



Carbon Positive

Soil Health Indicators

Dan Bloomer, LandWISE

LandWISE



HAWKE'S BAY FUTURE FARMING
TE MATAU A MĀUI AHU WHENUA-HĪKINA TAIAO

LandWISE



Carbon Positive Soil Health Indicators

Dan Bloomer and Alex Dickson

LandWISE

Ministry for Primary Industries
Manatū Ahu Matua



HAWKE'S BAY
REGIONAL COUNCIL



Wattie's
KraftHeinz

 **BASF**
We create chemistry

The Science Question

- Relative to a conventional “high input/high output” intensive process crop production system, does the adoption of regenerative principles have a measurable effect on:
 1. Soil carbon stocks
 2. Soil carbon cycling
 3. Soil health
 4. Crop yield
 5. Farm economics



SOIL HEALTH

— INSTITUTE —

Soil Health Institute Announces Recommended Measurements for Evaluating Soil Health

CATEGORY: PRESS RELEASE

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For Immediate Release

Morrisville, North Carolina – Aug. 12, 2022. The Soil Health Institute (SHI) today announced its recommended measurements for assessing soil health. These recommendations answer the No. 1 question about soil health that farmers, ranchers, and their advisers have been asking since the soil health movement began.

With support from the Foundation for Food & Agriculture Research, The Samuel Roberts Noble Foundation, and General Mills, the Soil Health Institute led a 3-year, \$6.5-million project to identify effective measurements for soil health across North America. SHI partnered with over 100 scientists at 124 long-term agricultural research sites in the U.S., Canada, and Mexico where conventional management systems were compared with soil health-improving systems.

- Selecting measures
 - Minimum suite
 - Relevant
 - Practical
 - Affordable
 - Available

Soil Health Institute



- SHI recommended measures

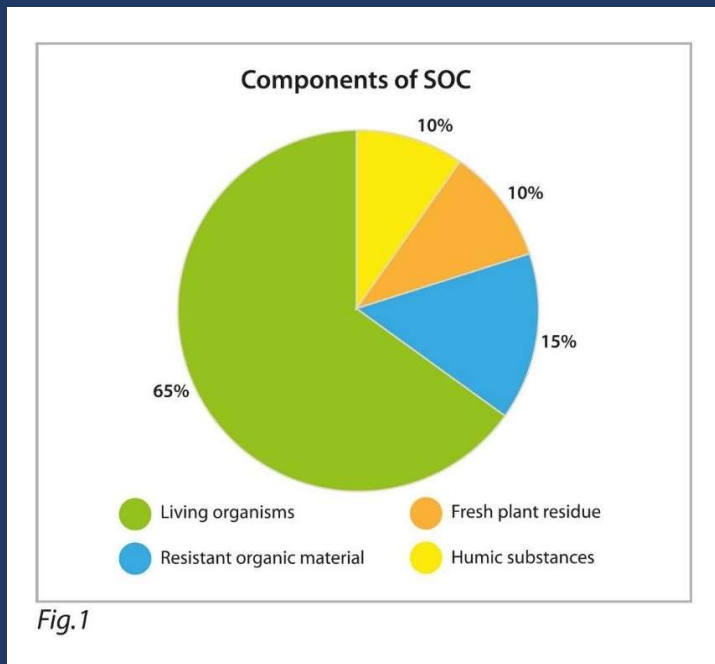
1. Soil organic carbon concentration
2. Carbon mineralization potential
3. Aggregate stability



- Carbon Positive additional measures

1. Visual Soil Assessment
2. Infiltration rate
3. Moisture release curve
4. Biological diversity (worms / eDNA)

Soil Organic Carbon Stocks



https://neutrog.com.au/2021/03/22/increasing_soil_organic_carbon/

- Not limestone
- Key component of organic matter stocks
- Influences
 - Water holding capacity
 - Nutrients
 - Biodiversity
 - Structure
 - More....
- MicroFarm soils non-calcareous:
 - Soil organic carbon = Soil carbon

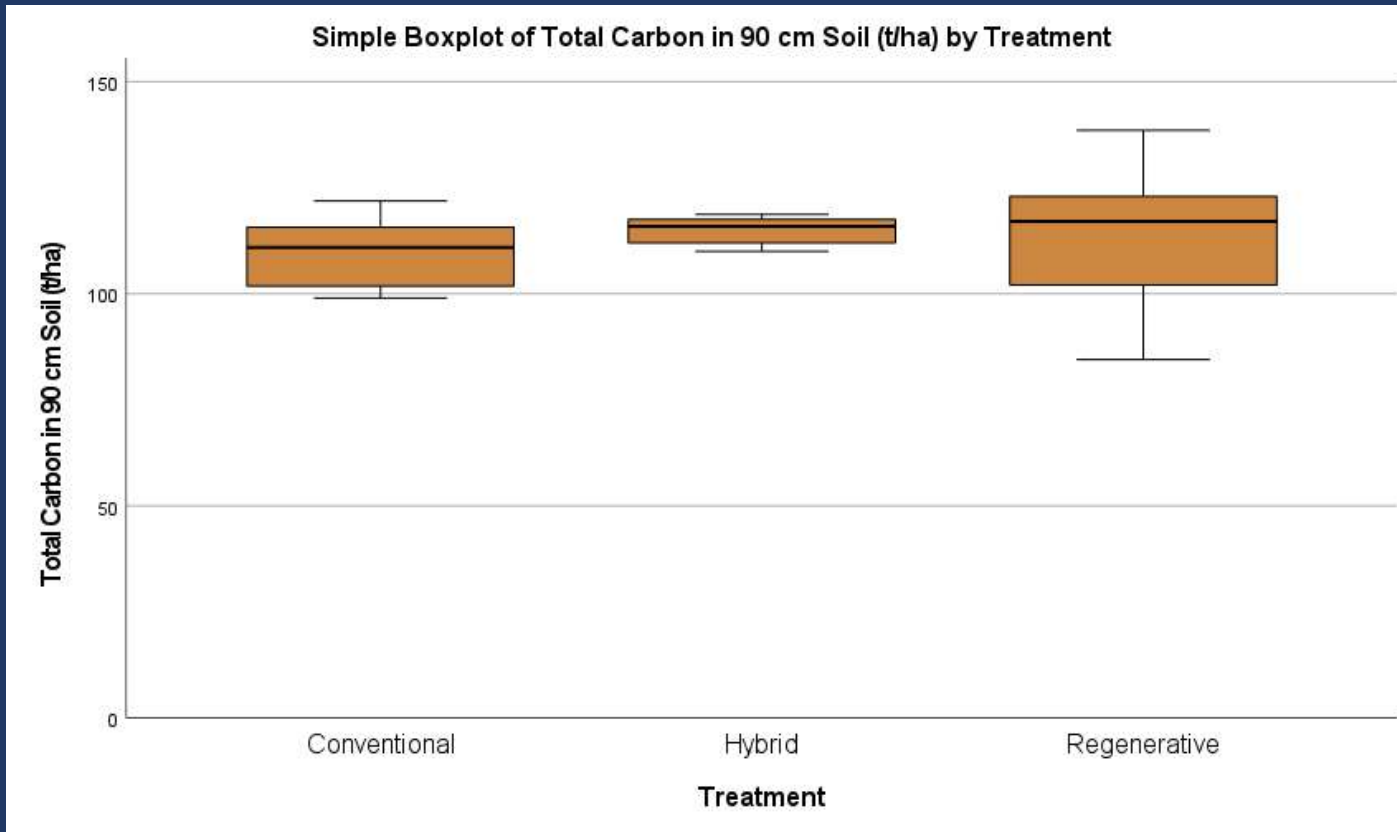
Soil Organic Carbon Stocks



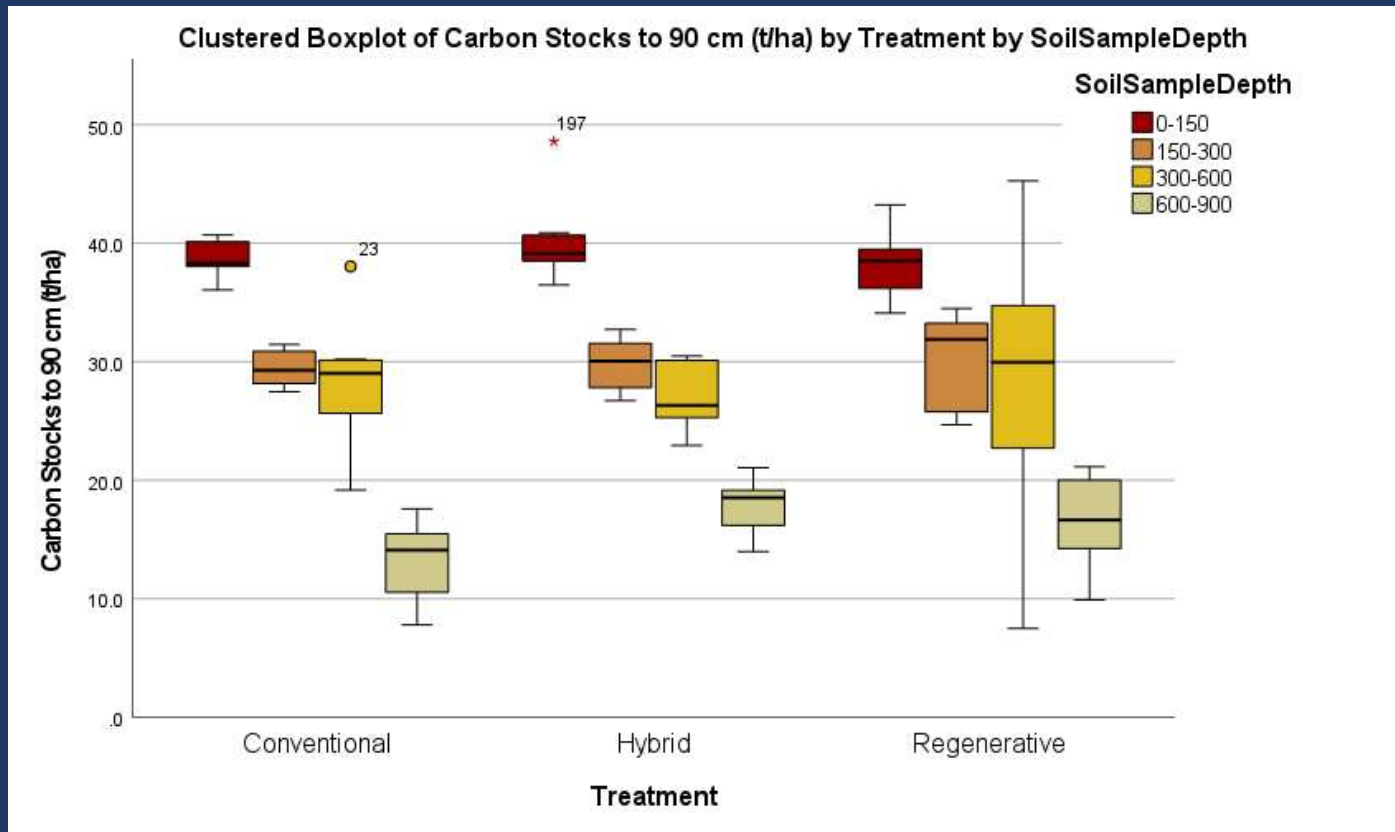
- Variable across landscape
- Need many sample points
- Measure
 - Year 1 - 96 cores, 4 depths (0-15, 15-30, 30-60, 60-90 cm)
 - Total soil carbon (lab measurement - Dumas combustion)
 - Soil bulk density (dry mass/volume)
- Repeat Years 3 and 6
 - (96 samples per treatment?)



Soil Organic Carbon Stocks



Soil Organic Carbon Stocks



Changing Soil Organic Carbon Stocks

- Increase C by 1% = 60 t/ha in top 30 cm

Add compost

- 1 ha soil 30 cm deep weighs ~ 3,600 tonnes
- 10 t OM @ 60% carbon increases SOC by 0.12%
- 80% carbon released = 0.024 % increase

- Very hard to measure small changes

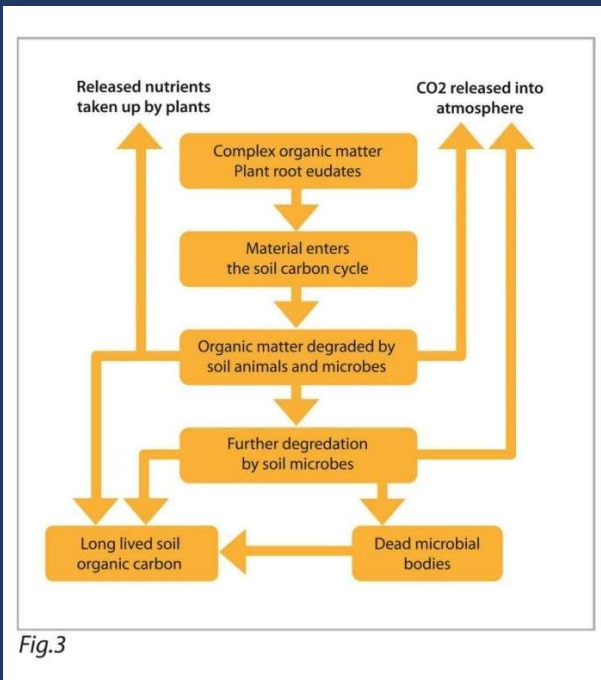
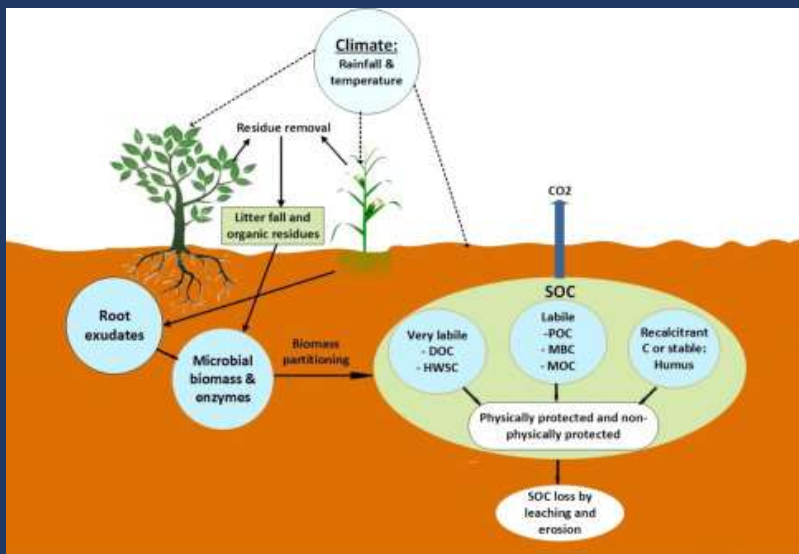


Fig.3

https://neutrog.com.au/2021/03/22/increasing_soil_organic_carbon/

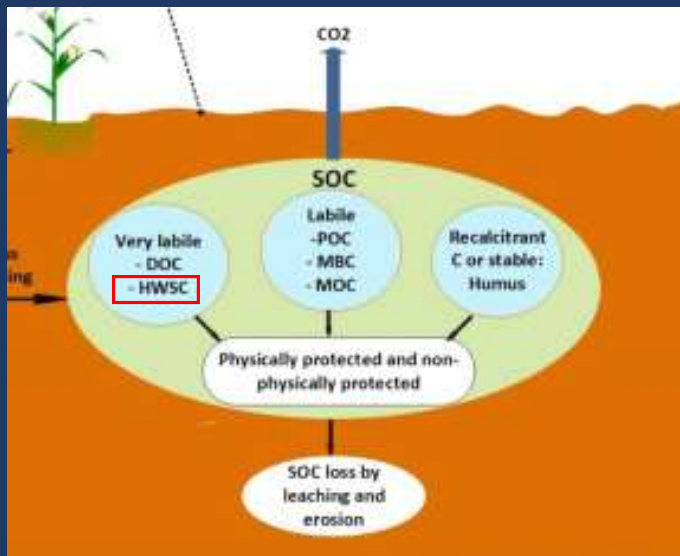
Carbon Mineralisation Potential



- Reflects the size and structure of microbial communities in soil
- Influences
 - Nutrient availability
 - Soil aggregation
 - Resilience to changing climatic conditions

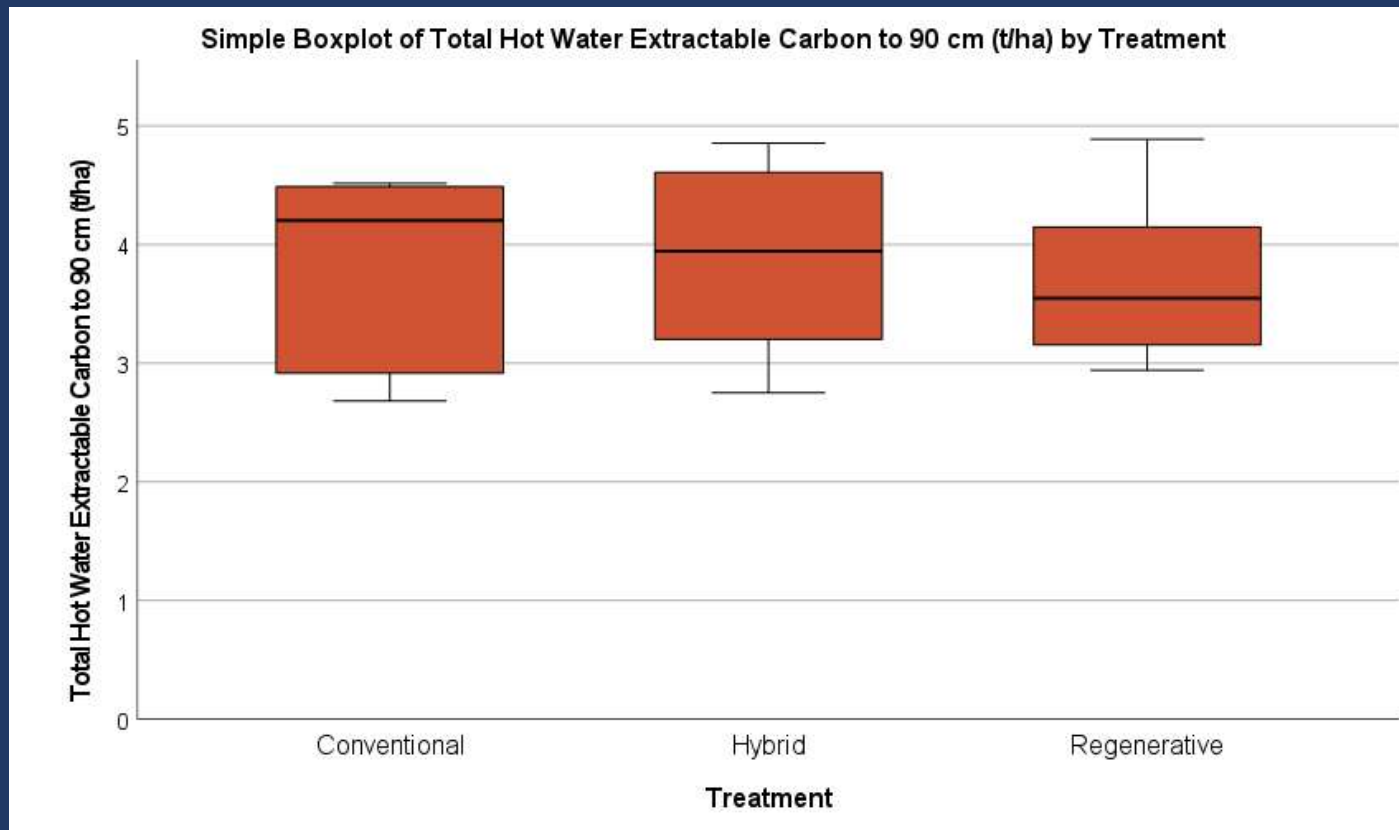
[Soil organic carbon dynamics: Impact of land use changes and management practices: A review - ScienceDirect](#)

Carbon Mineralisation Potential

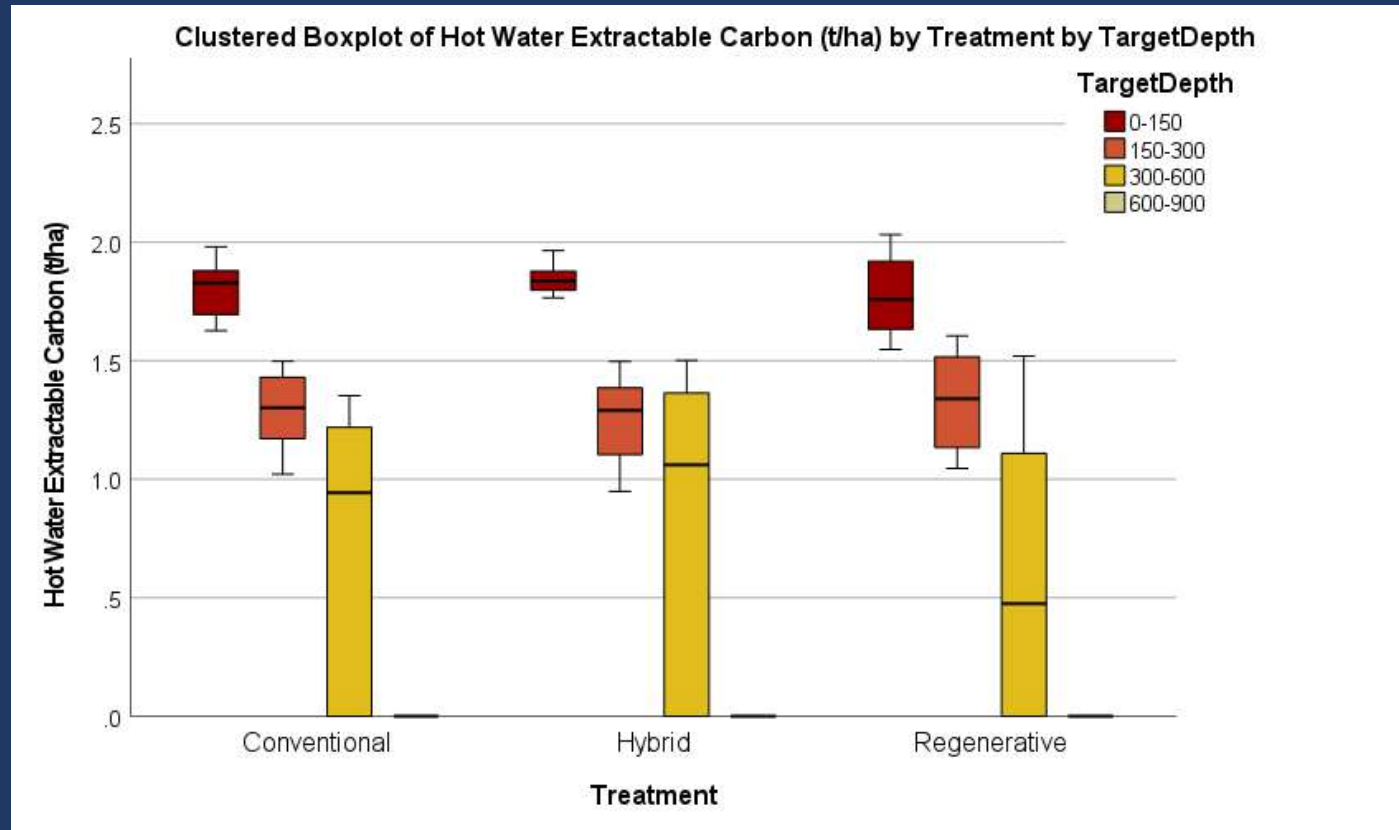


- Active forms change
 - Annually and seasonally
 - In response to management
- Hot water extractable carbon
 - Available lab test
 - Year 1 - 96 carbon stocks cores (0-15cm, 15-30cm)
 - Annually sample 10 cores/plot (0-15cm, 15-30cm)

Hot Water Extractable Carbon



Hot Water Extractable Carbon



Soil Aggregate Stability

- Describes how strongly soil particles group together
- Influences
 - Water infiltration
 - Runoff
 - Erosion
 - Aeration
 - Root growth
 - Nutrient uptake

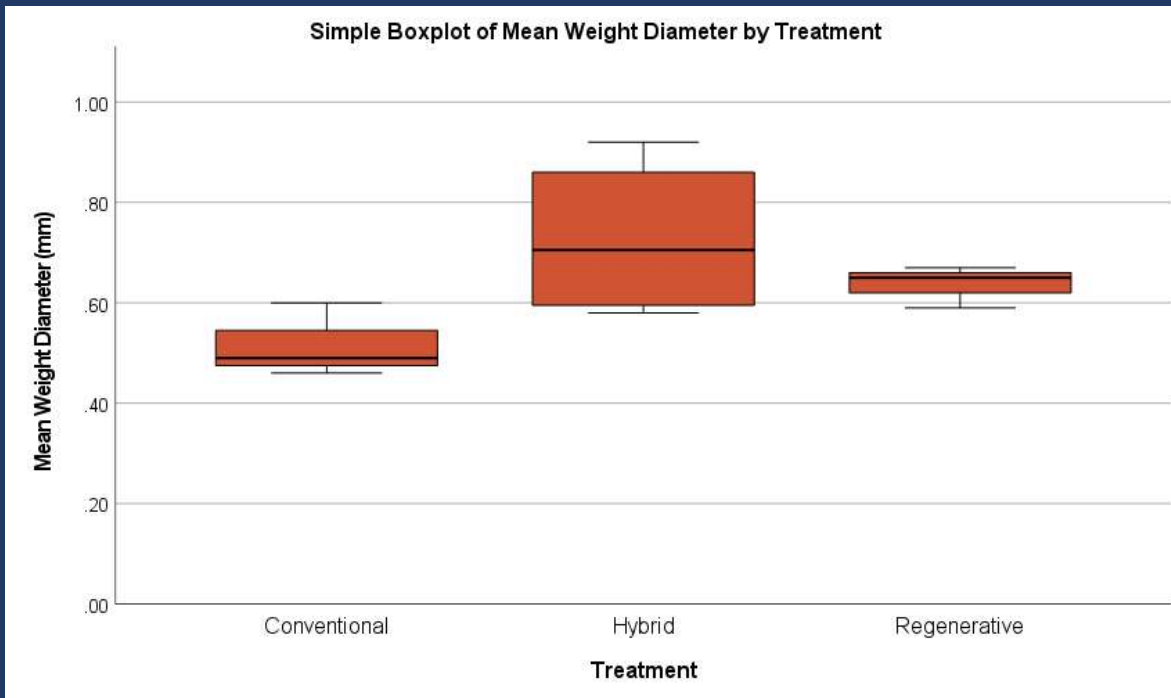


Aggregate stability test showing aggregates from (l to r) a no-till system, an intensive tillage (rototilling 5+ times/year), and conventional tillage system.

University of Wisconsin Integrated Pest and Crop Management.

See <https://youtu.be/d1M7EFqqsMM>.

Soil Aggregate Stability



- Years 1, 3 and 6
- Undisturbed sample cores (lab test – wet sieve)
- SLAKE tests on individual aggregates

Soil Slaking: SLAKE Test

- Years 1, 3 and 6

2023-01-31_18_49_45_P1_S1_A1_T000

2023-01-31_18_49_45_P1_S1_A1_T025

2023-01-31_18_49_45_P1_S1_A1_T090

2023-01-31_18_49_45_P1_S1_A1_T140

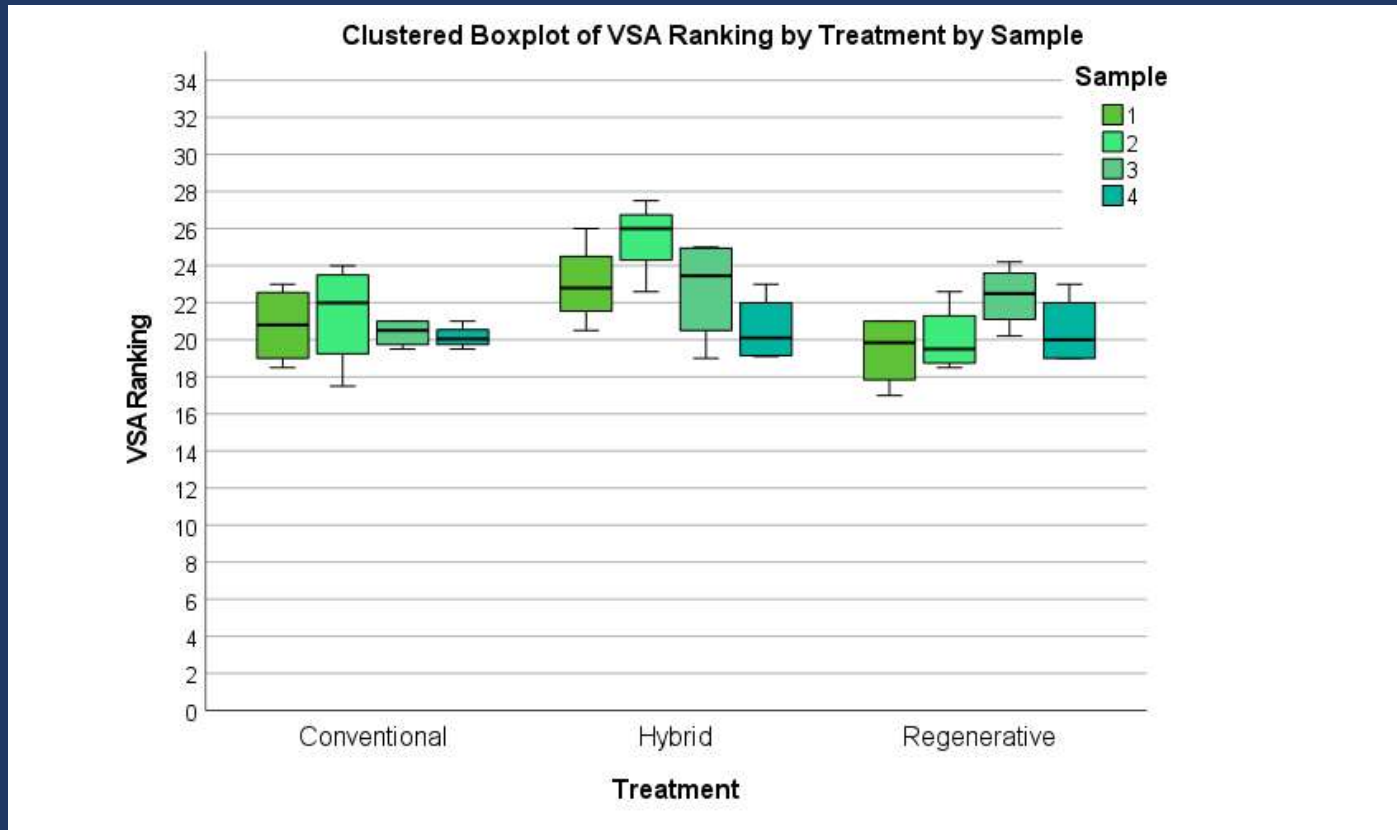
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2			other	2023-01-31_18_49_45_P1_S1_A1_T025.jpg	24.8			

Visual Soil Assessment

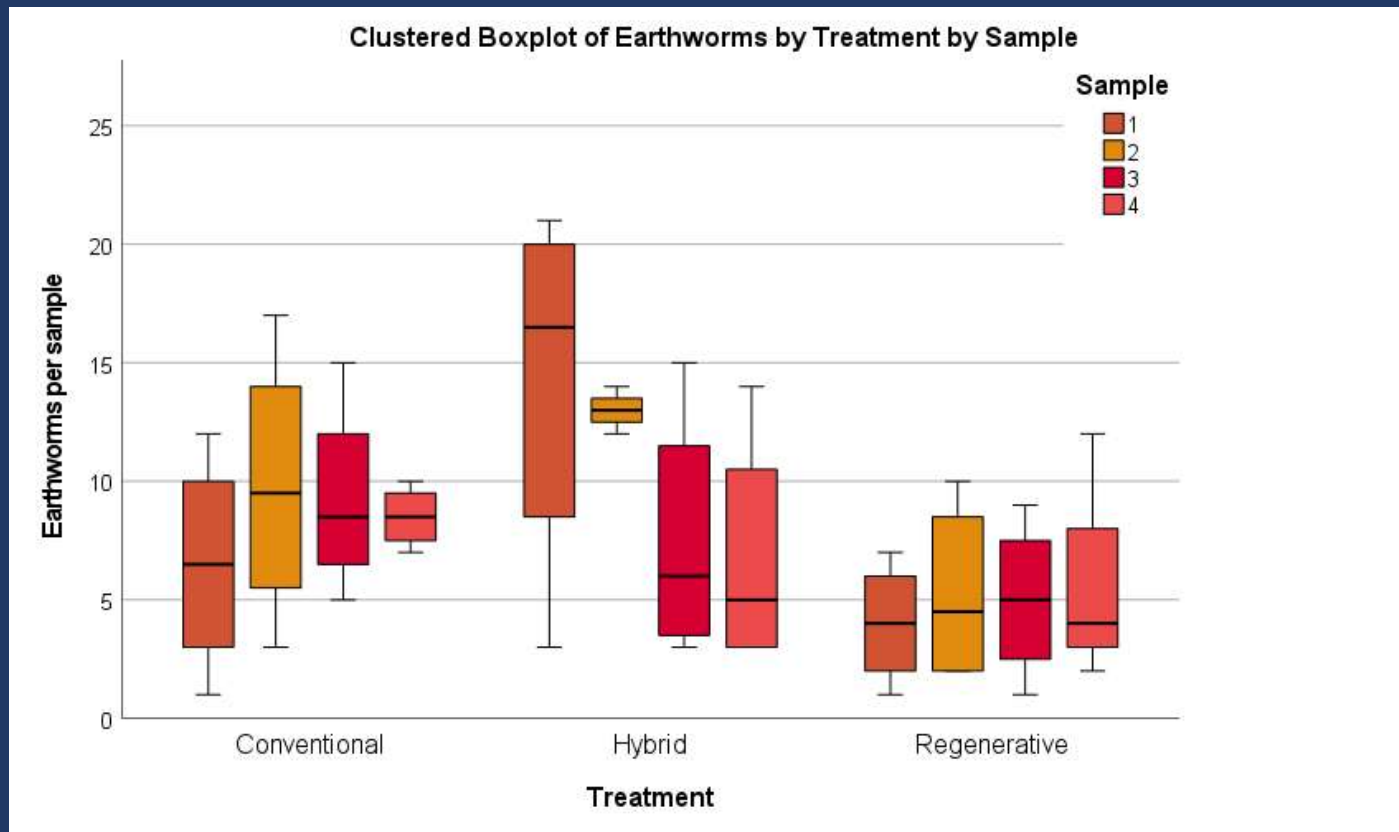
- Annually in spring
- Follow Shepherd's MWLR protocols
- 3 samples / plot
- Extra worm counts and classification (thanks Nicolle Schon!)



Visual Soil Assessment



Earthworms





Fenceline



Paddock

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