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Health Trinity

Healthy Soil =
Healthy Plants =
Healthy Planet

Paul Reed Hepperly
Fulbright Scholar
Rachel Carson Scientist

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Hay Belly Nation is Our Choice

1. Beyond Disease

2. There is Health

3. We Live in an Age of Soil-(lutions)

4. Let's Stop Treating our Soil Like Dirt!

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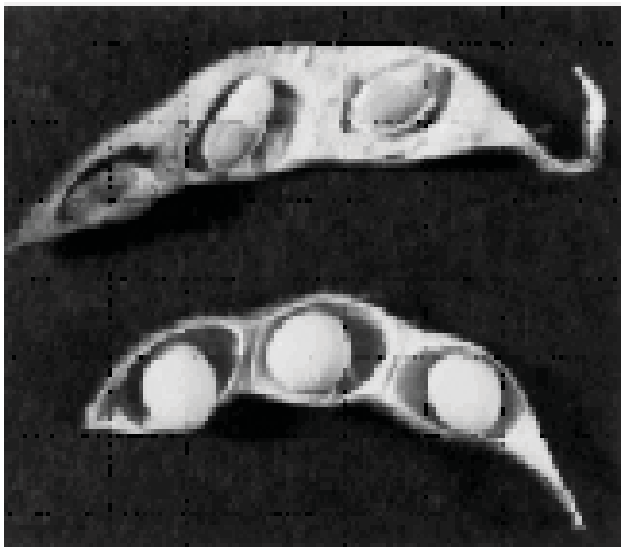
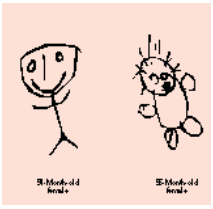
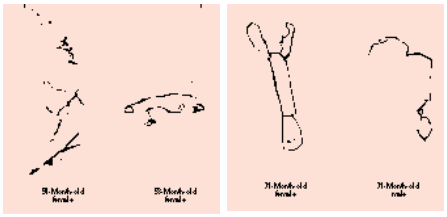
Beyond Disease Health



Pesticides, sewage sludge, irradiation, fertilizers, cannibalism and transgenetics…. Can we do Better?



Representative drawings of a person by Yaqui children from the foothills of Sonora, Mexico.



Representative drawings of a person by Yaqui children from the valley of Sonora, Mexico.

© Elizabeth A. Guillette, María Mercedes Meza, Maria Guadalupe Aquilar, Alma Delia Soto and Idalia Enedina Garcia

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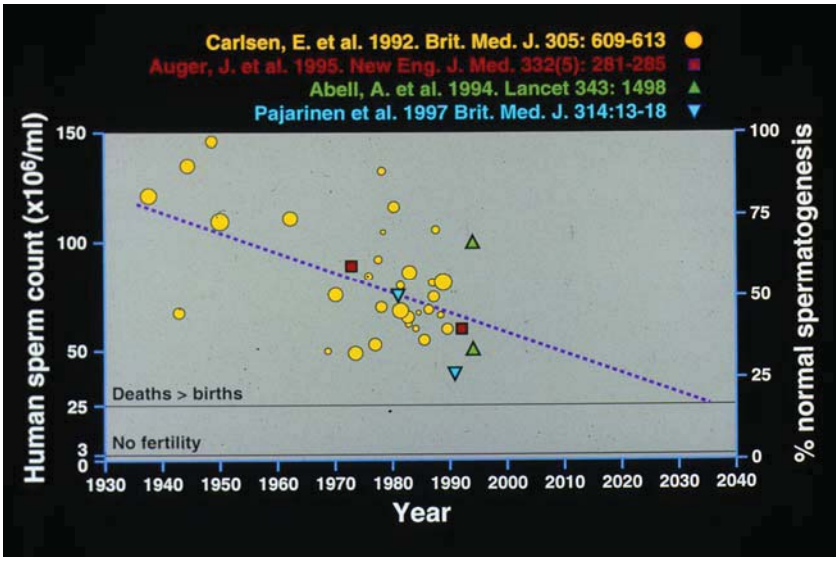
Human Fertility… the Canary in the Coal Mine



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C – N-H_2O Cycle Together

Carbon is King

Organic Matters

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Rodale Institute Paradise Lost

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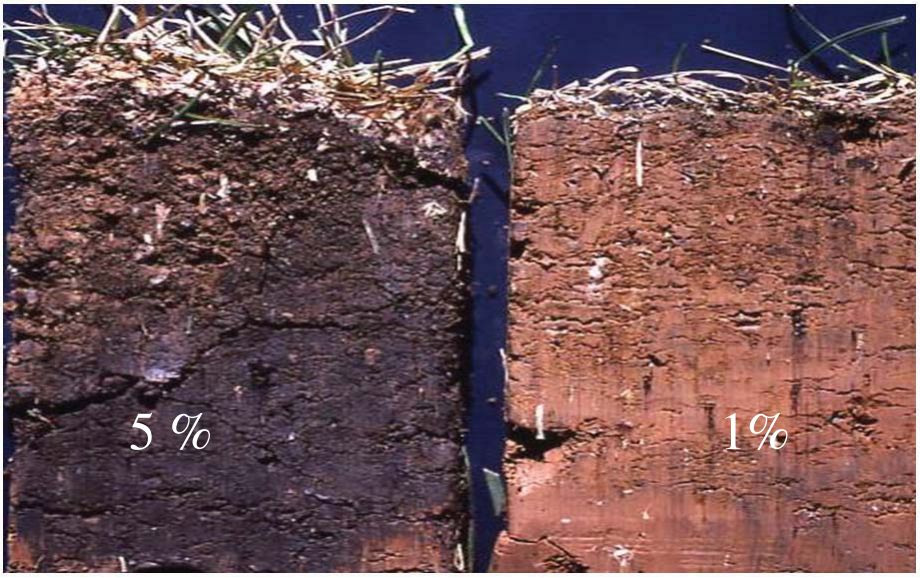
Soil Organic Matters



The Farming System Trial ®

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Fig. 1. Rotations employed in The Rodale Institute Farming Systems Trial®

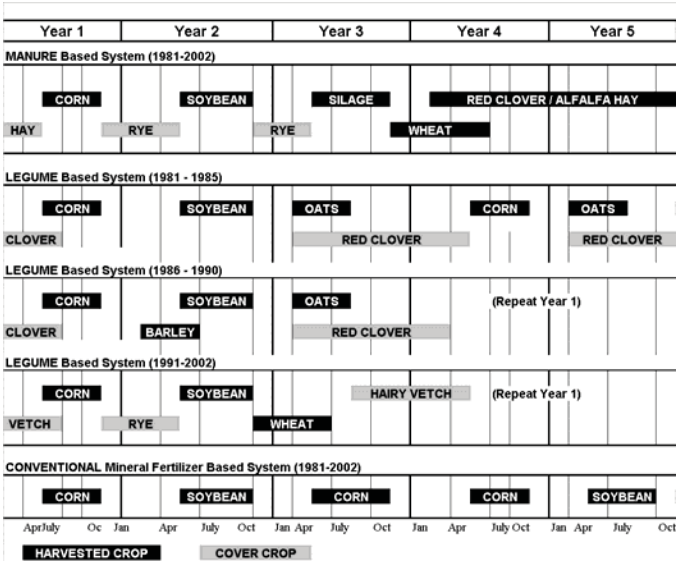

Table 1: Cultural practices used in the Rodale Institute Farming Systems Trial.

Cultural practices	Manure	Legume	Conventional
Crops	maize, soybeans, small grains, hay cover crop: rye	maize, soybeans, small grains cover crops: rye & vetch	maize, soybeans no cover crop
Nitrogen Input	40 kg ha^{-1} yr^{-1} manure + legume hay (198 kg N ha^{-1} on maize)	49 kg ha^{-1} yr^{-1} legume cover crop (140 kg N ha^{-1} on maize)	88 kg ha^{-1} yr^{-1} mineral fertilizer (146 kg N ha^{-1} on maize)
Ground Cover	living: 73% dead: 20% bare: 7%	living: 70% dead: 22% bare: 8%	living: 42% dead: 50% bare: 8%
Primary Tillage	moldboard plow 0.8/yr (4 times/5 yr rotation)	moldboard plow 1.3/yr (4 times/3 yr rotation)	moldboard/chisel plow 1.0/yr (5 times/5 yr rotation)
Weed Control	rotary hoeing cultivation, rotation	rotary hoeing cultivation, rotation	herbicides
Insect Control	rotation	rotation	insecticides for maize only in 1986-89, 1993

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Figure 2. Schematic drawing of the cold germination and emergence test of super sweet corn varieties.

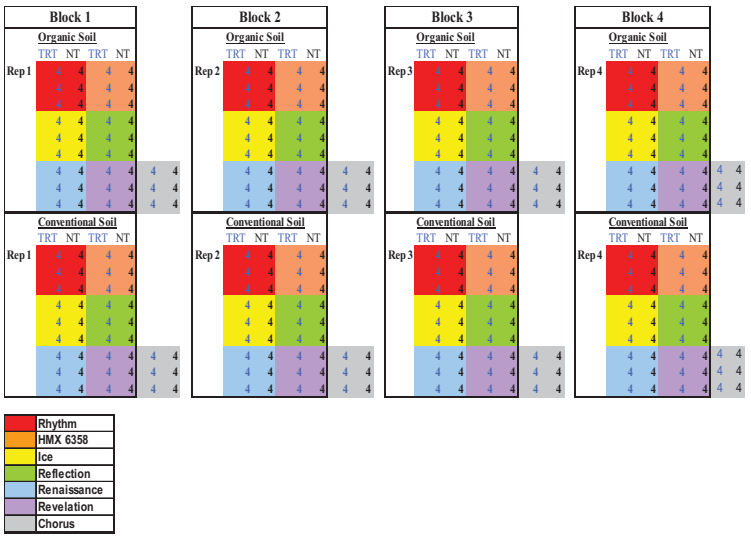

Fig. 3. Linear regression of soil C rise with time in both organic treatments; no increase is found in the conventional system

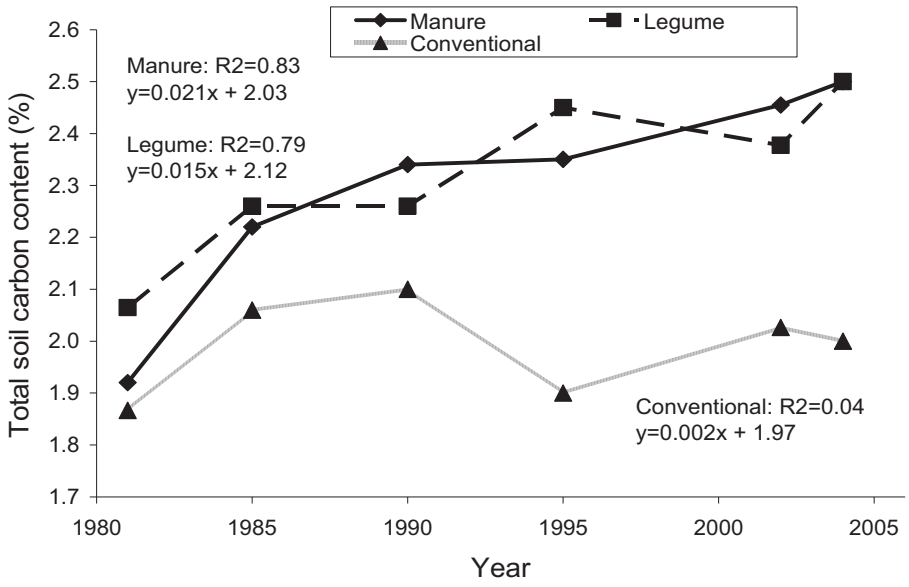

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Table 2: Soil C and N accumulation in kg ha^{-1} $year^{-1}$ between 1981 and 2002. Different letters indicate statistically significant differences for that element (p = 0.05).

	Carbon	Nitrogen
Manure	981 b	86 b
Legume	574 b	41 b
Conventional	293 a	-2 a

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Table 3. Uniform testing of corn hybrid yield and chemically labile organic matter show that 25 years of organic and conventional practice influence corn yield potential and active soil organic matter both of which increase under organic system management

Systems	Chemically Labile Soil Organic Matter	Yield of Maize (kg/ha)
Organic Animal System with Manure	590 A	11,900 A
Organic Cash Grain Cover Crops no Manure	530 AB	11,000 AB
Conventional Corn and Soybean Rotation Fertilizers and Pesticides based on PSU	450 B	9,600 B

Among the means those not sharing a common upper case letter are significantly different.
There was a direct relationship between the content of labile organic matter and high yield of corn in a favorable production year in uniform trialing. The average National Corn yield during this period is approximately 9,000 kg/ha showing the ability to increased soil organic matter to increase yield potential under a favorable production environment

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Organic matter increases Yield Potential

Percentage Corn Yield Increase related to Labile Soil organic Matter

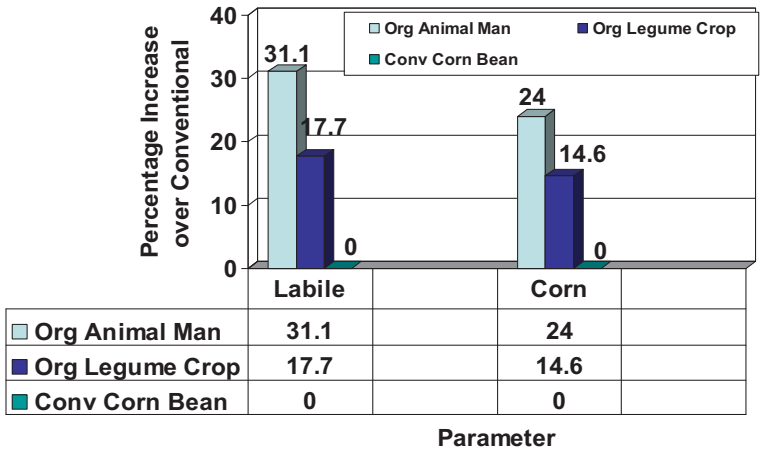
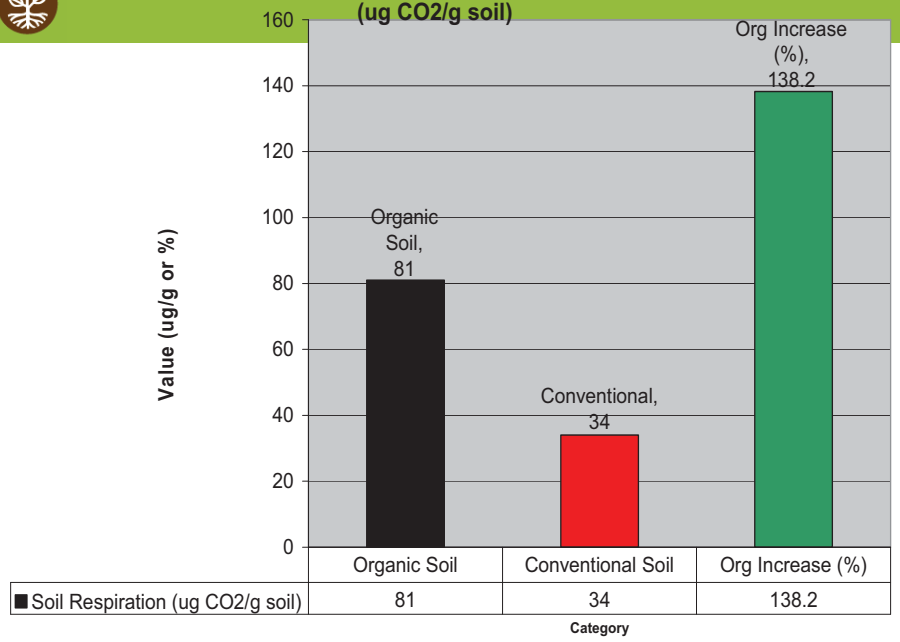


Figure 5. Influence of Organic Management on Soil Respiration (ug CO2/g soil)



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4. Cold test emergence of organic and conventional soil for 7 varieties of super sweet corn varieties.

Variety Name	Organic	Conventional	Statistical Sign.
Chorus	5	2	*
Renaissance	22	14	*
Reflection	25	29	Not Stat. Sign.
HMX6358	35	15	*
Ice	39	18	*
Rhythm	46	4	*
Revelation	53	21	*

Table 5. Warm germination on cellulose pads and warm temperature 25C.

Variety Name	Maxim Fungicide	Nontreated	Statistical Sign.
Chorus	100	100	Not Stat. Sign.
Renaissance	40	70	*
Reflection	80	100	Not Stat. Sign.
HMX6358	90	100	Not. Stat. Sign.
Ice	90	100	Not Stat. Sign.
Rhythm	40	100	*
Revelation	70	100	*
Overall Mean	72.9	95.6	*

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Table 6. Super sweet corn cold germination results factors of significance and their interactions.

Factor	Statistical Significance Level
Organic or Conventional Soil	****
Difference Among 7 Cultivars	**
Fungicide Treated or Not	NS
Soil by Cultivar	*
Soil by Fungicide	NS
Soil by Cultivar by Fungicide	NS

Figure 6. Mean Emergence (%) of Treated and Non Treated Super Sweet Corn Varieties Using Iowa Cold Germination Test

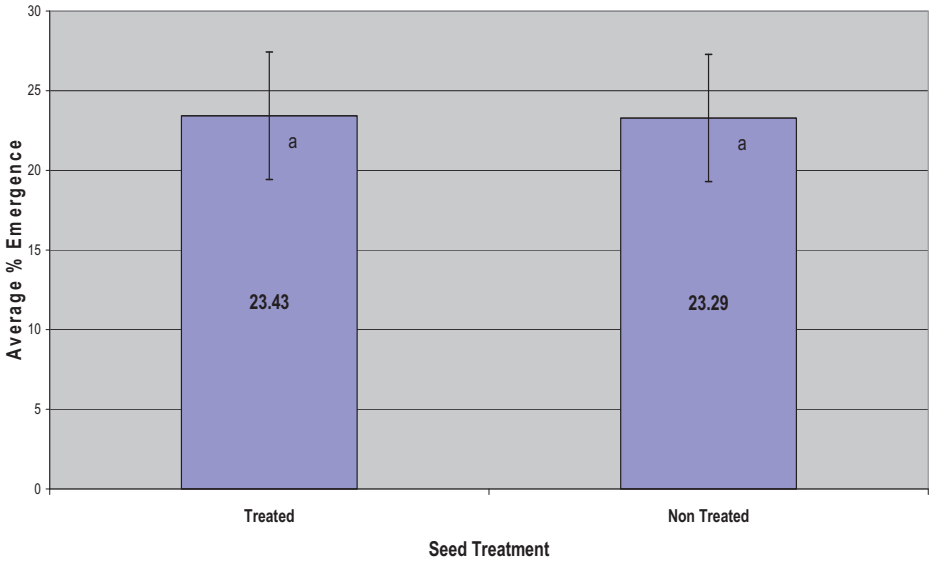

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Figure 8. The effect of soil organic management legacy on corn seed procedure designed to differentiate seedling based on reaction to *Pythium* under a natural inoculation and controlled stress.

Figure 7. Effect of Organic Soil on Corn Seed Emergence in Cold Test.

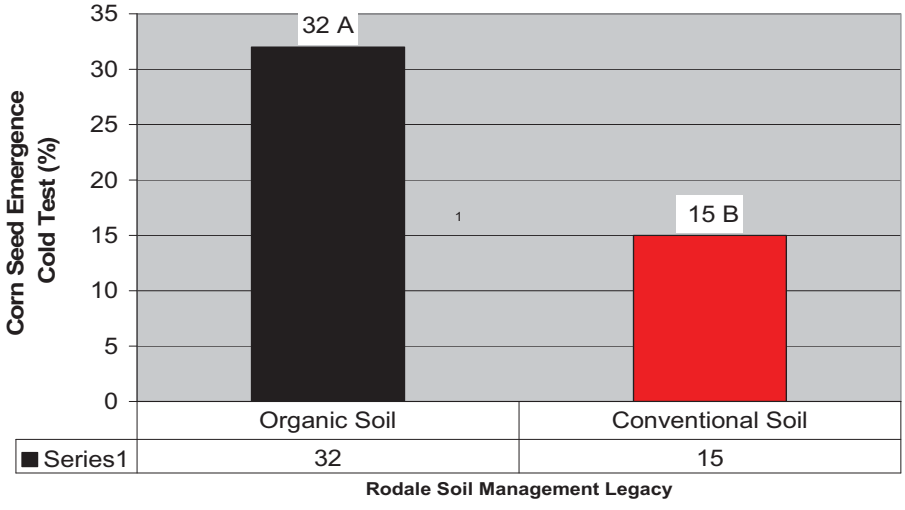
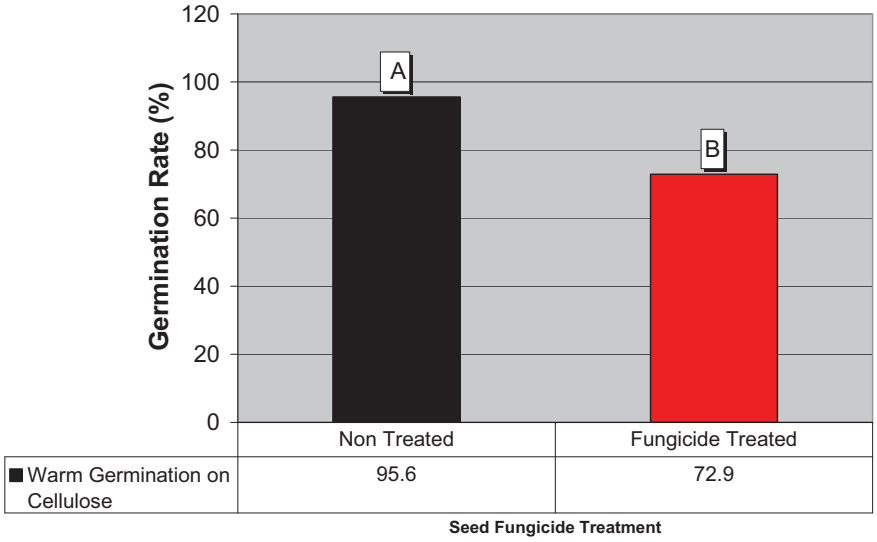


Figure 8. Effect of seed fungicide treatment on warm 25 C cellulose pad germ test.



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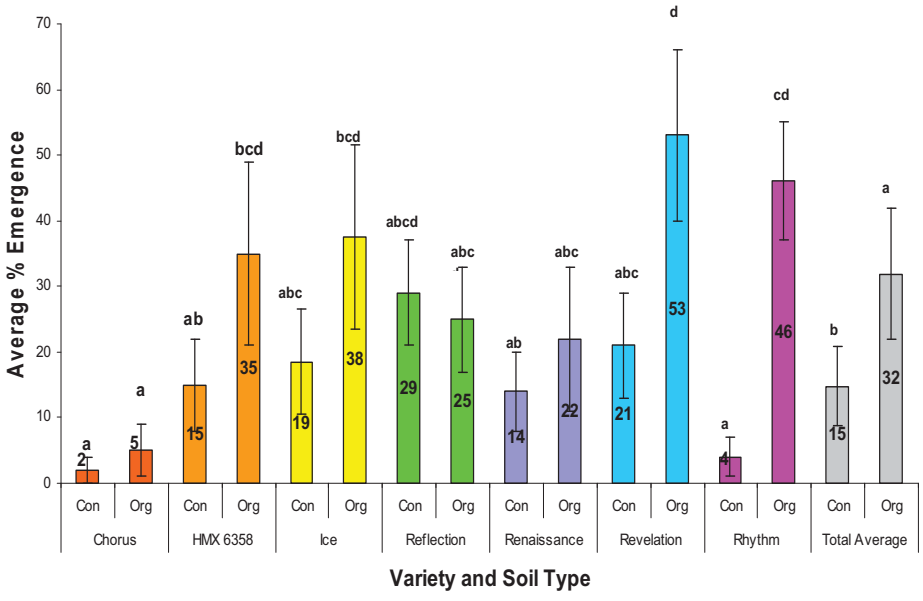
Cold test emergence of 7 Sweet Corn Varieties in Conventional and Organic Soils.



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

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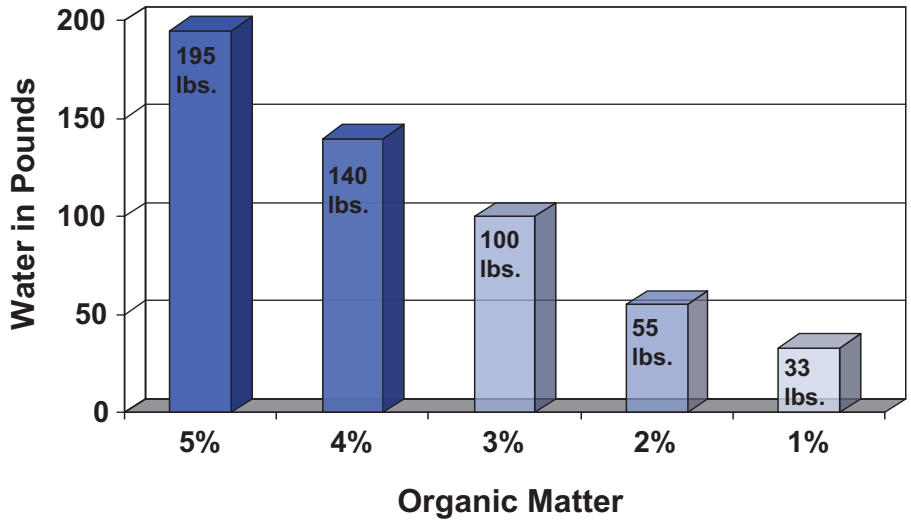
Organic Matter Increases Infiltration

Organic Using Compost

Conventional

Water Holding Capacity



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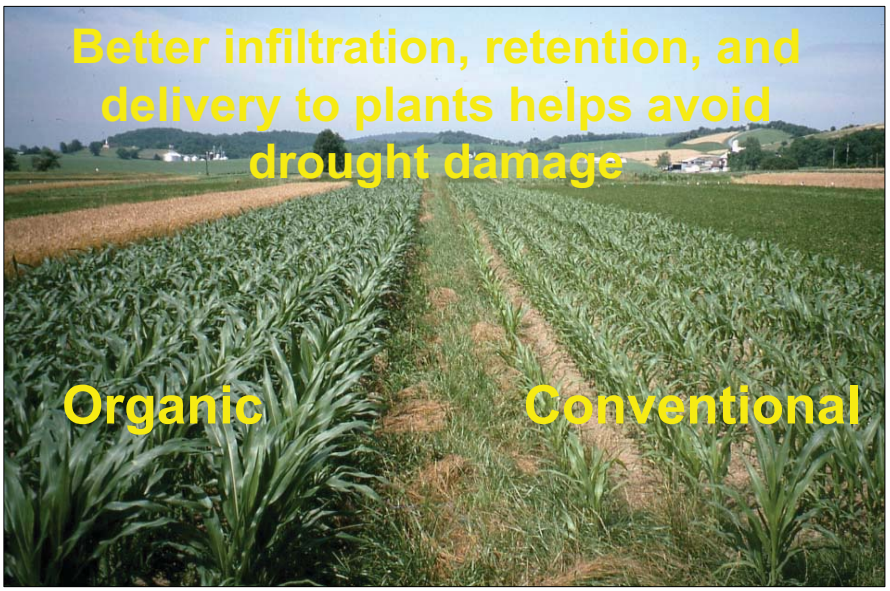
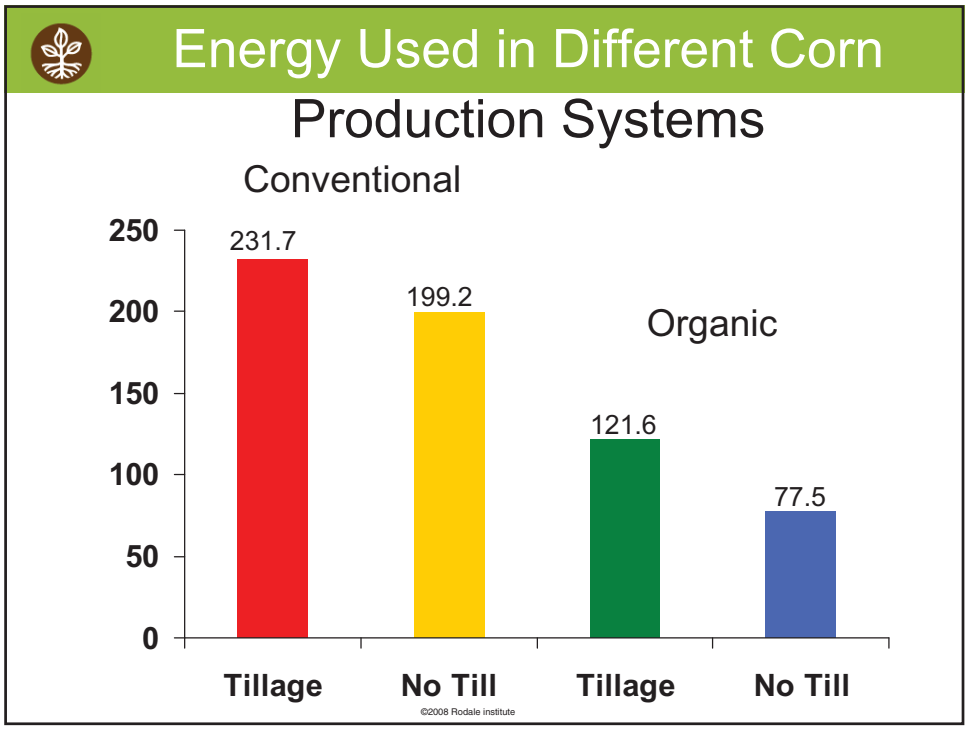
Organic Corn - 1995 Drought





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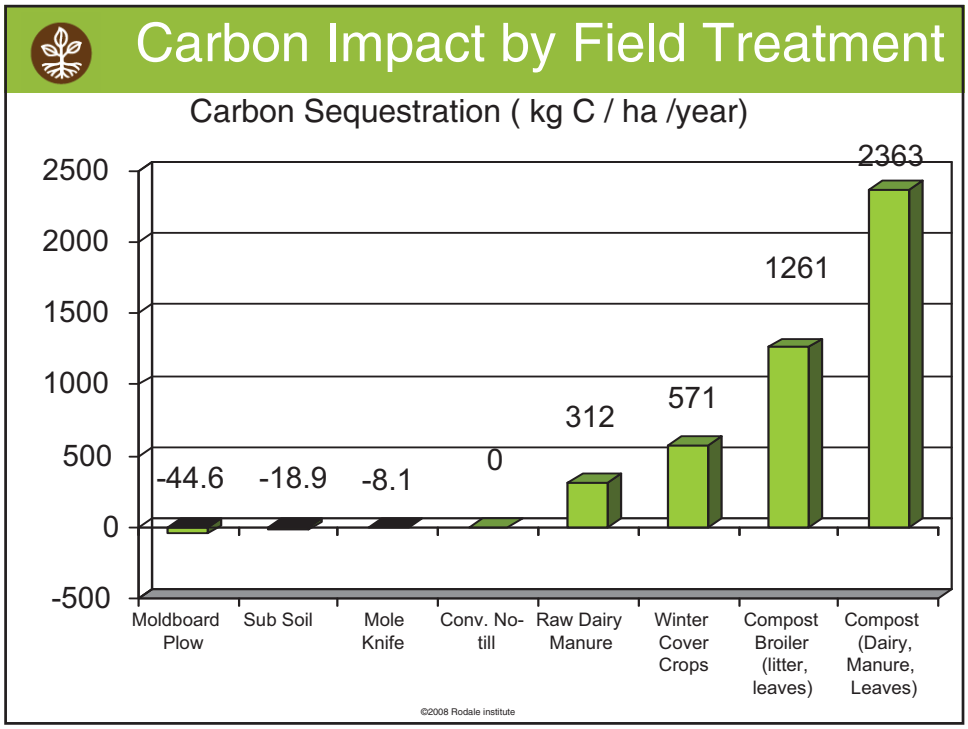

No-Till Roller Crimper

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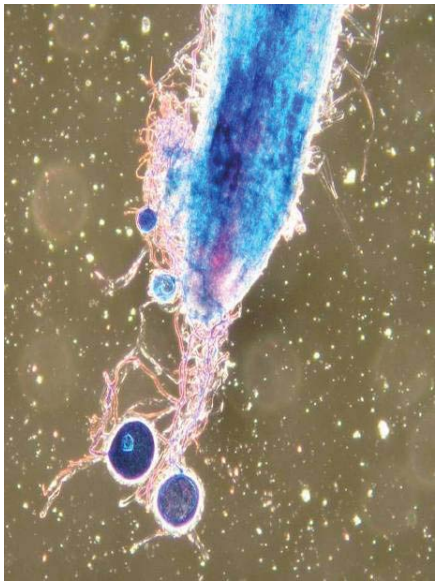
Successful Weed Control

Organic
No-Till Corn

Mycorrhizal Fungi



- Extends plant root systems
- Produces erosion-resistant, carbon enriched soil
- Provides mechanisms for soil biological carbon fixation
- Slows decay of organic matter

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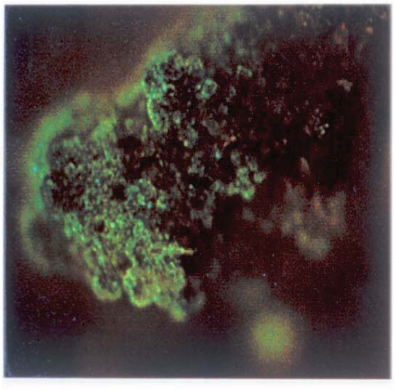
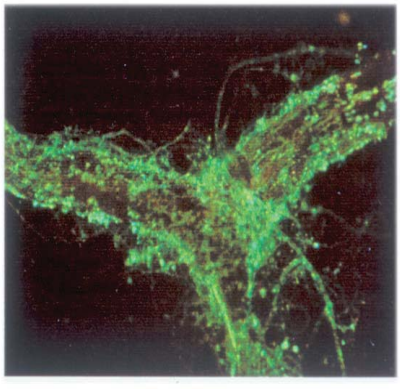
Soil Aggregation:

A Biological Process



Glomalin is the green material on this soil aggregate.



An arbuscular mycorrhizal fungus colonizing a root. Hyphae are the thread-like filaments. The green coating on hyphae is glomalin.

Sweet Corn

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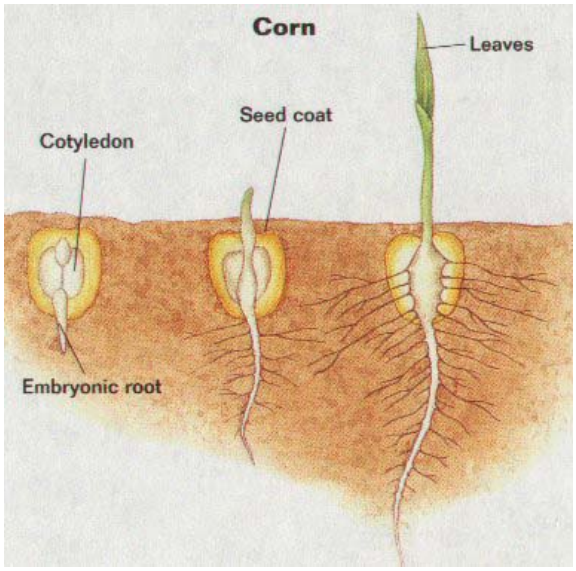
Healthy Seed Development



Pythium Damping Off Fungus

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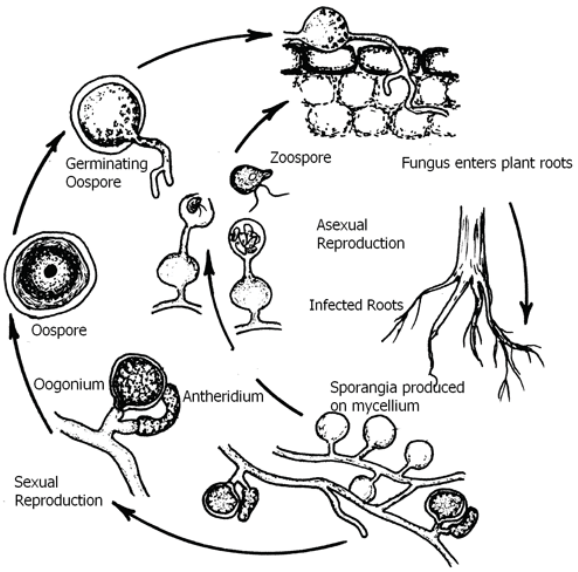
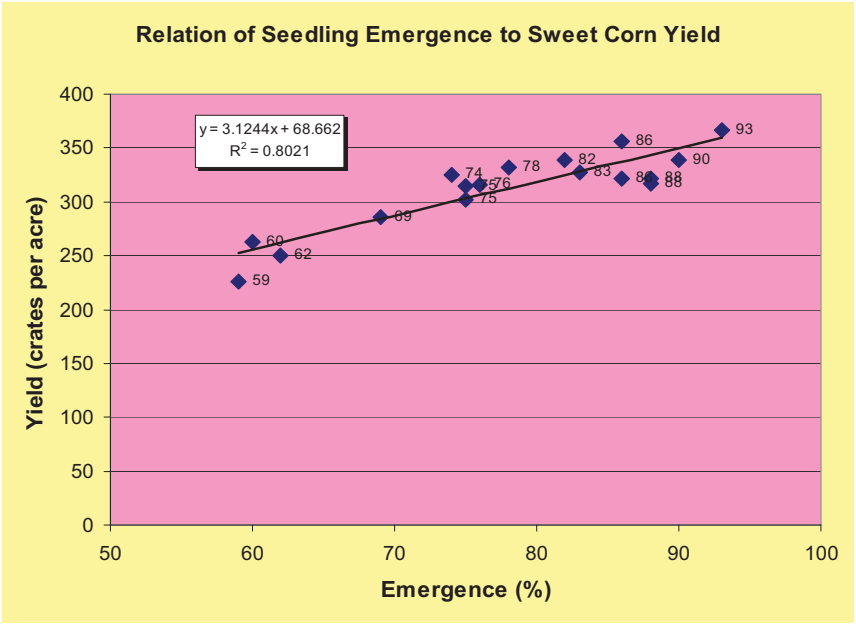
Pythium Life Cycle



Emergence, Yield, and Health



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Wheat Cold Test

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Seedling and Root Rot

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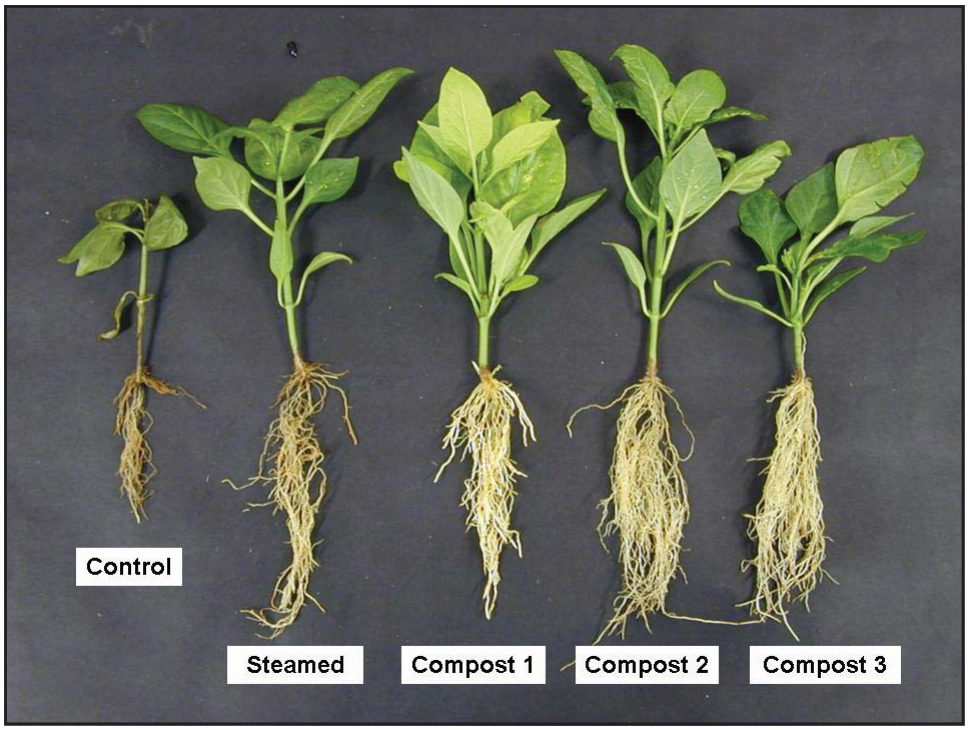
Humus Stimulates Healthy Roots



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