

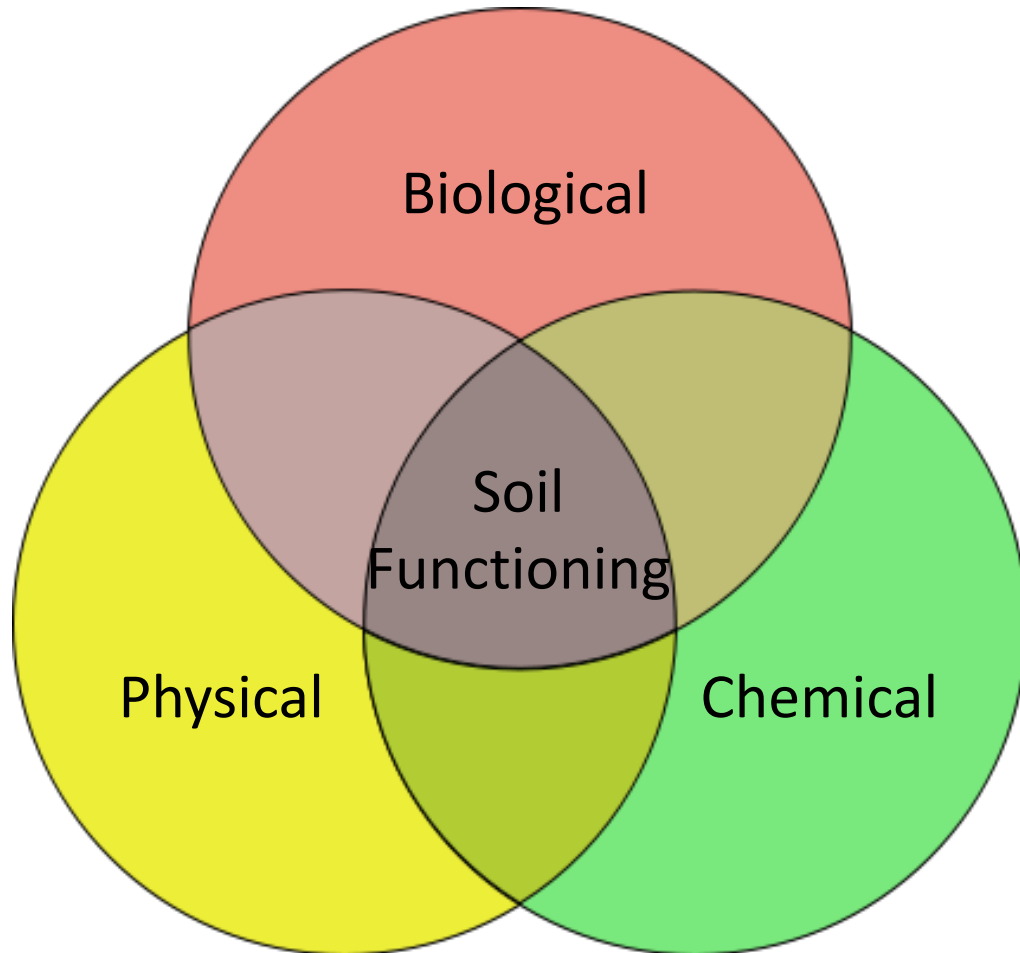
On-farm practices to improve soil health outcomes

Michelle Leinfelder-Miles
Delta Crops Resource Management Advisor

CA Plant and Soil Conference
February 7, 2024



What is soil health, how is it influenced by land management?

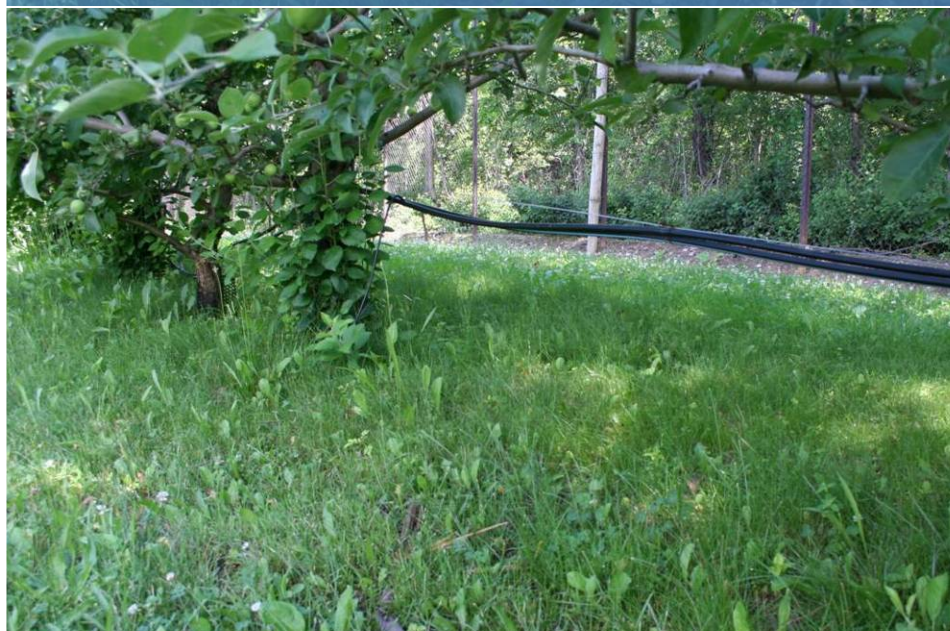




Pre-emergence herbicide



Post-emergence herbicide

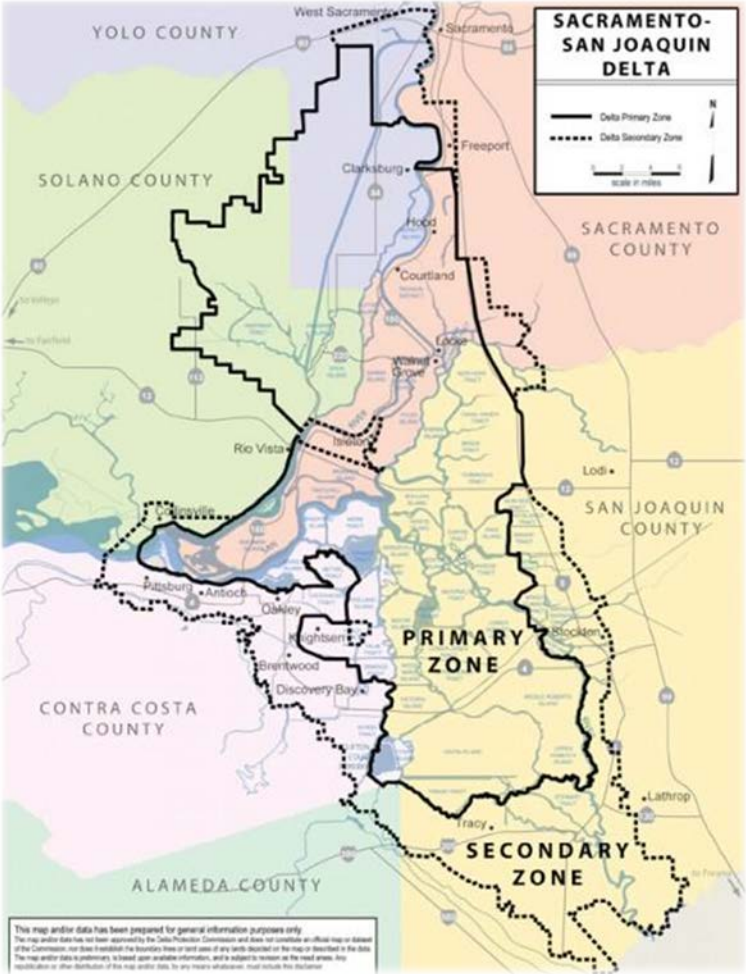


Sod

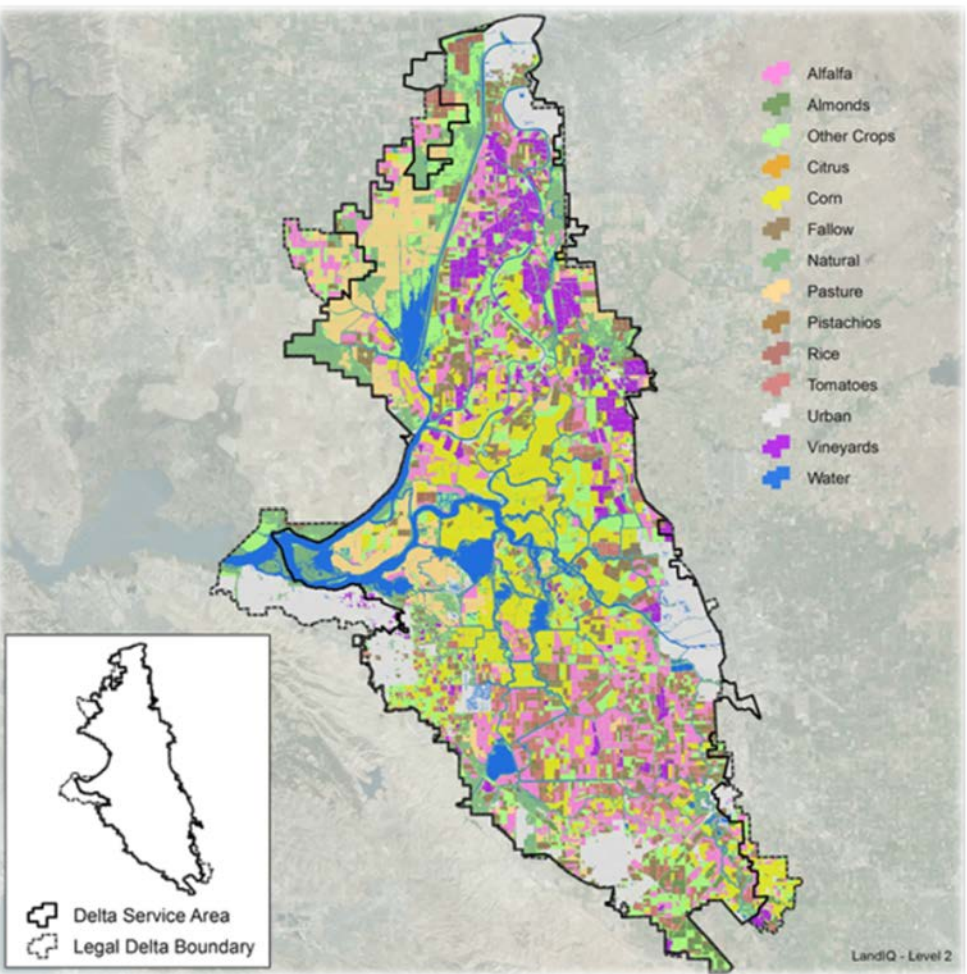


Bark mulch

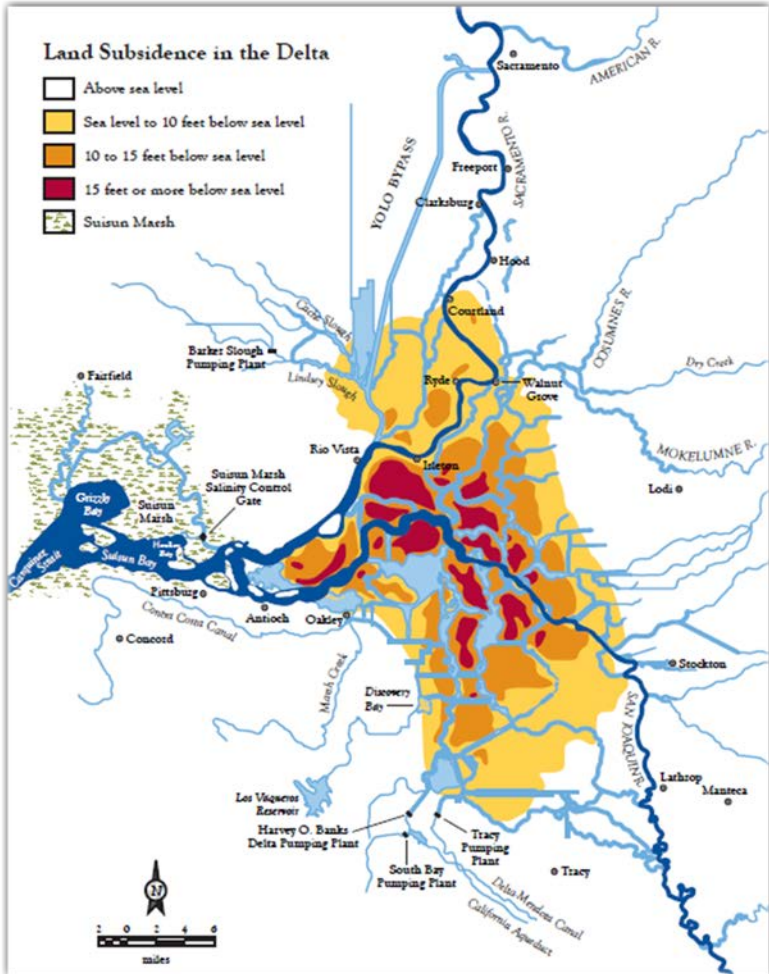
What does soil health mean in the Delta?



Source: Delta Protection Commission



Map by Land IQ. Source: California Water Blog



Source: Department of Water Resources

Warm-season legume cover cropping

CA Department of Food and Agriculture Healthy Soils Program (CDFFA-HSP)
Demonstration Project

Project team: M. Leinfelder-Miles, B. Aegerter, S. Stoddard, S. Light, A. Vinchesi-Vahl, J. Mitchell, W. Horwath, and V. Suarez-Romero



Project background and objectives

- Cover cropping is not a typical practice in the annual crop rotations in the Delta, but surface irrigation water makes this a potentially viable practice.
- Evaluate whether a summer cover crop could improve soil tilth at a time of year when the soil would otherwise be fallow and dry with no soil cover.
- Assess what cropping practices might make summer cover cropping more feasible for farmers?

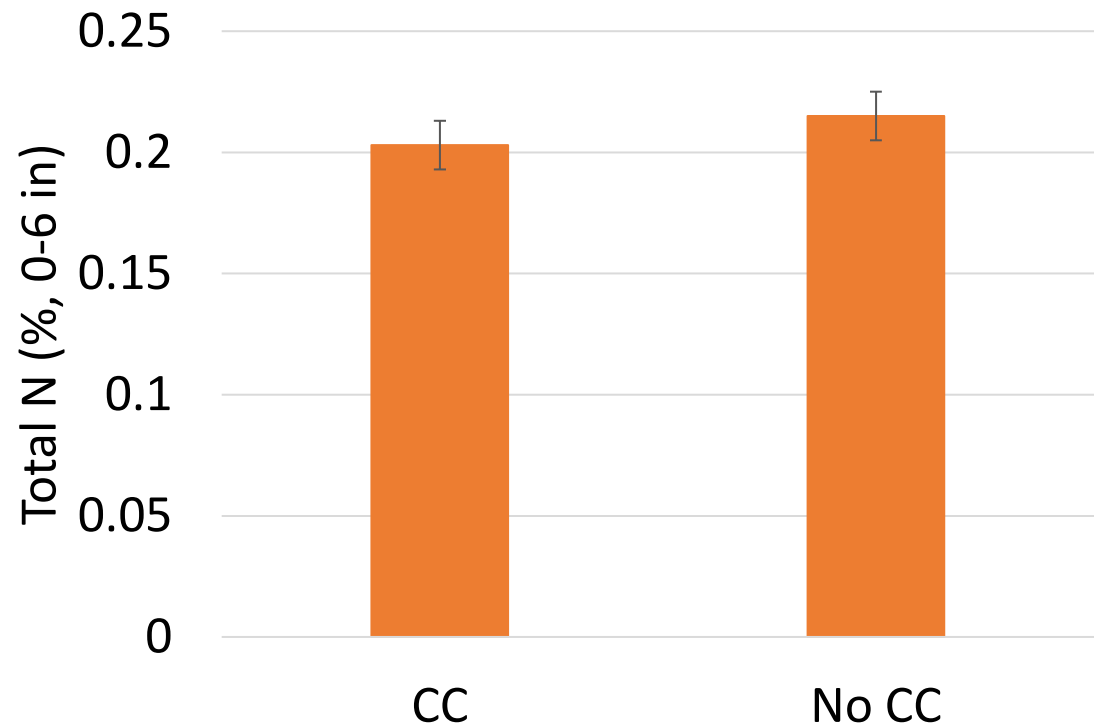
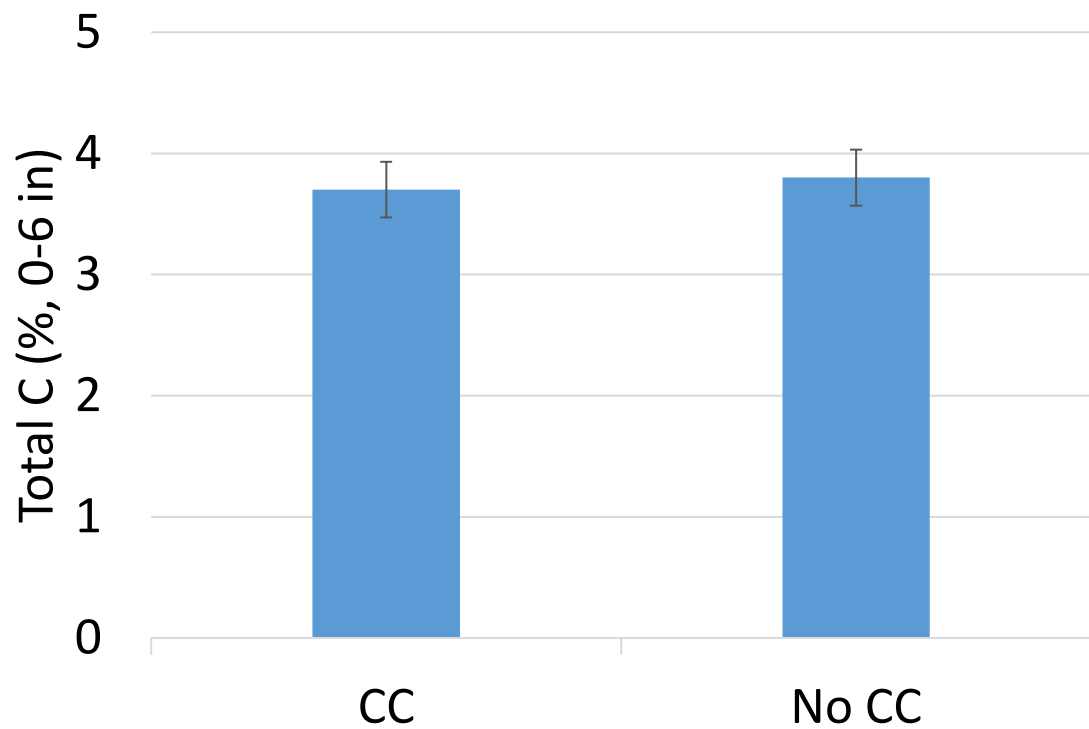


Site characteristics and trial design

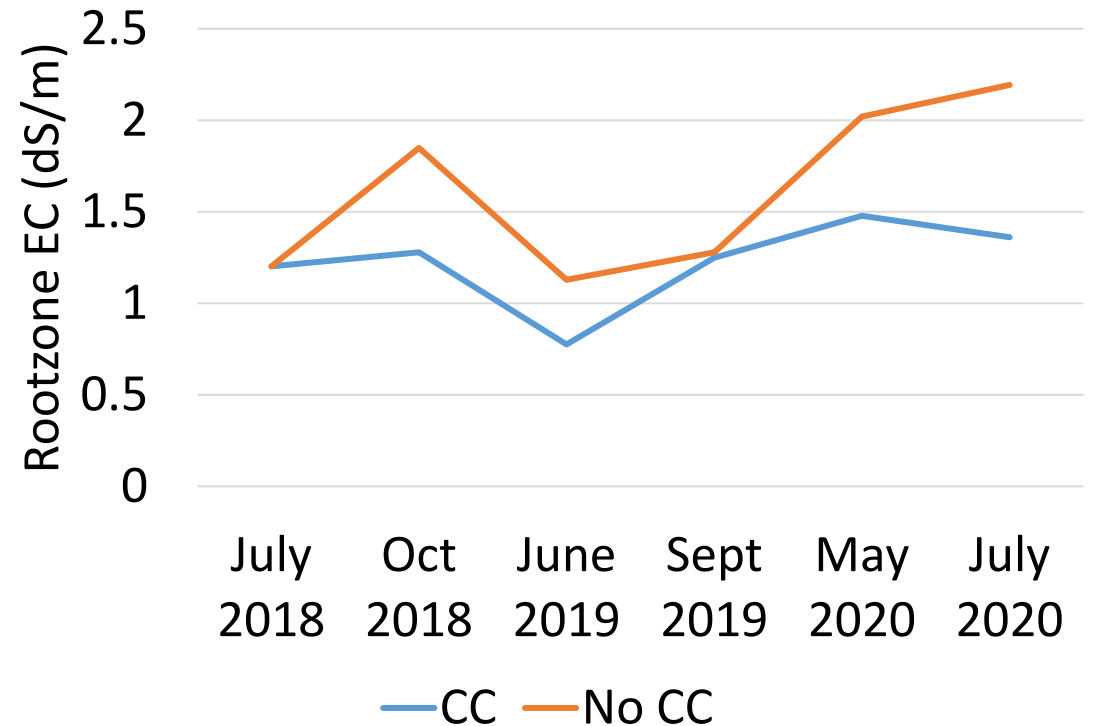
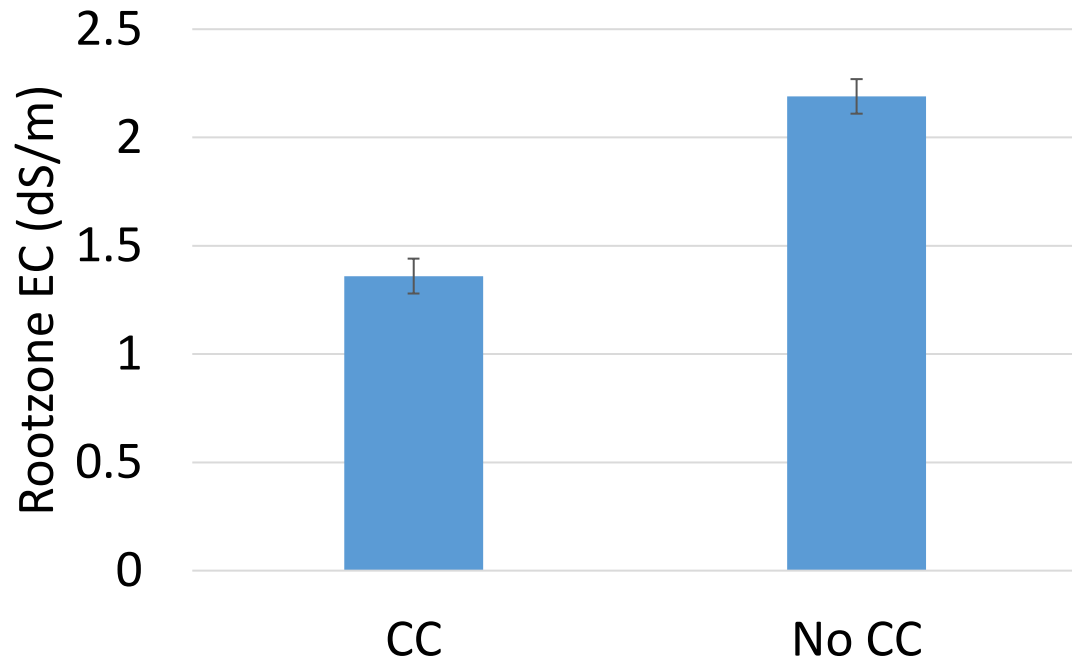
- Treatments: 'Red Ripper' cowpea vs. standard dry fallow between winter small grains
- Design: 3 replicate blocks over 4 acres in a commercial field
- Valdez silt loam soil with OM ~1%.

Year	Cover Crop Planting Date	Termination Date	Cowpea Seeding Rate (lb/ac)	Irrigation Method
2018	July 30 th	October 23 rd	51	Furrow/Flood
2019	July 15 th	September 13 th	56	Sprinkler
2020	May 29 th	July 29 th	50	Sprinkler

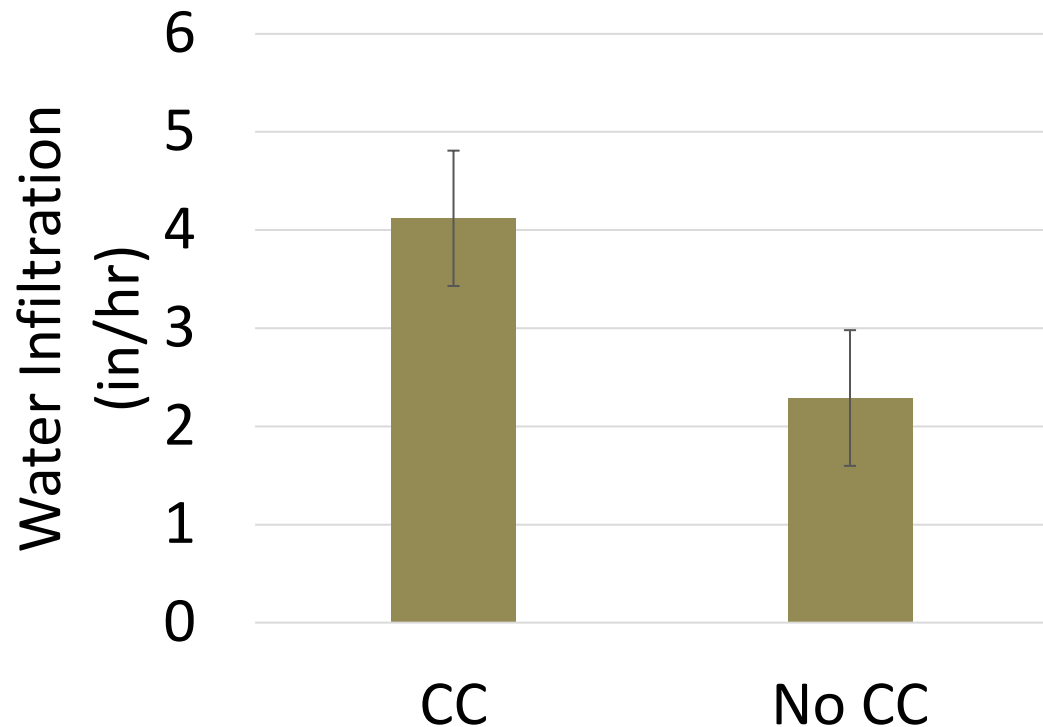
Three years of cover cropping yielded no improvements in C storage



Three years of cover cropping mitigated soil salinity

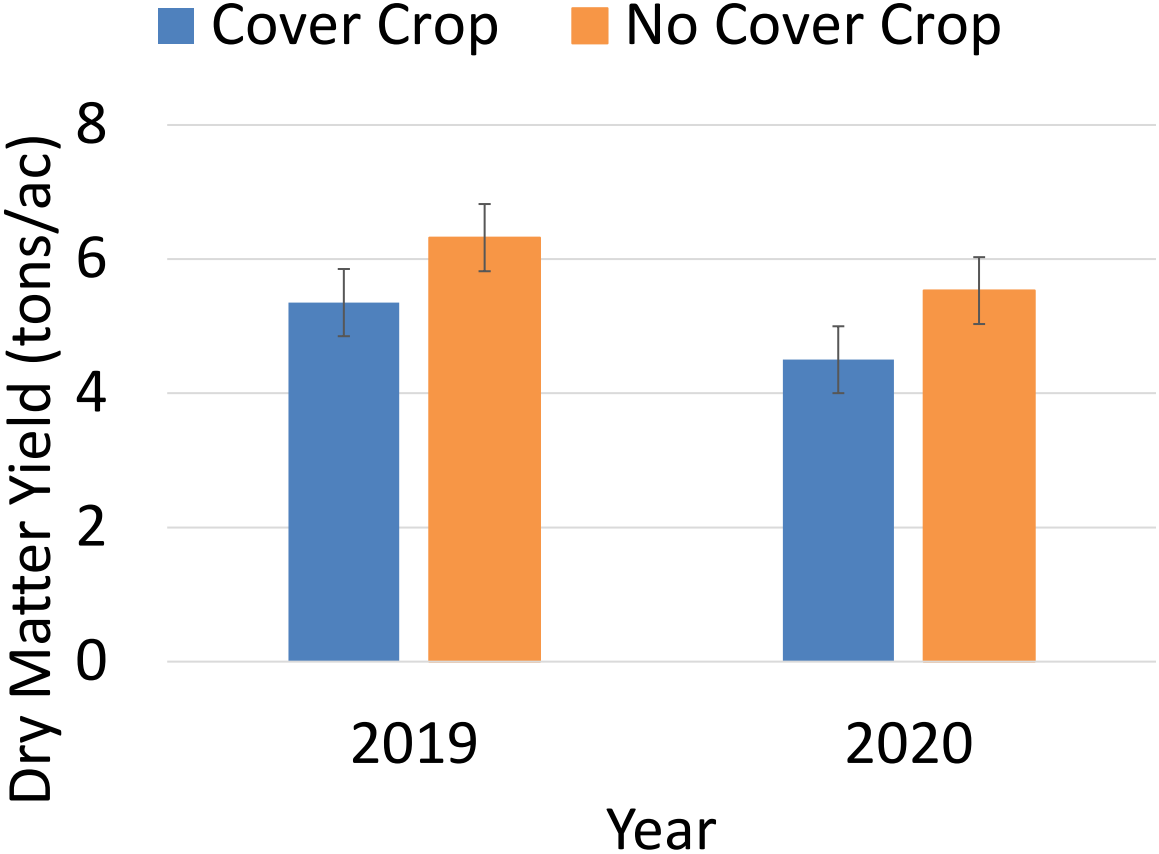


Cover cropping improved water infiltration



“The difference that I’ve seen is that in the places where there wasn’t a cover crop last year or the year before, the soil is really loose, and the wind blows it away. Where there was a cover crop, it’s not as powdery. Another benefit is that it’s holding moisture down at about 6 inches a lot better.”

Forage yield did not improve with cover cropping





Lessons learned and grower guidance

- Timing of operations (i.e. earlier planting and termination) and irrigation method makes a difference.
- Cowpea stand establishment and weed competition were the biggest challenges to growing a summer cover crop at this site.
- Growers incur costs to cover crop, and soil health outcomes may vary depending on the cover crop biomass obtained and other site-specific factors.

Compost application to alfalfa to improve soil structure and fertility

CDFA-HSP Demonstration Project

Project team: R. Schmidt and R. Long



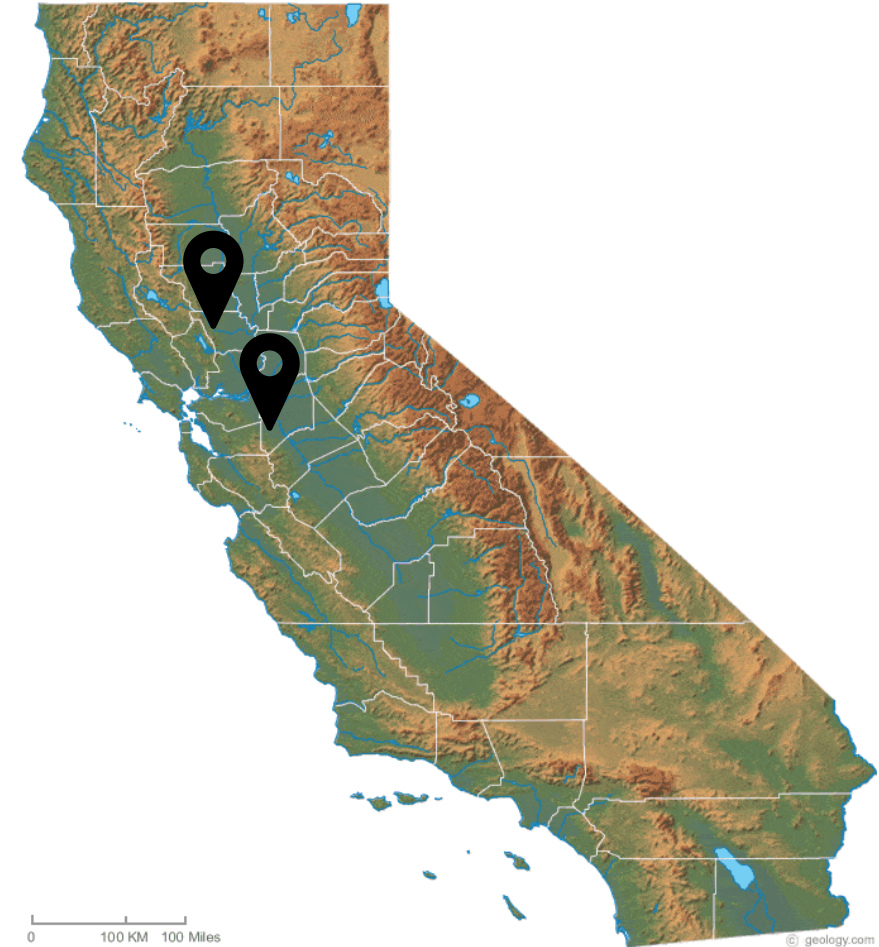
Project background and objectives

- Regulatory framework: AB 1826 required businesses to recycle organic wastes and jurisdictions to set up organic waste recycling programs in order to divert green waste from landfills.
- Alfalfa has a large footprint on the agricultural landscape, has a high nutrient need (particularly P and K), and as a 'high-traffic' crop, soils can have poor physical traits (e.g. compaction, water infiltration).
- Evaluate the effects of green waste compost on soil nutrient status and alfalfa yield/quality.

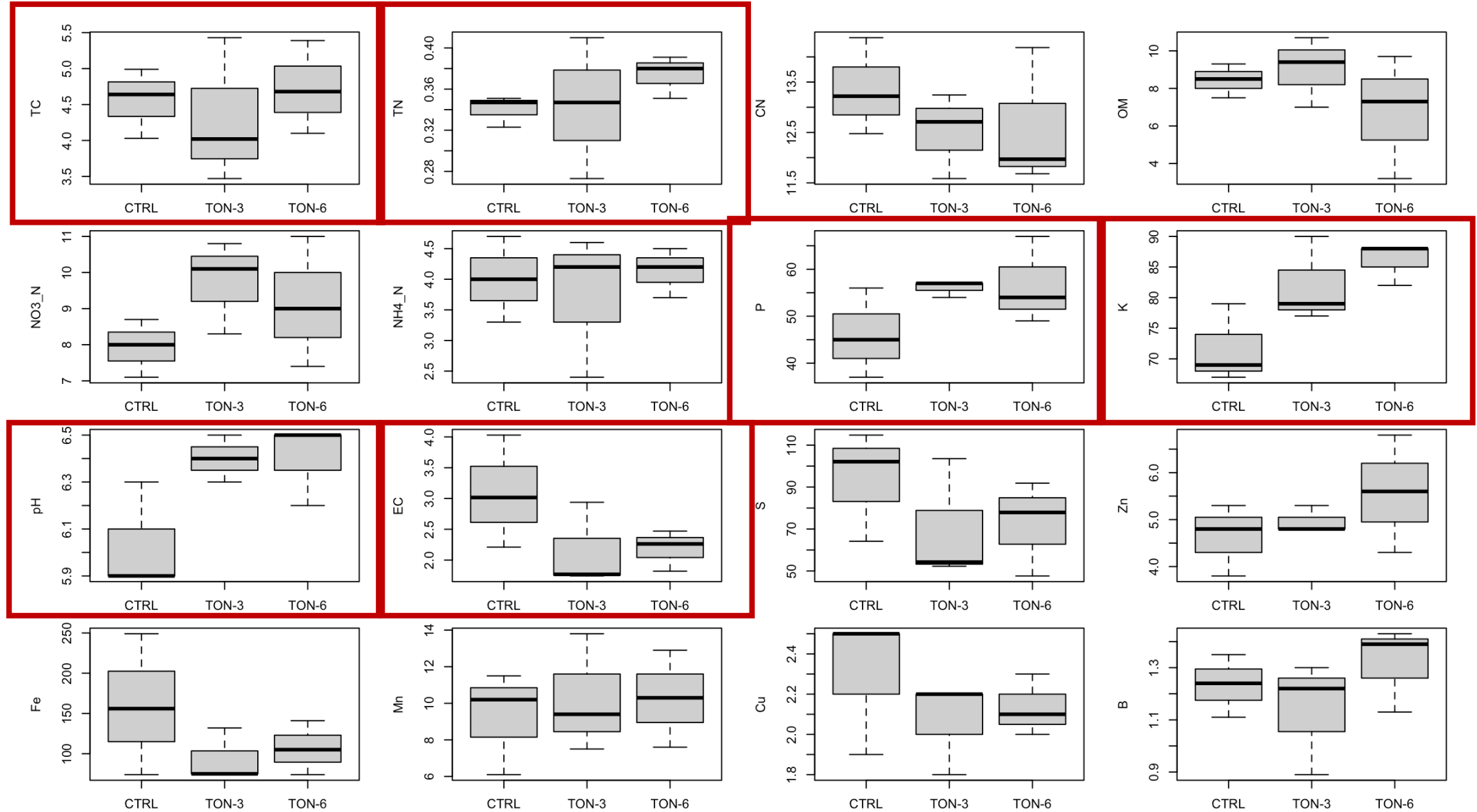


Site characteristics and trial design

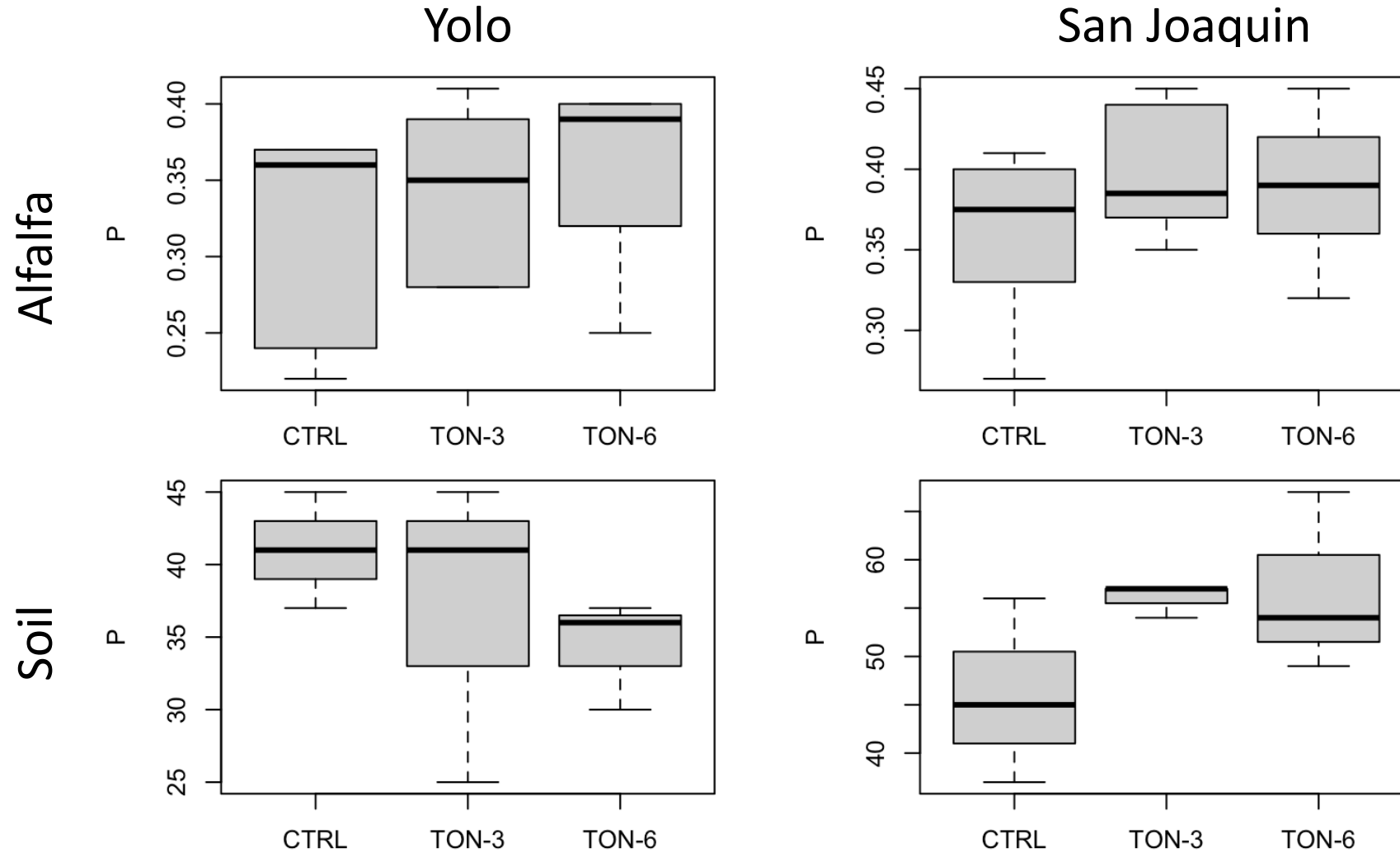
- Two commercial farms
 - San Joaquin County Delta (mucky clay loam with high OM ~8%)
 - Yolo County (mineral soil with high clay content ~50%)
- Green waste compost treatments
 - 3 or 6 tons/acre
 - No compost control
- Surface-applied to established alfalfa in the fall/winter season
 - 2020, 2021, 2022



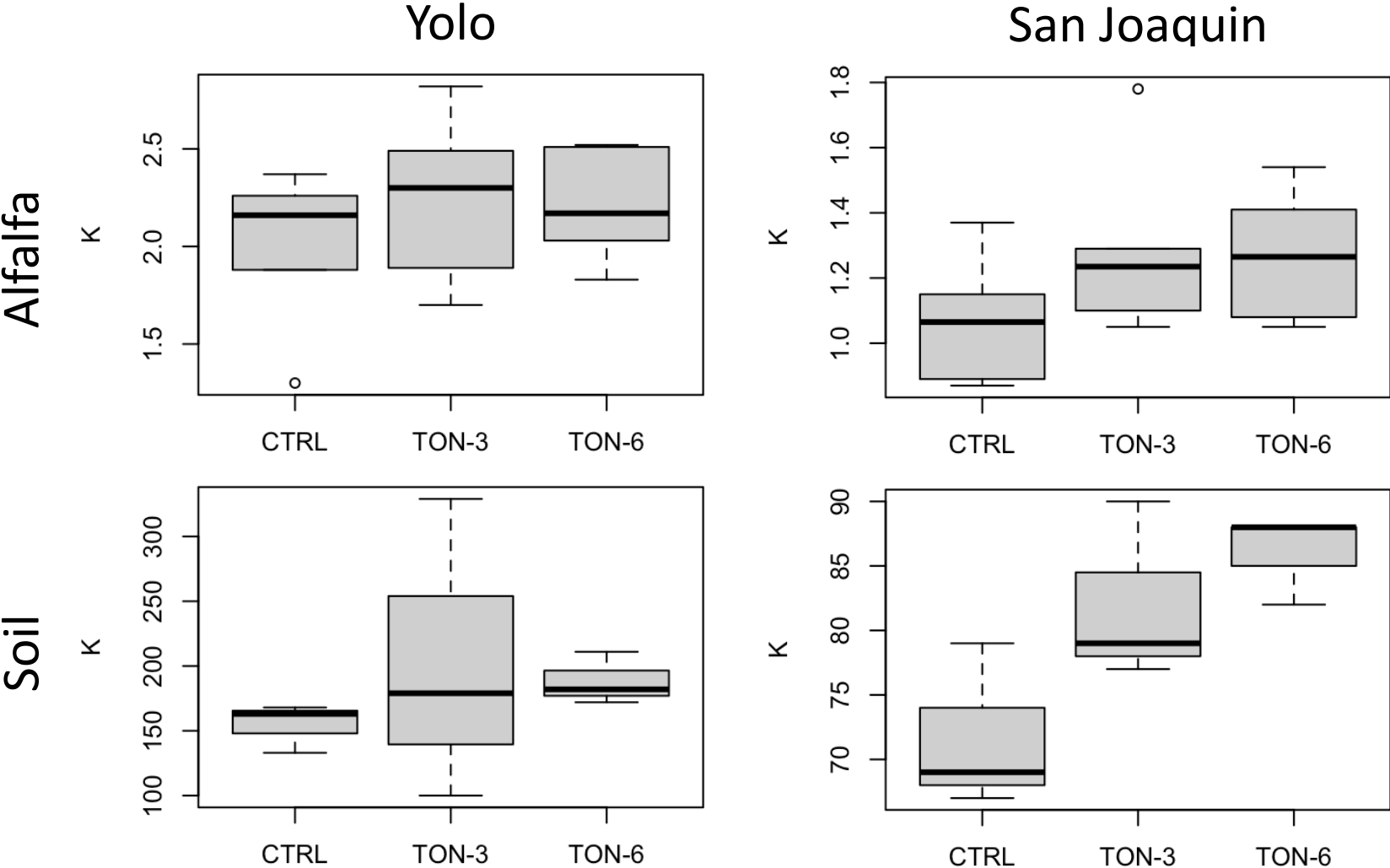
Soil Data – San Joaquin



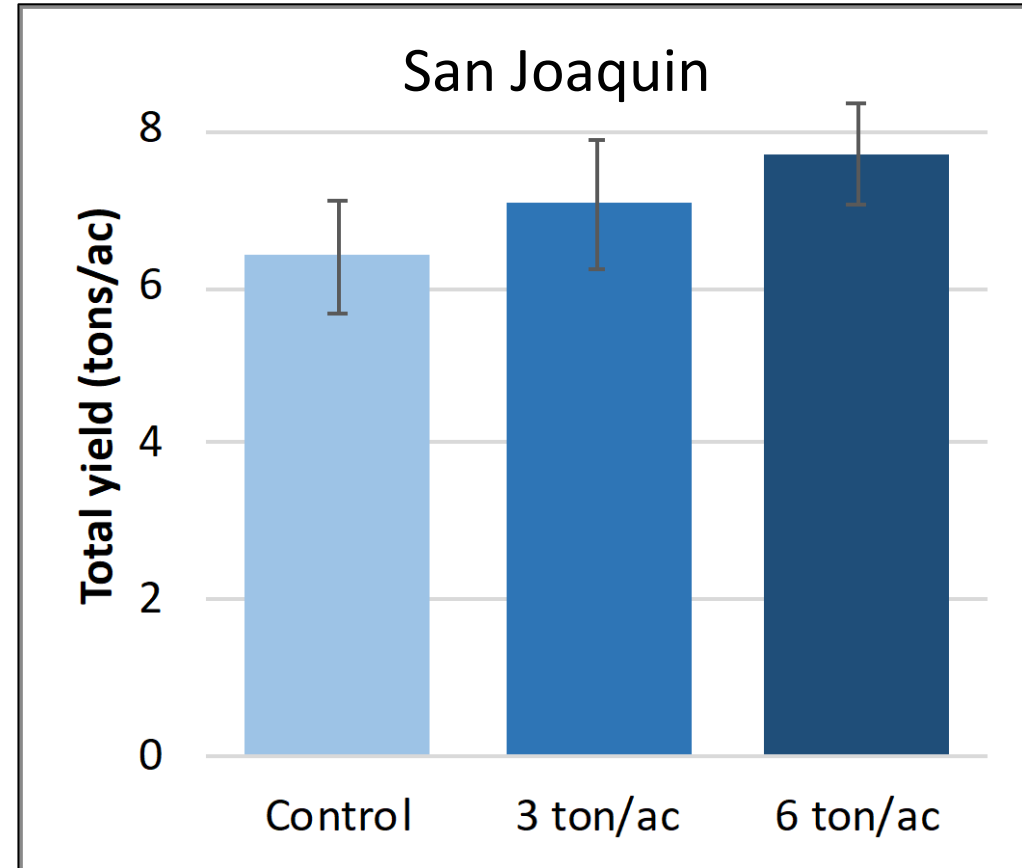
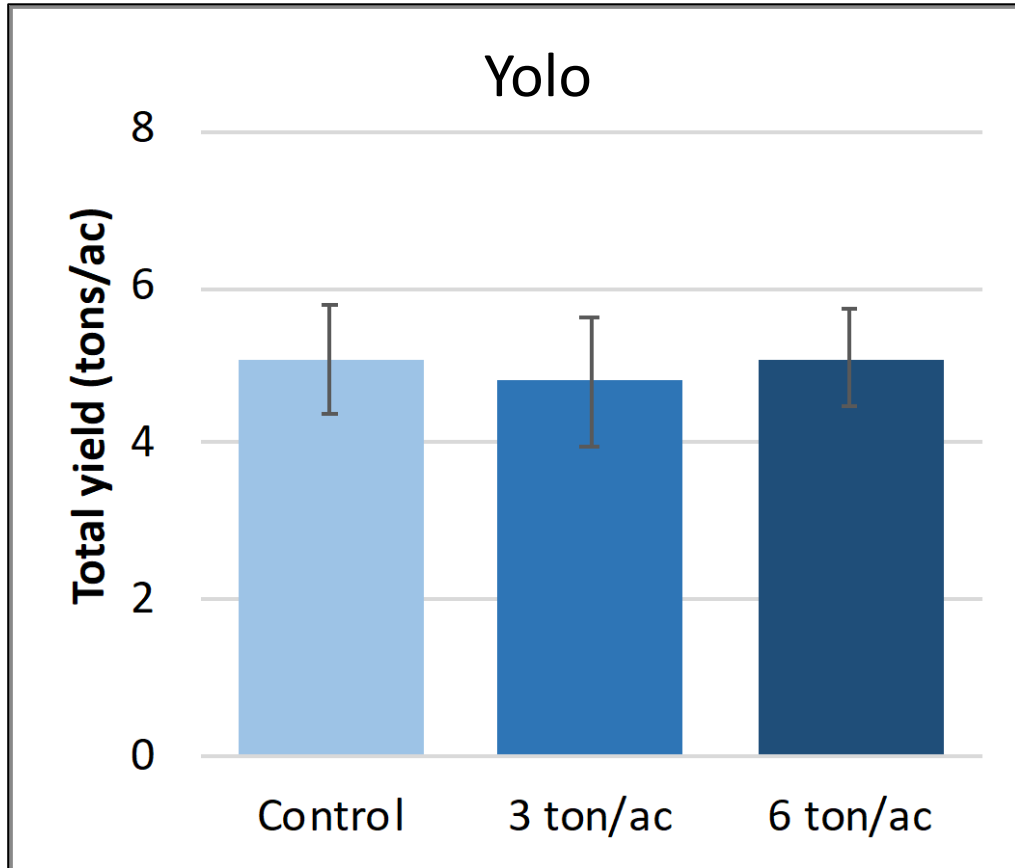
Slight trends for improved P status



Compost improved K status at SJ site



No statistical improvements in yield, but there is a trend for compost to improve yield at the SJ site





Lessons learned and grower guidance

- Green waste compost is a relatively cheap input, but transport cost can be high.
 - Material plus hauling: approximately \$27/ton
 - Spreading: \$10/ton
- Timing compost application can be a challenge (i.e. after all harvests but before soil gets too wet).
- Highest demand for compost is in the fall. To ensure availability, growers should aim to purchase it in the spring/summer and store it on-site until fall.
 - Also tends to be higher quality (i.e. less trashy) when purchased in spring/summer

Soil health under deficit irrigation

Financial support from the South Delta Water Agency

Project team: M. Leinfelder-Miles, D. Putnam, I. Kisekka, D. Geisseler, W. Horwath, U. Gull, and V. Suarez Romero

Project background and objectives

- During the 2012-2015 drought, water shortages and regulatory curtailments meant that growers had to make tough decisions on how to apply scarce water resources.
- Some growers opted to cut irrigation to alfalfa because research has shown that, while yield may be impacted, alfalfa is resilient during drought.
- Evaluate soil health properties under deficit irrigation (a proxy for drought).
- Evaluate how the levels and timing of deficit during the cropping season impact soil properties.



Site characteristics and trial design

Treatments

Full irrigation (100% ET_c)

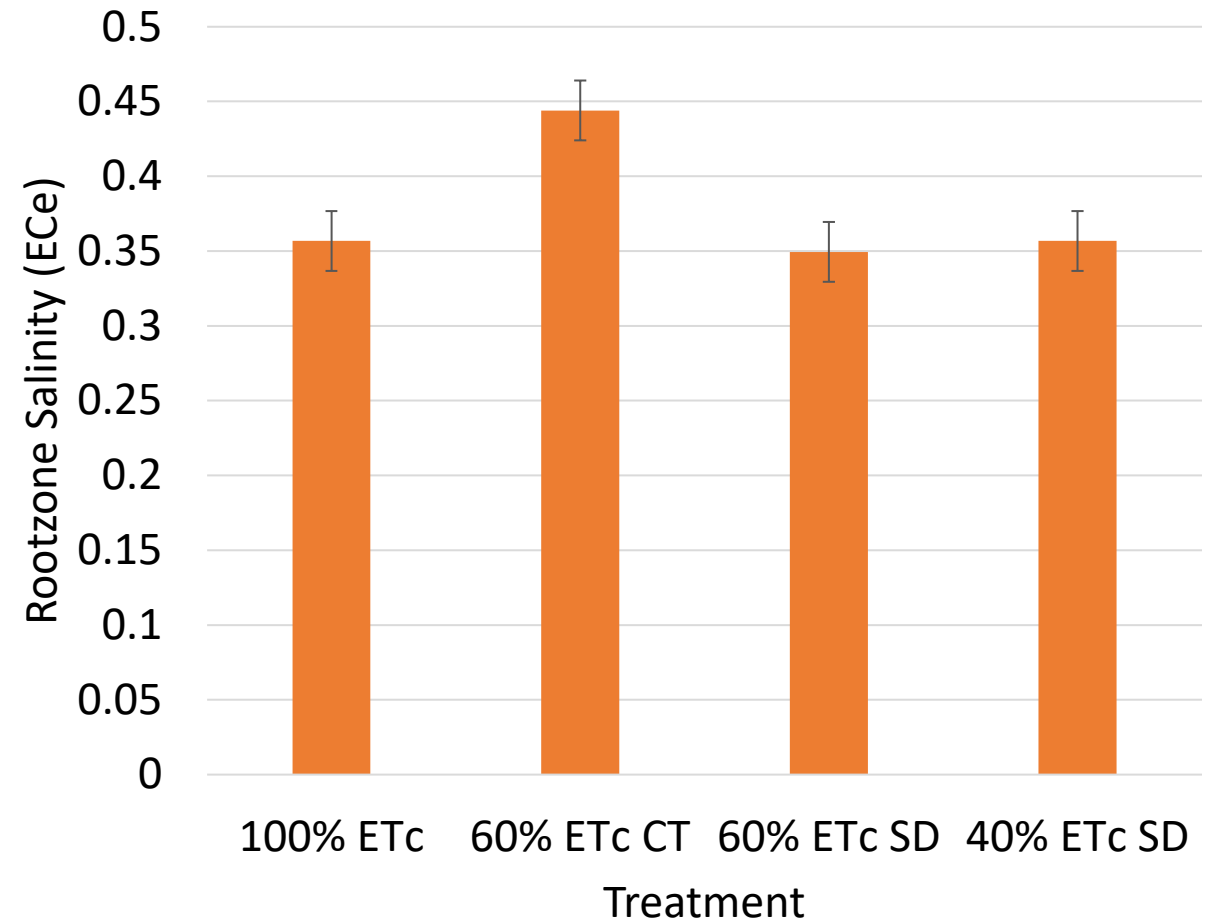
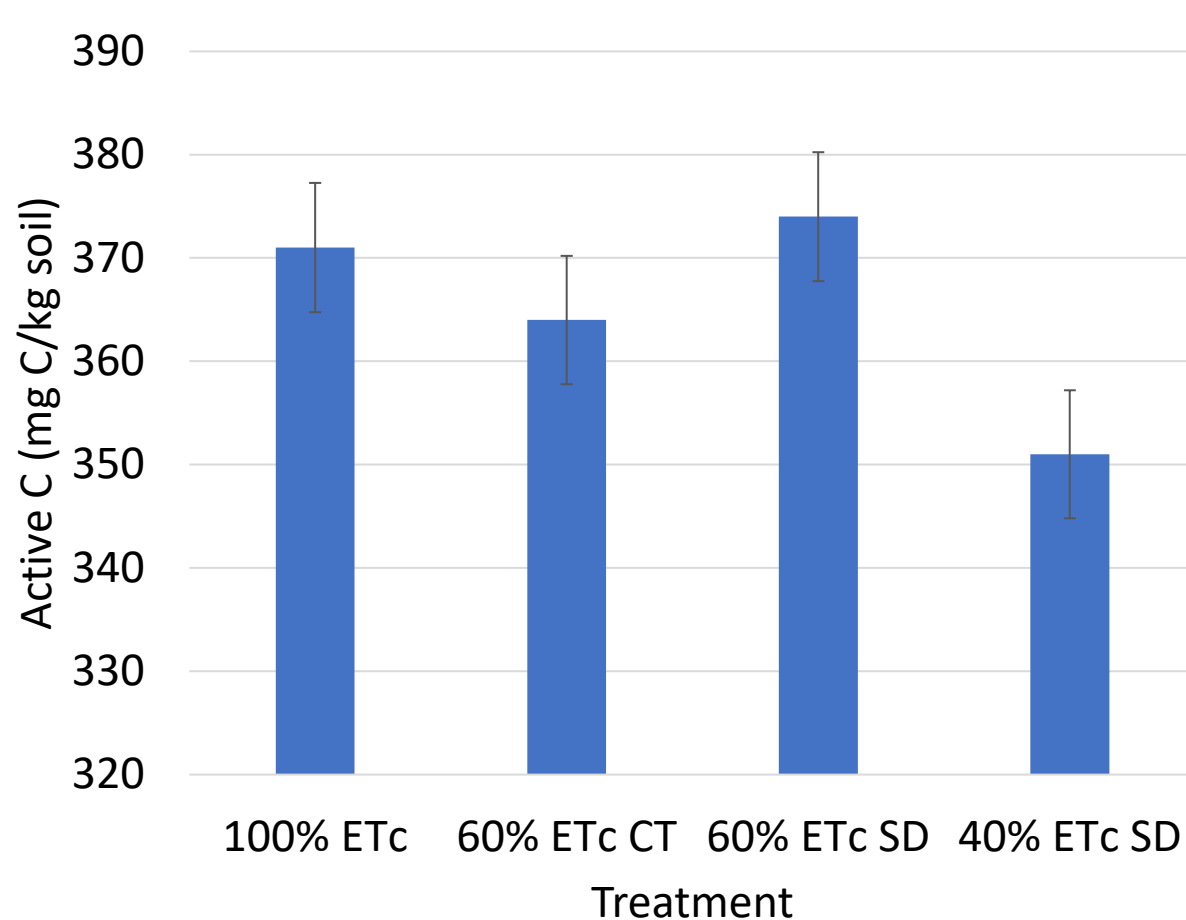
Full early-season irrigation with a sudden cutoff later in the season (60 percent ET_c, CT)

Sustained deficit where each irrigation imposes restriction (60 percent ET_c, SD)

More-severe sustained deficit throughout the season (40 percent ET_c, SD)

- Soil sampling occurred in spring before irrigation began and in the fall after the last irrigation (Spring 2019 to Fall 2021): from 0-6", 6-12", 12-24", and 24-36".
- We evaluated macro- and micronutrients, organic matter, total carbon (C) and nitrogen (N), salinity, compaction, bulk density, N mineralization, and active C.
- Yolo silt loam

Deficit irrigation appears to negatively impact some soil health properties





Lessons learned and grower guidance

- Soil health properties may not be resilient under deficit irrigation/drought, even if alfalfa is.
- The level and timing of deficit are important.
- Many factors will influence grower decision-making.
- Water use prioritization during drought may have implications for soil health.

Commonalities among projects

- We did not observe changes to soil carbon with short-term trials.
- Observed changes included water infiltration, macronutrient availability, salinity, biological activity.
- The potential benefits of soil health practices may be variable, which could hinder growers' long-term adoption.
- Soil health research funding and incentive programs need longer terms to enhance our scientific and practical understanding of practices.

Thank you!

Michelle Leinfelder-Miles

(209) 953-6100

mmleinfeldermiles@ucanr.edu

<http://ucanr.edu/sites/deltacrops/>

<http://ucanr.edu/blogs/sjcfieldcrops/>

UC
CE