Soil Biology in Long term Conservation-Tillage Soils, Five Points, CA

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Fourteen years of data from the Five Points research station and numerous other studies show that no-till agriculture leads to changes in soil physical and chemical properties. These changes are thought to lead to differences in microbial community abundance and structure. This Five Points experiment has a unique drip irrigated long term no-till/tillage and cover-crop/no cover-crop comparison. We are studying the microbial response to no-till and cover cropping in this drip-irrigation management system.

Research questions:

- Does higher microbial population density in surface soil of no-till systems found in other regions hold true in San Joaquin Valley and the Central Valley?
- Does sub-surface drip irrigation maintain higher microbial population density of deeper soils than other regions due to sub –surface addition of water and nutrients?
- How do long term reduced tillage and cover-cropping practices change the microbial population density at different depths and at different times during the year?
- Do variations in carbon, nitrogen and soil moisture gradients lead to different microenvironments with diverging microbial communities?

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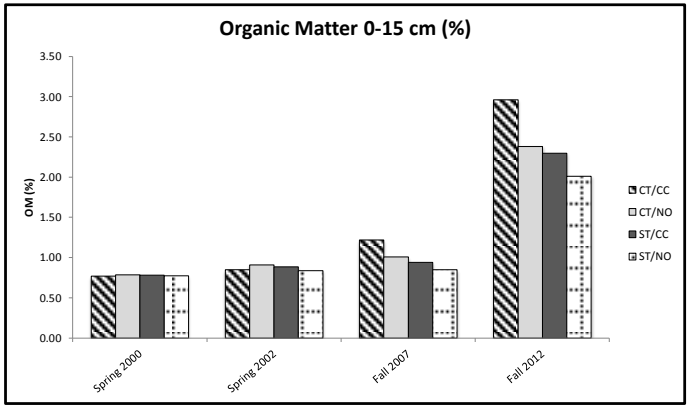
Soil Physical and Chemical Changes

Study History

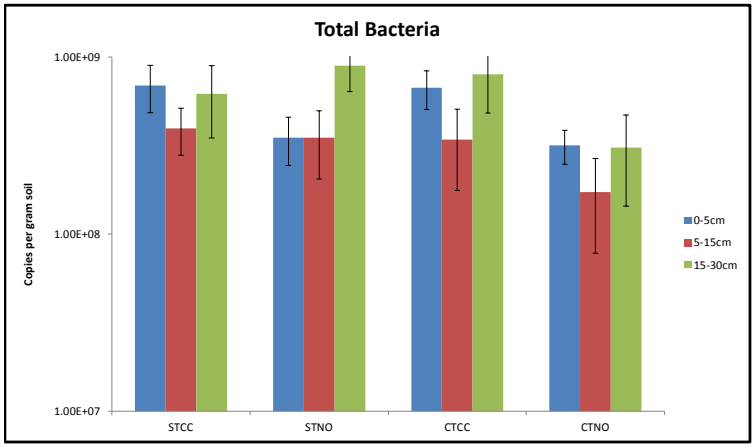
- 14 year tomato-cotton rotation
- Buried drip-irrigation since 1999
- 4 treatments
  - Conservation-till with winter cover crop (CTCC)
  - Conservation-till no cover crop (CTNO)
  - Standard-till with winter cover crop (STCC)
  - Standard-till no cover crop (STNO)



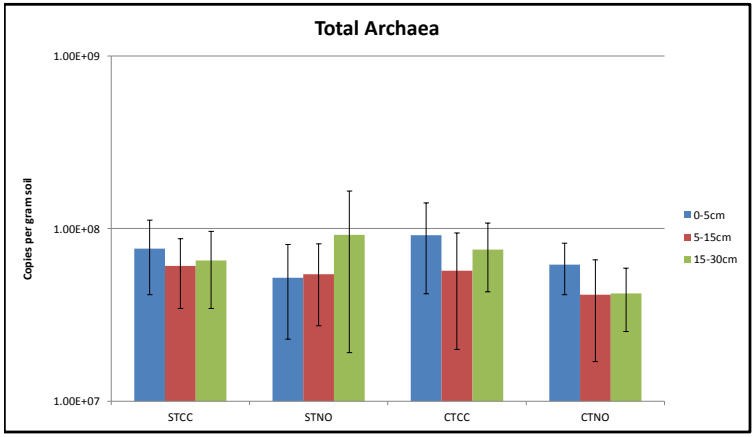
Soil chemical properties after 14 years:

- Increase total %C in surface soil of CT and CC treatments
- Increase total %N in surface soil of CT and CC treatments

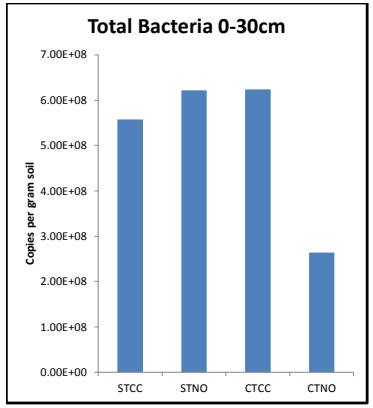
November 2013 Microbial Population Density

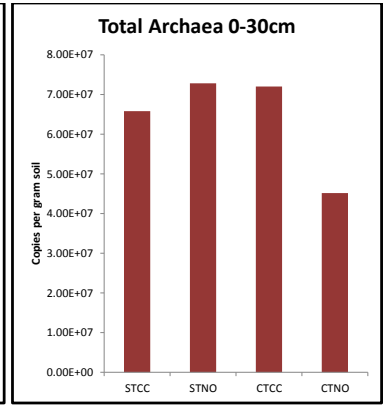


The CTNC had lowest bacterial density while the others were not different. The 5-15cm depth was generally the lowest population for each treatment. The deepest measurements at 15-30 cm maintained high population density.



Archaea population density did not vary with tillage, cover crop or depth.





Conclusions

- November bacterial and archaea population densities do not demonstrate large differences which could be due to low activity across treatments post season. Additional sample dates are needed.
- The CTNC had lowest bacterial density while the other treatments were not different. In CT plots paired with winter cover cropping the microbial population density didn't vary from the standard tillage treatments.
- The 5-15cm depth was generally the lowest population for each treatment. The deepest measurements at 15-30 cm maintained high population density potentially due to subsurface drip irrigation and fertigation.

Future Research

- Four additional sample dates will be analyzed to address temporal variation. How do bacterial, archaea and fungal abundance change throughout a season in each treatment as inputs of water, fertilizer and crop residue change?
- Do changes in microbial communities due to reduced tillage and cover-cropping lead to differences and resistance and resilience to perturbations (drought, tillage, fertilization event, wet-dry events)?
- Does abundance of key groups of microbes in the nitrogen cycle vary throughout the year and at varying soil depths?