Intrafield Variability of Soil Health Indicators After Whole Orchard Recycling

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Site Background

Almond production in the San Joaquin Valley

Field characterization was conducted on a young almond orchard located in the San Joaquin Valley of California for baseline soil properties as part of a long-term soil health study.

Whole orchard recycling of the previous orchard was conducted in 2020 before the planting of the current orchard in spring of 2021.

What is whole orchard recycling (WOR)?

Photo from: orchardrecycling.ucdavis.edu

- Whole orchard recycling is the process of grinding old trees into woodchips and incorporating them into the topsoil up to 30 cm [1].
- Additional biomass input from whole orchard recycling is estimated at 135 Mg ha^{-1}. This has been shown to improve soil health indicators in California where soils are historically low in organic matter [2].

Intrafield Soil Health Variability

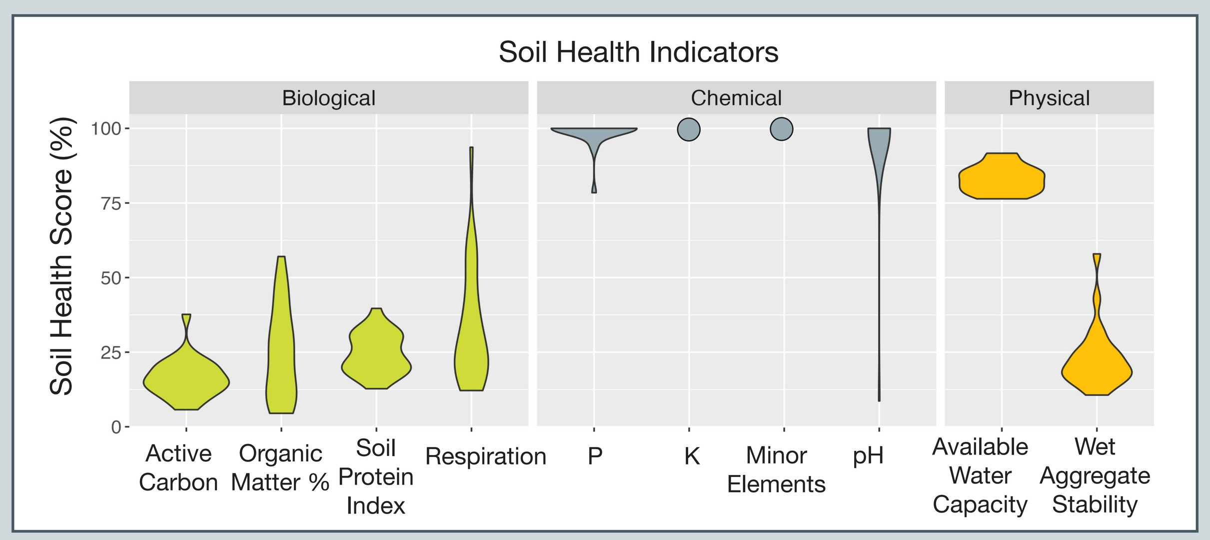
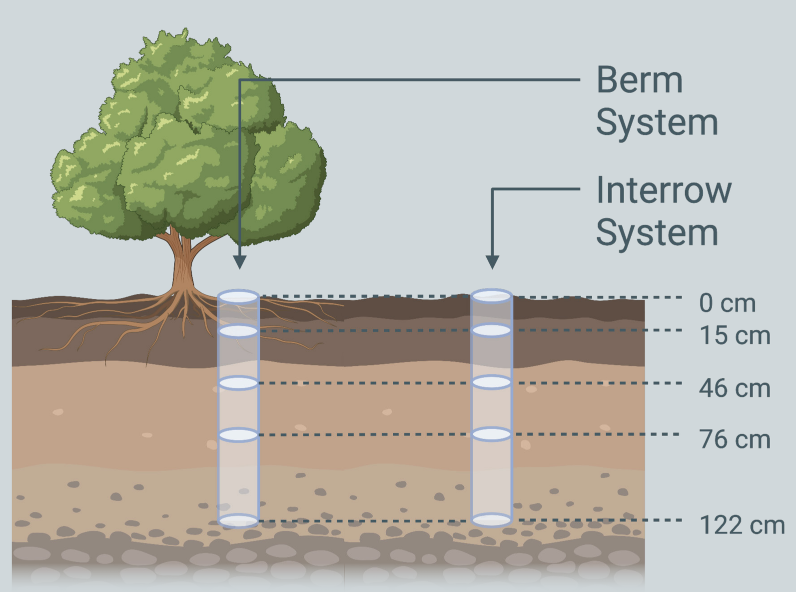


Figure 1. Range of scores received for each soil health indicator. 90 soil samples were analyzed for 10 soil health indicators according to the Cornell Assessment of Soil Health [3].

Soil health scores are based on a cumulative data set of soils from across the country where California soils are underrepresented [4]. Low scores for biological indicators may be caused by low amounts of organic matter in the soil [5].

Orchard soil system



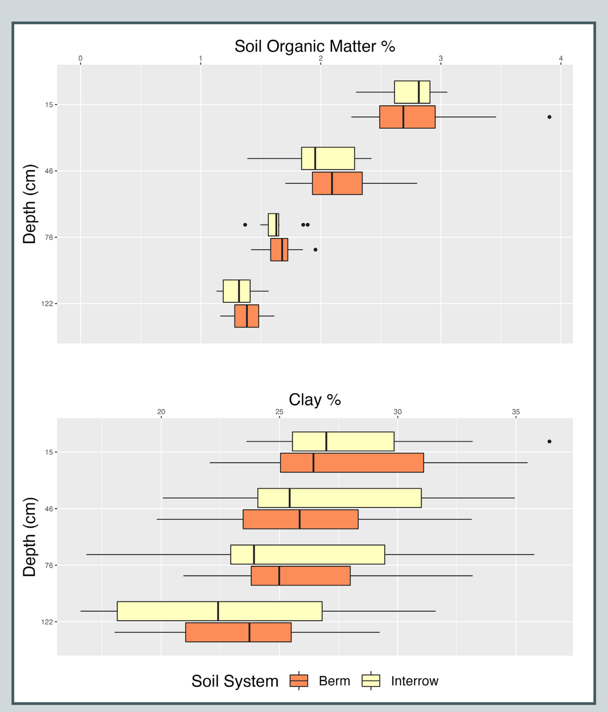
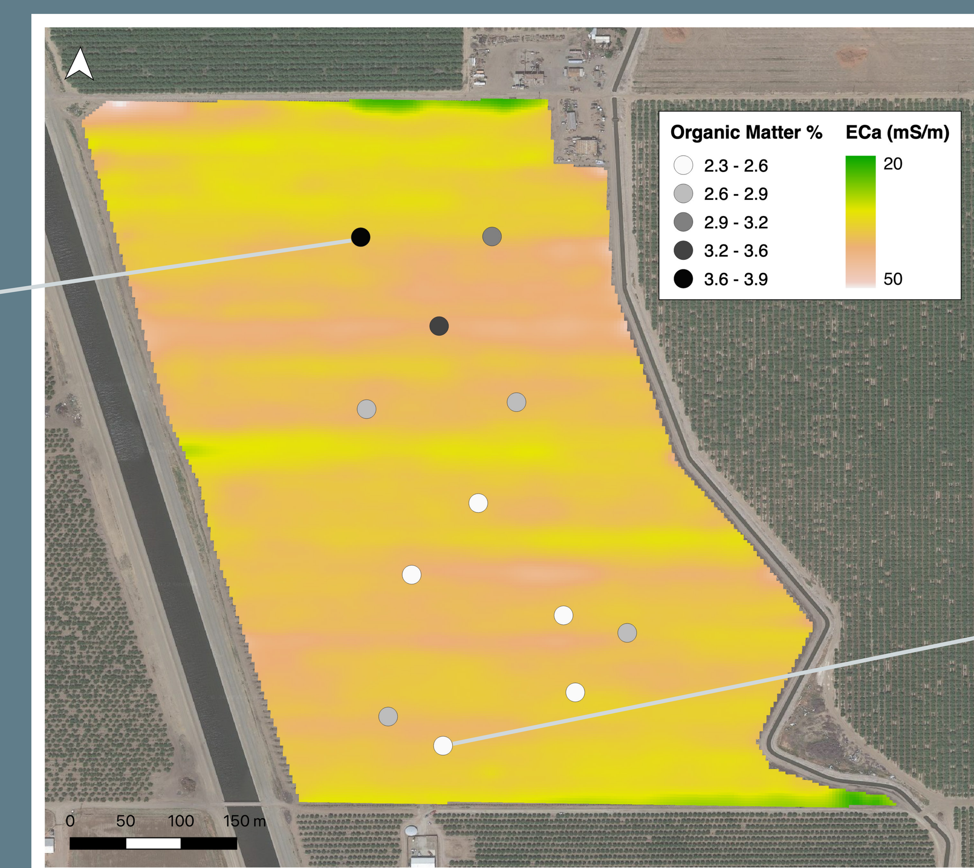


Figure 2. Soil cores were collected from the berm and interrow at 12 trees throughout the field and were subsampled at 4 depths layers: 0-15 cm, 15-46 cm, 46-76 cm, and 76-122 cm. There was no significant difference of soil health indicators between berm and interrow systems.

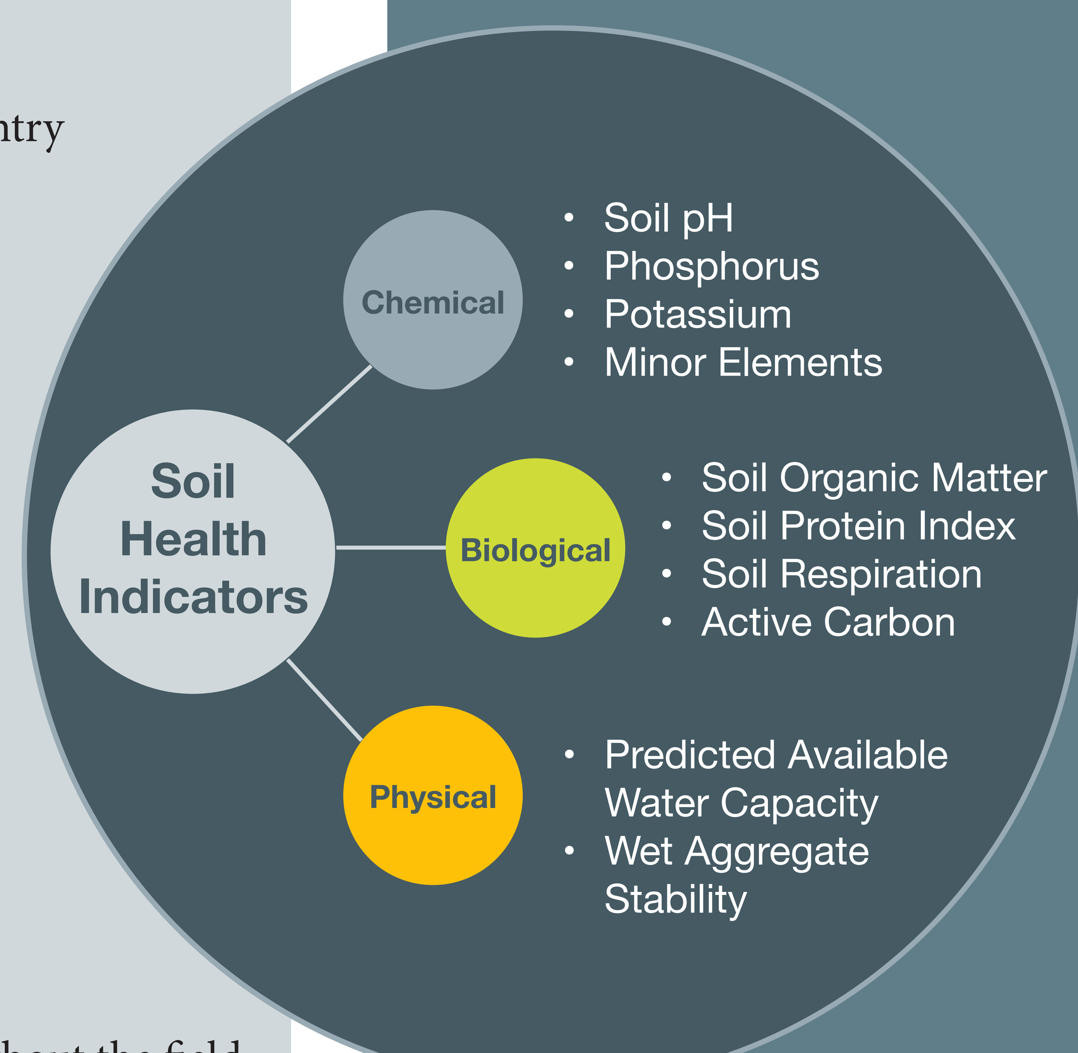
A combination of novel **digital soil cores** and apparent **electrical conductivity maps** can predict **soil health variability** with minimal soil sampling.

(Soil health indicators shown in Table 1)



(Soil health indicators shown in Table 1)

Figure 3. Organic matter (%) at 0-15 cm was mapped on top of apparent electrical conductivity to show intrafield variability. This soil health indicator could reflect the effect of whole orchard recycling on soil properties. LandScan, LLC performed an electromagnetic induction survey using a Dual 1-HS electrical conductivity meter at depths of exploration of 30 cm, 50 cm, 80 cm, and 160 cm.



Soil Health Indicator	Low OM	High OM
Organic Matter (%)	2.43	3.9
Protein index (mg protein g^{-1} soil)	4.6	5.11
Respiration (mg CO_2 g^{-1} soil)	0.36	1.06
Active C (ppm)	350	421
AWC (cm^3 water cm^{-3} soil)	0.207	0.246
Aggregate Stability (g g^{-1})	18.3	38.8
pH	6.81	6.6
Phosphorus (ppm)	24.5	21.7
Potassium (ppm)	98.4	228.3
Bulk Density (g soil cm^{-3} soil)	1.03	0.8

Table 1. Soil health indicators for soil samples with the highest and lowest amount of organic matter in the top soil layer (0-15 cm) identified in Figure 3.

Field Characterization Methods

Digital soil cores

92 digital soil cores were taken using an integrated 7 sensor probe that produces a continuous profile of all sensor data to a depth of 130 cm. A Partial Least Squares Regression was trained with soil sample data to apply to digital soil core data.

Predicted field scale map

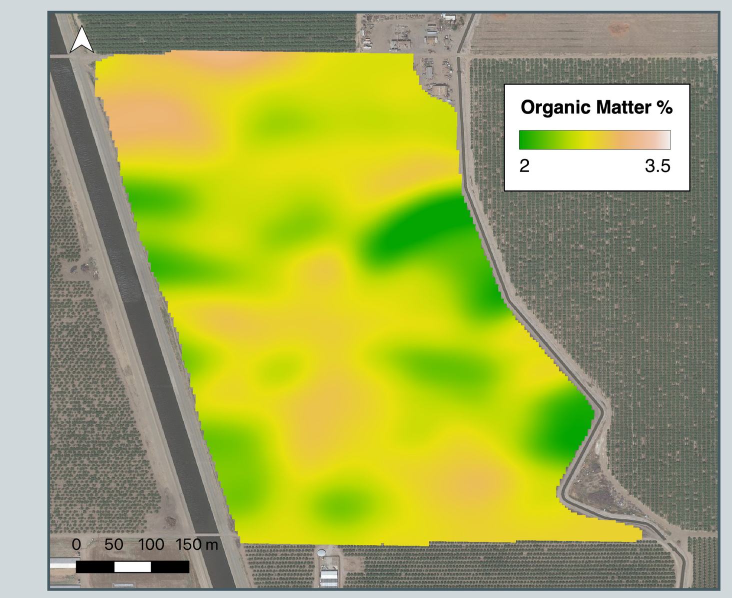


Figure 4. A supervised classification model using apparent electrical conductivity maps and digital soil cores produced predictive maps of soil organic matter and clay content at four depth layers.

Vertical variability in soil properties

Figure 5. (Left) Predicted map of clay % at the shallow soil layer. (Right) A vertical soil profile of a digital soil core and prediced soil properties.

Conclusions

It is important to measure soil health properties both vertically and horizontally to capture the full range of variability that may be caused by management practices. Proximal sensing is an increasingly important tool because of its ability to accurately measure field conditions with relatively low effort and disruption to the field, but soil samples are still necessary for parameterization.

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Scan for references & contact information