36 ft.
- Both ammonium (NH_4-N) and nitrate (NO_3-N) are higher in the active root zone (0-3 ft) than in the lower profile, showing residuals from fertilization during the growing season (See graphs on the right).
- Groundwater monitoring wells will be installed at the edge of the field, down gradient to the general groundwater flow. Water levels and nitrogen concentrations will be measured every six weeks.
- Two deep vadose zone monitoring systems will be installed from the root zone and up to the groundwater level. Water content and soil solution nitrogen concentrations will be measured weekly all year round. Changes in vadose zone nitrogen concentrations will reflect changes in management practices as well as nitrogen leaching potentials.
- Water fluxes below the root zone will be measured by potential differences using tensiometers.
- Nitrogen loads at the bottom of the root zone will be calculated by multiplying concentration by flux.

Mineral nitrogen in the soil profile in November 2019



Collaborators and Stakeholders

UC DAVIS UNIVERSITY OF CALIFORNIA
CALIFORNIA WATER BOARDS Central Valley - R5
THE SOUTHERN SAN JOAQUIN VALLEY MANAGEMENT PRACTICES EVALUATION PROGRAM
California Tomato Research Institute
cdfa
california almonds Almond Board of California

More Information

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