Examining Soil Pore Structure and Preferential Flow in Agricultural Soil using X-ray Computed Tomography

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Much of the western United States experiences significant variability in annual precipitation between wet and dry years. As a result, surface water and groundwater supplies can become depleted during dry years, while in wet years, water infrastructure necessary to replenish these systems is often inefficient and outdated. The unsaturated zone acts as a critical freshwater storage mechanism between wet and dry periods. Agricultural surface treatments, such as cover cropping and reduced tillage, have the potential to modify infiltration rates and route valuable quantities of water, below the root zone of crops, to this subsurface region. At the University Farm in Chico, CA we investigate links between crop and management type on soil structure and preferential flow for locations within an almond orchard, across a conventional wheat and vegetable field, and in an organic vegetable plot. We collected soil cores across 15 sampling locations at half meter depths for subsequent measurements of saturated hydraulic conductivity (Ks) and scans of soil pore structure using x-ray computed tomography (CT). Rates of Ks were compared for soils under different surface treatments, with results showing median rates of 80, 425, and 503 centimeters per day in the conventional wheat and vegetable field (tillage without cover crop), the organic vegetable plot (minimal tillage with cover crop), and the almond orchard (cover crop without tillage), respectively, with the highest variability of Ks measured in the almond orchard. Preliminary analysis of soil core CT scans reveal the pore network structure of samples. These data will be used to spatially characterize expected infiltration rates and estimate storage implications for high magnitude rain events, guiding decision making for future water distribution across the site.