

# Soil Carbon Changes in Conservation Tillage and Cover Crop Systems in California

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## Introduction

Conservation tillage (CT) has many potential benefits. It can reduce soil erosion, soil compaction, dust production, diesel fuel needs and production costs. This project looks at the potential for CT and or cover cropping to increase soil carbon storage.

## Background

- Cotton-tomato rotation
- Winter cover crop cereal/legume mixture
  - Juan triticale 30%
  - Merced ryegrain 30%
  - Common vetch 40%
- Established in 1999, making it the oldest CT project in California
- West side of the San Joaquin Valley in Five Points, CA.



Mean Annual Air Temperature: +17 C / 63 F  
 Mean Annual Precipitation: +18 cm / 7 inches

## Hypothesis

- Conservation tillage:**
- reduces soil disturbance, leading to
  - Increases in particulate organic matter
- Both of which increase aggregate stability.  
 By increasing aggregate stability, CT stores more carbon than standard tillage systems.  
 Cover cropping may enhance this effect.  
**Is this true for irrigated systems in hot climates?**

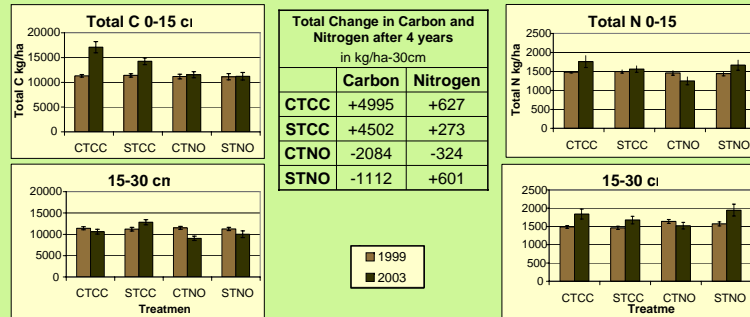
## Bulk Density

	CTCC	STCC	CTNO	STNO
Average	1.20 b	1.28 c	1.05 a	1.24 bc
Std. Error	0.036	0.034	0.015	0.021

	CTCC	STCC	CTNO	STNO
Average	1.42 e	1.37 e	1.36 e	1.35 d
Std. Error	0.057	0.041	0.030	0.026

## Total Carbon and Nitrogen



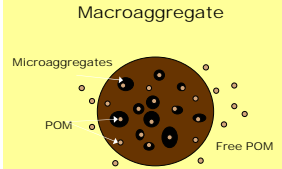
## Microaggregate-associated Carbon

### Idea Behind Method

We measured:

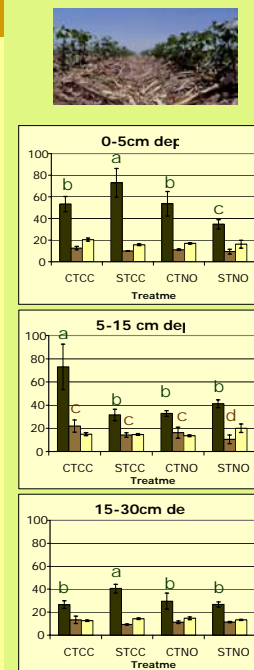
- total carbon
- intra-aggregate particulate organic matter (POM)
- free particulate organic matter

Increases in intra-aggregate POM can indicate future increases in total carbon (Six, et al. 2002).



A macroaggregate is made up of many stable microaggregates. the core of each microaggregate, POM functions as a nucleus (Tisdall and Oades 1982).

- free/loose POM (considered active SOM)
- intra-aggregate POM (considered stable SOM)



## Conclusions

- After 4 years of conservation tillage:
- Total C
    - Increases in surface
    - Decreases in subsurface
    - Carbon losses in CTNO and STNO
    - Cover crop systems gained C regardless of tillage
  - Total N
    - Increases in all systems except CTNO
    - Most increase in CTCC and STNO
  - Microaggregate-associated C
    - More POM C in C T and cover crop systems in the surface.
    - No trend yet in microaggregate C

Carbon sequestration may not be a benefit of CT in this part of California.

Important reasons for adopting CT in CA

- dust reduction
- improved water quality
- decreased production costs
- reduced diesel fuel consumption
- reduced winter runoff

## References

Six, J., P. Callawaert, S. Lenders, S. De Gryze, S. J. Morris, E. G. Gregorich, E. A. Paul, and K. Paustian. 2002. Measuring and Understanding Carbon Storage in Afforested Soils by Physical Fractionation. *Soil Science Society of America Journal* 66:1981-1987

Tisdall, J.M., and J.M. Oades. 1982. Organic matter and water-stable aggregates in soil. *Journal of Soil Science* 33:141-163

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## Treatments & Tillage Passes

Standard Tillage		Conservation Tillage		
with cover crop	no cover crop	with cover crop	no cover crop	
STCC	STNO	CTCC	CTNO	
# of tractor passes	21	18	13	12

Depth of Tillage:  
 Disking — 12-20 cm  
 Ripping — 35 cm

Standard Tillage	Conservation Tillage
After tomato: Disk twice Ripping Level Last beds	After tomato: None
After cotton: All of the above plus Shred cotton Undercut cotton Incorporate/shape beds Cultivate Roll beds	After cotton: Clean furrows Shredder/Bedder Cultivate



## Yields

Treatment	Tomato (tons/acre)	Cotton (lbs lint/acre)
Standard tillage no cover crop	51	1879
Standard tillage cover crop	51	1677
Conservation tillage no cover crop	57	1653
Conservation tillage cover crop	51	1351

