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Managing irrigation for multiple goals in organic systems

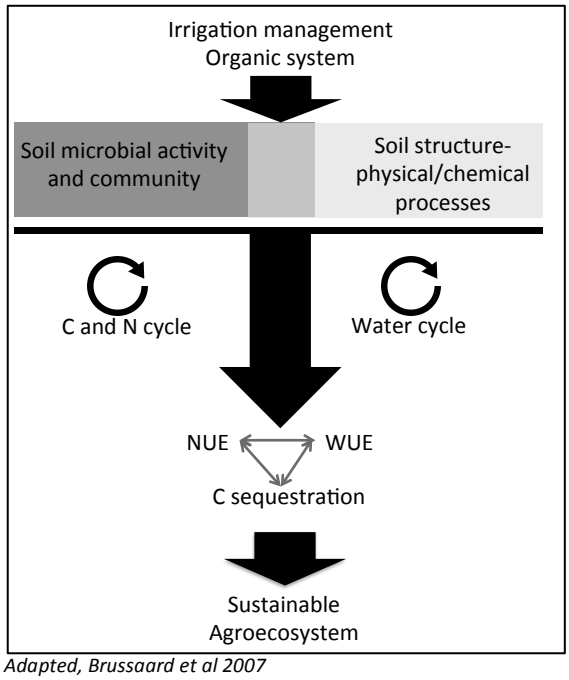
Russell Ranch Field Day, June 8, 2016

Why this study?

- The current drought has incentivized the adoption of more efficient irrigation technology such as subsurface drip (SSD) to improve yields and increase water use efficiency of processing tomato production systems.
- However question remains about the long-term sustainability of this practice and potential tradeoffs for harnessing and building soil health.
- Especially true for organic systems that rely on transformation of organic N sources and soil functions for productivity.

Potential benefits	Potential tradeoffs
Productivity and plant nutrition	
Increase yield Higher water use efficiency	N availability and mineralization rates in time/space? Root growth and R:S ratios?
Soil health	
	Salinity
	Microbial activity and community?
	Aggregation – aggregate stability?
Emissions	
Decrease N_2O emissions	C sequestration?
Water resources	
Decrease leaching potential Reduced water use	Soil hydraulic properties? (ie. infiltration) Ground water recharge? Pressure on groundwater supply?
Pests	
Decrease weed pressure	Plant resilience to stress?

Goals and research questions



Adapted, Brussaard et al 2007

The goals of the ongoing research are to (1) to assess benefits and tradeoffs of drip irrigation for organic growers and the environment and (2) optimize wetting patterns (double drip systems) to maximize benefits.

- How does drip irrigation impact soil ecosystem functions and services?
- What are the implications for integrated fertility management and resource use efficiency?
- What is the optimal option for organic systems?
- Can you maintain/build up soil natural capital in drip system?

Long-term research

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Our study

- Second processing tomato season, long-term organic tomato-corn rotation (cover crop - composted chicken manure trenched –drip- or broadcasted –furrow-)
- Three irrigation strategies (single subsurface drip, double subsurface drip and furrow)
  - Yield, biomass accumulation, N uptake and productivity
  - Root properties (root length density, specific root length)
  - Salinity and water distribution
  - Mineralization (spacial/temporal)
  - Microbial activity and C/N cycling soil enzyme
  - Aggregation, stability and C in aggregate fractions
  - Infiltration and soil moisture release curves

Preliminary Results

- We found no reduction in yields despite concentrated N resources and a sharp decrease in biologically active soil surface in time and space. No significant differences were observed between single-line and double-drip line.
- Preliminary results suggest reduced aggregation and aggregate size under drip. This might increase the amount of unprotected and vulnerable carbon and decrease system's ability to sequester carbon over time.

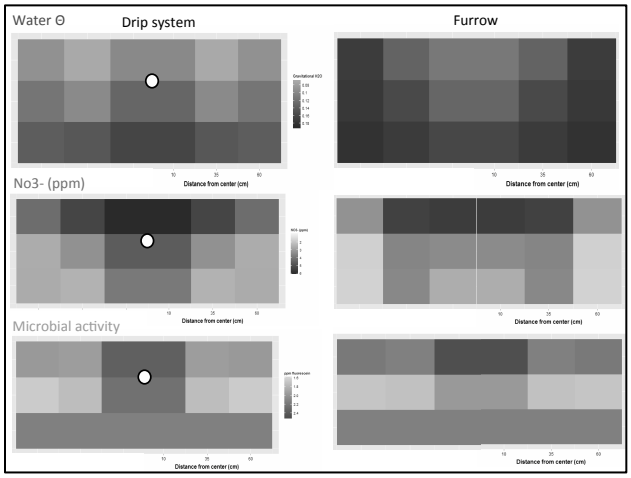

Figure 1: Cumulative Water, N mineralization and microbial activity across the bed (April-August)

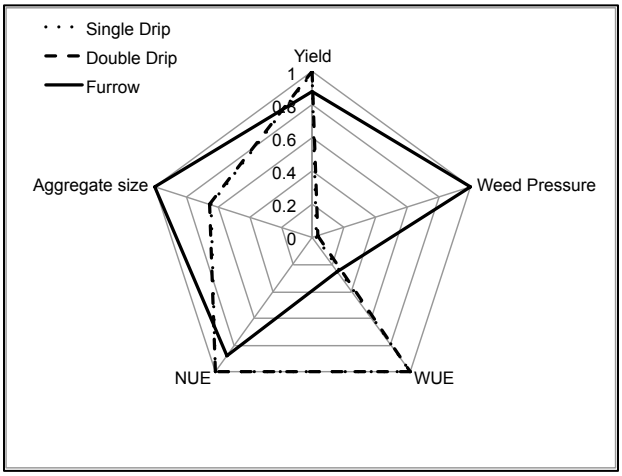

Figure 2: Normalized system performance metrics in the different irrigation systems

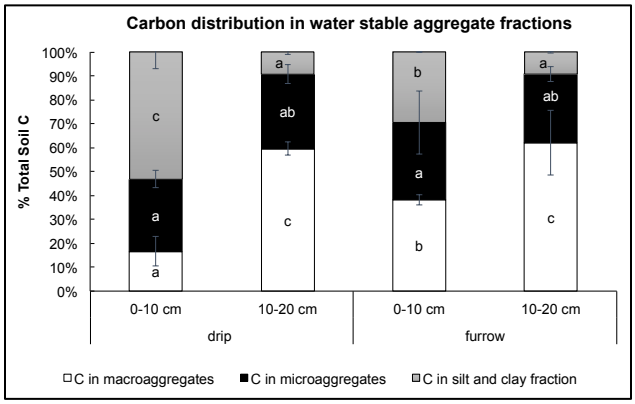

Figure 3: Shifts in Carbon distribution in water stable aggregate fractions (Fall samples).