SOIL SAMPLING

Certification Requirements

By

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Soil Scientist

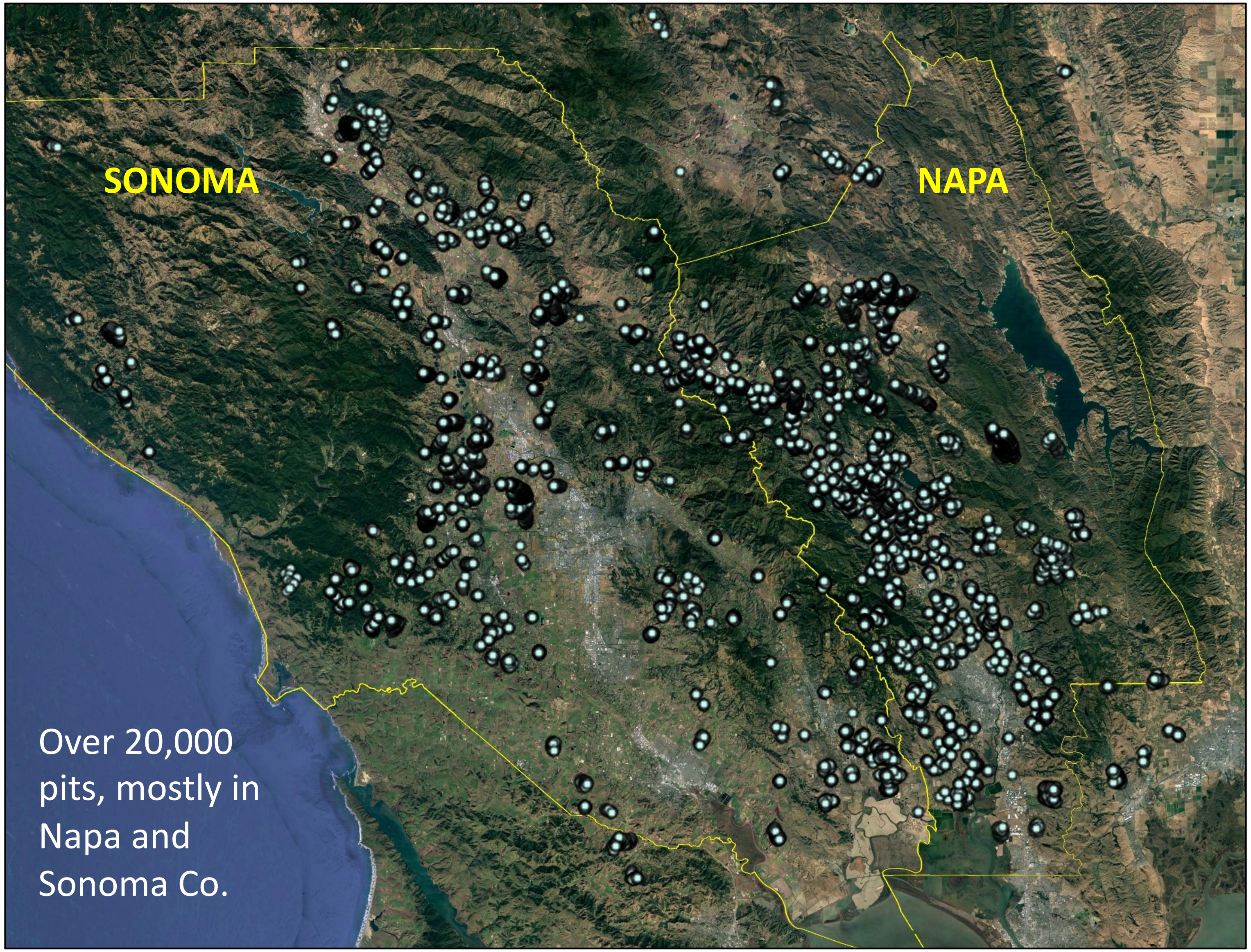
Vineyard Soil Technologies

Napa, California

Background

Vineyard Soil Technologies

We specialize in land evaluations for winegrape production, soil analysis, and vineyard design and health.



SOIL SAMPLING:

GUIDELINES FOR LAB ANALYSIS

MATERIALS

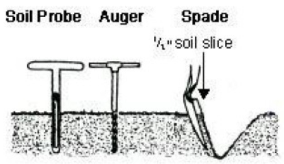
- Spade, soil auger, or hand trowel (stainless or chrome finish, marked clearly @ 6")
- 2 (+) Plastic Buckets- One labeled vinerow and one labeled alley
- Plastic Bags
- Sharpie
- Map

DETERMINING SAMPLING LOCATIONS:

- For soil samples to provide the clearest comparison over time, each years' samples should be collected from the same locations, at a similar time of year and soil condition
- All sub-sample locations should be within homogenous soil type and management history
- It is recommended to select a sub-sampling layout procedure that can be easily documented and replicated in the future- such as a grid layout, using the vineyard spacing as the guide.
- Sub-sample locations should be recorded in a replicable format- row/ vine locations noted, points on a map, flags on vines or electronically recorded with GPS or GoogleMaps
- For guidance on soil sampling locations, contact Ben@napagreen.org

SAMPLING PROCESS:

1. Establish the blocks and sublocations to be sampled beforehand
2. Collect 10-20 samples each from the vinerow and the alley
   - Undervine: avoid within 1' of drip emitters
   - Alley: avoid the wheel track in the alley
3. Gather sample either by digging a shallow hole and collecting a ½" x 2" x 6" ribbon of soil, or using a soil corer
4. Collect top 0-6 inches, removing the top debris (rocks, sod, etc)
5. Mix all 10-20 subsamples from the vinerow together and put about a pint (2 cups) in a plastic bag, clearly labeled; repeat process for alleys
6. Upon returning from the field, store samples in the refrigerator or cold room and ship within 24 hours (*Following requirements for specific lab*)



SOIL SAMPLING:

CERTIFICATION REQUIREMENTS

Soil sampling is essential to effectively and efficiently manage soil health and vine nutrition. Soil testing also establishes a baseline of Soil Organic Matter (SOM, including carbon) and other important soil health indicators, and tracks changes over time. Note that soil sampling is most effective when the soil is moist (November-April) so we recommend soil sampling in the winter/spring and sample at the same time of year each time- most growers sample in late winter, around bud-break. If it is not currently soil sampling' season', this item can be added to your Action Plan.

Integrated Nutrient Management: Soil samples should also be used to identify when and if the vines need nutrients. Growers should use both soil tests and petiole testing to help target fertilizer applications, recognizing that there can be discrepancies between soil and plant indicators. While petiole samples can provide a snapshot of vine nutrient content, soil samples can help identify systemic nutrient and pH imbalances. This larger context can help target fertilizer application, reducing material use and cost.

- When you receive your Carbon Farm Plan onsite assessment the Napa Green/RCD staff can assist with soil sampling and testing of physical parameters.
- If you are in queue for a CFP onsite assessment when you need to do soil sampling please reach out to Ben Mackie (ben@napagreen.org), Napa Green's Vineyard Program Manager, to schedule a brief call to review your block map(s) and determine the best locations for soil sampling. Once you have identified where best to sample you will need to conduct your own soil sampling for lab tests. RCD Soil Sampling Guidance, Cornell Cooperative Extension: Soil Sampling in the Vineyard.

Soil Sample Requirements: Napa Green requires each vineyard to sample three blocks (6 soil samples) within their first year in the program and every following certification period (3 years). These samples will be 3 undervine and 3 in the alleys, with each sample to be tested made up of at least 10 subsamples from a given block and soil type.

For vineyards under 10 acres or several vineyard locations of similar soil types and management, contact Ben Mackie.

	Required	Recommended
Lab Test	Organic Matter, Macronutrients, CEC, pH (Most standard tests)	Micronutrients, texture, bulk density, respiration
On-site/ Physical test		Bulk density, aggregate stability, infiltration, compaction

Overview

- Soil Sampling for Certification
    - Lab tests and On-Site/Physical tests
- Soil Sampling Protocols
    - Materials
    - Field Sampling Design
    - Sampling, storage, and shipping

Vineyard Soil Technologies

Soil Lab and Field Tests

Lab

- **Required:**
  - Soil Organic Matter
  - Macronutrients (N, P, K, Ca, Mg, S)
  - Cation Exchange Capacity
  - pH
- Recommended:
  - Micronutrients (Zn, Fe, Mn, Cu)
    - Mo, B, Ni, Cl
  - Texture
  - Bulk Density
  - Respiration

Field

- **Required:**
  - None
- Recommended:
  - Bulk Density
  - Aggregate Stability
  - Infiltration
  - Compaction

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Cornell Soil Health Lab

Ithaca, NY

- **pH and Nutrients- $30**
  - pH
  - P, K, Mg, Fe, Mn, Zn (Mod. Mehlich or Morgan Ex)
  - Organic Matter (LOI, 500°C)
- **Total Org. Carbon and Nitrogen - $30**
  - Combustion,1100°C
- **CEC - $25**
- **Texture - $25**
  - Wet sieving (sand/silt)
- **Soil Respiration - $25**
  - 4-day incubation
- **Bulk Density/Stone Content - $25**

Total per Sample: $160

WARD Laboratories, Inc.

Kearney, NE

- **Routine - $21.50**
  - pH (1:1)
  - Soluble Salts (EC; 1:1)
  - K, Ca, Mg, Na (Ammonium Acetate Ex)
  - S (Mehlich 3 Ex)
  - Zn, Fe, Mn Cu (DTPA Ex)
  - P (multiple Ex, available)
  - Sum of Cations (SEC)
  - Organic Matter (LOI, 500°C)
- **Total Org. Carbon - $15**
  - Combustion, 1100°C
- **CEC – $6.25 (?)**
- **Texture - $15**
  - Hydrometer
- **Soil Respiration - $27**
  - 24-hour CO_2 Burst
- **Bulk Density - $50**

Total per Sample: ≈ $135

Regen Ag Lab – Gain Ground

Pleasanton, NE

- **Basic - $18**
  - pH (1:1)
  - Soluble Salts (EC; 1:1)
  - K, Ca, Mg, Na (Ammonium Acetate Ex)
  - S (Mehlich 3 Ex)
  - Zn, Fe, Mn Cu (DTPA Ex)
  - P (multiple Ex, available)
  - Sum of Cations (SEC)
  - Organic Matter (LOI, 500°C)
- **Total Org. Carbon - $13.50**
  - Combustion, 1100°C
- **CEC -** NA
- **Texture - $17.50**
  - Hydrometer
- **Soil Respiration - $25**
  - 24-hour CO_2 Burst
- **Bulk Density - $10**

Total per Sample: ≈ $90

Lab Methods to Measure SOC

Using Low Organic Matter Soils to Compare Conventional Soil Organic Carbon Measurements
NC STATE UNIVERSITY
Presenter: Wayne Roper
Co-authors: Wayne Robarge, Deanna Osmond, Joshua Heitman
Department of Crop and Soil Sciences, NC State University

Loss on Ignition (LOI)

~ 10 g
soil

Ceramic crucible

Mass soil with SOM

Muffle furnace

SOC oxidation

Mass soil without SOM

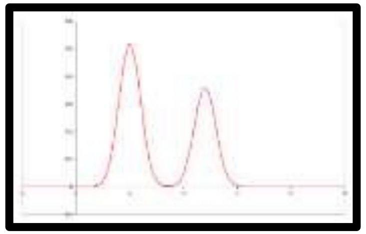
SOC Calculation

$$\frac{g\ SOM \times 0.58}{g\ soil}$$

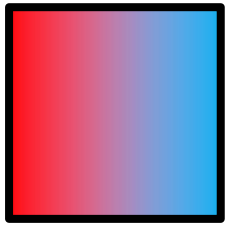
Dry Combustion (DC)

~ 0.03 g
soil

Thermal digestion
SOC oxidation



Gas chromatography



Thermal detection

SOC Calculation

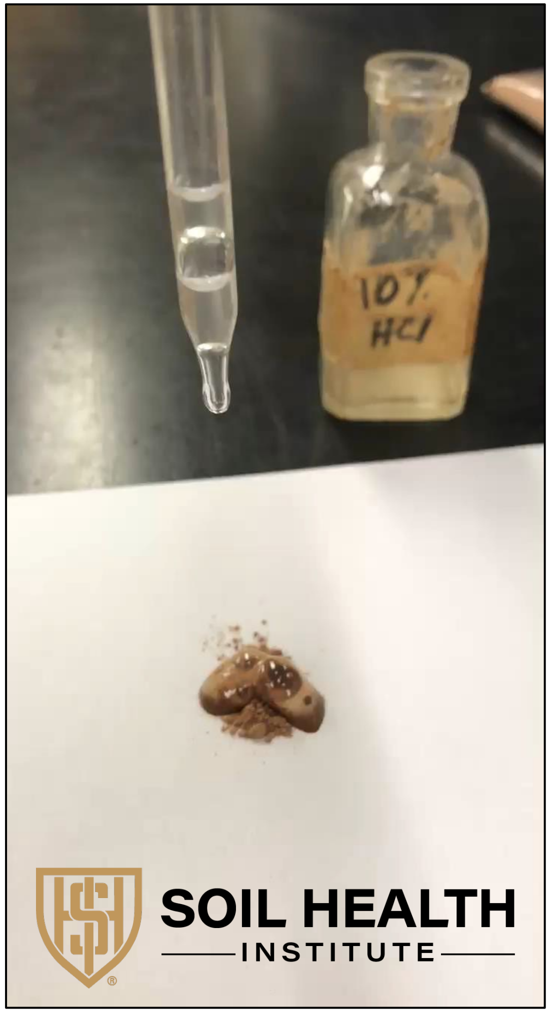
$$\frac{g\ C}{g\ soil}$$

Organic and Inorganic Carbon

Organic C = Total Soil C – Inorganic C

Inorganic C = $CaCO_3$ (calcite) + $MgCO_3$ (dolomite)

Pressure calcimeter methodology on samples with a pH > 6.5



Soil Health Assessment

PHYSICAL:

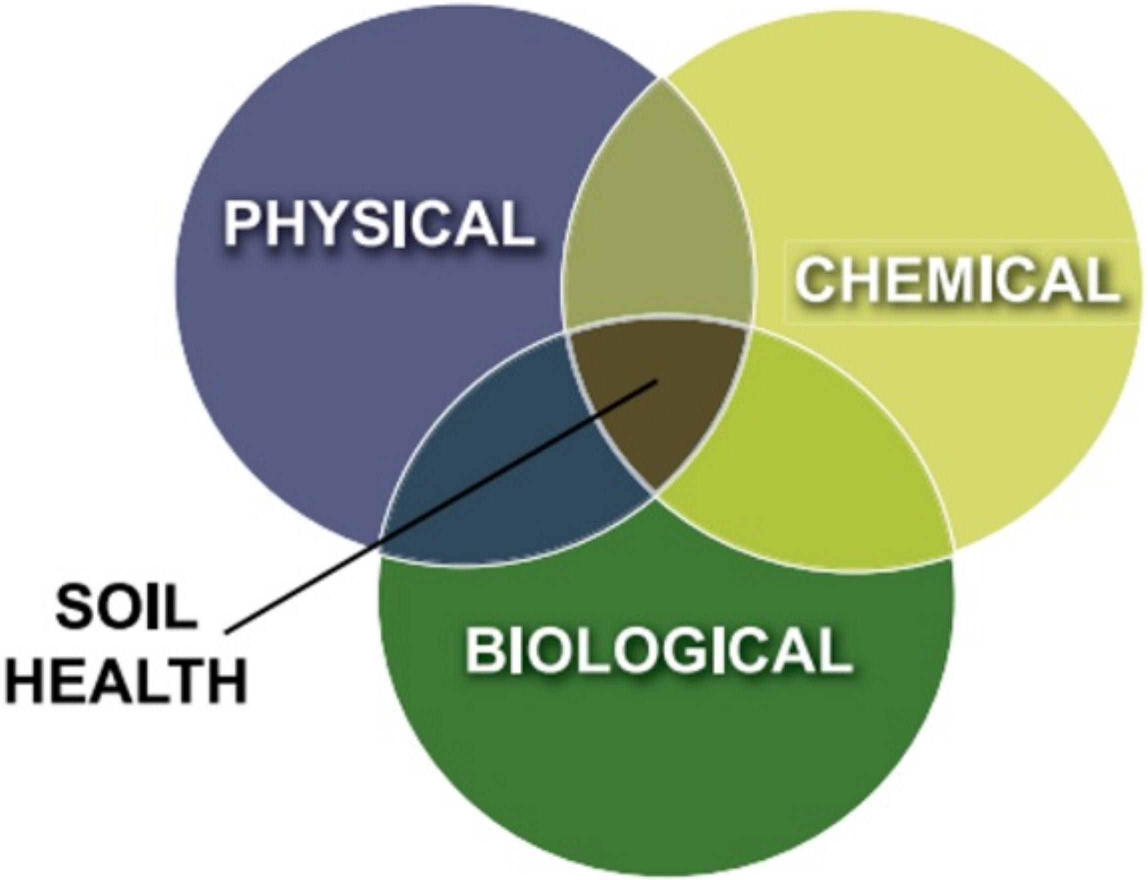
- Water Stable Aggregates (modified)

BIOLOGICAL:

- Soil Respiration 24-hour CO_2
- H_2O Extract:
  - NH_4-N, NO_3-N, Total N, Total Organic C, Total Organic N

CHEMICAL:

- Ammonium acetate extract: K, Ca, Mg, Na
- DTPA extract: Zn, Fe, Mn Cu
- Mehlich 3 extract: S
- Olsen extract: P
- Soil pH (1:1)
- EC (1:1)
- SOM (LOI)
- Sum of Cations (SEC)



Soil Health Assessment

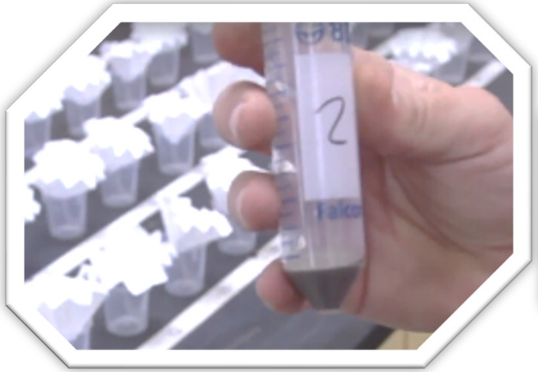
- Overall Chemical

Location	pH	EC (dS/m)	Na (ppm)	P (ppm)	K (ppm)	S (ppm)
Under Vines	6.7	0.3	19	45	365	261
Mid-Row	6.6	0.3	12	29	310	258
Uncultivated	6.8	0.2	13	19	512	57

Location	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	SEC	%Ca of SEC	%Mg of SEC
Under Vines	5	28	12	2	13	66	21
Mid-Row	3	31	13	2	13	65	22
Uncultivated	7	40	14	3	15	52	28

Soil Health Assessment

- Overall Biological



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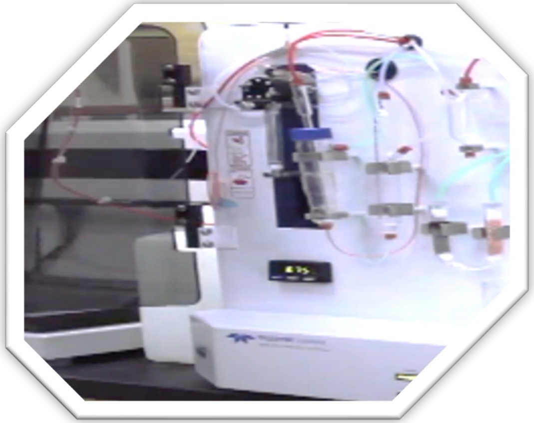


Location	SOM%	Co (ppm)	POX-C (ppm)	CO2 Respir (ppm)	SHS
Under Vines	3.0	116	715	58	9
Mid-Row	3.2	124	680	105	12
Uncultivated	5.9	290	1001	313	26

Location	NO3 (ppm)	NH4 (ppm)	No (ppm)	Total N (ppm)	No:Ni
Under Vines	22	5	6	32	0.7
Mid-Row	11	2	9	22	0.8
Uncultivated	5	3	19	27	3.2

- CO_2: Most ag soils normally below 200 ppm
- C_o: Most ag soils are 40 - 300 ppm; < 120 is low
- POX-C: medium is 500 ppm (+/- 185)

Soil Health Score = $(CO_2/10) + (C_O/50) + (N_O/10)$

Vineyard Soil Technologies

Soil Health Assessment

- Overall Physical

Location	WSA (Mod)
Under Vines	60
Mid-Row	59
Uncultivated	86

- Stable aggregates are built by biological activity, stuck together by fungal hyphae/roots and plant/microbial exudates

- Soils higher in clay and silt will form more stable aggregates
  - Clay type also influences aggregate stability (2:1 > 1:1)
  - Iron oxides/calcium carbonate also act as binding agents

Wet Sieve Procedure

0.25-2 mm diameter

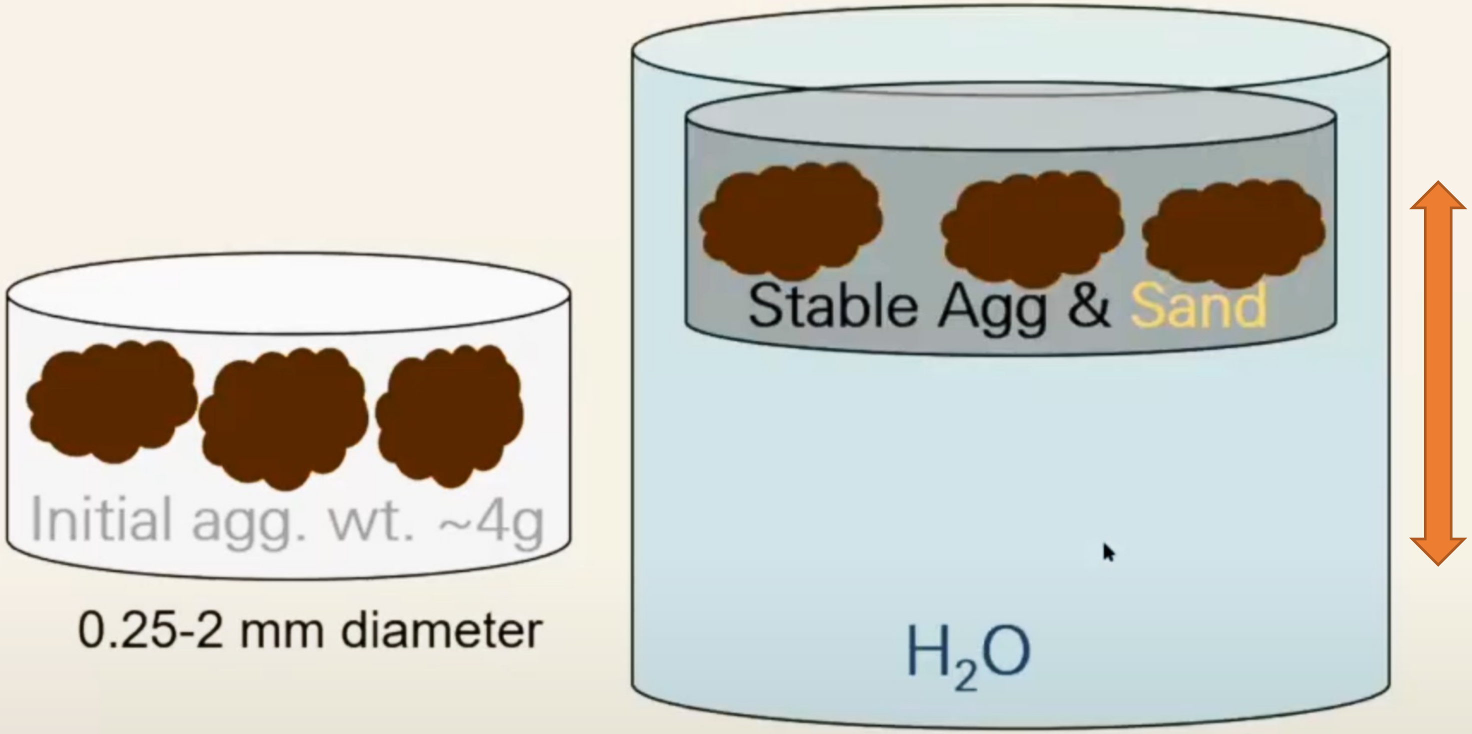
https://www.youtube.com/watch?v=RKT1r1mUinU&t=5s

SOIL HEALTH INSTITUTE

Kemper and Rosenau, 1986

Wet Sieve Procedure

1) Oscillation in water



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Wet Sieve Procedure

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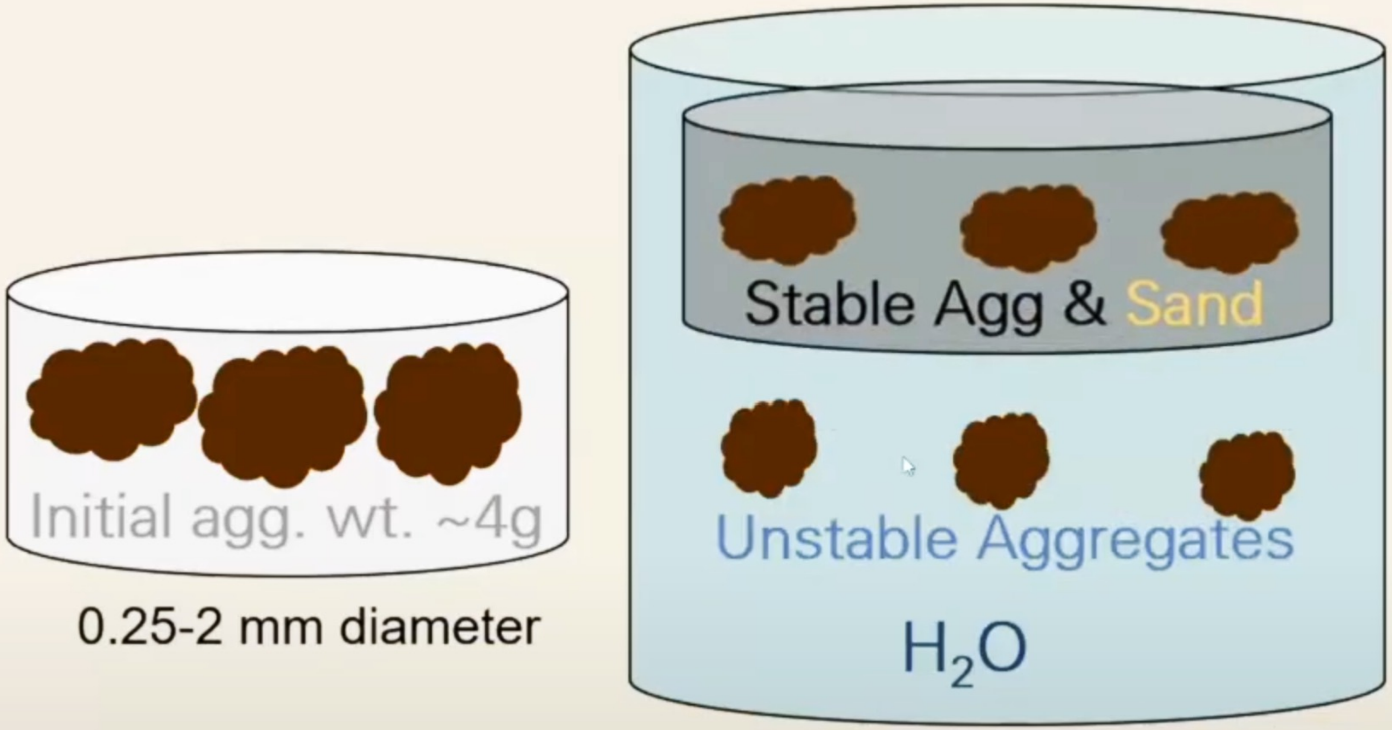

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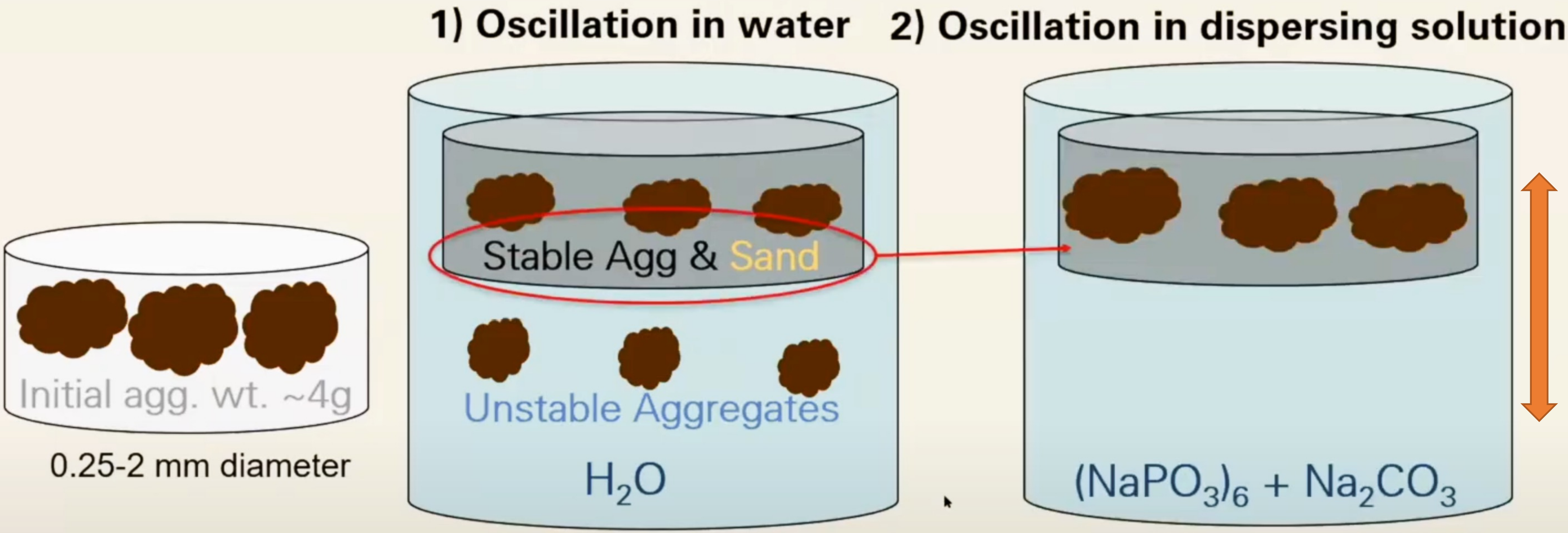
Wet Sieve Procedure



SOIL HEALTH INSTITUTE

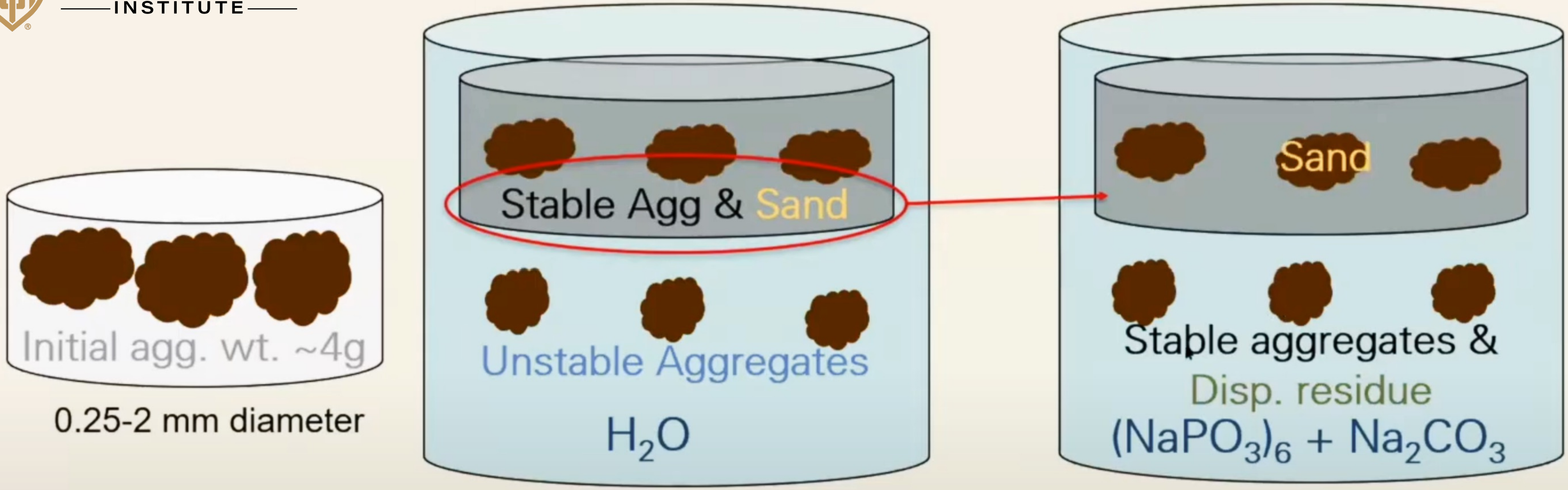
https://www.youtube.com/watch?v=RKT1r1mUinU&t=5s

Kemper and Rosenau, 1986

Wet Sieve Procedure

SOIL HEALTH INSTITUTE

1) Oscillation in water **2) Oscillation in dispersing solution**



$$\%\,\textit{water stable aggregates} = \frac{(\textit{stable agg.wt.} - \textit{disp.residue wt.})}{(\textit{unstable agg.wt.} + \textit{stable agg.wt.} - \textit{disp.residue wt.})}$$

Kemper and Rosenau, 1986

Soil Health Assessment

Chimney Rock
STAGS LEAP DISTRICT
NAPA VALLEY

- Overall Chemical

Location	pH	EC (dS/m)	Na (ppm)	P (ppm)	K (ppm)	S (ppm)
Under Vines	7.0	0.1	87	42	442	6
Mid-Row	7.0	0.1	44	22	431	6
Uncultivated	6.9	0.2	17	23	612	7

Location	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	SEC	%Ca of SEC	%Mg of SEC
Under Vines	12	46	7	1	16	60	31
Mid-Row	7	43	9	1	16	74	17
Uncultivated	20	62	10	1	19	66	25

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Soil Health Assessment

Chimney Rock
STAGS LEAP DISTRICT
NAPA VALLEY

- Overall Biological

Location	SOM%	Co (ppm)	CO2 Respir (ppm)	SHS
Under Vines	3.4	192	143	19
Mid-Row	4.1	197	231	24
Uncultivated	6.7	400	462	38

- CO_2: Most ag soils normally below 200 ppm
- C_o: Most ag soils are 40 - 300 ppm; < 120 is low

Location	NO3 (ppm)	NH4 (ppm)	No (ppm)	Total N (ppm)	No:Ni
Under Vines	2	2	16	19	4.5
Mid-Row	3	3	17	23	3.1
Uncultivated	4	4	32	40	4.0

Soil Health Score = $(CO_2/10) + (C_O/50) + (N_O/10)$

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Soil Health Assessment

Chimney Rock
STAGS LEAP DISTRICT
NAPA VALLEY

- Overall Physical

Location	WSA (Mod)
Under Vines	75
Mid-Row	68
Uncultivated	75

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Field Tests

- Bulk Density = $\dfrac{weight\ of\ oven\ dried\ soil\,(g)}{Bulk\ volume\ of\ the\ soil\ at\ a\ field\ moisture(cm^3)}$

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Clod method

Core method


Compliant cavity

https://www.youtube.com/watch?v=E7BSZrJ-TDw&t=2s

		
SOM =	2.6%	3.4%
SOC =	1.3%	1.7%
Bulk Density =	1.4 g/cm^3	1.2 g/cm^3
% Rock =	10%	20%
Carbon Stock =	**45,708 lb C/acre-ft**	**45,424 lb C/acre-ft**

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Field Tests

SOIL HEALTH ACADEMY

- Aggregate Stability
  - Slake Test
    - Measures soil stability to rapid wetting
    - Air-dried soil
    - Qualitative test

NRCS

Vineyard Soil Technologies


Liquid Carbon Pathway:
The most powerful pathway that feeds the soil.
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Technologies

After 5 min

Field Tests

- Slake Test
  - Make observations after 5 minute
  - Then raise and lower basket 5 times
  - Make observations again

Stability class	Criteria for assignment to stability class (for "Standard Characterization")
0	Soil too unstable to sample (falls through sieve).
1	**50 %** of structural integrity lost within **5 seconds** of insertion in water.
2	**50 %** of structural integrity lost **5 - 30 seconds** after insertion.
3	**50 %** of structural integrity lost **30 - 300 seconds** after insertion or **< 10 %** of soil remains on the sieve after 5 dipping cycles.
4	**10 - 25%** of soil remaining on sieve after 5 dipping cycles.
5	**25 - 75%** of soil remaining on sieve after 5 dipping cycles.
6	**75 - 100%** of soil remaining on sieve after 5 dipping cycles.

NRCS

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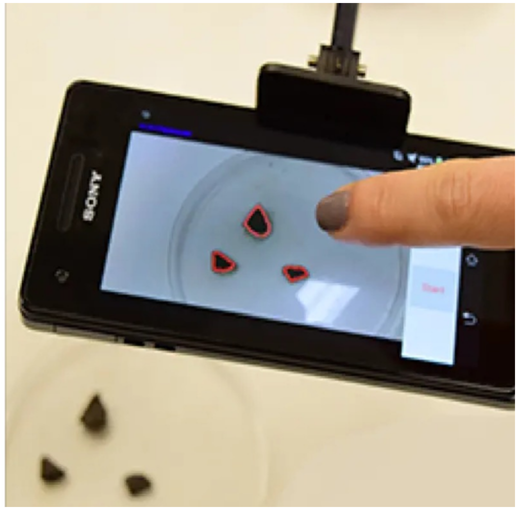
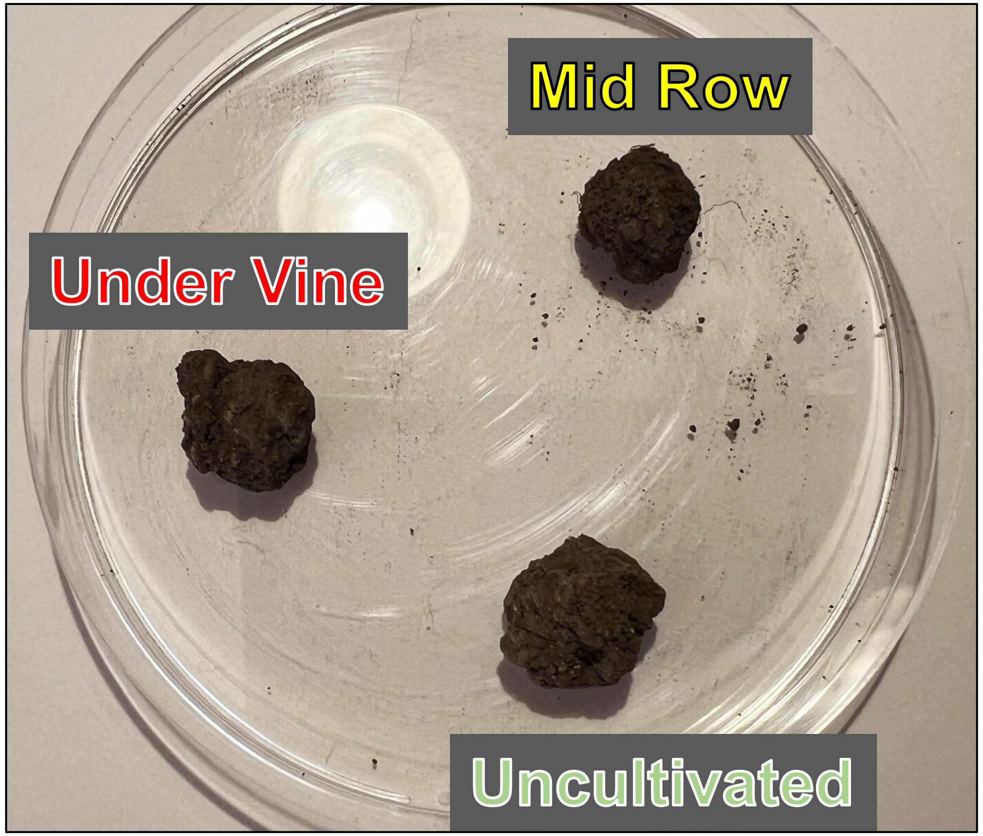
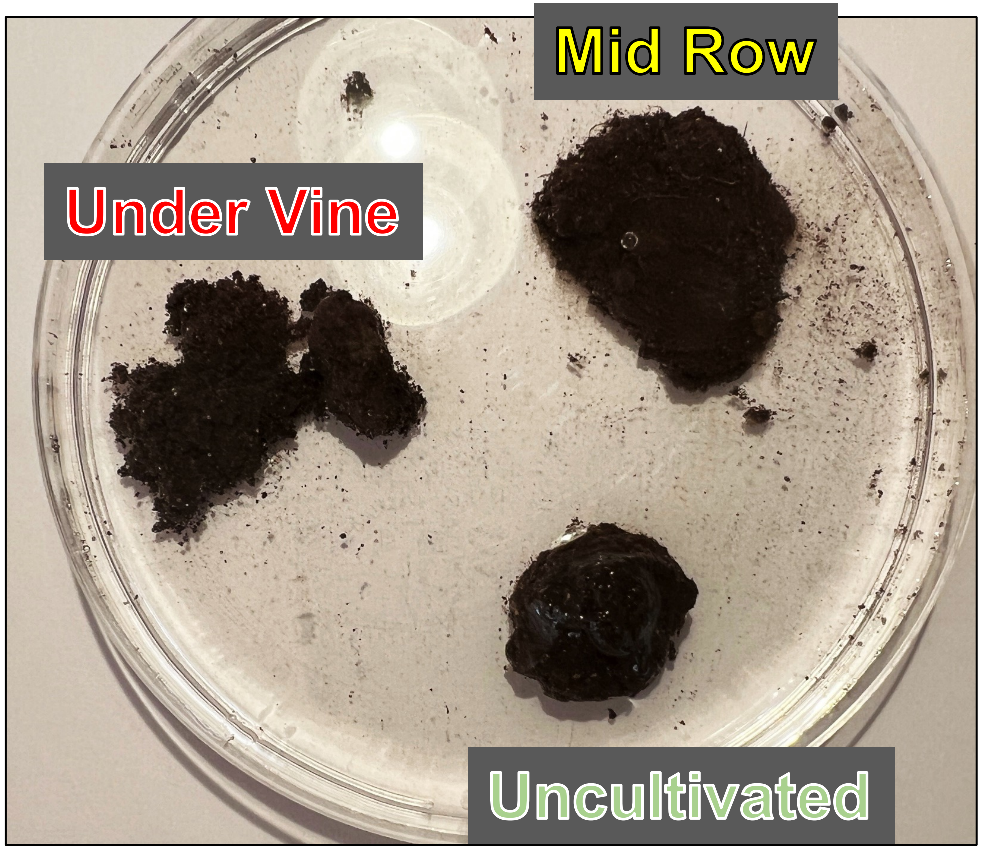
Slakes 4+
Soil aggregate stability
Mario Fajardo
Designed for iPhone
★★★★☆ 3.3 • 4 Ratings
Free

THE UNIVERSITY OF SYDNEY







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Field Tests

- Infiltration
  - Dependent on
    - Soil type
    - Pore size, amount, continuity
    - Water content

- Best determined when the soil is near field capacity

Table 3. Infiltration rates and classes.

Infiltration rate (minutes per inch)	Infiltration class
< 3	Very rapid
3 to 10	Rapid
10 to 30	Moderately rapid
30 to 100	Moderate
100 to 300	Moderately slow
300 to 1,000	Slow
1,000 to 40,000	Very slow
> 40,000	Impermeable

A Field Visit with NRCS Soil Health Specialist Jay Fuhrer

Cronin Farms, Potter County, SD

Field Tests

- Compaction
  - Surface (0 - 6”)
  - Subsurface (6 - 18”)
- Taken near field capacity
  - 2 to 3 days after free drainage
- Penetrometer
  - Cone-tip (½” tip for most soil; ¾” tip for very soft soil)
  - Metal shaft
  - Pressure gauge
- Root growth ceases for most crops: 300 psi

Vineyard Soil Technologies

> Wet Aggregate Stability > Soil Texture
> Active Carbon > Soil Respiration
> **Total Carbon & Total Nitrogen & Soil Organic Carbon** ***replaced ACE Protein 2020**
> **Surface & subsurface hardness (optional-you provide the penetrometer readings**
> *Predicted* ACE Protein (Lab test available as Add-On) *info here:* https://bit.ly/2KDTLQe
> *Predicted* Available Water Capacity (Lab test available as Add-On) *info here:* https://bit.ly/2KDTLQe

STANDARD PLUS Soil Health Package $150/sample (sample size 5 cups)
> **STANDARD Package** (above) **plus** lab measured Soil Protein "bioavailable N"

NRCS 216 Soil Health Package $165/sample (sample size 5 cups)
Recommended for: USDA-NRCS Projects, CIG Soil Health Demo Trials
> **STANDARD PLUS Package** (above) **plus** EC electrical conductivity (soluble salts)

Recommended applications: high tunnels, lawns, urban areas, composted areas, home gardens, landscaped areas

***Hot Water-soluble Boron $25/sample**
Recommended applications: small fruits, vegetables, gardens

*** Bulk Density $25/sample**
Recommended applications: A fixed-volume cylinder is repeatedly used to collect soil volumes into a separate BD sample bag. Data used to convert % carbon to tons carbon per acre

*Many of the soil analyses in the CASH packages are available as individual tests. Submission form for individual tests at:
https://soilhealthlab.cals.cornell.edu/testing-services/individual-soil-analyses/

15 **Soil penetrometer data-** record the highest number (PSI) encountered in the 0-6" and the 6-18" depth for each subsample location

	location 1		location 2		location 3		location 4		location 5		location 6		location 7		location 8		location 9		location 10	
Sample #	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"	0-6"	6-18"
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

Using a penetrometer to detect soil compaction

College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN–MADISON

UW Extension
University of Wisconsin-Extension

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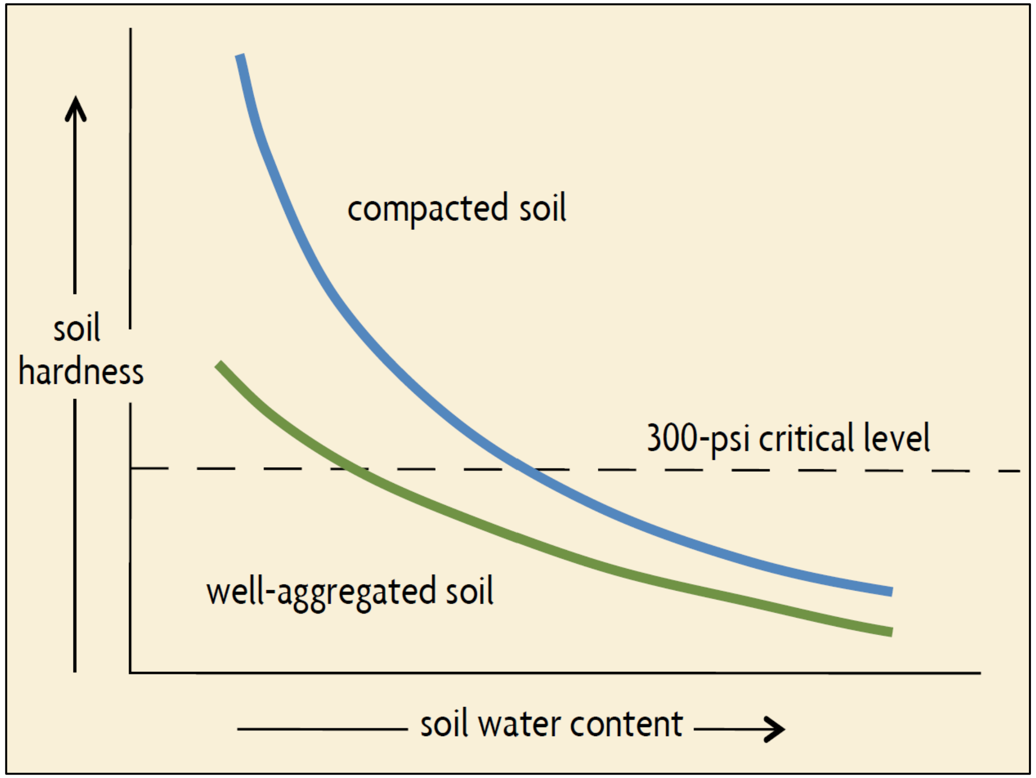
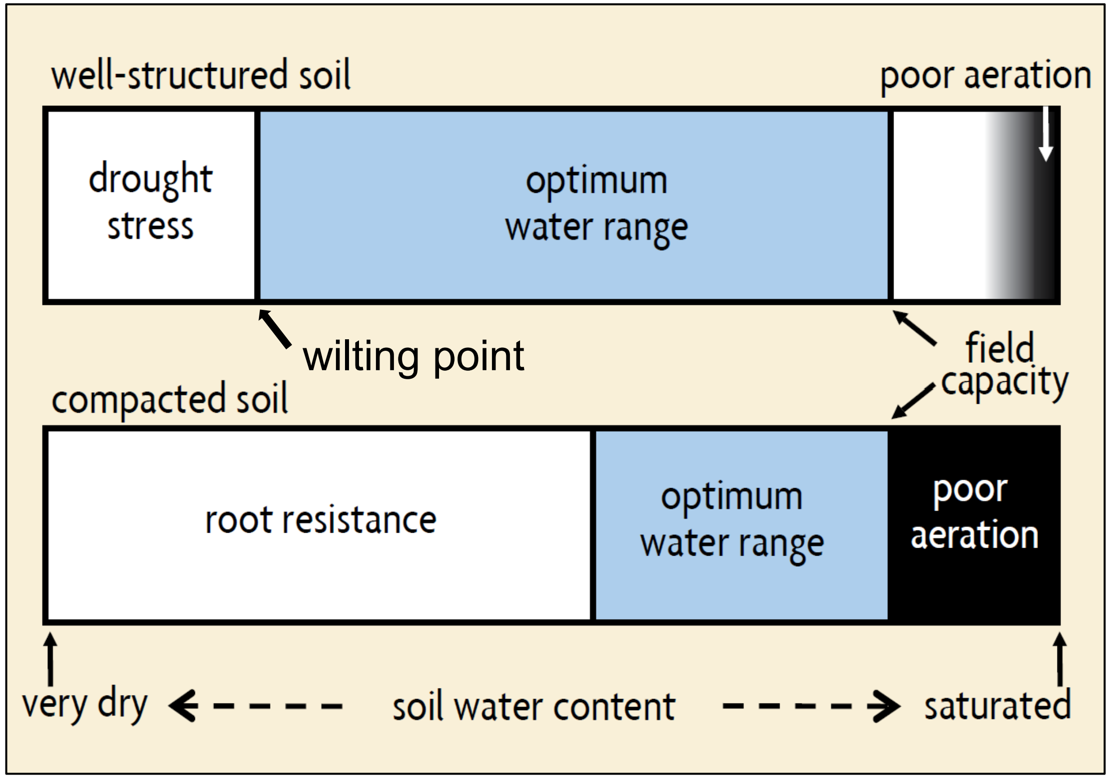
Compaction and Available Water

- Plants in compacted soils experience water stress in both wet and dry periods



Compacted soils harden more quickly upon drying than well-aggregated soils.



The optimum water range for crop growth for two different soils.


20
21
10
15
16


20
22
07
7
3
Vineyard Soil

REPORT

Plant roots sense soil compaction through restricted ethylene diffusion

BIPIN K. PANDEY, GUOQIANG HUANG, RAHUL BHOSALE, SJON HARTMAN, CRAIG J. STURROCK, LOTTIE JOSE, OLIVIER C. MARTIN, MICHAL KARADY, LAURENTIUS A. C. J. VOESENEK, [...], AND MALCOLM J. BENNETT +6 authors Authors Info & Affiliations

SCIENCE • 15 Jan 2021 • Vol 371, Issue 6526 • pp. 276-280 • DOI: 10.1126/science.abf3013

Ethylene aplenty signals soil compaction

It's tough to drive a spade through compacted soil, and plant roots seem to have the same problem when growing in compacted ground. Pandey *et al.* found that the problem is not, however, one of physical resistance but rather inhibition of growth through a signaling pathway. The volatile plant hormone ethylene will diffuse through aerated soil, but compacted soil reduces such diffusion, increasing the concentration of ethylene near root tissues. The cellular signaling cascades triggered by too much ethylene stop root growth. Therefore, gaseous diffusion serves as a readout of soil compaction for plant roots growing in search of productive nutrition.

Soil Sampling Protocols

- Materials Needed

Soil Sampling Protocols

- Field Sampling Design
  - Sampling goals
  - # of Samples
    - Three blocks
    - Samples per block
      - 1 Vinerow
      - 1 Ally
    - Each sample is made up of 10 subsamples
    - Penetrometer (Compaction)

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Soil Sampling Protocols

- Considerations
  - Collect samples from same locations, same time of year and soil condition
  - Take subsample locations within homogenous soil type/management
  - GPS locations

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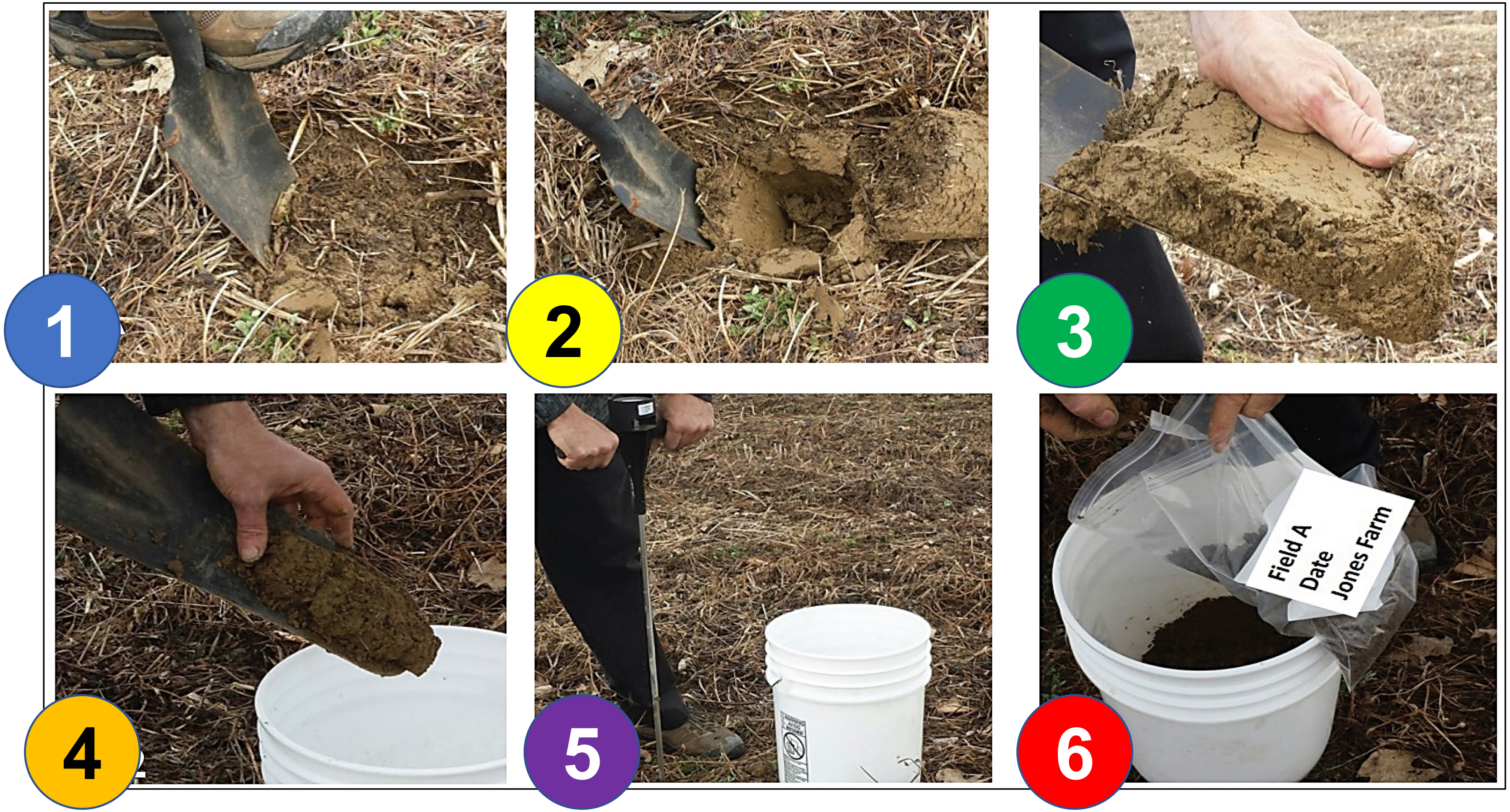
Soil Sampling Protocols



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Thank You!

Nicholaus Madden, PhD, CCA

Soil Scientist

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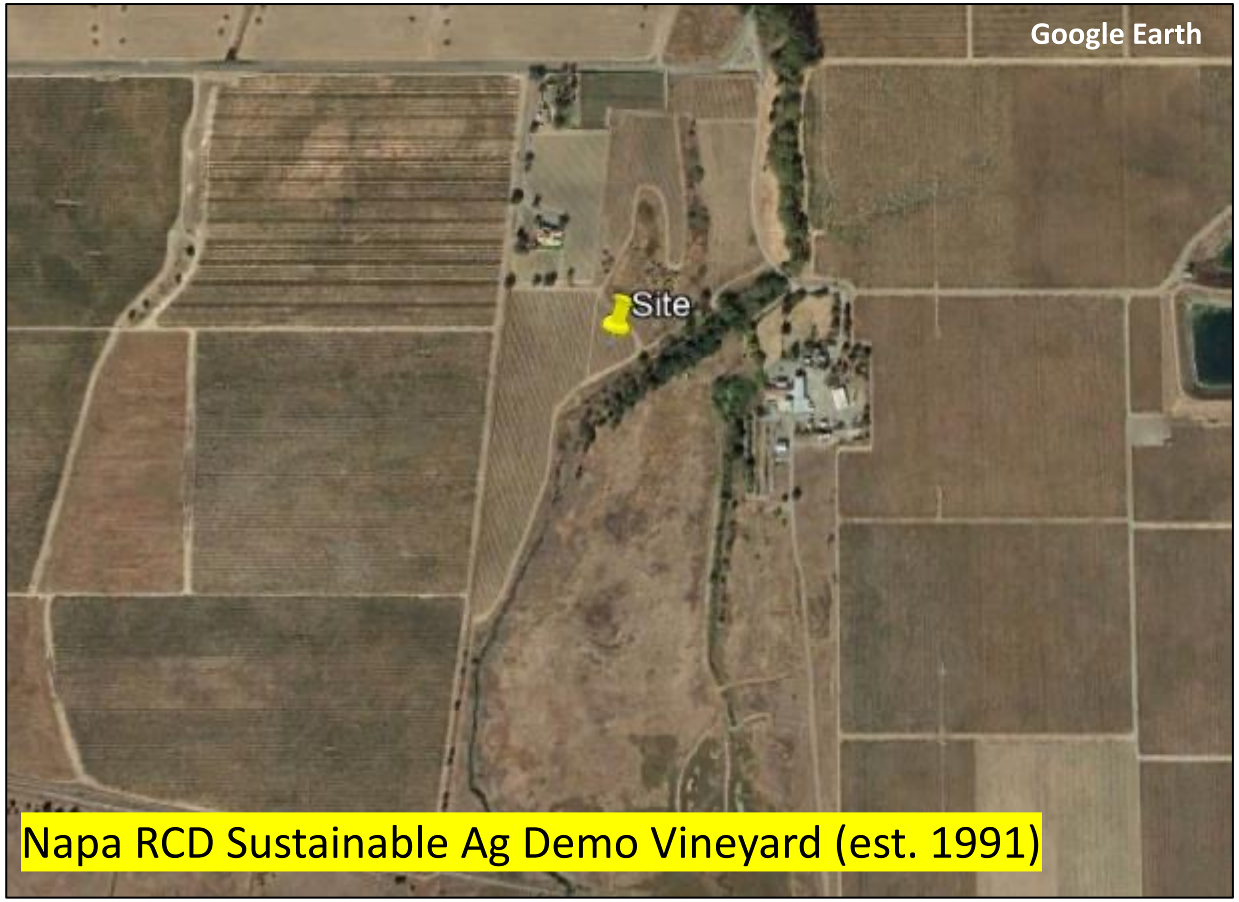
Napa, California

Effect of Long-Term Soil Management on the Mutual Interaction Among Soil Organic Matter, Microbial Activity and Aggregate Stability in a Vineyard

Belmont et. al., 2018

PEDOSPHERE



- 22-year experiment
- Haire loam; clay = 22%
- Carneros, CA (off Duhig Rd)
- Pinot Noir - 1103P
- 8 X 5 (≈ 1100 vines/acre)
- pH = 6
- Top 2 in (5 cm) sampled

- **CC + NT:** mid-row cover crop and no-tillage
- **CC + T:** mid-row cover crop and tillage
- **UV:** under-vine with no vegetation or tillage

VineyardSoil Technologies

Effect of Long-Term Soil Management on the Mutual Interaction Among Soil Organic Matter, Microbial Activity and Aggregate Stability in a Vineyard

Belmont et. al., 2018

PEDOSPHERE

Item	CC + NT	CC + T	UV
Biomass (g dry weight m^{-2})			
Shoot	195.6	147.4	4.7
Root	208.9	64.1	5.9

- Root biomass highest in S + NT; 3- and 30-fold
- Absence of tillage = supports long-term root establishment
- 404.5 g/m^2 ≈ 3600 lb/acre

Root Exudates

- Rhizosheath
  - Layer of soil particles that adheres firmly to the root surface
  - Roots exude **11 - 40%** of photosynthetically fixed carbon

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Belmont et. al., 2018

PEDOSPHERE

Item[b)]	CC + NT	CC + T	UV
TOC (g kg^{-1})	26.64	17.75	19.28
TN (g kg^{-1})	2.45	1.70	1.86
Olsen-P (mg kg^{-1})	16.38	16.30	36.68
NH_4^+-N (mg kg^{-1})	2.75	2.53	1.22
NO_3^--N (mg kg^{-1})	1.18	1.56	9.69

- In 22 years, TOC increased from ≈1.9% to 2.7%
  - 0.04% per year (?)
  - Every 1% increase = 25,000 gal H_2O/acre
- Greater importance of intact root biomass to C pools than incorporation of shoot biomass

VineyardSoil Technologies

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PEDOSPHERE

Item[b)]	CC + NT	CC + T	UV
DOC (g kg^{-1})	0.042	0.028	0.035
POM (g kg^{-1})	7.93	3.34	4.59
< 53 µm OM (g kg^{-1})	17.81	14.35	15.05
TOC (g kg^{-1})	26.64	17.75	19.28

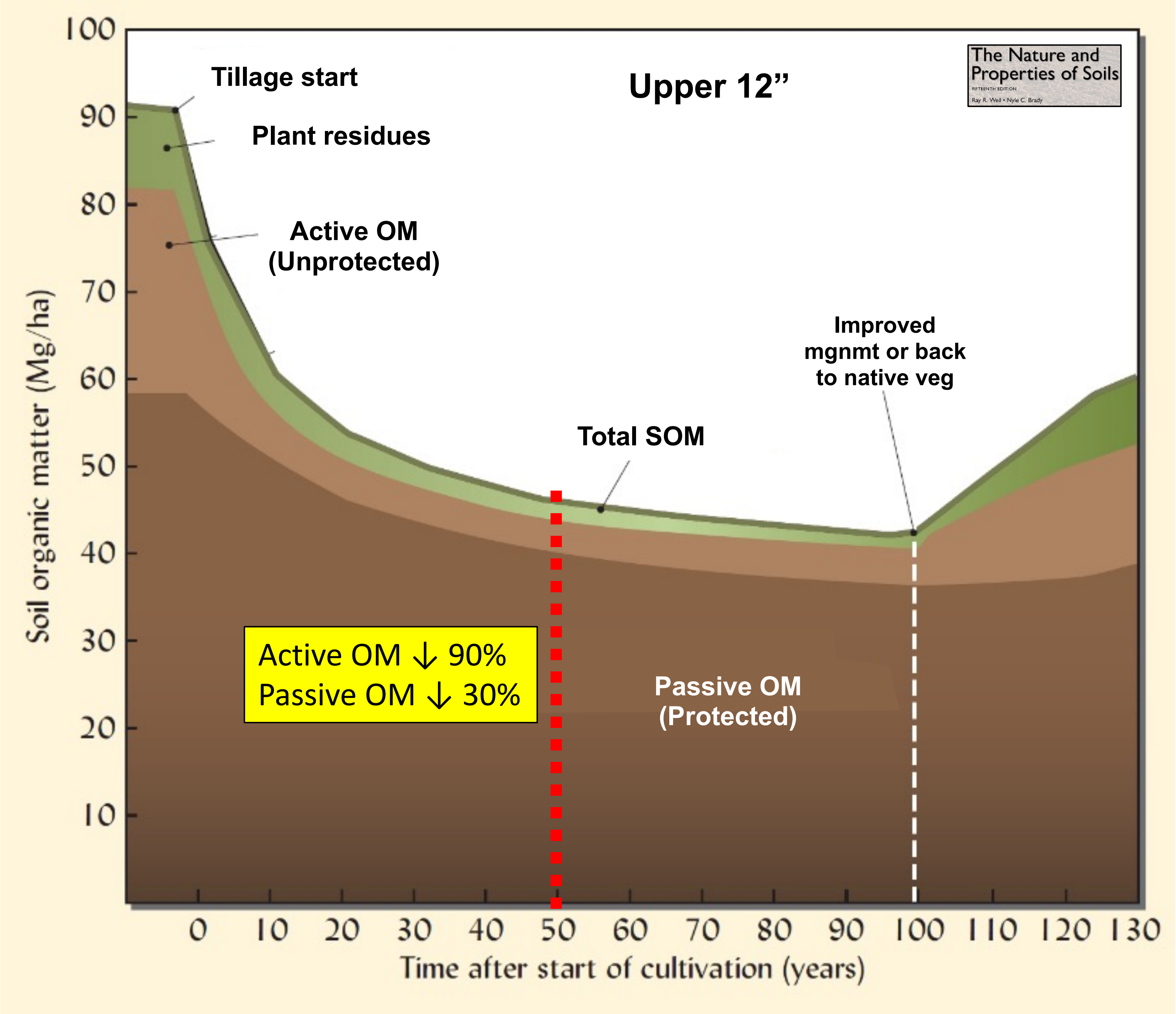
- **Active Carbon (Unprotected):**
  - **DOC**
    - Whatever passes through filter
    - < 12 month turnover
  - **POM**
    - 2000 - 53 um
    - human hair = 100 um
    - < 10 yrs turnover

Passive Carbon (Protected):

- < 53 um
- Humus
- Exists for decades
- Largest proportion SOM, 45-75%

<u>% increase after 22 yrs:</u>
Active C = 99%
Passive C = 21%

VineyardSoil Technologies



- Small changes in **Active Carbon** produces big changes:
  - Aggregate stability
  - N mineralization

Effect of Long-Term Soil Management on the Mutual Interaction Among Soil Organic Matter, Microbial Activity and Aggregate Stability in a Vineyard

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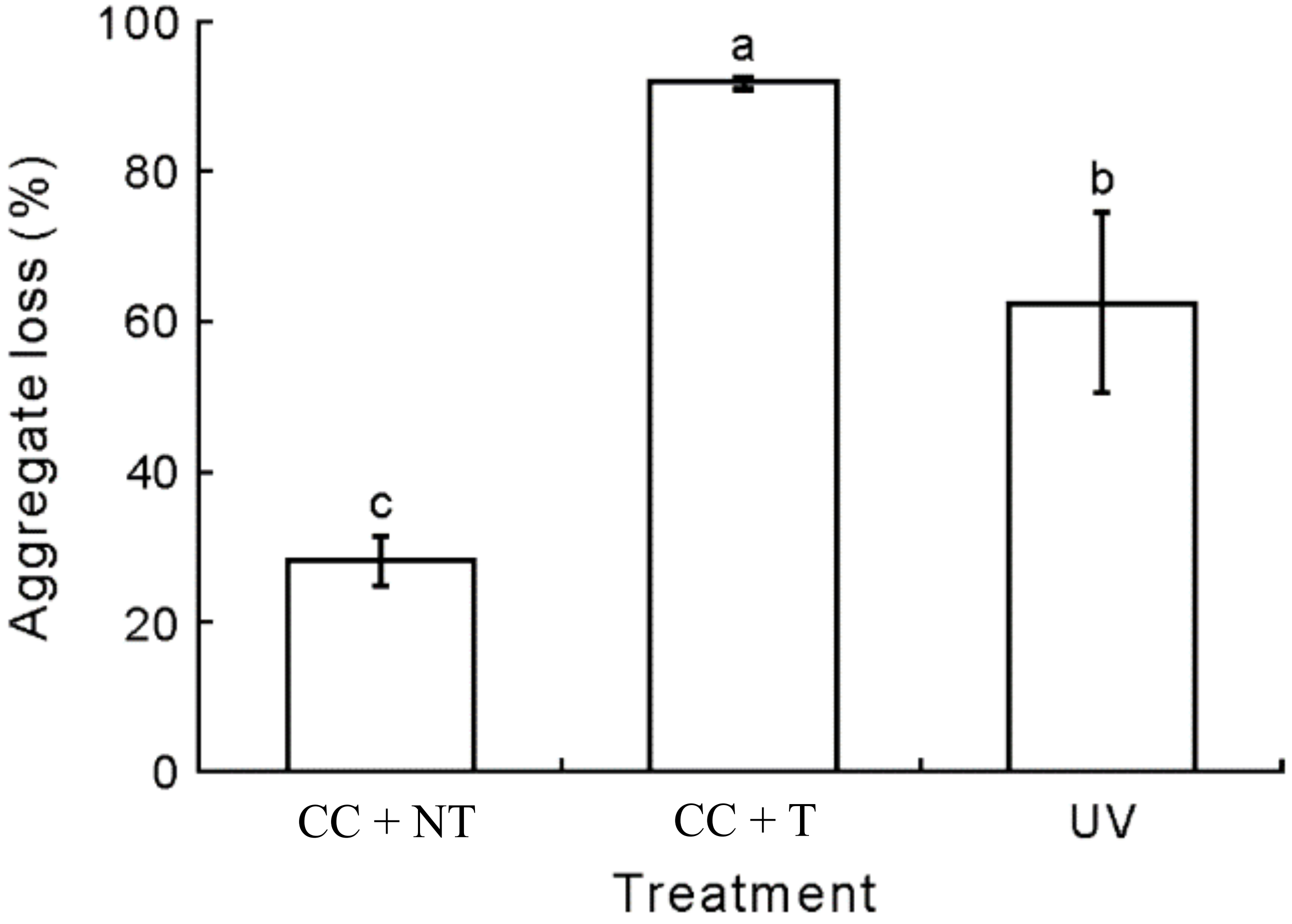
PEDOSPHERE



- Tillage = poor aggregate stability

Tips for No-Till Transition

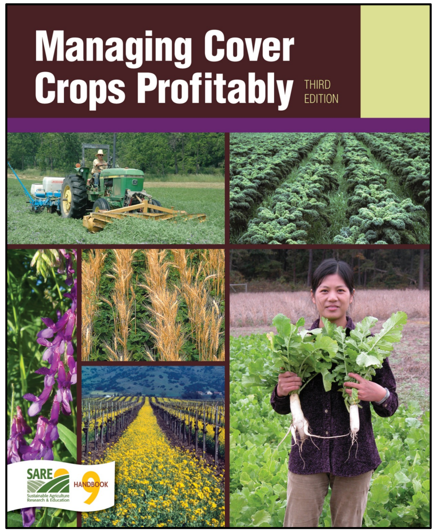
- **Leave enough residue**

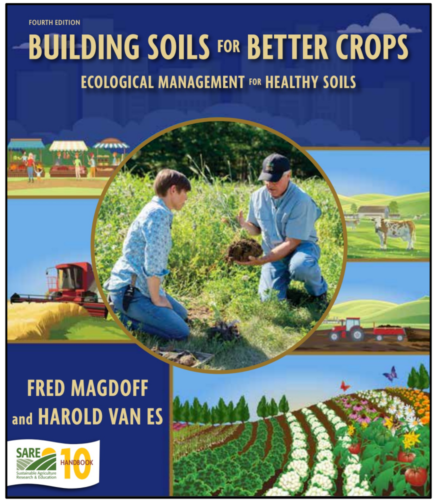
- To maintain 2.5% SOM ≈ 4 tons ac^{-1} yr^{-1}

- To maintain 3.3% SOM ≈ 5 tons ac^{-1} yr^{-1}

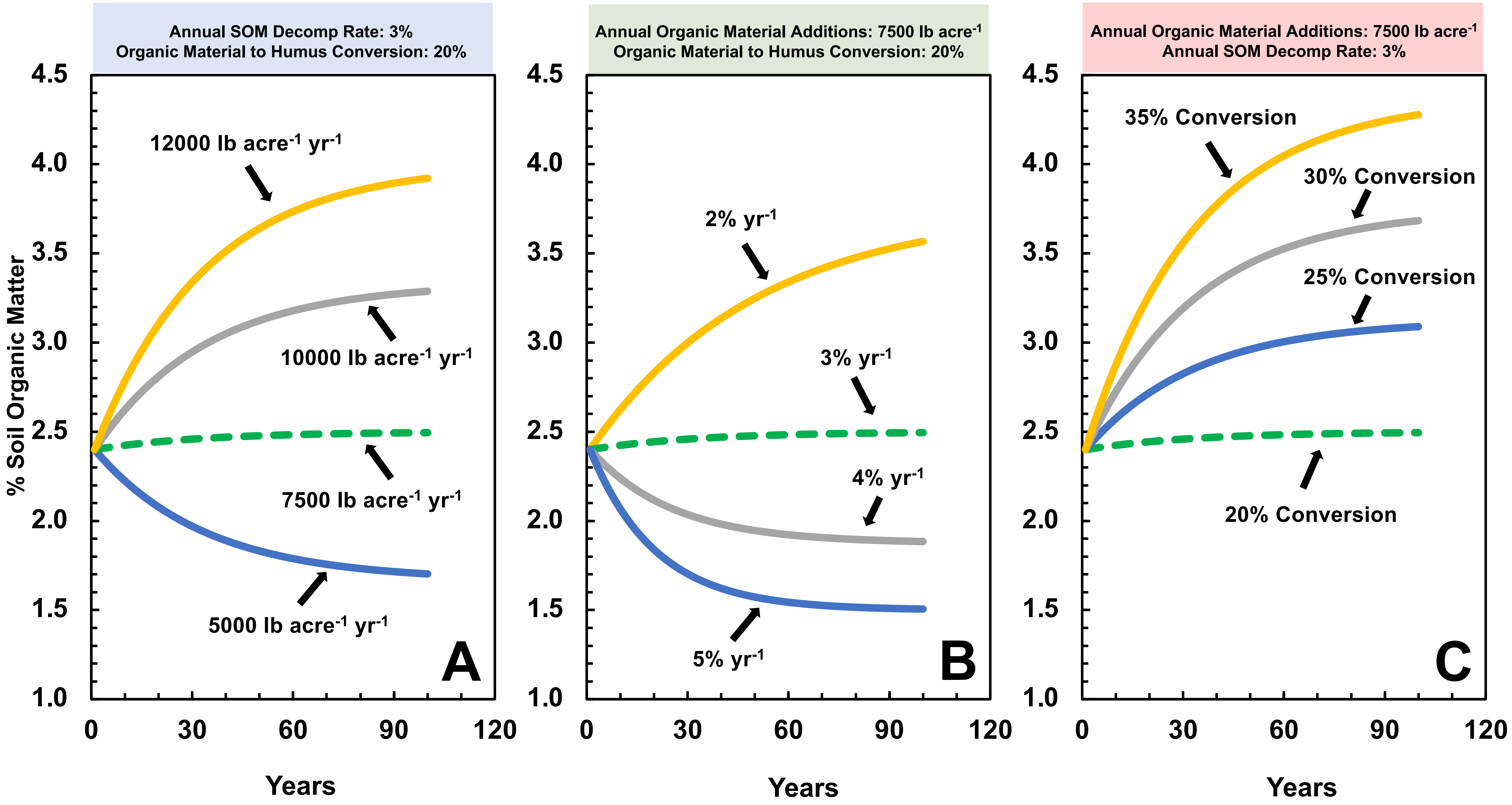
  - **Depending on texture and environment**

- In CA, 5.5 tons ac^{-1} yr^{-1} is possible w/o irrigation

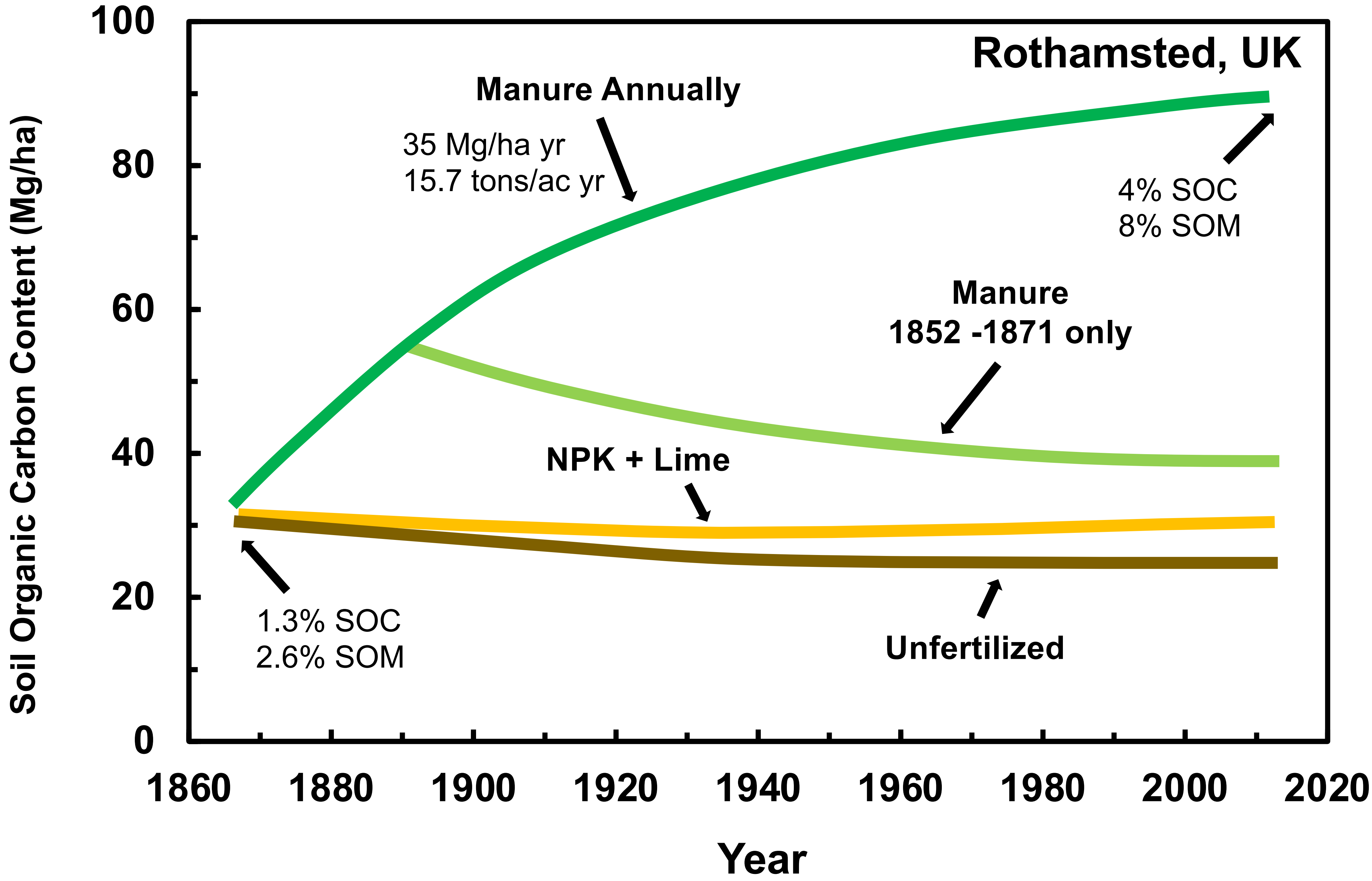




VineyardSoil Technologies



Annual SOM Decomp Rate: 3%
Organic Material to Humus Conversion: 20%
% Soil Organic Matter
12000 lb acre-1 yr-1
10000 lb acre-1 yr-1
7500 lb acre-1 yr-1
5000 lb acre-1 yr-1
A
Years
Annual Organic Material Additions: 7500 lb acre-1
Organic Material to Humus Conversion: 20%
2% yr-1
3% yr-1
4% yr-1
5% yr-1
B
Years
Annual Organic Material Additions: 7500 lb acre-1
Annual SOM Decomp Rate: 3%
35% Conversion
30% Conversion
25% Conversion
20% Conversion
C
Years



30% Remains
3% Annual
Decomp Rate

or

20% Remains
2% Annual
Decomp Rate

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.controllabs.com

Account #: 2030382-1/2-7235
Group: Mar22C #19
Reporting Date: March 30, 2022

- For 5 tons/acre of compost
  - 270 lb K/acre

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	2.1	1.2	%
Ammonia (NH_4-N):	520	290	mg/kg
Nitrate (NO_3-N):	3.6	2.0	mg/kg
Org. Nitrogen (Org.-N):	2.0	1.1	%
Phosphorus (as P_2O_5):	0.83	0.46	%
Phosphorus (P):	3600	2000	mg/kg
Potassium (as K_2O):	3.3	1.8	%
Potassium (K):	27000	15000	mg/kg
Calcium (Ca):	1.2	0.66	%
Magnesium (Mg):	0.31	0.17	%
Sulfate (SO_4-S):	280	150	mg/kg
Boron (Total B):	54	30	mg/kg
Moisture:	0	44.0	%
Sodium (Na):	0.041	0.023	%
Chloride (Cl):	0.028	0.016	%
pH Value:	NA	4.85	unit
Bulk Density :	22	39	lb/cu ft
Carbonates ($CaCO_3$):	< 0.1	< 0.1	lb/ton
Conductivity (EC5):	6.6	NA	mmhos/cm
Organic Matter:	82.1	46.0	%
Organic Carbon:	44.0	25.0	%
Ash:	17.9	10.0	%
C/N Ratio	21	21	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:	
CO2 Evolution	Respirometery
mg CO_2-C/g OM/day	2.6
mg CO_2-C/g TS/day	2.1
Stability Rating	*stable*

Maturity Indicator: Cucumber Bioassay	
Compost:Vermiculite (v:v)	1:2
Emergence (%)	100
Seedling Vigor (%)	69
Description of Plants	*fungus*

Pathogens	Results	Units	Rating
Fecal Coliform	< 7.5	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 16 Mar. 22

Physical Contaminants**	% by dry wt
Total Plastic	< 0.1
Film Plastic	< 0.1
Glass	< 0.1
Metal	< 0.1
Sharps	ND
Total	< 0.5