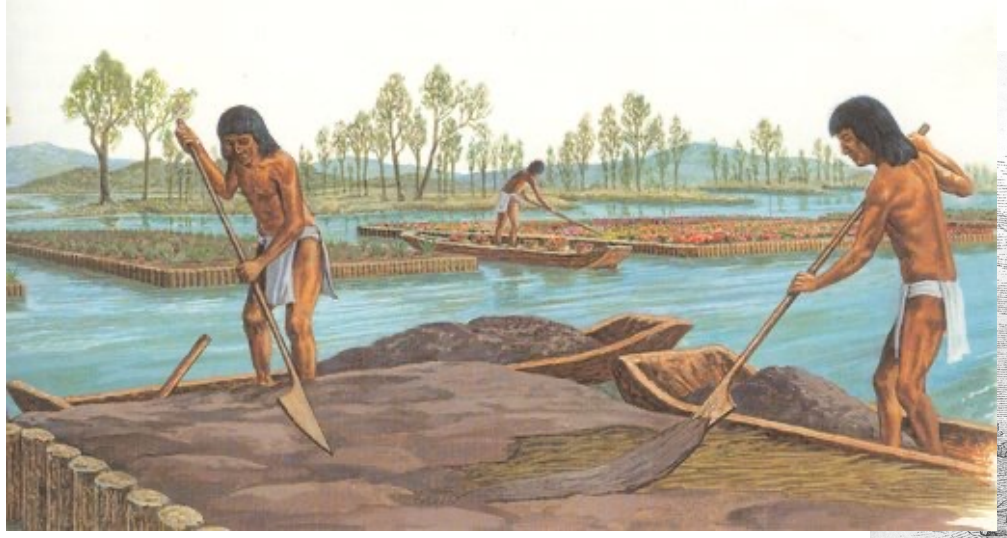
Compost application in vineyards

Two case studies in the Paso Robles AVA

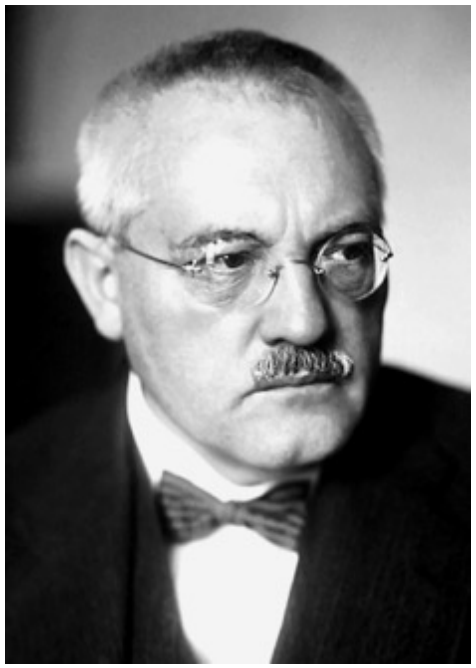
Charlotte Decock, PhD

An ancient practice



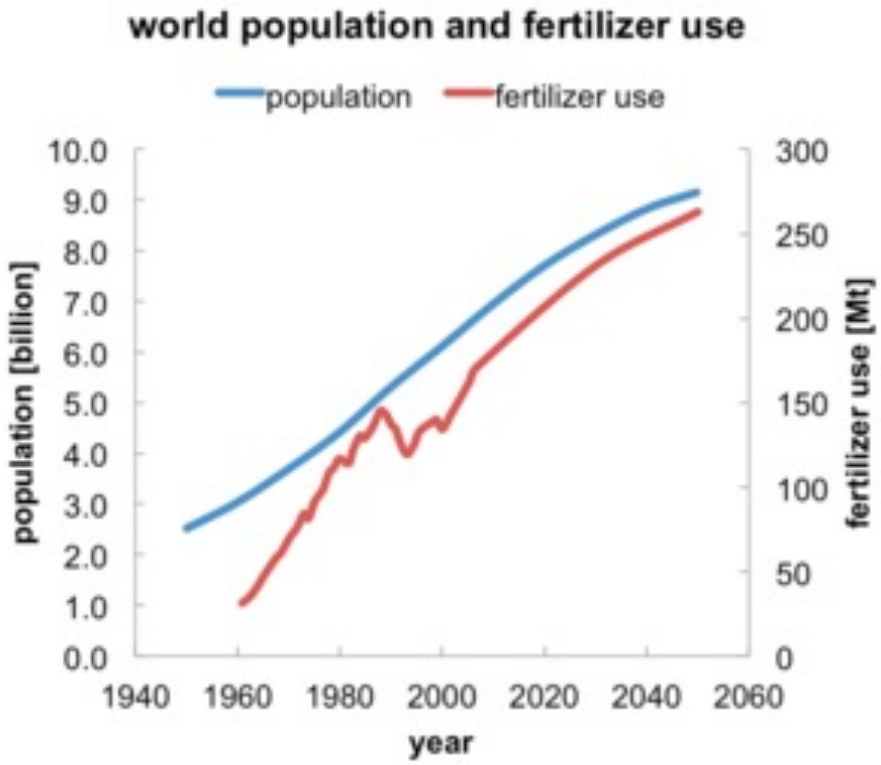
Sources: https://www.compostmagazine.com/compost-history/, https://www.nationalgeographic.com/culture/article/compost--a-history-in-green-and-brown, https://www.compostmagazine.com/composting-facts/

So, why are we still discussing the benefits of compost in 2023?



Bosch

Haber



Where we are today…

CALIFORNIA AIR RESOURCES BOARD

AB 32, the California Global Warming Solutions Act of 2006

THE OFFICE OF ENVIRONMENTAL FARMING & INNOVATION

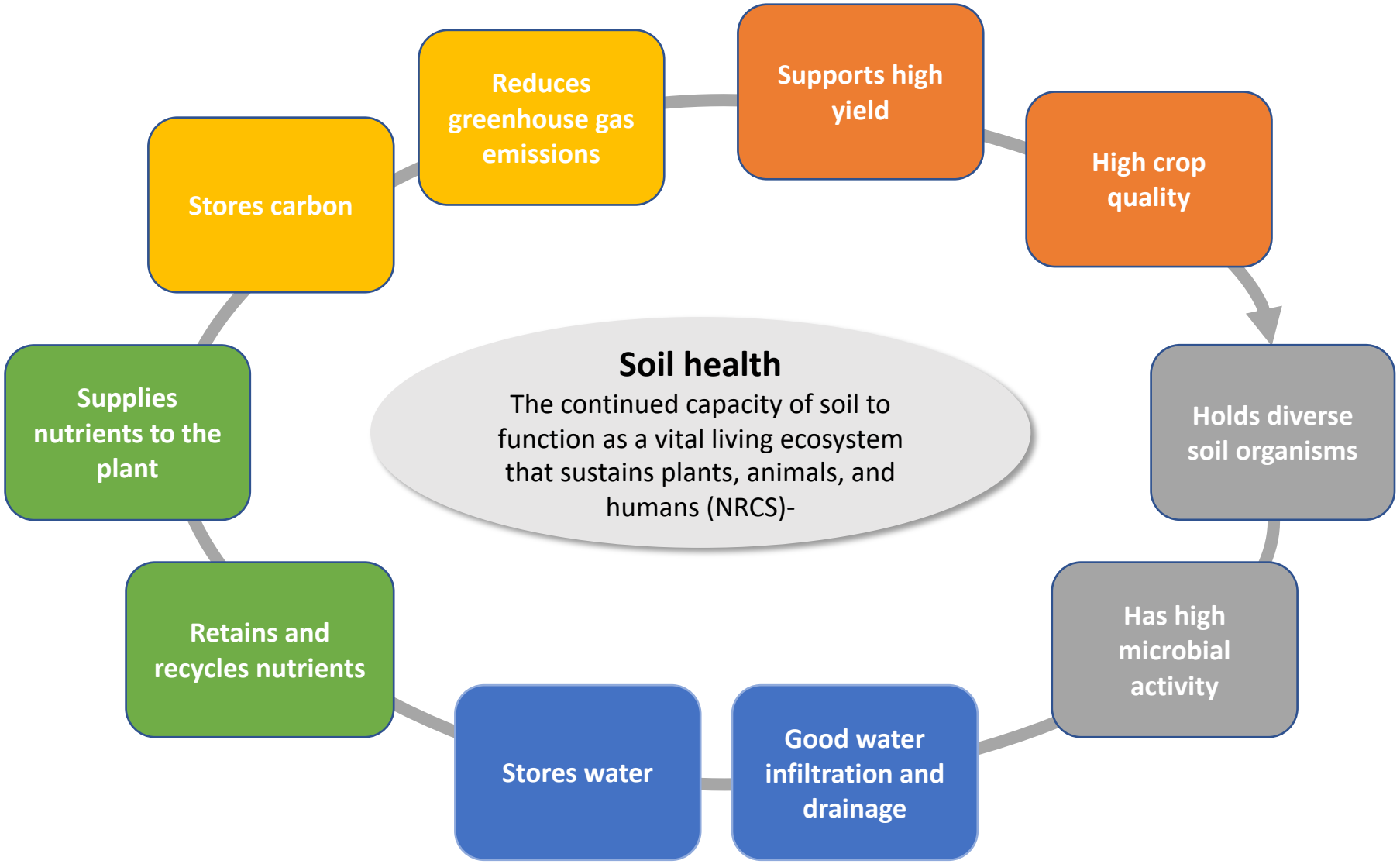
healthy soils program

Senate Bill 859

Mandatory Commercial Organics Recycling

Assembly Bill 1826

CalCAN
CALIFORNIA CLIMATE & AGRICULTURE NETWORK


Soil health
The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans (NRCS)-
Supports high yield
High crop quality
Holds diverse soil organisms
Has high microbial activity
Good water infiltration and drainage
Stores water
Retains and recycles nutrients
Supplies nutrients to the plant
Stores carbon
Reduces greenhouse gas emissions

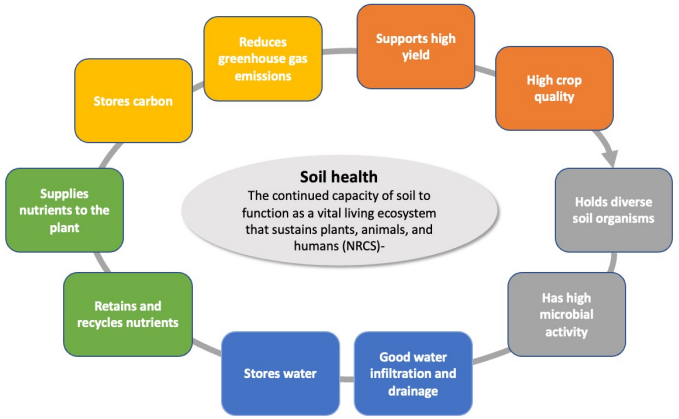
So, Does composting work?

Soil function	Goal	Indicator	Short-term	Medium-term	Long-term
Nutrient cycling	Supply	Available soil N	0% to 40%	2.1% to 7.8%	NA
		Soil P	7% to 13%	25% to 525%	NA
		Soil K	35% to 297%	26%	NA
		Soil S	7% to 186%	NA	NA
		Soil Zn	12.5% to 290%	NA	NA
		CEC	NA	NA	NA
		pH	NA	NA	NA
	Recycling and retention	N mineralization	5% to 30%	40% to 50%	50% to 60%
		P mineralization	2% to 50%	90% to 100%	90% to 100%
		K mineralization	75% to 80%	20% to 100%	NA
Soil hydraulic properties	Water retention/ infiltration	Aggregate stability	18% to 41%	0% to 63%	29% to 238%
	Water infiltration	Infiltration rate	0% to 300%	24% to 396%	339%
	Compaction	Bulk density	−2.5% to −55%	0.7% to −40%	−20.6% to −40%
	Water retention	Water holding capacity	0% to 50%	0% to 2.6%	−0.4% to 1.7%
Crop productivity	High crop yield	Crop yield	−48% to 106%	0% to 71%	10% to 27%
	High crop quality	Vitamin content	24%	NA	NA
		Phytochemicals (phenols, sinapic acid, anthocyanins)	−33% to 76%	NA	−2%
		Micronutrient content (Zn, Fe)	+ 12% to 26%	NA	NA
	Crop health	Disease incidence	−83% to 53%	NA	NA
Soil biodiversity	High microbial abundance	Microbial biomass	0% to 106%	10% to 97%	10% to 400%
	High diversity	Microbial diversity	18% to 34%	NA	3% to 4%
	High activity	Soil basal respiration	133% to 500%	29%	0% to 43%
		Enzyme activity	0% to 500%	−18% to 730%	−29% to 300%
Environmental quality	Mitigate climate change	Soil C sequestration (% of applied C)	40% to 53%	30%	2% to 16%

Lazcano *et al.* 2022

Is composting right for you?

What is your goal?



Compost application specs

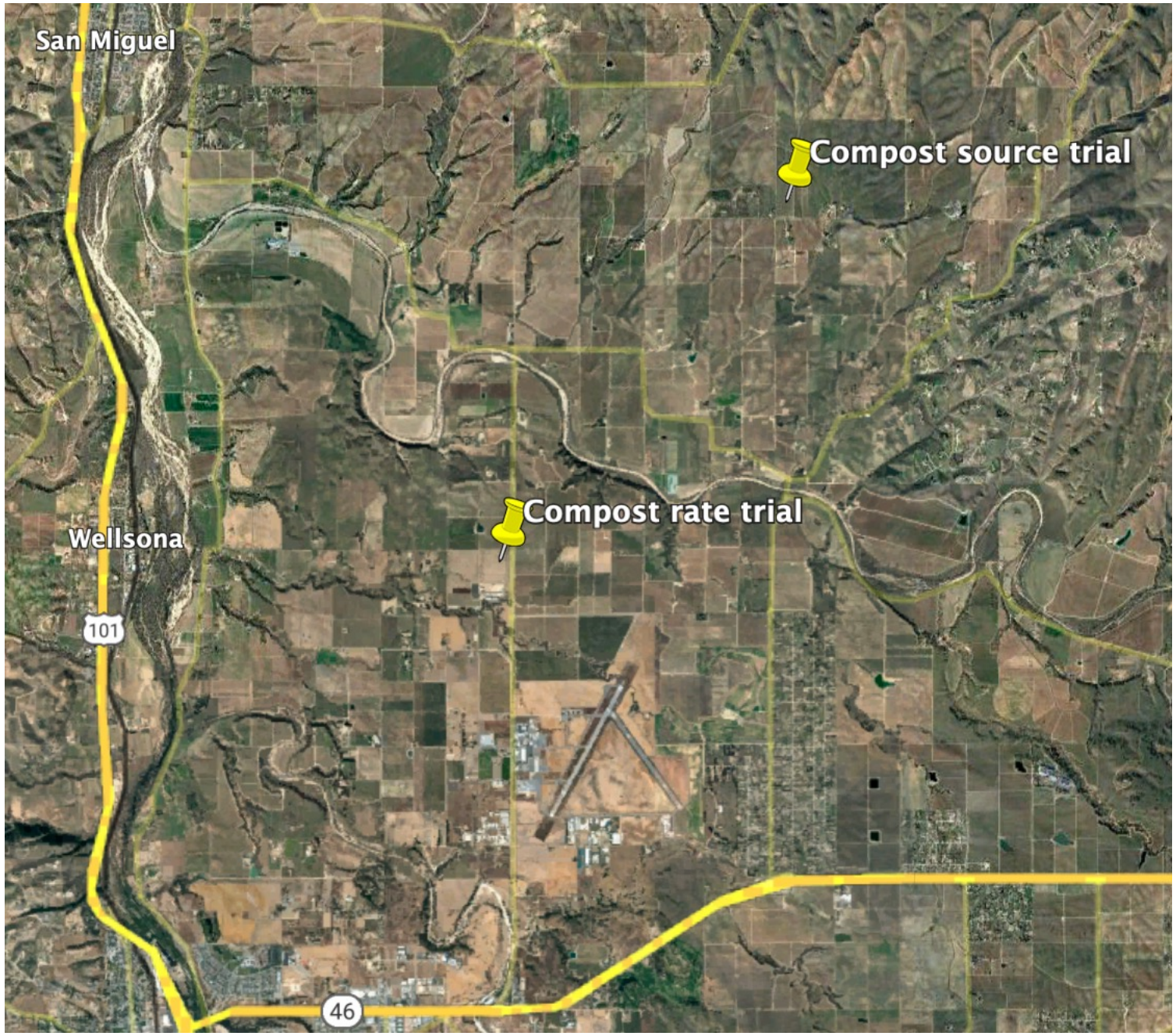
Right Place

Right Time

Right Rate

Right Source

Risk tolerance



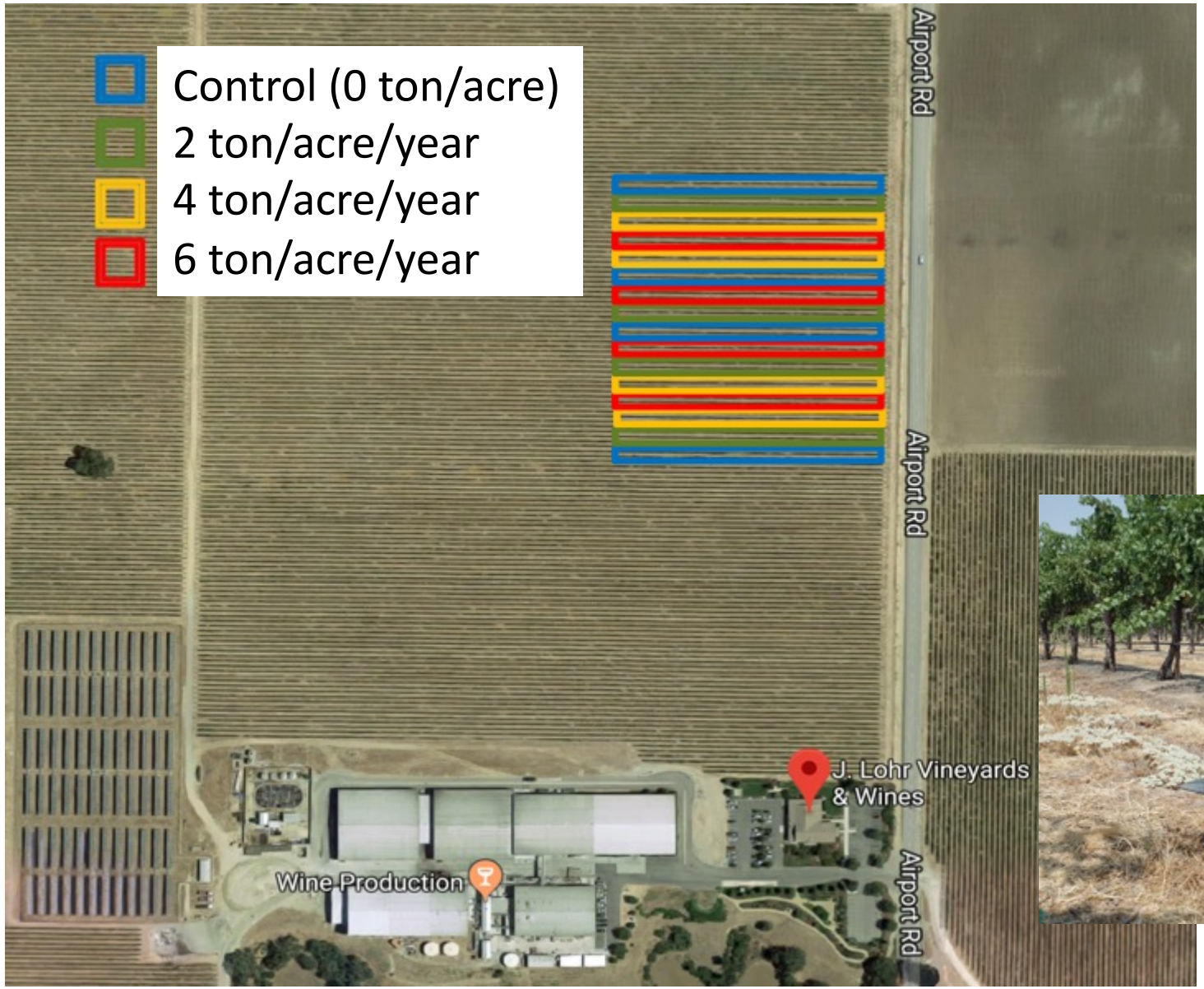
Compost source trial

- CCOF and SIP certified
- clone 3 Primitivo on 1103P rootstock
- Planted in 2013
- Arbuckle-Positas complex
- Fine sandy loam
- Treatments: No compost, dairy compost, vermicompost, vermicompost extract

Compost rate trial

- SIP certified
- clone 8 Cabernet Sauvignon on 5C rootstock
- Planted in 1989
- San Ysidro series and Arbuckle-San Ysidro complex
- Loam, fine sandy loam
- Treatments: 0, 2, 4, 6 tons dairy compost/acre

Experimental design Compost rate trial

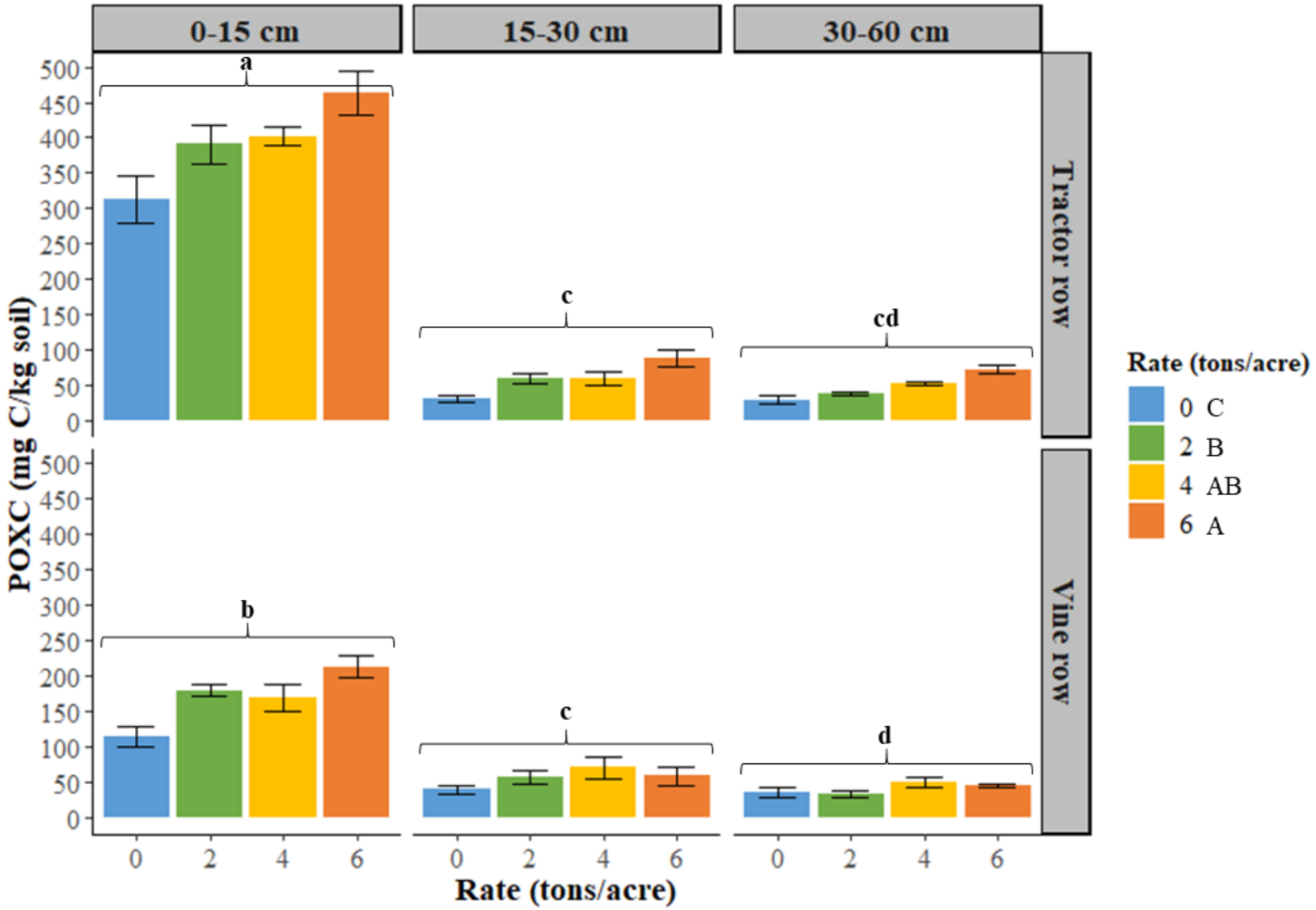


- Dairy manure compost
- C:N ratio 9-10
- Fall application
- Surface applied across entire vineyard floor
- Cover crop/no till

No effects on yield

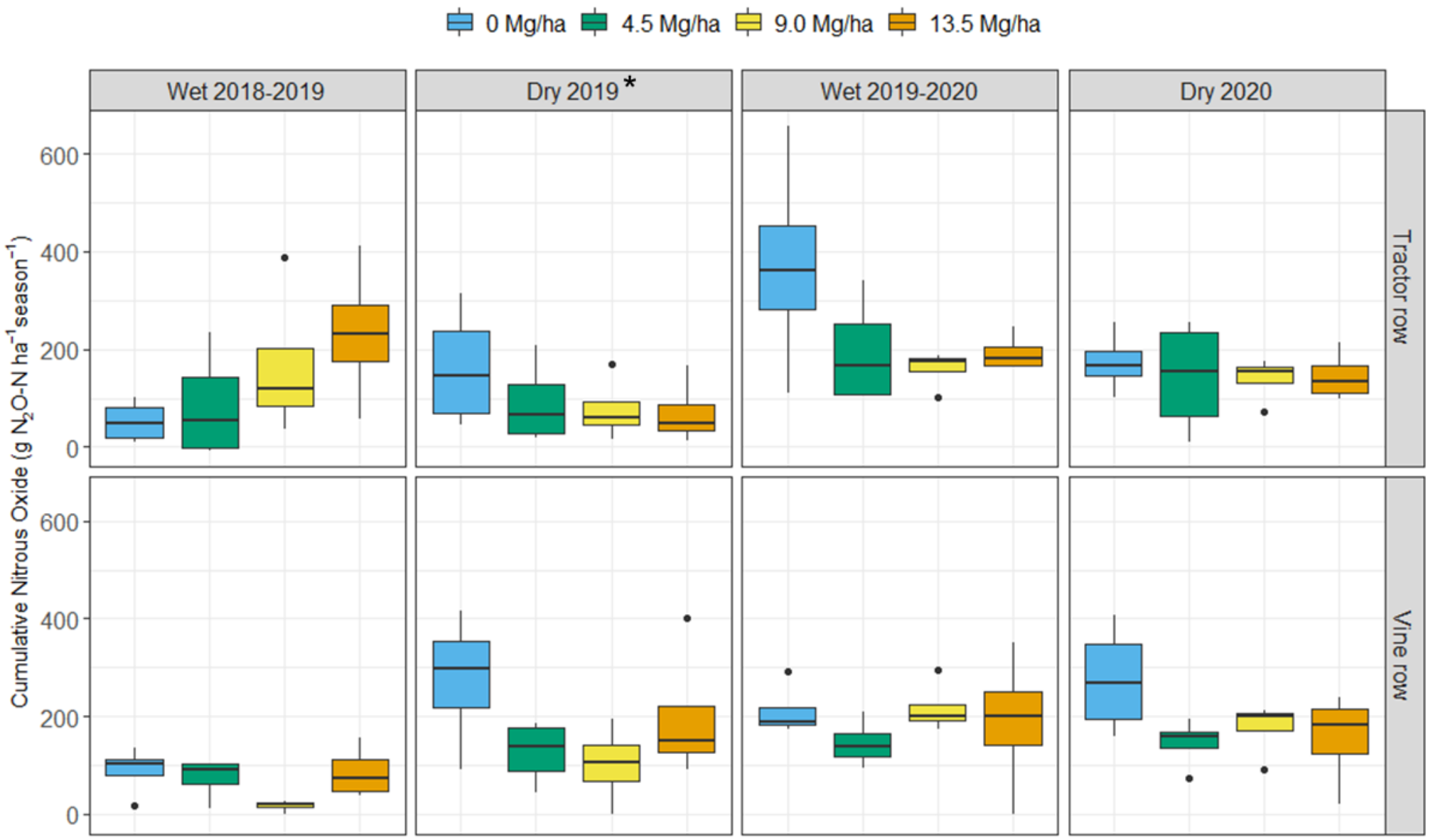
		Grape yield			
Year	Application rate (Mg ha^{-1})	Clusters per vine	Cluster weight (g/cluster)	Berry mass (g/berry)	Yield (tons ha^{-1})
2019	0	63 ± 3	91.8 ± 4.4	0.71 ± 0.02	11.5 ± 2.0
	4.5	62 ± 2	88.3 ± 2.9	0.62 ± 0.05	10.9 ± 2.4
	9.0	62 ± 2	86.9 ± 3.5	0.66 ± 0.02	10.6 ± 1.9
	13.5	61 ± 2	90.0 ± 1.8	0.66 ± 0.01	10.8 ± 2.0
2020	0	52 ± 2	69.8 ± 2.6	0.69 ± 0.03	7.3 ± 1.6
	4.5	50 ± 4	64.2 ± 1.4	0.75 ± 0.02	6.6 ± 1.9
	9.0	58 ± 6	68.7 ± 2.3	0.70 ± 0.03	8.0 ± 1.6
	13.5	54 ± 4	67.3 ± 3.3	0.68 ± 0.02	7.2 ± 2.0

Increased potential for C sequestration to 3 feet depth



- No effect of compost application on C stocks
- POX-C increases with increasing compost application rate in all depth increments
- POX-C represents a pool of active C that will likely contribute to stabilized soil organic matter

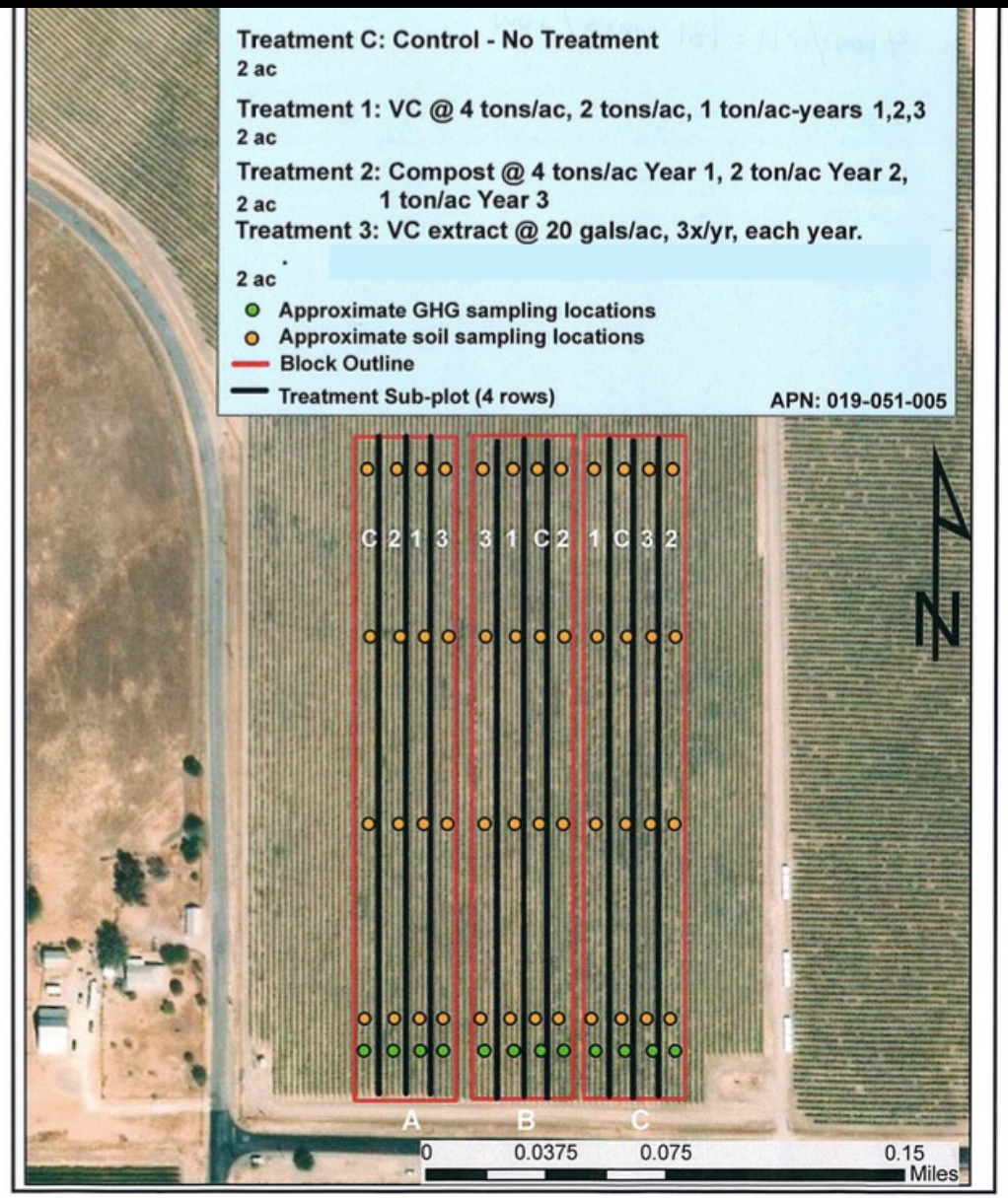
No tradeoffs with N_2O emissions



Improved aggregation in the topsoil

Depth	Application rate (Mg ha^{-1})	MWD
0 – 15 cm	0 (control)	0.40 ± 0.03BC
	4.5	0.47 ± 0.05AB
	9.0	0.48 ± 0.04A
	13.5	0.45 ± 0.04AB
15 – 30 cm	0	0.34 ± 0.01C
	4.5	0.34 ± 0.00C
	9.0	0.34 ± 0.01C
	13.5	0.35 ± 0.02C

Experimental design Compost Source trial



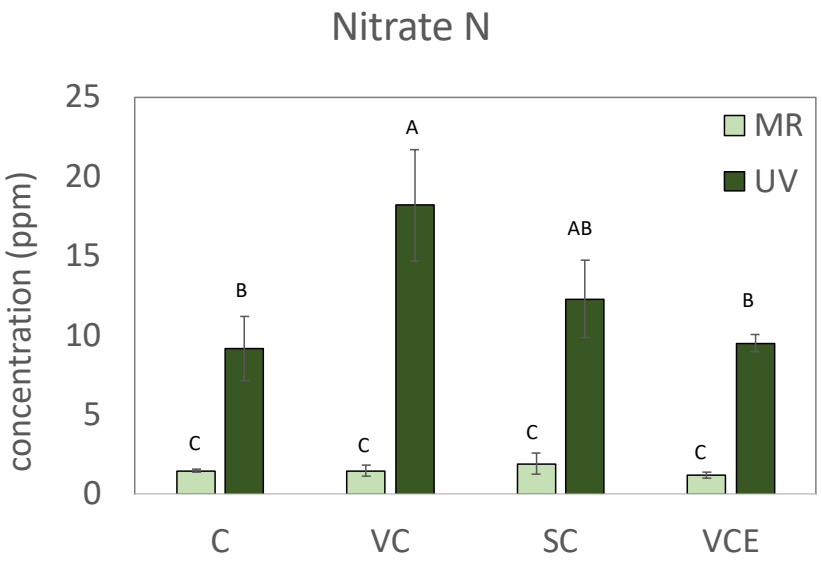
- Fall application
- Banded under the vine
- Cover crop

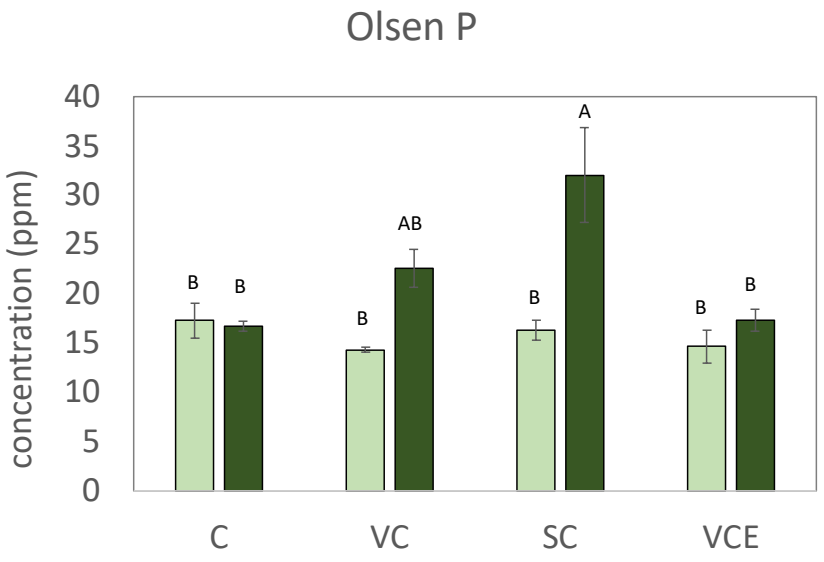
Nutrient Percentage	Vermicompost	Dairy Compost
C:N ratio	12	9.1
Organic matter (%)	67.1	30.5
Carbon (%)	29.0	14.0
Organic Nitrogen (%)	1.9	1.6
pH Value	6.95	9.18
Phosphorus (mg/kg)	3300	7100
Potassium (mg/kg)	10000	29000
Sodium (Na) (%)	0.31	0.66

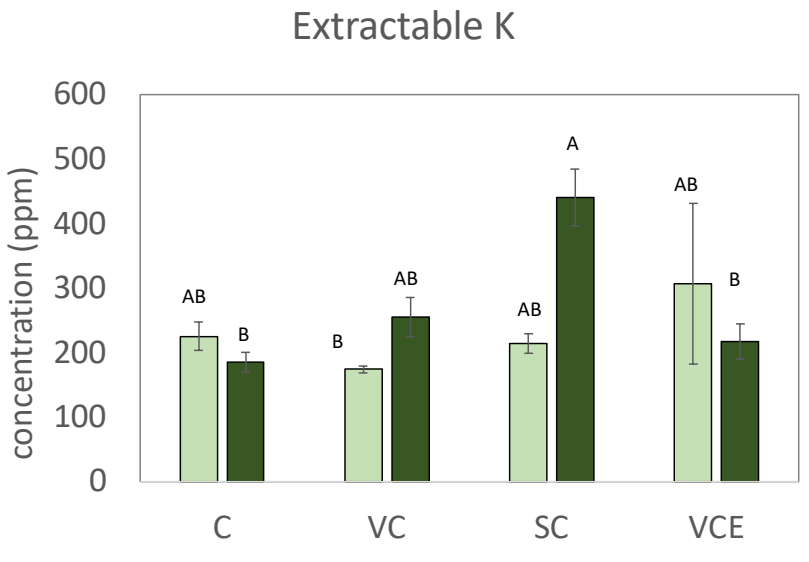
Soil responses mimic amendment chemical composition

Treatment	SOM (%)		pH (-)		
	MR	UV	MR (B)	UV (A)	
Control	1.8± 0.1 (A)	1.4± 0.0 (B)	7.3± 0.1	7.8± 0.2	ab
Vermicompost	1.6± 0.1 (AB)	1.8± 0.1 (A)	7.3± 0.1	7.6± 0.1	b
Standard Compost	1.6± 0.1 (AB)	1.5± 0.1 (AB)	7.4± 0.0	8.0± 0.0	a
Vermicompost extract	1.6± 0.1 (AB)	1.3± 0.0 (B)	7.4± 0.1	7.8± 0.1	ab

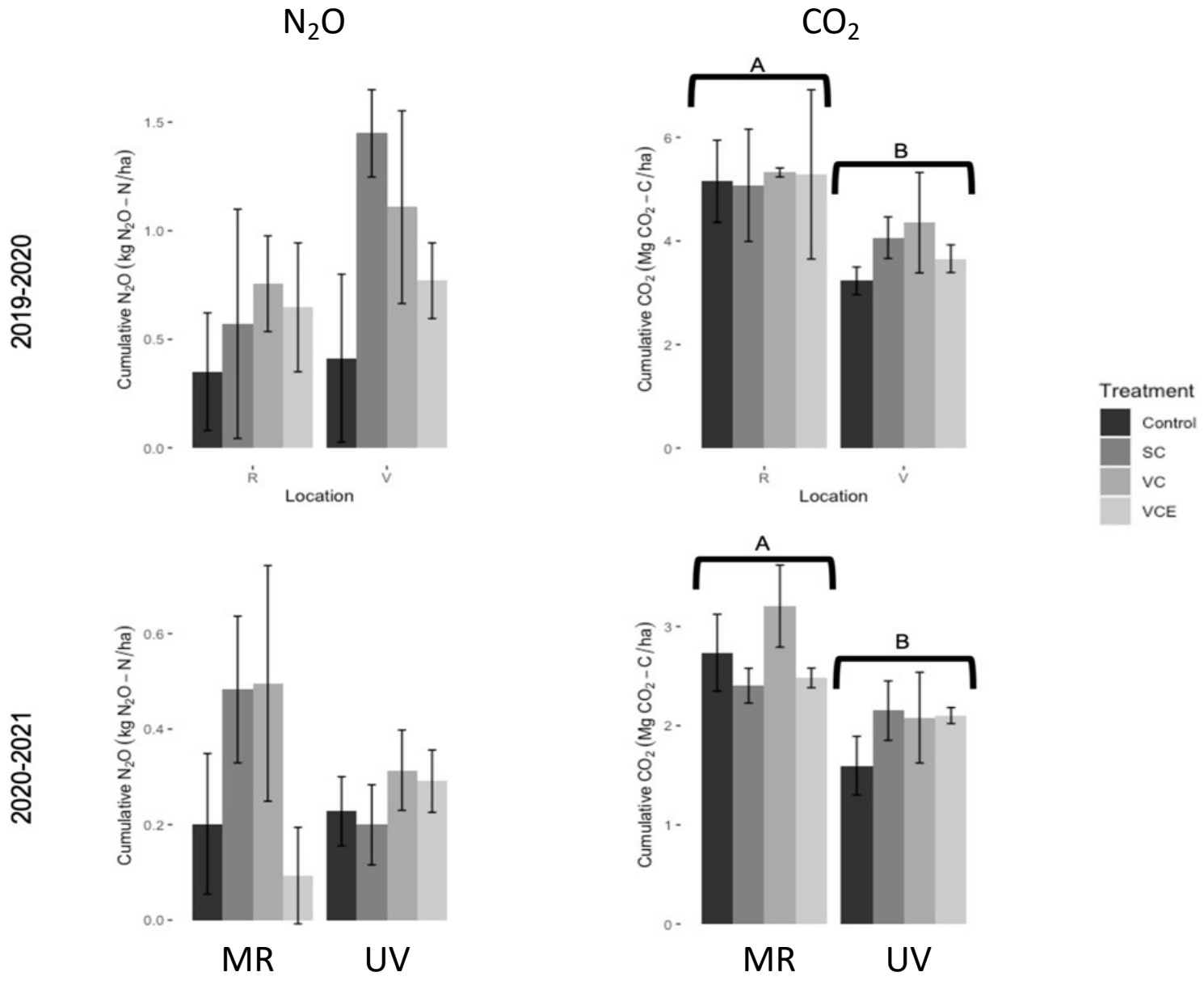
Soil responses mimic amendment chemical composition







Soil responses mimic amendment chemical composition



Take home messages

- Compost application had no impact on yield in any of the trials
- Surface applied compost can impact subsoil soil health
- Soil health benefits likely increase linearly with application rate between 2-6t/acre
- Effects on soil nutrition mimicked compost chemical composition
- There was no evidence of negative externalities in terms of N_2O
- In both trials, effects on soil health were only observed in year 2

Longer Term Impacts?

Would you like to participate in a regenerative agriculture (RA) research project?

Cal Poly SLO is looking for two types of participants:

- Growers with Pinot Noir vineyards that have adopted one or more RA practices (compost, cover crop, no-till, and livestock grazing) for 5 years or more.
- Growers with Pinot Noir vineyards that have not adopted any of these practices (compost, cover crop, no-till, and livestock grazing) for 10 years or more.

If you are interested in participating in this study, please contact Corinne Butler at cebutler@calpoly.edu or call/text at (714) 398-9193.

Photo courtesy: Jackson Family Wines

Thank You!

- CDFA Healthy Soils Program
- Research, Scholarship, and Creative Activity (RSCA)
- Upper Salinas Las Tablas Resource Conservation District
- Cal Poly Compost
- Black Diamond Compost
- Graduate students and undergraduate assistants
- Anji Perry, and J. Lohr vineyard staff
- Melissa Egger, Castoro Cellars, and Mesa Vineyard Management staff
- Dr. Cristina Lazcano, Craig Stubler, Cal Poly Center for Sustainability
- Niner Wines