Conservation Agriculture
Soil Health Matters

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**Water Holding Capacity**

- **5% Organic Matter**: 195 lbs.
- **4% Organic Matter**: 140 lbs.
- **3% Organic Matter**: 100 lbs.
- **2% Organic Matter**: 55 lbs.
- **1% Organic Matter**: 33 lbs.
Soil Organic Matters

• Holds water

• Cements soil particles

• Reduces acid soil toxicity through natural liming

• Increases micronutrient availability

Electron micrograph of soil humus
Reducing Erosion
Organic Matter Increases Infiltration

Organic Using Compost

Conventional
Better infiltration, retention, and delivery to plants helps avoid drought damage.
Soil Organic Matter (mt / ha)

Historical Management

Future Prediction

- No Till, Cover Crop, Compost
- Compost
- Cover Crop
- Fertilizer
- Conventional Monoculture

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The Farming System Trial®

- Established in 1981.
- Three cropping systems are compared.
- 8 replications, 3 crops represented each year in each system
- Plot size: 20 x 300 ft (6 x 91.5 m)
- Lysimeters installed in 4 reps in fall of 1990
Soil Organic Matters

5 %

1 %
FST Soil Carbon and Soil Nitrogen change from 1981 to 2002

% Carbon
% Nitrogen
Soil in Organic Systems

- Higher corn and soybean yields in drought years
- Increased soil C and N
- Higher water infiltration
- Higher water holding cap.
- Higher microbial activity
Carbon is Covered

- **Manure**: $R^2 = 0.83$
  
  \[ y = 0.021x + 2.03 \]

- **Legume**: $R^2 = 0.79$
  
  \[ y = 0.015x + 2.12 \]

- **Conventional**: $R^2 = 0.04$
  
  \[ y = 0.002x + 1.97 \]
Carbon Profile

Depth in Organic & Convention Systems
Farming Systems Trial 2006

Soil Depth (cm)

Conventional  Organic Legume  Organic Animal
Mycorrhizal Fungi

- Extends plant root systems
- Produces erosion-resistant, carbon enriched soil
- Provides mechanisms for soil biological carbon fixation
- Slows decay of organic matter
No-Till Roller Crimper

Biologically Based No-Till
Energy Used in Different Corn Production Systems

Conventional

- Tillage: 231.7
- No Till: 199.2

Organic

- Tillage: 121.6
- No Till: 77.5

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Successful Weed Control

Biologically Based
No-Till Corn
Proven, Affordable, Immediate

Holistic Grazing

Biologically Based

No Till
Basic grazing determine

If landscapes are like this:...............  

...or like this.  

(Two rivers in the same area, with the same soils and rainfall, on the same day.)
Soil carbon under continuous cropping for forage and in permanent pasture and short and long pasture rotation with no till cropping 1995 to 1999.

Management

Soil Carbon (%)
Water Holding Capacity

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Carbon Impact by Field Treatment

Carbon Sequestration (kg C/ha/year)

- Moldboard Plow: -44.6
- Sub Soil: -18.9
- Mole Knife: -8.1
- Raw Dairy Manure: 312
- Cov. No Till: 330
- Winter Cover Crops: 1000
- Compost Broiler (litter, leaves): 1261
- Compost (Dairy, Manure, Leaves): 2363

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Creating New Soil

A photo from a Canadian research station showing the root growth of bunchgrass plants that were kept clipped at certain levels.

Research efforts in the soil science arena have concentrated on reducing the rate of soil loss. The concept of building new topsoil is rarely considered.

From Dr. Christine Jones, Carbon For Life, Inc.
Creating New Soil

Figure 1. Root volume, rhizosphere surface area, exudation of carbon, microbial activity, humification and soil building are highly correlated with the perenniality and vigour of groundcover plants.

From Dr. Christine Jones, Carbon For Life, Inc.
Premium Prices

1995 to 2007

Soybean, Corn, Wheat, Oats

Mean Organic Premium (% 1995 to 2007)

- Soybean: 145%
- Corn: 104%
- Wheat: 76%
- Oats: 70%
Increased Foliar Nutrients

Organic Livestock System Compared To
Conventional Corn Soybean Row Crop System

Percent Increase over
Conventional Control

Oat Leaf Tissue Mineral Comparative Mineral Content

*Zero is equal to the conventional baseline.

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Increased Grain Mineral Content

Increases in mineral contents in oat grain comparing organic and conventional production systems after 22 years of system differentiation.

When zero Organic and Conventional were equal.

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Vegetables

Quality Analysis of Carrots, Peppers & Tomatoes:

- Antioxidants
- Vitamin C
- Carotenoids
- Pigments
• Better Disease reaction to carrot necrosis and leaf blight, pepper virus complex and tomato late blight. Equal yield except higher in organic when disease was limiting as carrot necrosis.

• Higher Calcium, Magnesium, Sulfur, and Boron in Tomato fruit

• Higher Calcium, Sulfur, and Boron in Tomato leaves

• Higher Boron and Sodium in Carrot leaves and roots

• Higher ascorbic acid and total antioxidants in dry environment for tomato, peppers, and carrots
Ecological Regeneration

1. Building Soils
2. Cleaning up Waterways
3. Improving Water Dynamics
4. Avoid Drought & Floods
5. Improve Yield Productivity
6. Increase Adaptability to Climate Change
7. Improve Food Quality
Conservation Agriculture
Questions

Thank You