SJSU | DEPARTMENT OF GEOLOGY
California State University Chico

Root Holes to Water Conduits: Investigating Recharge Potential with Varied Agricultural Management at the University Farm in Chico, CA

[1]Raymond Hess, [1]Nick Riqueros, [1]Nicholas Edholm, [2]Garrett Liles, [1]Nathaniel Bogie

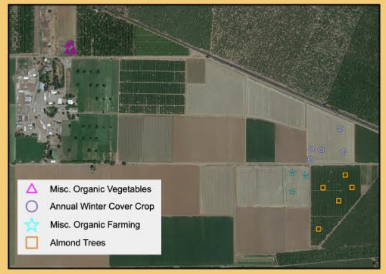
[1]Department of Geology, San José State University

[2]Center for Regenerative Agriculture and Resilient Systems, California State University, Chico

UC ANR

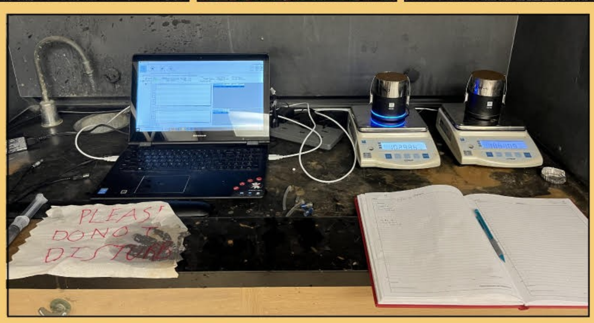
Background

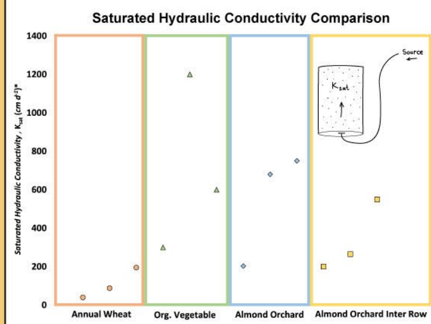
In recent years, inundating agricultural fields for flood management and recharge has grown as a strategy for meeting the goals of California's Sustainable Groundwater Management Act (SGMA). Flood Managed Aquifer Recharge (Flood MAR), sometimes referred to as on farm recharge or AgMAR, diverts excess flows to working lands with high recharge potential (coarse sediments, vertical connectivity) as a mitigation strategy for industrial and municipal groundwater pumping. Here, we conduct a site characterization of soil hydraulic properties across varying agricultural management for soils broadly defined by the National Resources Conservation Service Web Soil Survey (NRCS WSS) as Almendra loam and alluvial fan deposits.

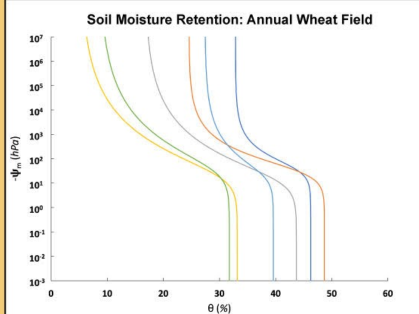


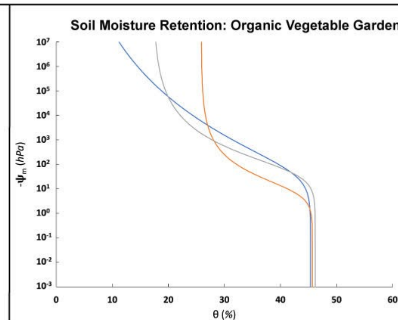
Study Site & Approach

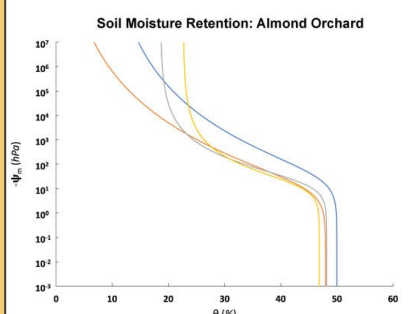
We collected 250 mL in tact soil cores from a depth of 18 inches below ground surface across three locations at the CSU Chico University Farm: *First*, a conventionally tilled annual wheat field with no cover crop. *Second*, a regenerative agriculture experiment featuring an organic vegetable garden with cover crop, no till, and residue retention. *Third*, an almond orchard with cover crop and no till. Samples at the almond orchard were taken both along the tree line and at inter row spacing. In situ permeameter measurements were also recorded at sample locations. Samples were transported to SJSU for analysis of soil hydraulic properties (i.e. saturated hydraulic conductivity, unsaturated hydraulic conductivity, moisture retention, and bulk density) using the HyProp and Ksat analytical tools by Meter Group, Inc. USA. Measured values from the HyProp were used to interpolate values of volumetric water content and unsaturated hydraulic conductivity using a range of matric potential values up to the theoretical maximum of 1.0 x 10^7 hPa.

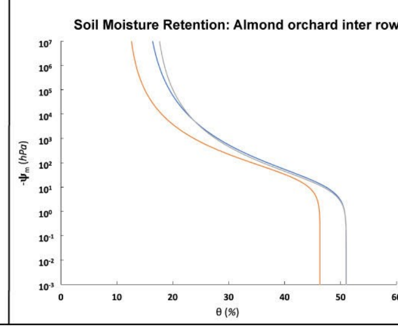


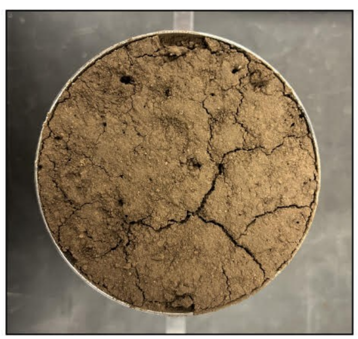


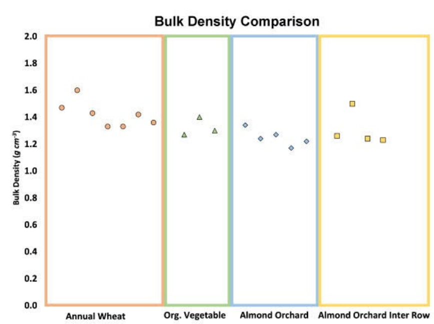












Results

Based on our observations from measurements and interpretations of the maximum theoretical matric suction between the varying agricultural management practices, data suggests that conventionally tilled annually cropped soils (wheat fields) without cover crop will promote slower rates of saturated hydraulic conductivity and reduced water holding capacity than soils employing the use of regenerative agriculture (i.e. no till and cover crop). Results for bulk density did not show significant differences across the three agricultural treatments. Observations indicate that regular tilling of the soil without use of cover crops disrupts the structure of soil, otherwise created by bioturbation in the form of worms and roots. These structural elements may provide key pathways and void spaces that facilitate the movement of water from surficial soils to subsurface aquifers during rain and flood events.

Saturated Hydraulic Conductivity (cm d^{-1})

	Min	Max	Std. Dev.
AC	13	270	96
TA	12	4000	1069
OV	25	1200	410

Bulk Density (g cm^{-3})

	Min	Max	Std. Dev.
AC	1.33	1.60	0.09
TA	1.27	1.40	0.07
OV	1.17	1.50	0.09

Next Steps

In support of these observations, we will analyze in situ permeameter measurements and perform grain size analysis (using the hydrometer method) to classify sand, silt, and clay fractions of sampled soils. Future studies will look at pore size distribution and vertical connectivity of soil structure.

Acknowledgements

Funding for this work was provided through a partnership between University of California Agriculture & Natural Resources and the United States Geological Survey. Additional funding was provided by the SJSU Department of Geology Bogie Lab Startup.