# Healthy vineyard soils
## Cover crop management
## Tilling and grazing trial

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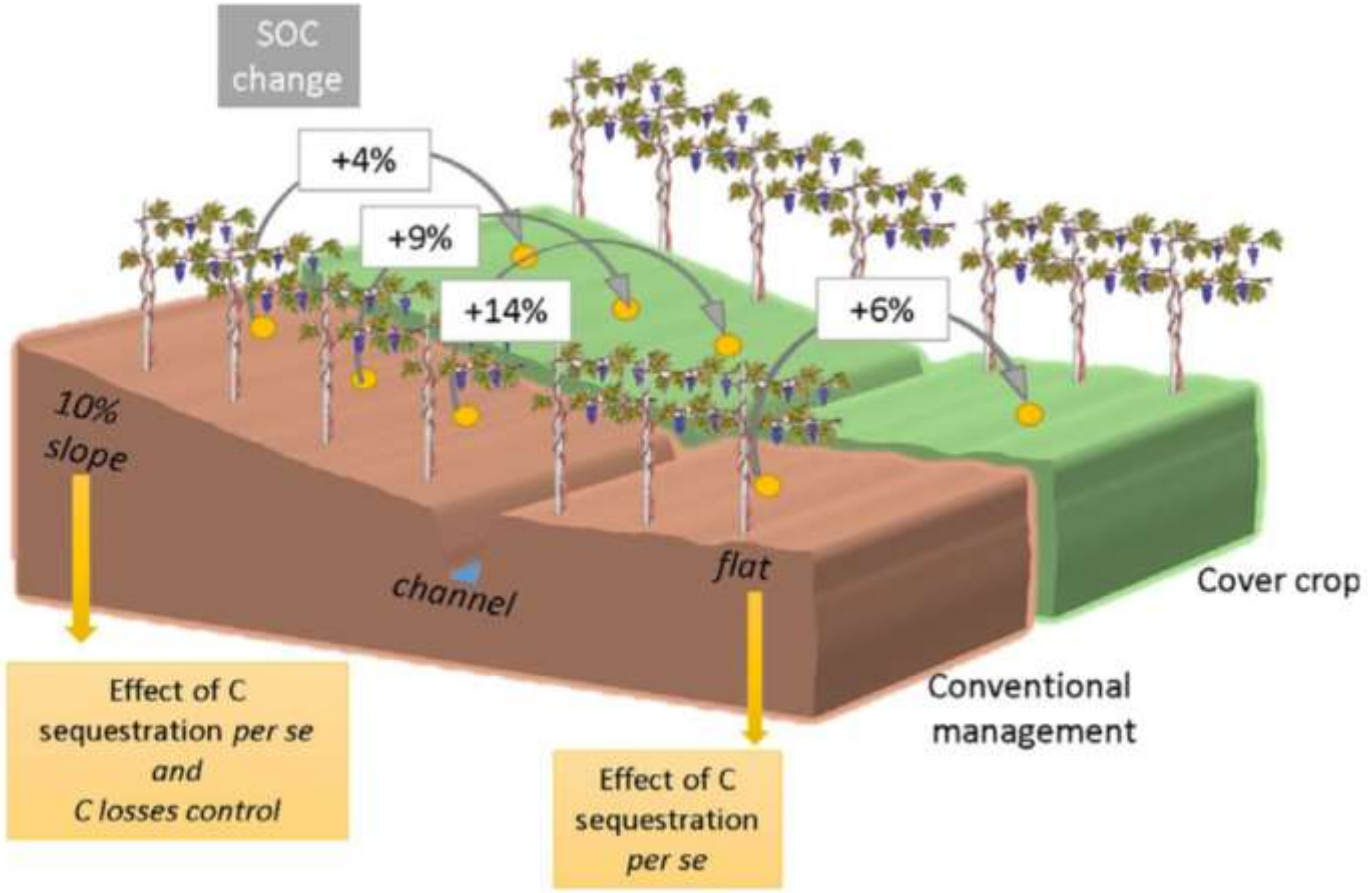
College of Agriculture, Food & Environmental Sciences

# Outline

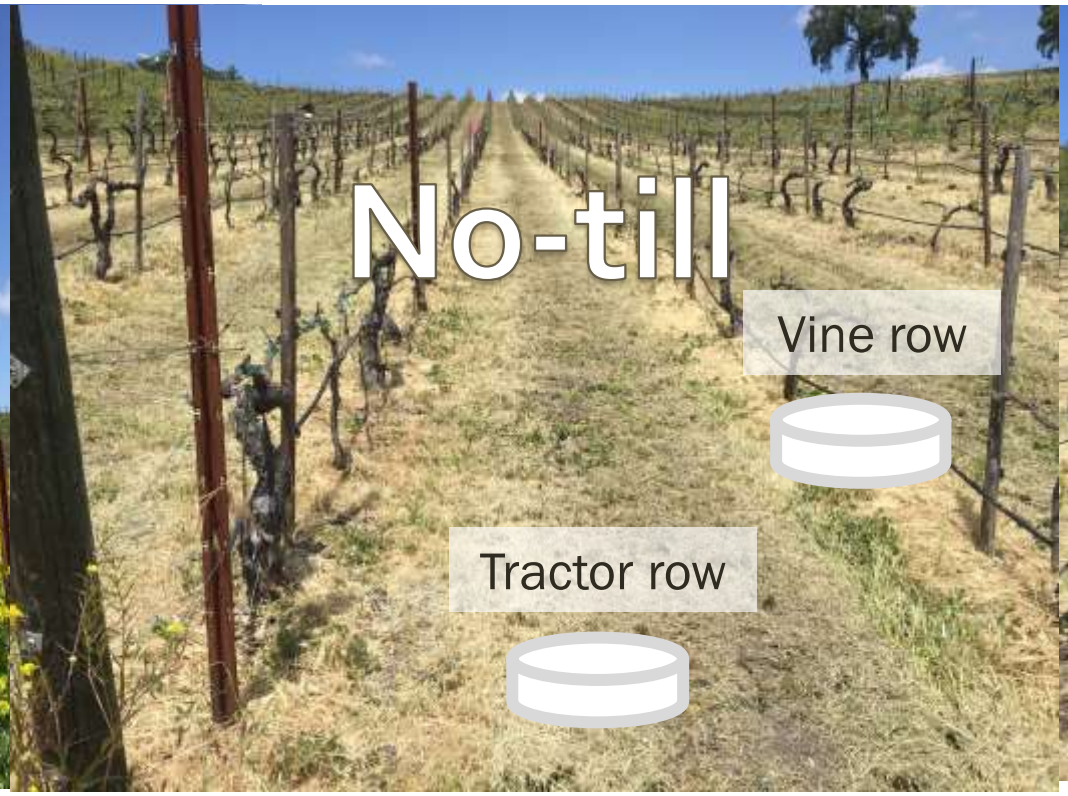
I. Methodology
II. Greenhouse gas results
III. Soil chemical & physical properties (C and N)
IV. Grape yield & berry quality analysis
V. Conclusions

# Introduction

- Cover crops used to **mitigate soil loss** and **increase soil organic matter** to improve soil health
- Cover crops may be either
  A. mowed and left on the soil surface
  B. incorporated into the soil through tillage



# Vineyard management influence on soil ecosystem functioning over time





Tablas Creek Vineyard, Paso Robles CA

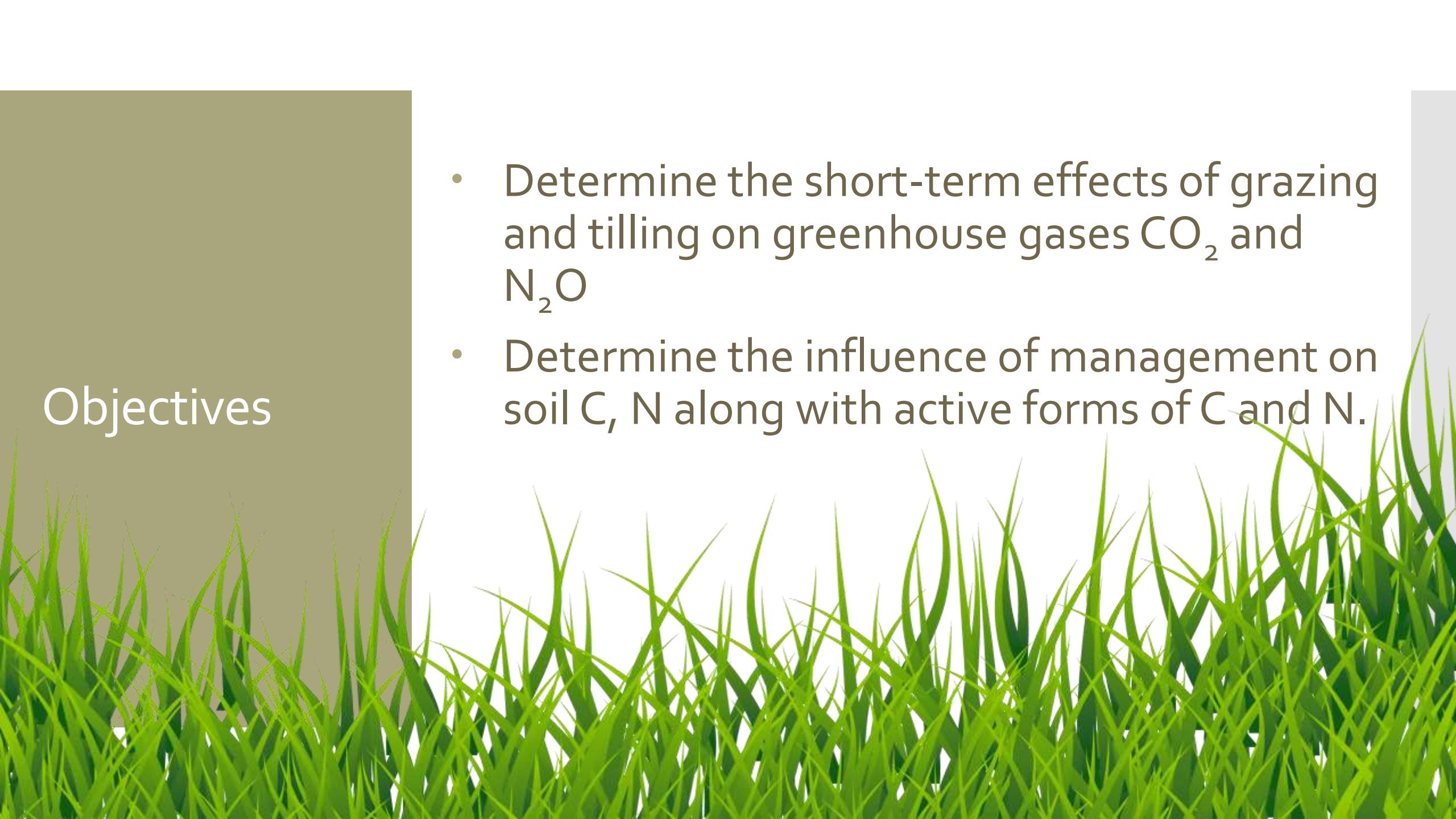
# Introduction continued

- Sheep grazing is used as an alternative to mowing
- It's unclear whether the removal of organic biomass and inputs of N-rich urine and feces will negatively impact GHGs

Photo: Byrnes, R.C. et al 2018

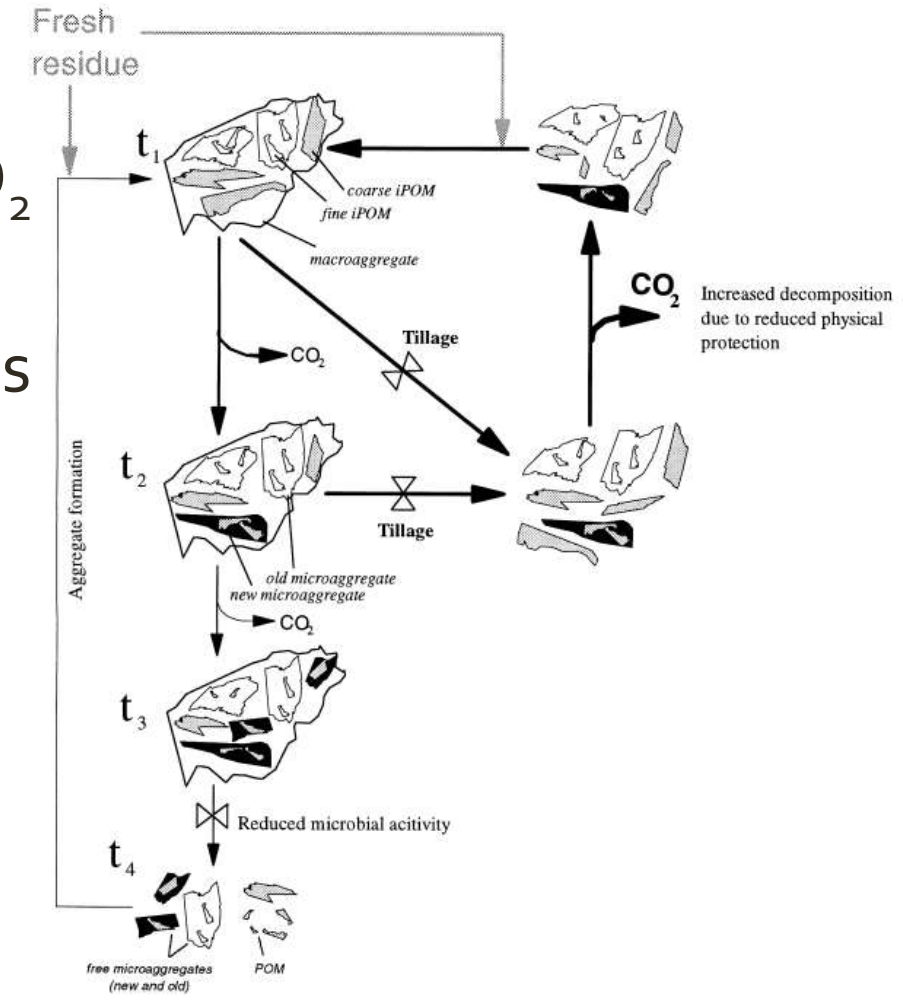
# Objectives

- Determine the short-term effects of grazing and tilling on greenhouse gases $CO_2$ and $N_2O$
- Determine the influence of management on soil C, N along with active forms of C and N.



# Hypothesis

- We hypothesized that tillage would increase $CO_2$ emissions by disturbing aggregate stability in soils
- We hypothesized that grazing would increase $N_2O$ from N-rich manure inputs

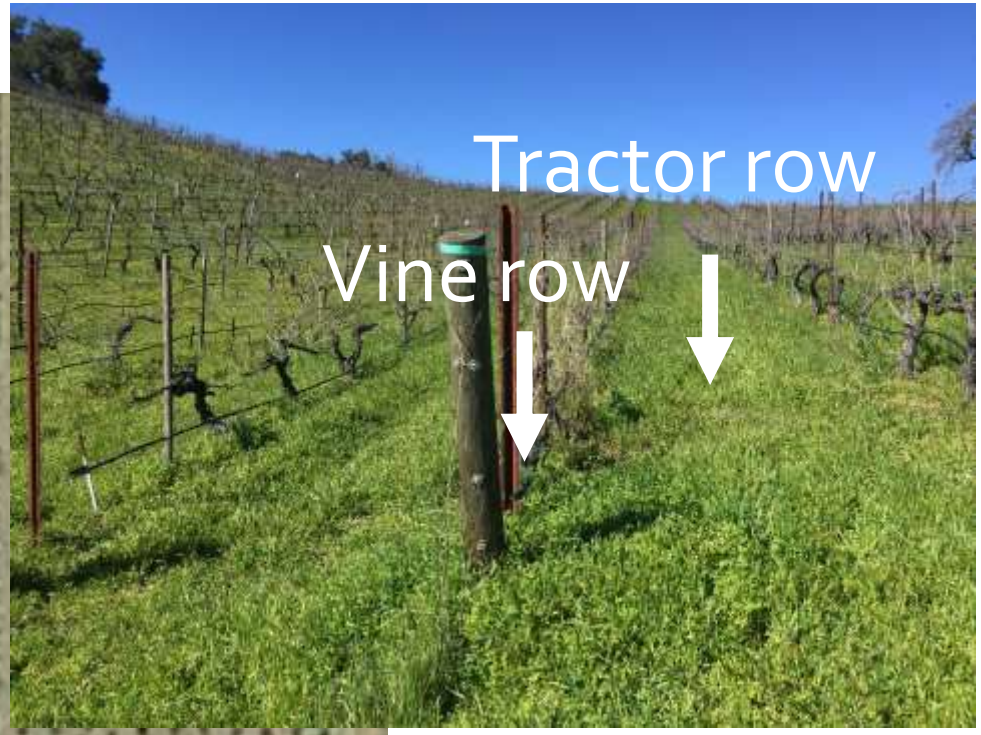



Six et al. 2000

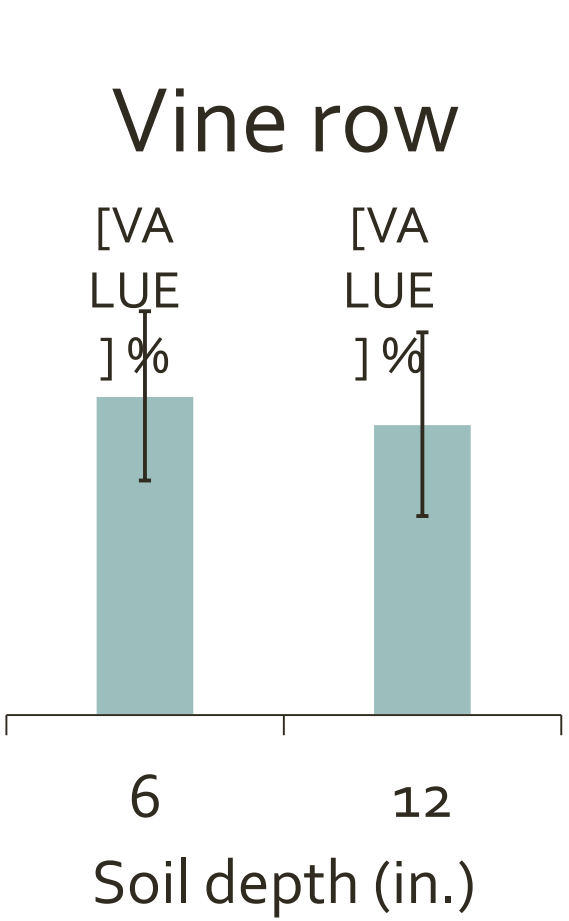
# Site and Method

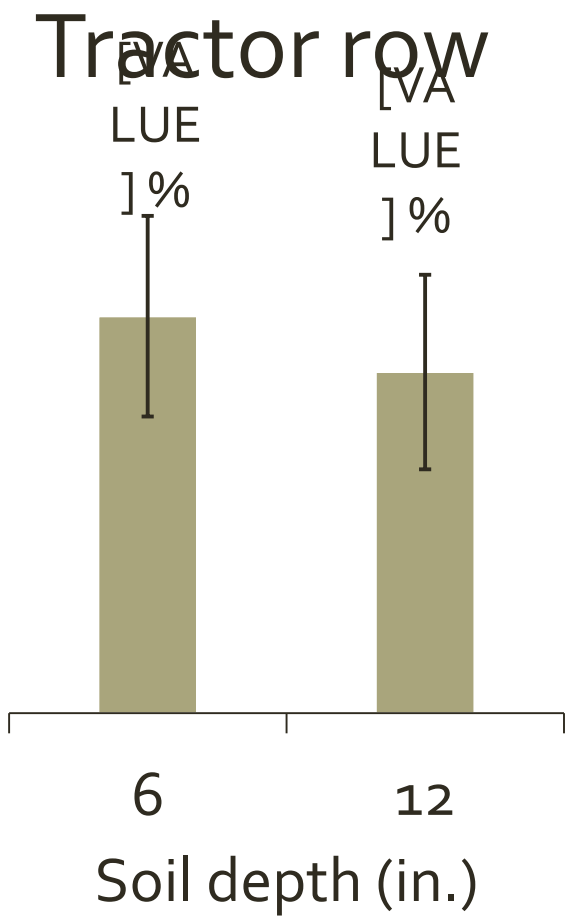
- Grapes are a Syrah variety historically under **cover crop and tillage** management
- Linne-Calodo complex,
- 30% clay,  pH 8.1
- Treatment groups each replicated 4 times
    1. Grazed + Till
    2. Grazed + No-till
    3. Non-grazed + Till
    4. Non-grazed + No-till (control)


Legend
Grazed
No till
Non-grazed
Till


Tractor row
Vine row

# Soil organic matter % and active C were highest in the 0-6” in tractor row



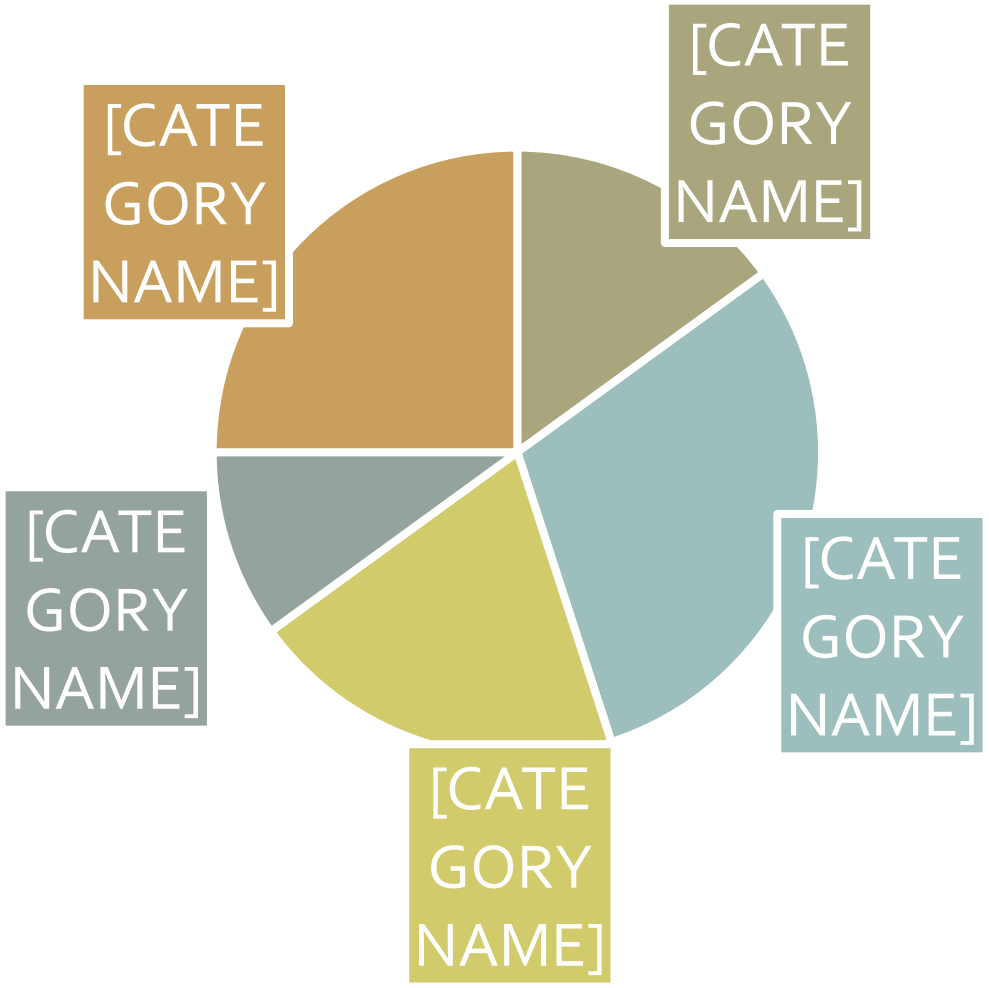



# Animal grazing

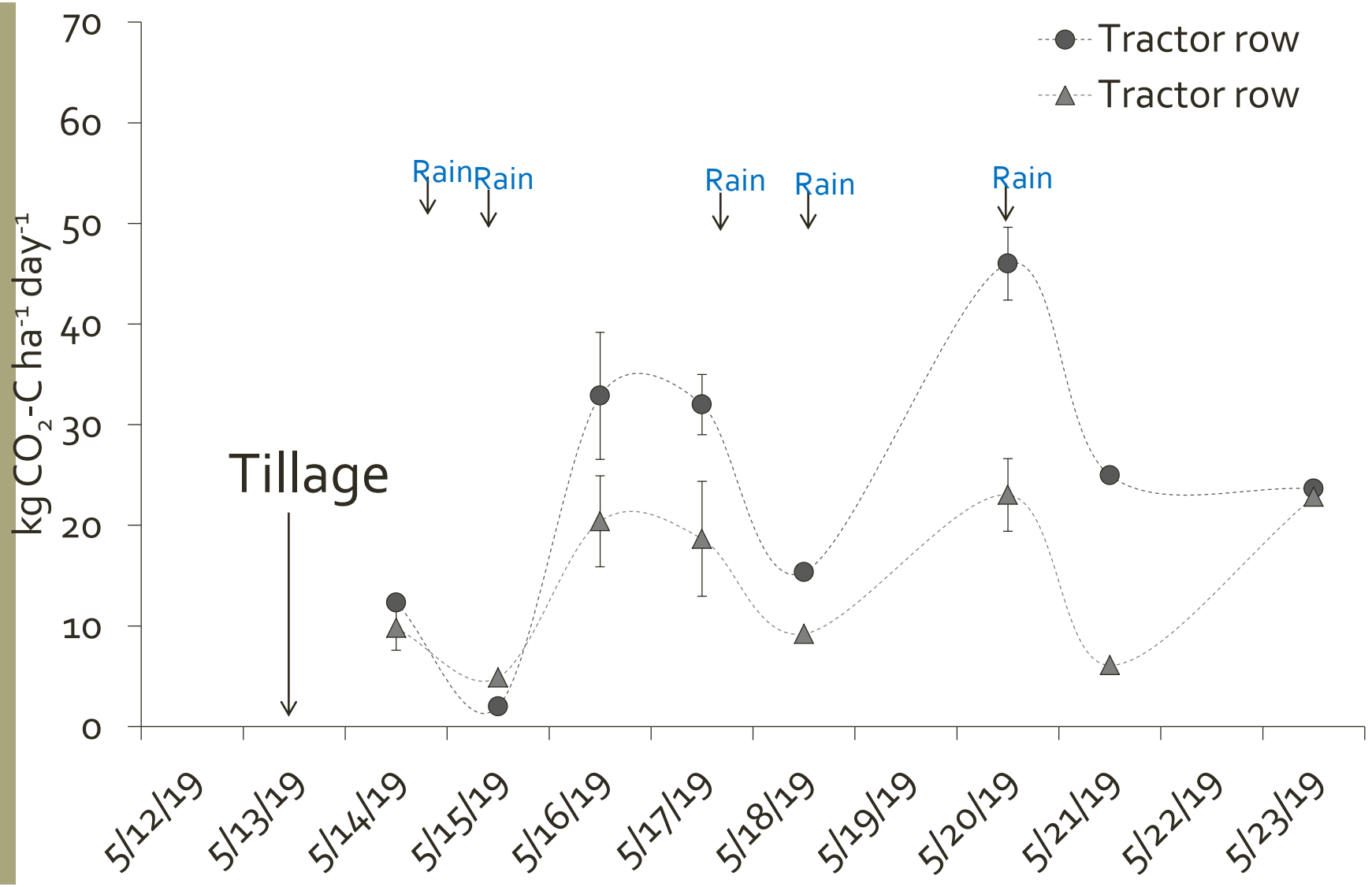
- Grazing density: 150 sheep/acre/day

# Cover crop

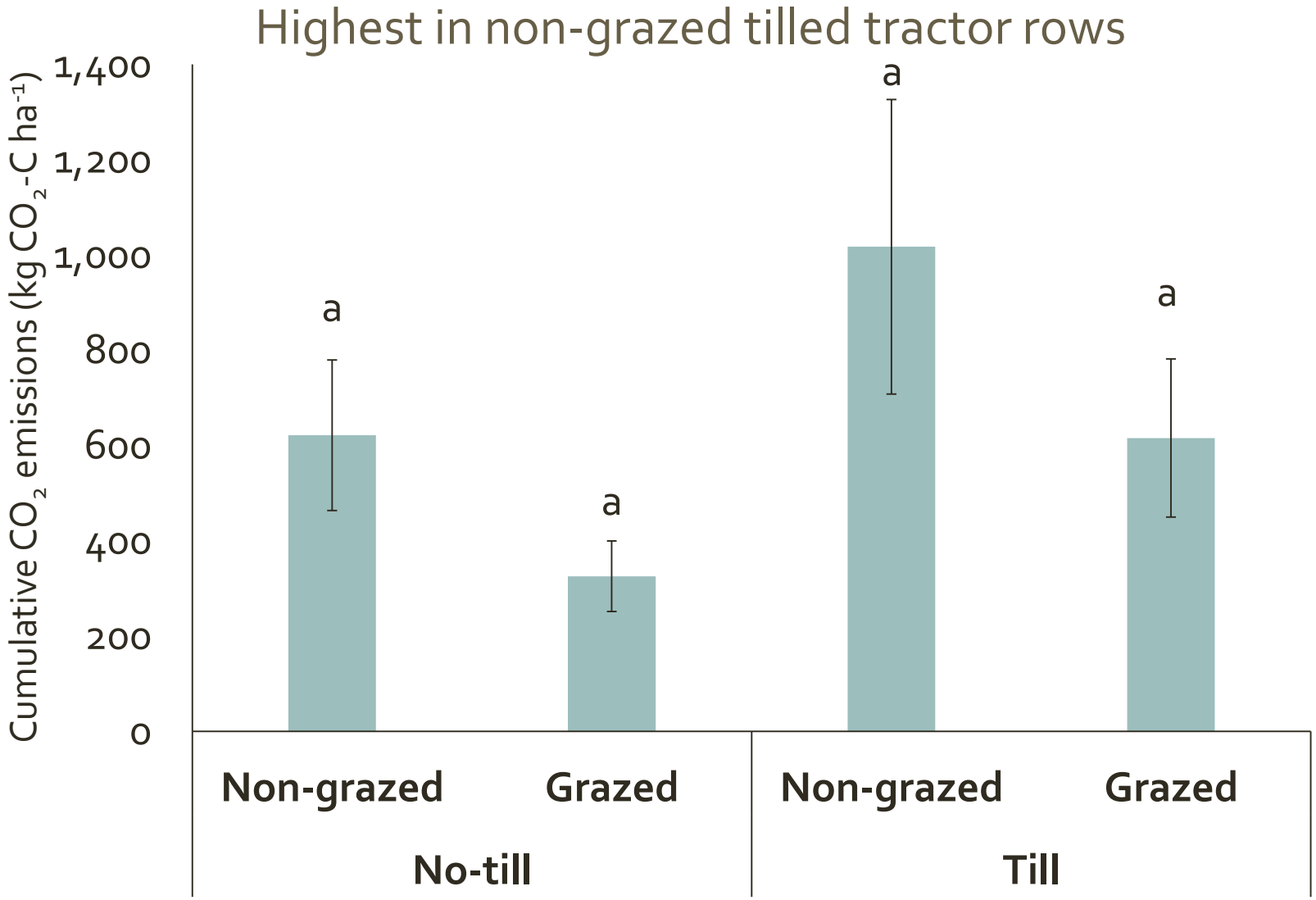
- Soil Max Organic Legume Mix by LA Hearne Seed Co.
- 100-175 lbs./acre



# Soil greenhouse gas emissions



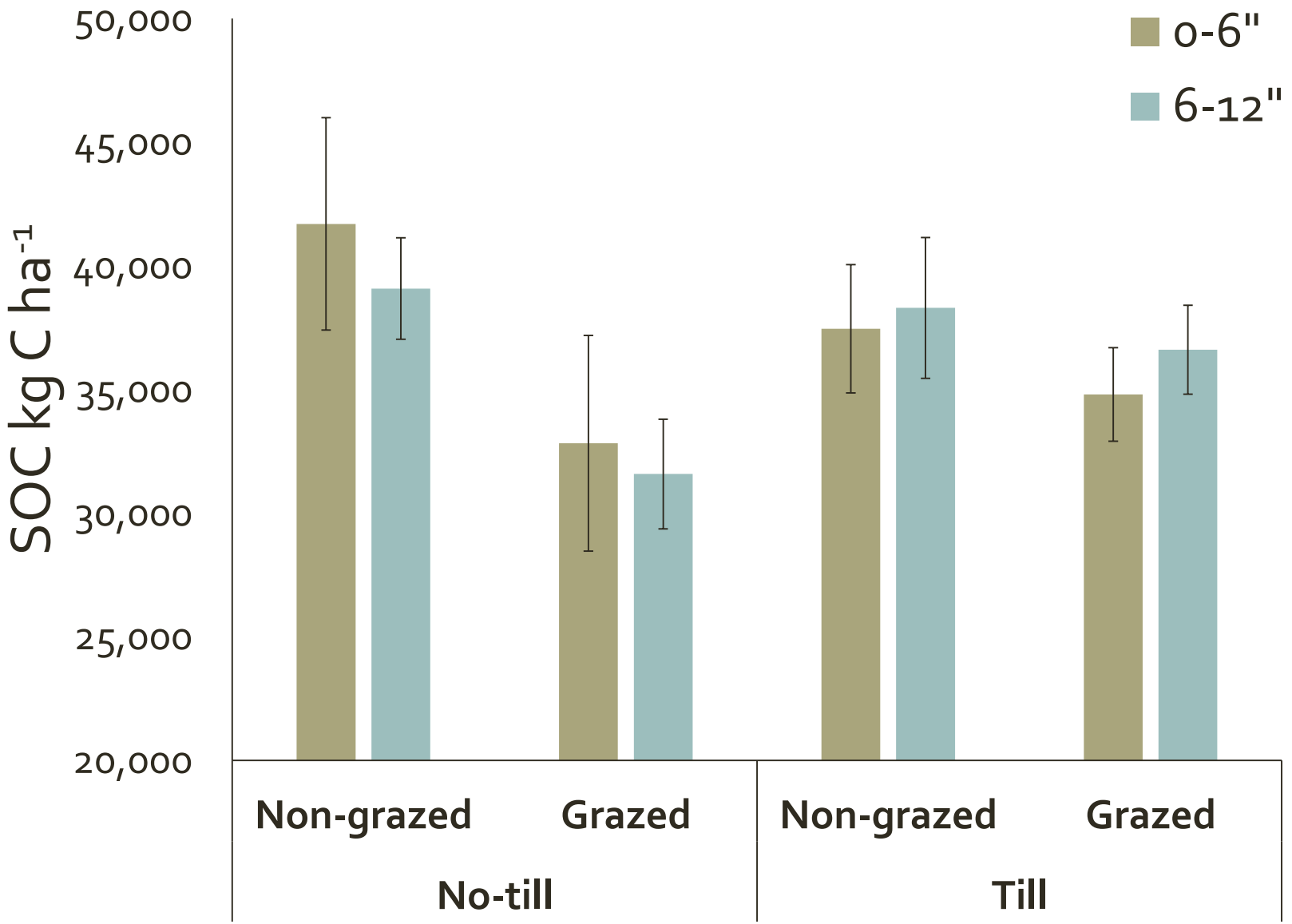
# $CO_2$ after tillage & grazing



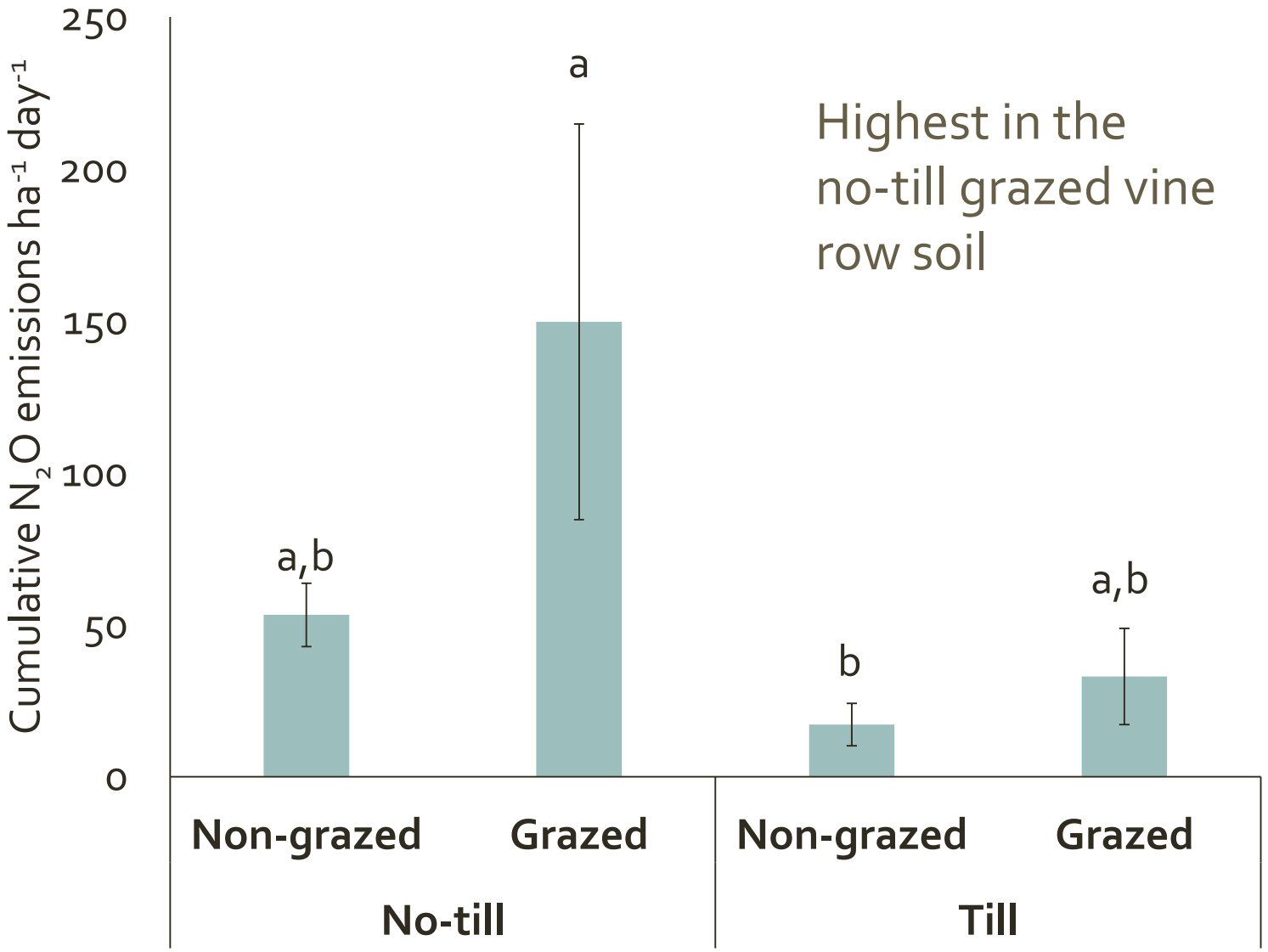
# Soil C

no significant differences in organic C between management after 1 year

control has highest

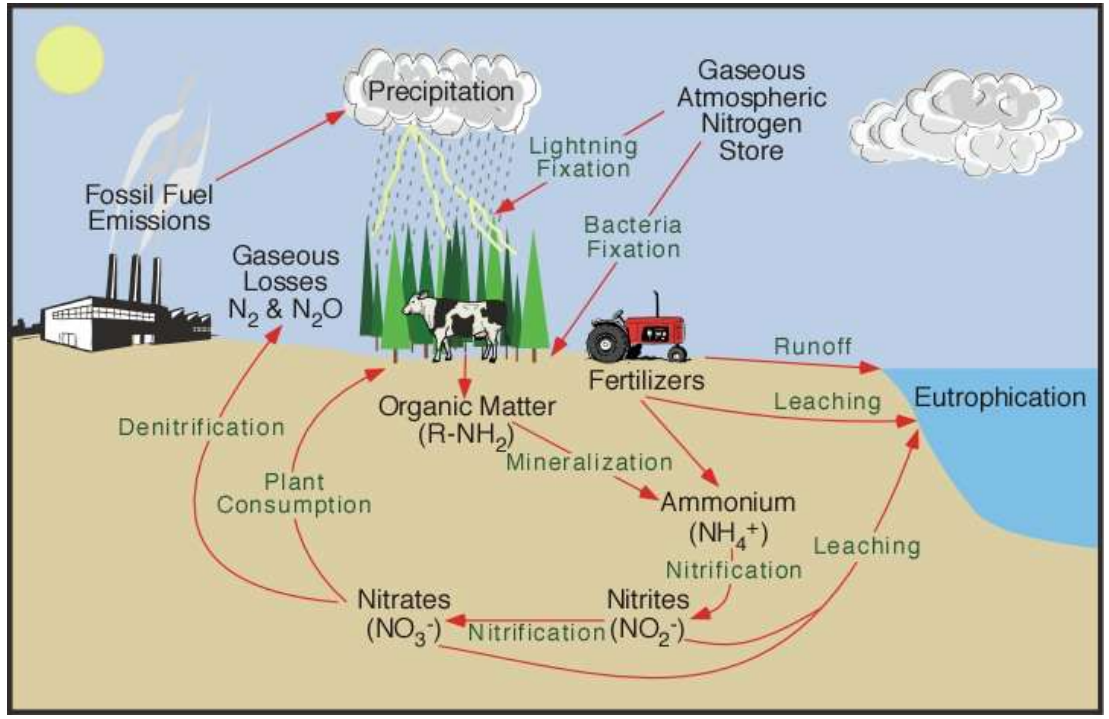


# $N_2O$ emissions after tillage & grazing

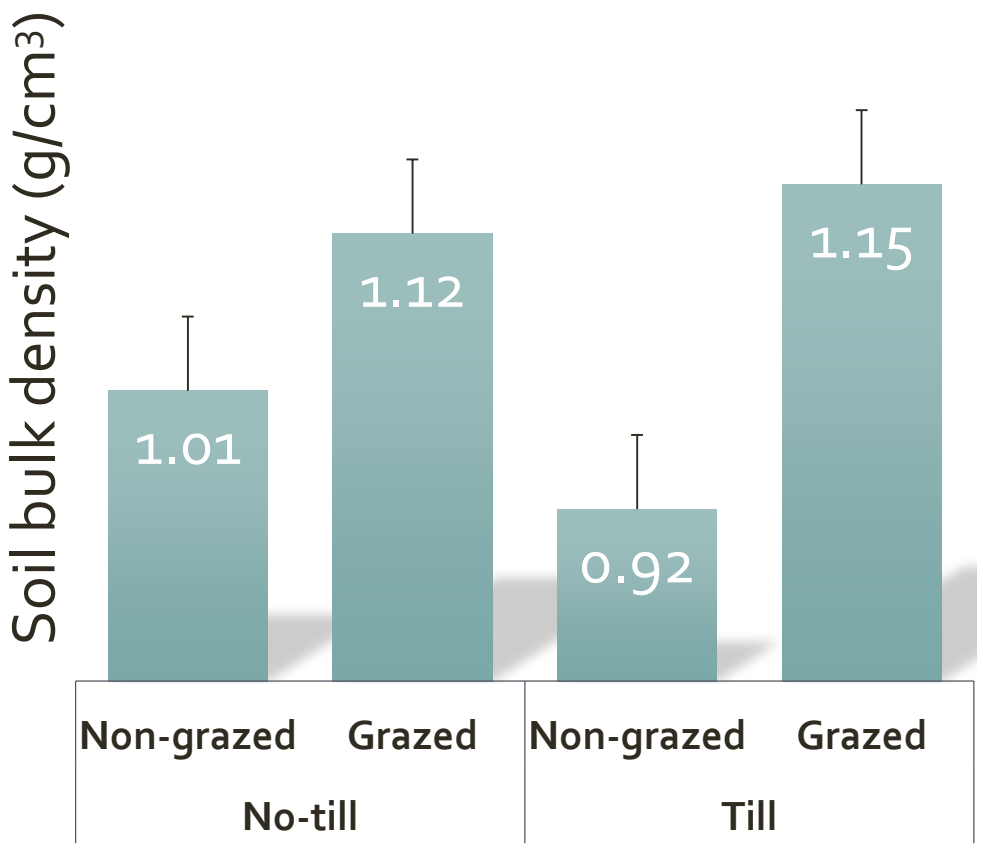


# N cycling likely influenced by management especially grazing

- Management influenced $N_2O$ emissions
- Relationship to active N forms in soil ($No_3$ and $NH_4$) is not yet clear



# Surface-level compaction was lowest in the tilled non-grazed soil



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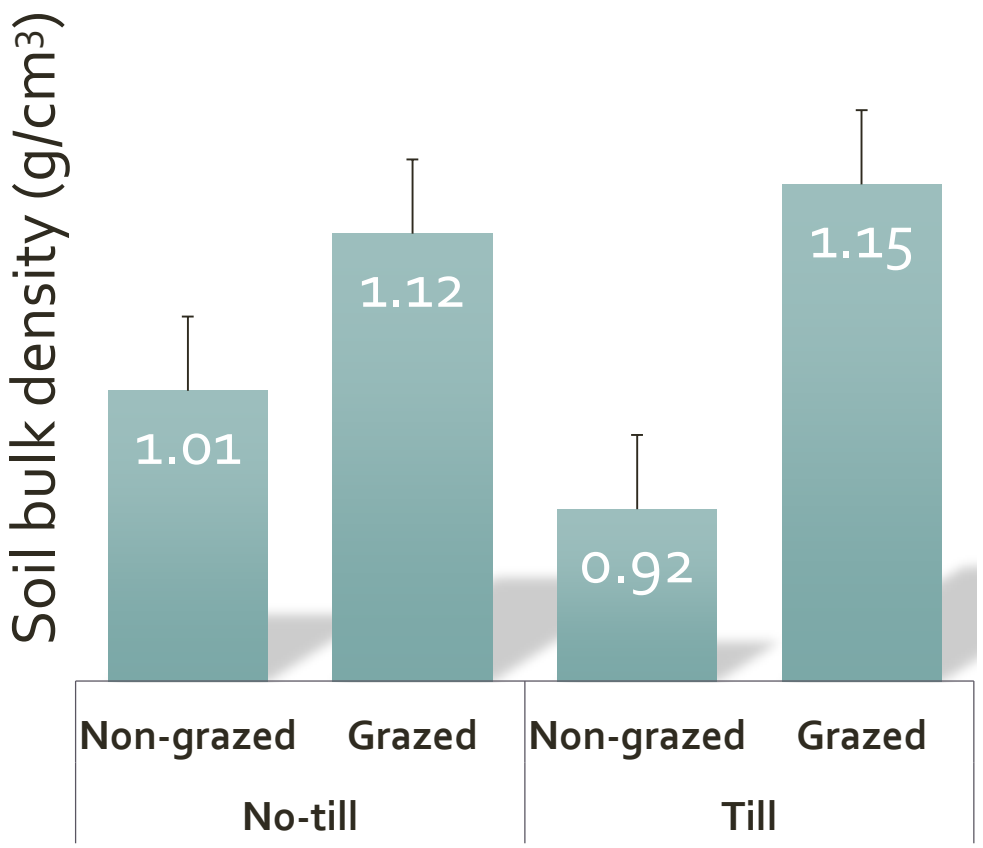
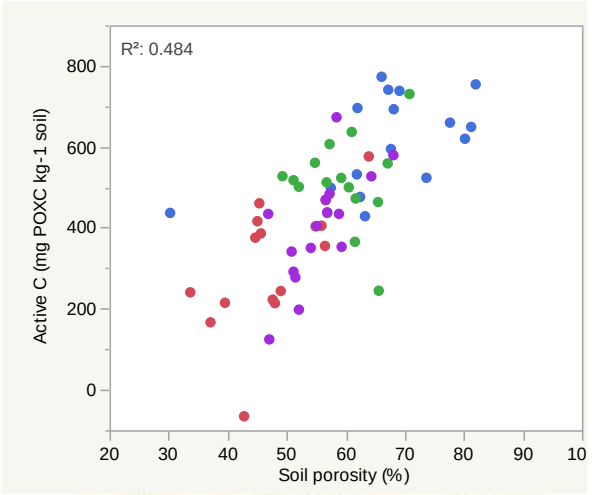
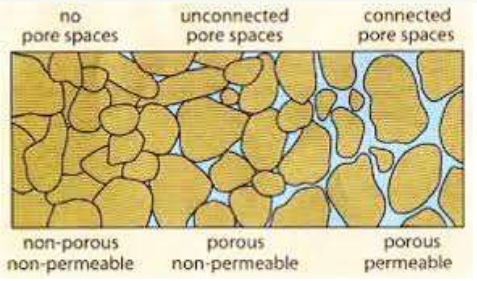


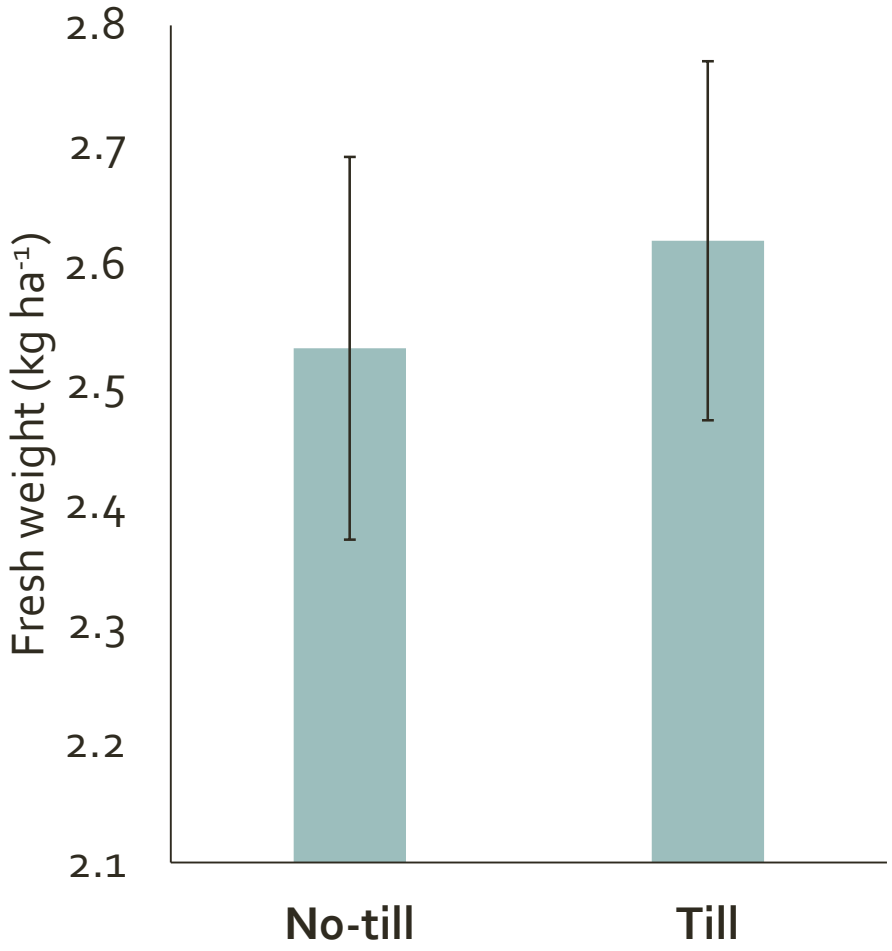



# Grape yield

# Grape yield

- Total yield (kg/ha)
- Fresh wt. / vine
- # clusters / vine
- No significant differences between tilling treatments



# Berry quality

# Berry quality

**Physical**

- Fresh wt. (skins)
- Fresh wt. (pulp)
- Fresh wt. (seeds)
- Fresh wt. (berry)

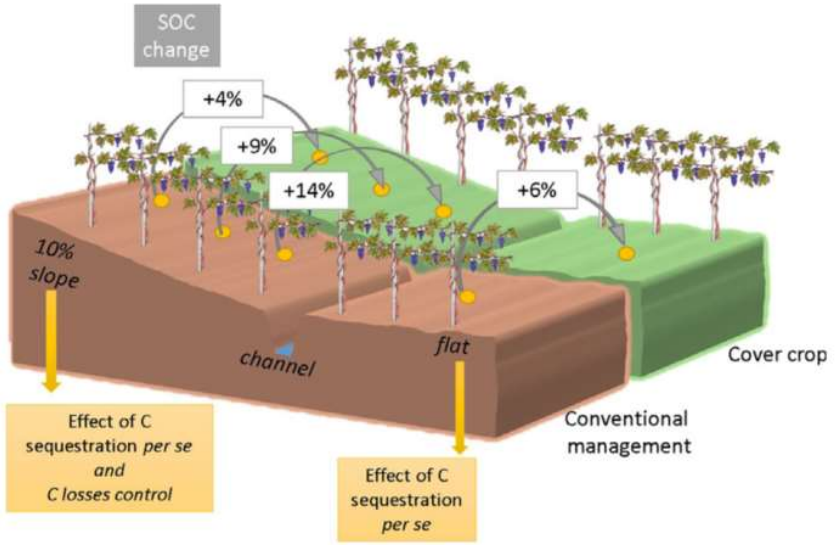
**Chemical**

- Brix (handheld)
- pH
- Titratable Acidity
- Malic acid (enzymatic)
- Anthocyanins
- Phenolics

no changes to quality following 1 year of tillage management

# Conclusions

- No changes in $CO_2$, grape quantity or quality from management
- There is an interaction between grazing and tilling on $N_2O$ emissions
- $CO_2$ emissions likely influenced by amount of available C
- Further investigating the role of active soil C and N will give us more insight into how C and N are cycling
- Understanding the influence of management on GHGs will inform our knowledge on soil health, long-term GHG rates and C sequestration



# Thank you

The staff of Tablas Creek Vineyard, the Center of Sustainability, the Vineyard Team, The California State University Agricultural Research Institute (ARI), & California Department of Food and Agriculture (CDFA) for support on this project.