



## Background

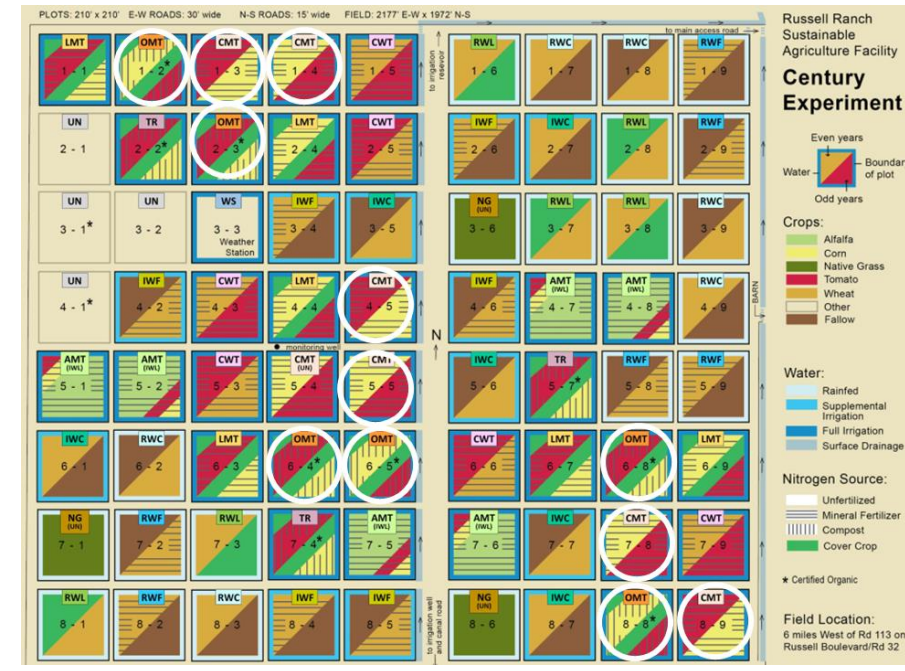
A useful indicator for monitoring soil health over time must be sensitive enough to respond quickly to management changes. However, it should not be too influenced by variations in sampling time or location, previous crop, or normal year-to-year differences in weather or operations timing.

## Questions we asked

- Which indicators show the strongest differences between management systems?
- Does the management effect depend on when or where the soil is sampled?
- Which indicators are most sensitive to non-management related factors?

## Location and Experimental Design

The Century Experiment at the Russell Ranch research facility at the University of California, Davis was started in 1993 and has run continuously for 27 years. A corn-tomato rotation either receives poultry manure compost and a cover crop (ORG) or conventional fertilizer and no cover crop (CONV).



Soil was collected for a soil health assessment in 2018 and 2019. Samples were taken prior to planting and at flowering or tasseling from ORG and CONV plots, in both corn and tomato rotations. Three subsamples were taken per plot.



## Average soil properties for conventional and organic plots at Russell Ranch

Soil Property	CONV	ORG
Total Organic Carbon (C) (%)	0.92	1.37
Total Nitrogen (N) (%)	0.10	0.17
Water Holding Capacity (g H <sub>2</sub> O/ g dry soil)	0.52	0.52
Sand (%)	22.3	20.2
Clay (%)	29.3	32.8

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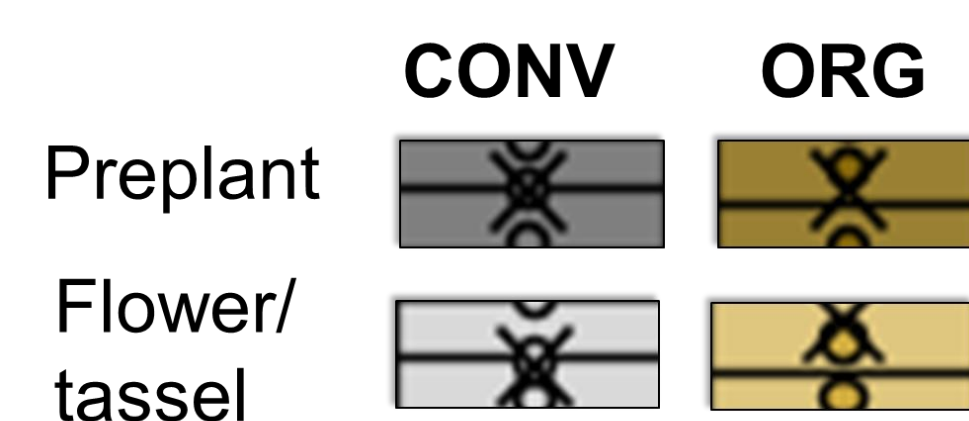
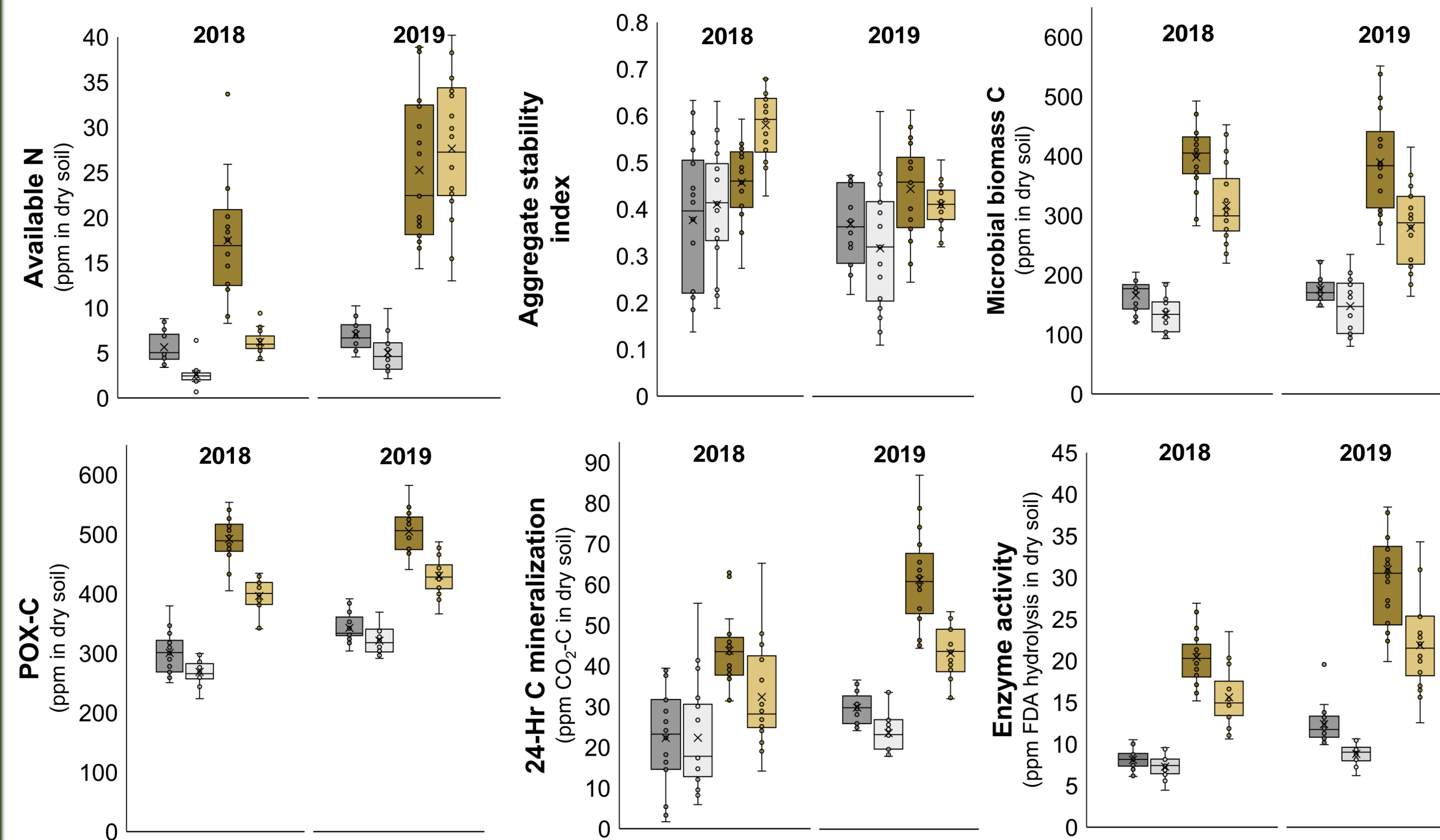
## Sensitivity of Preplant Soil Health Indicators to Different Factors

Soil Health Indicator	Mgt	Year	Crop	Block	In-Plot
Microbial biomass C	**	*			*
Enzyme activity	**	**			
Permanganate-oxidizable C	**	**			*
Particulate organic matter N	**				
Particulate organic matter C	**		*		*
Short-term C respiration (24 hr)	**	**			
Long-term C respiration (4 wk)	**	*			
Short-term N mineralization (1 wk)	**	**			
Long-term N mineralization (4 wk)	**	**			*
Wet-aggregate stability	*			**	**
Bulk density		**			
Available N (Ammonium+nitrate)	**	**	**	*	*
pH	**		*		
Salinity (EC)	**		**		
Available phosphorus (Olsen P)	**	**	*		

Sensitivity	Biological/organic C indicators	Physical indicators	Chemical indicators
Not sensitive			
Somewhat sensitive	*	*	*
Very sensitive	**	**	**

Not sensitive:  $p > 0.10$   
 \* Somewhat sensitive:  $0.01 < p < 0.10$   
 \*\* Very sensitive:  $p < 0.01$

## Range and Seasonal Variability of Selected Indicators



Data from samples taken either preplant or at flowering (tomato) / tasseling (corn) in 2018 and 2019. Values for different crop types are reported together.

## Results and Conclusions

- **Soil biology and carbon accumulation indicators**  
 Showed strong management-based differences which were consistent across years, dates, crops and soils.
- **Physical and chemical indicators**  
 Showed management differences, but were influenced more by previous crop or soil than were the biological/ C accumulation indicators
- **Year and in-season sampling date**  
 Affected all indicators, but differences normally small compared with management differences.

**Soil biology and organic C accumulation analyses were the most robust indicators of management-based soil health improvement.**

## Acknowledgements

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