How does Using Sheep to Manage Vineyard Cover Crops affect Soil Health and Greenhouse Gas Emissions?

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Soils = Life

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Soil Organisms

Soil Processes

- Decomposition
- Nutrient Cycling
- Soil Structure
- Biological popupation regulation
- Plant growth

Soil Ecosystem Services

• Food, Fuel, Fibers • Antibiotics • Construction materials • C Sequestration • Waste decomposition • Water purification • Foundation human infrastructure and culture



Labile C & N from SOM as Soil Health Indicators

- Soil Organic Matter & Soil Health
 - $\circ~$ Sensitive to soil management
 - Rapid Nutrient Cycling
 - Soil Aggregates
 - Carbon Sequestration

os Soil Management can impact Soil Health





- Intensive Tillage & Uncovered Soils
 - Soil Erosion
 - Gas emissions
 - Soil Organic matter
 - Soil Biodiversity
 - J Overall Soil Quality

⁰⁶ Soil Management can impact Soil Health

- CA vineyard soils are highly suceptible to erosion
- Soil Conservation Practices for Soil Health
 - Cover Crops
 - No-Till & Reduced Tillage





o7 Cover Crops need to be managed correctly

Herbicide





os Cover Crops need to be managed correctly

Tilling

+ effective, quick incorporation of the organic matter, infiltration?
- destroys structure, compaction, C loss
- Labor & fuel intensive



op Cover Crops need to be managed correctly

Grazing

+ effective, N addition, stimulates cover crop growth, stimulates soil biota?

 compaction, only in dormant season, source of greenhouse gases (CH₄ and N₂O)

10 Cover Crops need to be managed correctly

Herbicide

+ effective

non-targeted effects
 on soil biota and
 human health

Tilling

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Grazing

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Problems

- understood.



• The effects of grazing cover crops in tilled vs not-tilled in soil health are not well

• It is thought that increased cover cropping, no-till and sheep grazing could impact soil greenhouse gas emissions





Research Questions

1.How can different cover crop termination strategies affect soil health indicators such as carbon and nitrogen?

2.What is the impact of different tillage intensities and grazing activity in greenhouse gas emissions from soils?



Hypotheses

1) Soils that were grazed and not tilled will result in higher labile carbon and nitrogen

2) Soils that were grazed and tilled will result in higher greenhouse gasemissions



Carbon:

- Active C (POXC)
- Mineralizable Carbon (Min C)
- Microbial Biomass Carbon (MBC)

Nitrogen:

• Soil Nitrate (NO₃⁻)

Greenhouse Gasses:

- Carbon Dioxide (CO₂)
- Nitrous Oxide (N₂O)
- Methane (CH₄)

Data Analysis: Analisis of Variance

Methods



Experimental Design

- Tablas Creek Vineyard in Paso Robles, CA
- Syrah Grape, Cover Crop mix
- Biodynamic Management
- Established in 2018







¹⁶ Samplings

- Gas samples: gas chambers
- Time: February 2020
- Soil Depth:
 - **0-15 cm**
 - **15-30 cm**
- Location
 - \circ Vine Row
 - \circ Tractor Row



Results: No significant increase in Active Carbon and Microbial Biomass Carbon

Hypothesis 1: Soils that were grazed and not tilled will result in higher labile carbon and nitrogen





• Grazing and No-Tillage had no negative effects on Active C and MBC.

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Results: Mineralizable C



Hypothesis 1: Soils that were grazed and not tilled will result in higher labile carbon and nitrogen

- In general, Higher Min C in Grazed soils
- Inconsistent trends among tillage treatments

Results: Nitrate overall higher in Non-Grazed





Hypothesis 1: Soils that were grazed and not tilled will result in higher labile carbon and nitrogen

- Slightly lower nitrate in Grazed plots
- No-Till mean values were less variable





Grape Yields

- No negative effects of Grazing
- No-Till had higher yields

Preliminary Results: Greenhouse Gas Emissions







Vine Row

Grazing Grazed Non-Grazed Hypothesis 2: Soils that were grazed and tilled will result in higher greenhouse gas emissions

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Tractor Row





Possible Implications

- Soil Health indicators minimum responses to treatments
- Higher C and N values in the top depth were expected
- High SOM soil + Biodynamic Vineyard
- Tillage and Grazing might increase CO2 and CH4 emissions





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Questions / Suggestions?

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