



Building Better Soils

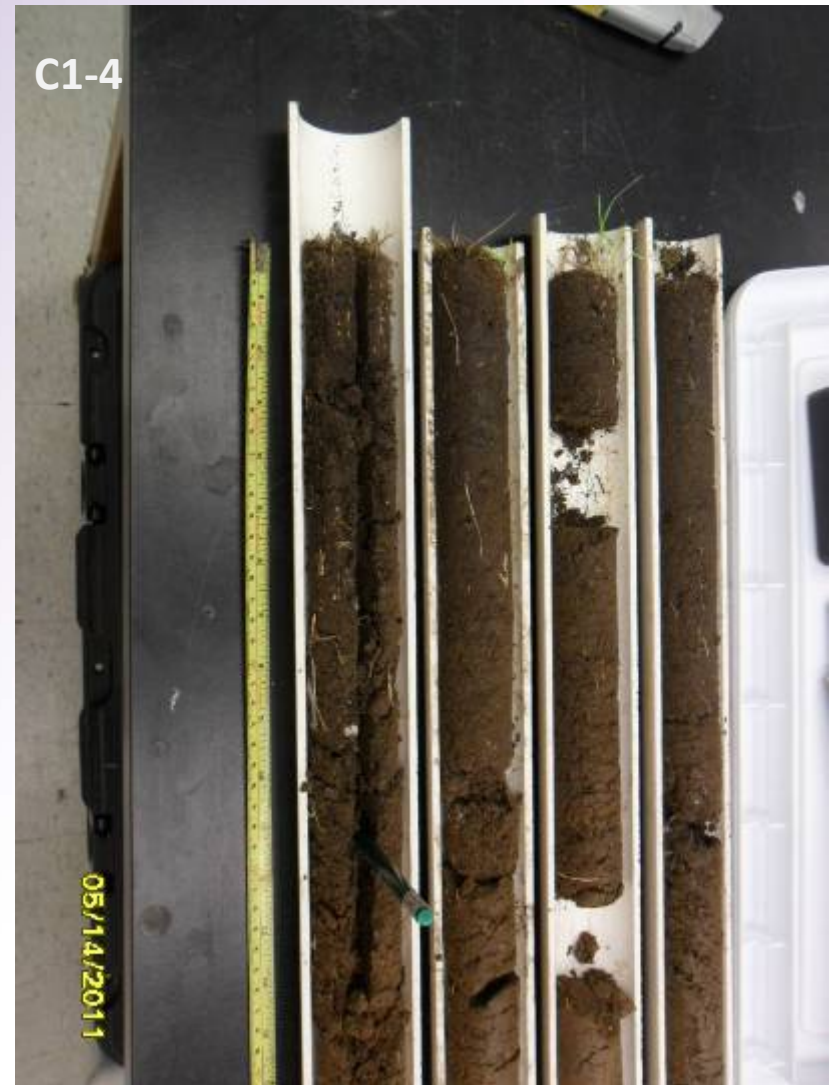
DeAnn Presley

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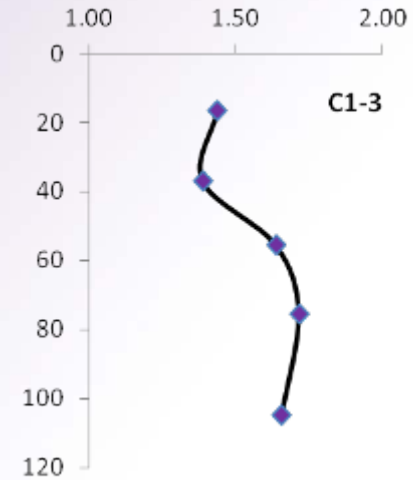
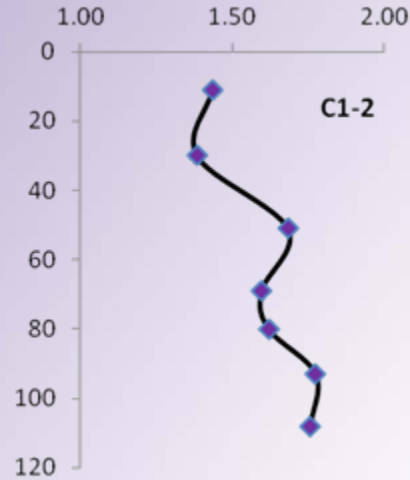
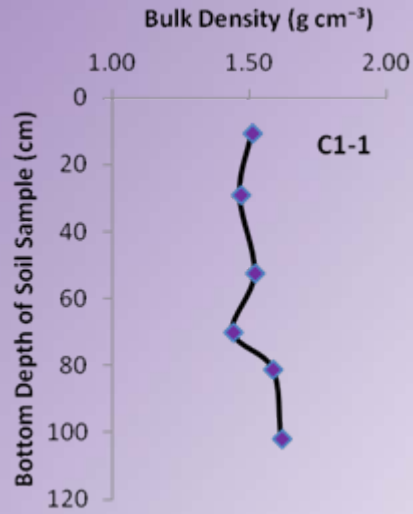


Cropland

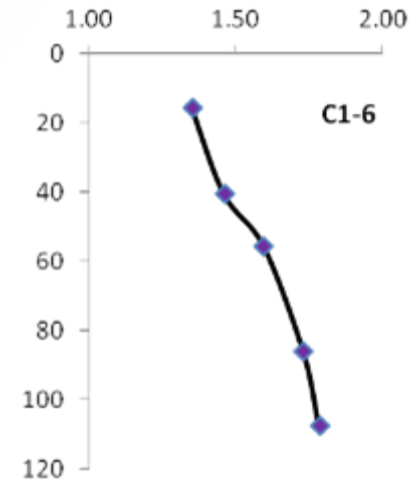
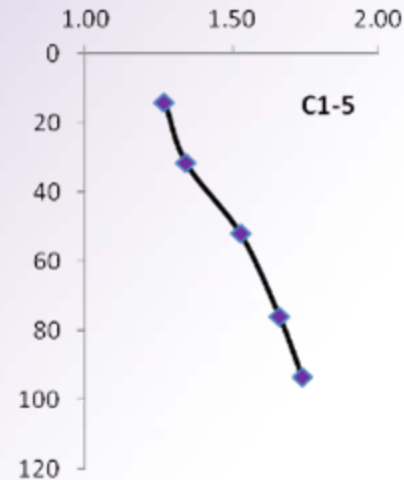
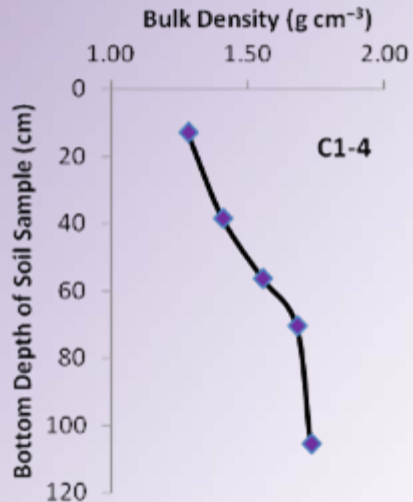
Pasture



Bulk density



Cropland



Pasture

Cropland vs. Pasture

Cropland

Core ID	Mollic Thickness (cm)	Carbon Content (Mg ha ⁻¹)
C1-1	16	48.5
C1-2	19	43.7
C1-3	21	61.2

Pasture

C1-4	43	113
C1-5	35	56.1
C1-6	46	106

Approximately 50% of the topsoil is no longer present on cropland.

P values are higher on cropland, but relatively low, as crops would likely respond to additions of P when values are < 20.



Infiltration

- The average K for the C-1 pasture is 6.8×10^{-4} cm/s or 6.8 $\mu\text{m/s}$.
- The average K for the C-1 cropland is 2.8×10^{-4} cm/s or 2.8 $\mu\text{m/s}$.
- K at the pasture is about 2 to 2.5 times greater than K at the cropland site.
- USDA-NRCS rating: $3 \mu\text{m s}^{-1}$
 - 7500, Pawnee clay loam,
1 to 3 percent slopes

Are your soils “healthy”? :

Do they:

- drain and warm quickly in spring?
- stay open and friable after planting, i.e. aren't prone to crusting?
- have little runoff, even after heavy rains?
- store moisture well for crop use during dry periods?
- resist erosion and compaction?
- decompose residue?
- produce high yielding crops?



How do you place a value on health?

- If you are a cautious driver, your car insurance usually costs less
- If you are healthy, it costs less to buy life insurance
- And if you live a healthy lifestyle, you spend less on medical bills



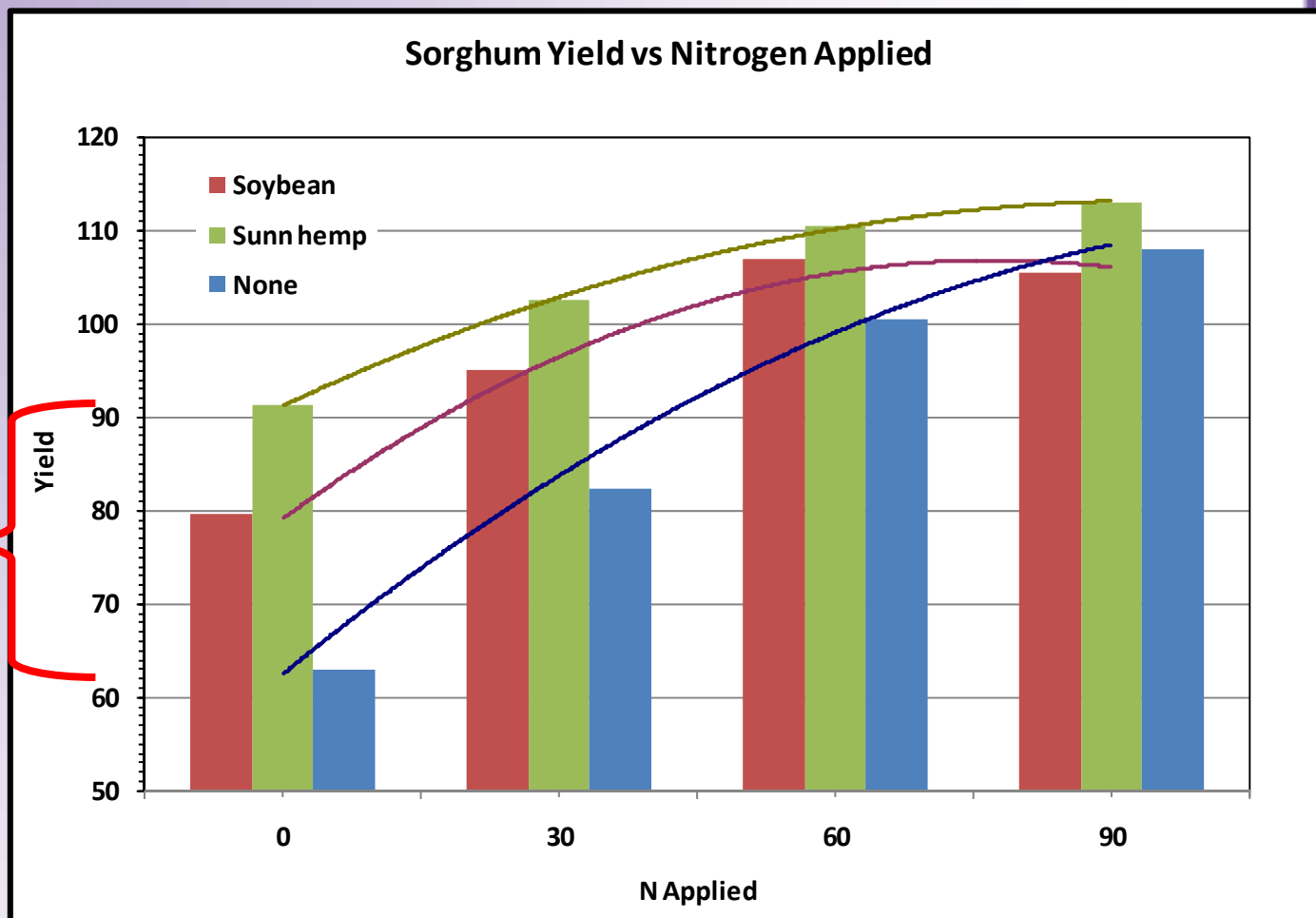
Yield Benefits from Cover Crops

Notice the yield boost with no applications of N.

The boost comes from improvements in soil productivity.

For sunn hemp, this persists, even with increasing N.

Is it high enough with N credit to cover establishment costs?

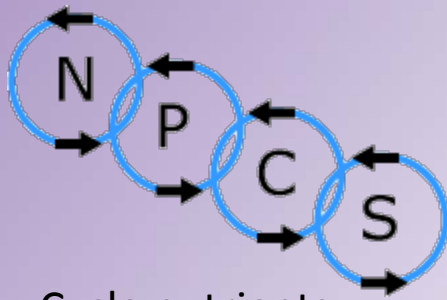


Hairy Vetch & N Rate Effects on Wheat Yield (Hesston)

Fertilizer	Yield (years)
0	+17 (4/4)
30	+14 (3/4)
60	+9 (3/4)
90	+6 (1/4)

Vetch-sorghum-wheat rotation, yields are relative to a sorghum-wheat rotation

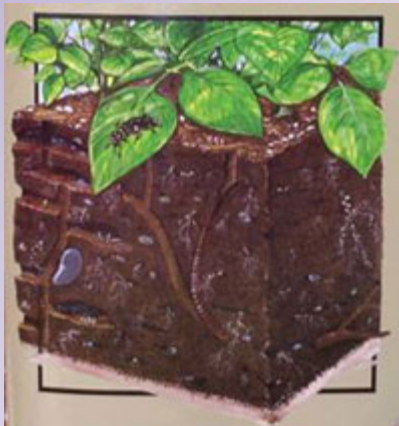
Soil functions



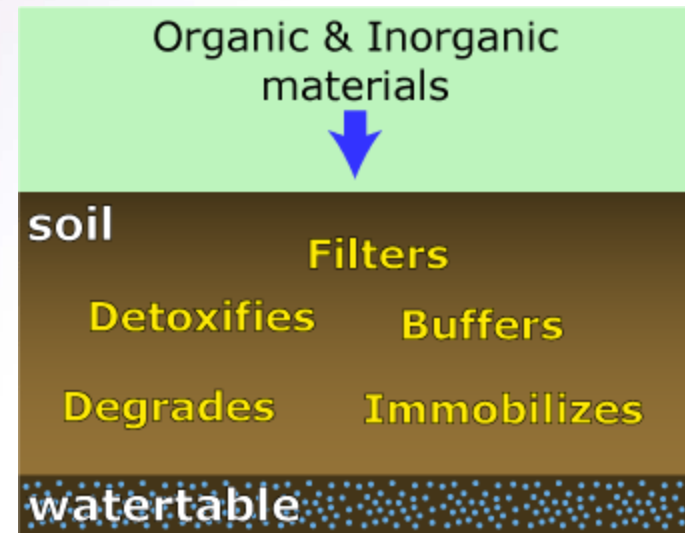
Cycle nutrients



Water relations



Diversity and habitat



Filter and buffer

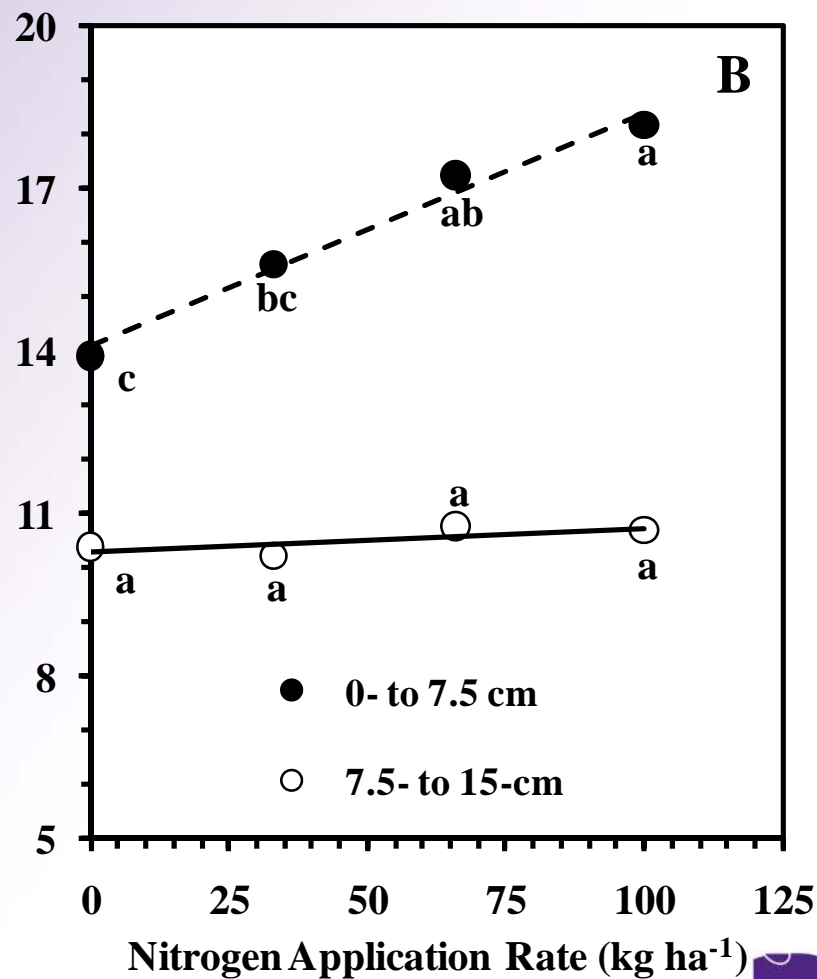
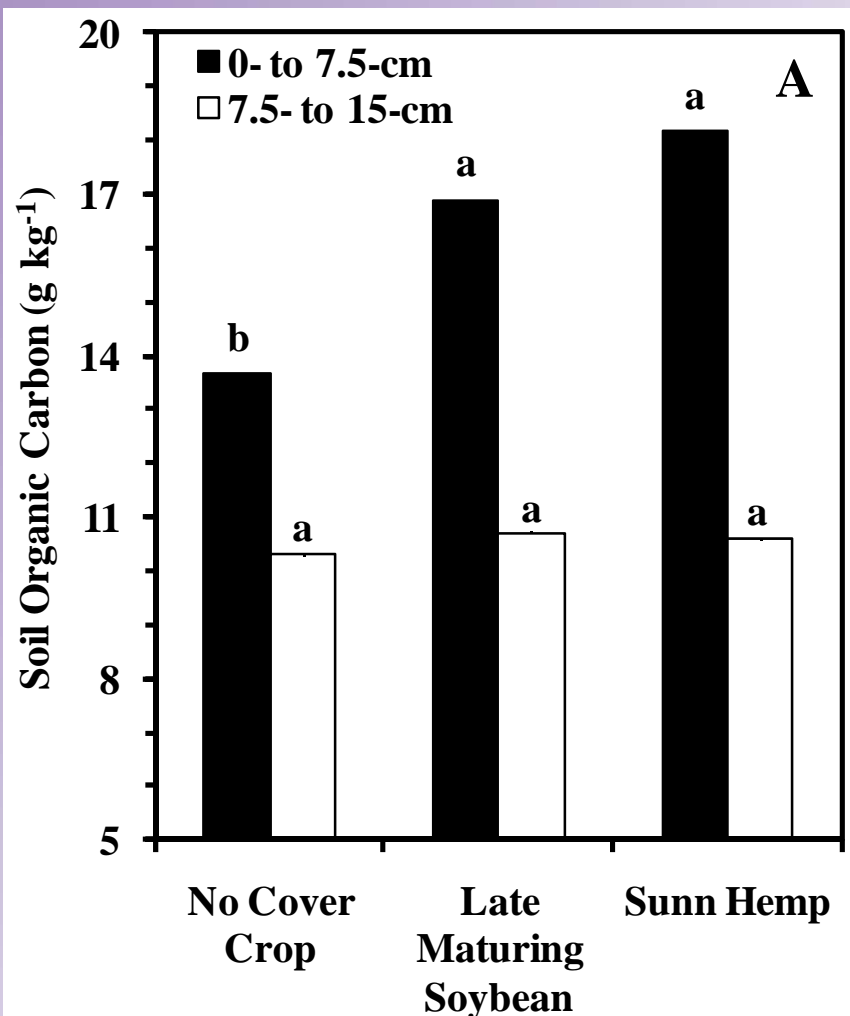
<http://soilquality.org>

Conventional logic

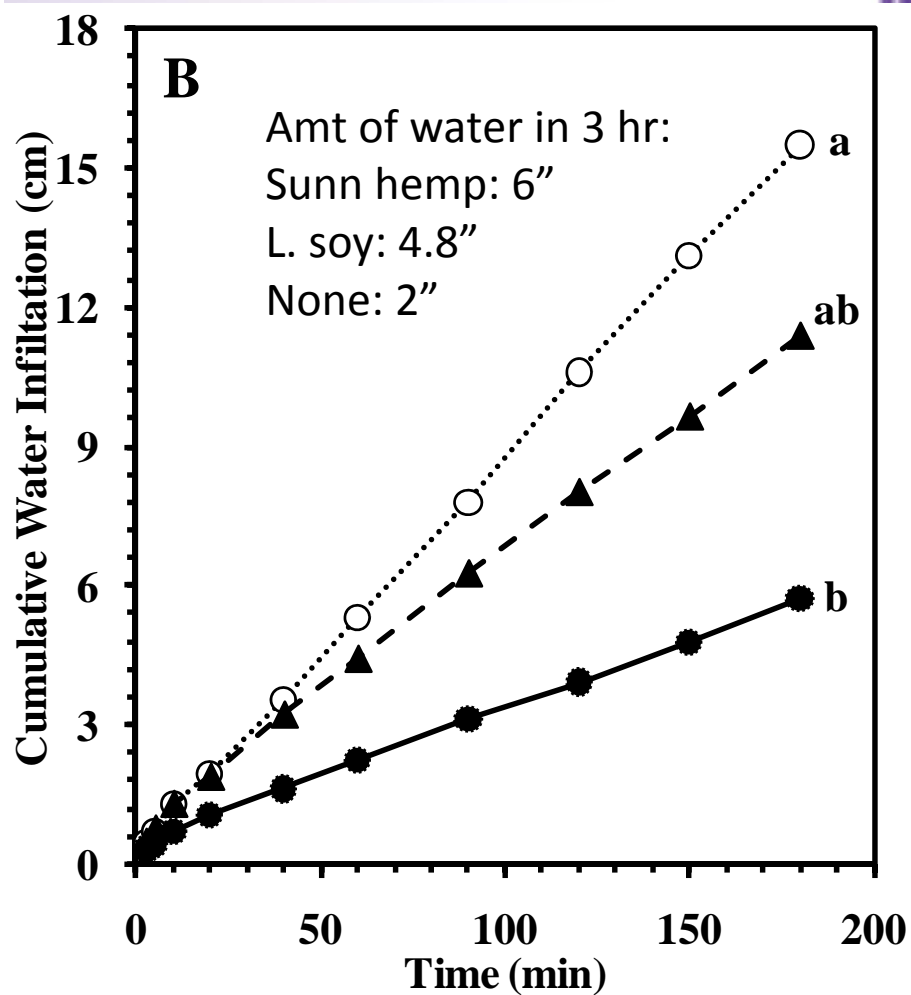
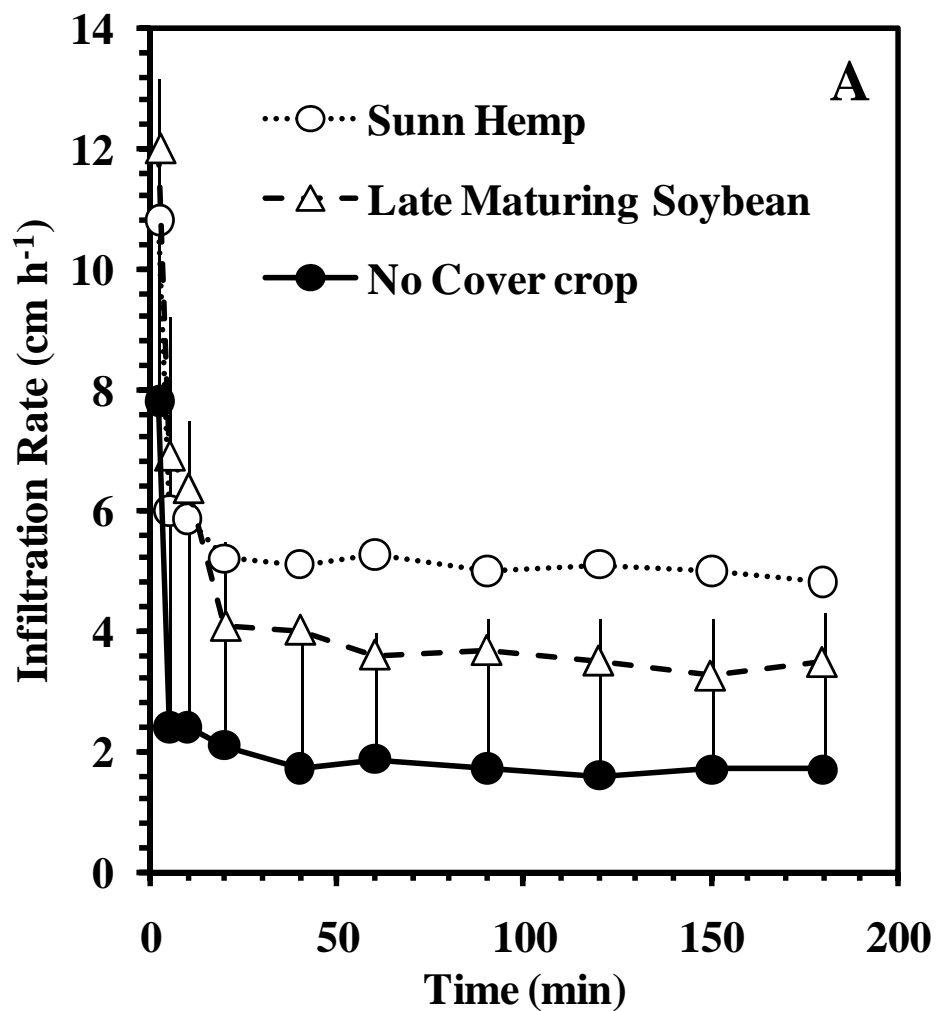
- Reactive: Have a problem, treat it
 - Tillage, fertilizer (more), irrigation (more), pesticide
- Proactive: Solve problems so that you don't have to keep treating them
 - Improve soil health and function = more sustainable
 - "While the farmer holds the title to the land, actually it belongs to all the people because civilization itself rests upon the soil."
 - *Thomas Jefferson*

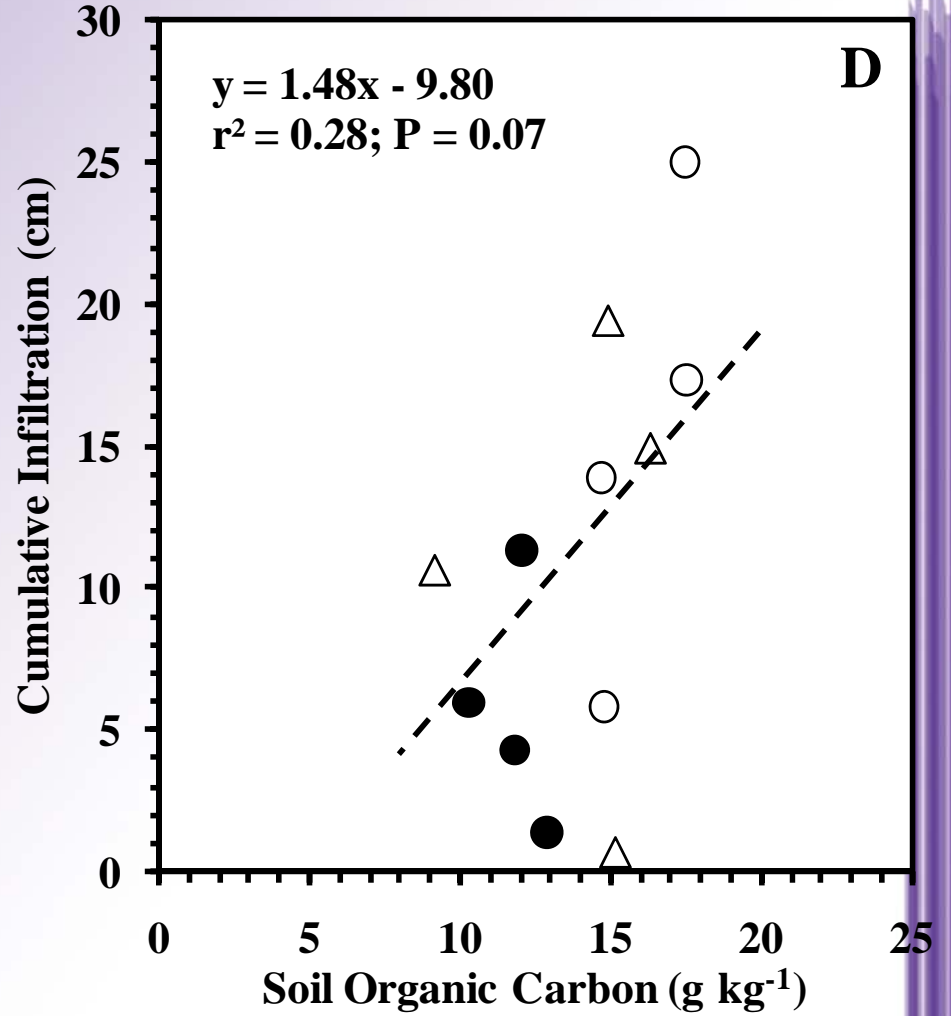
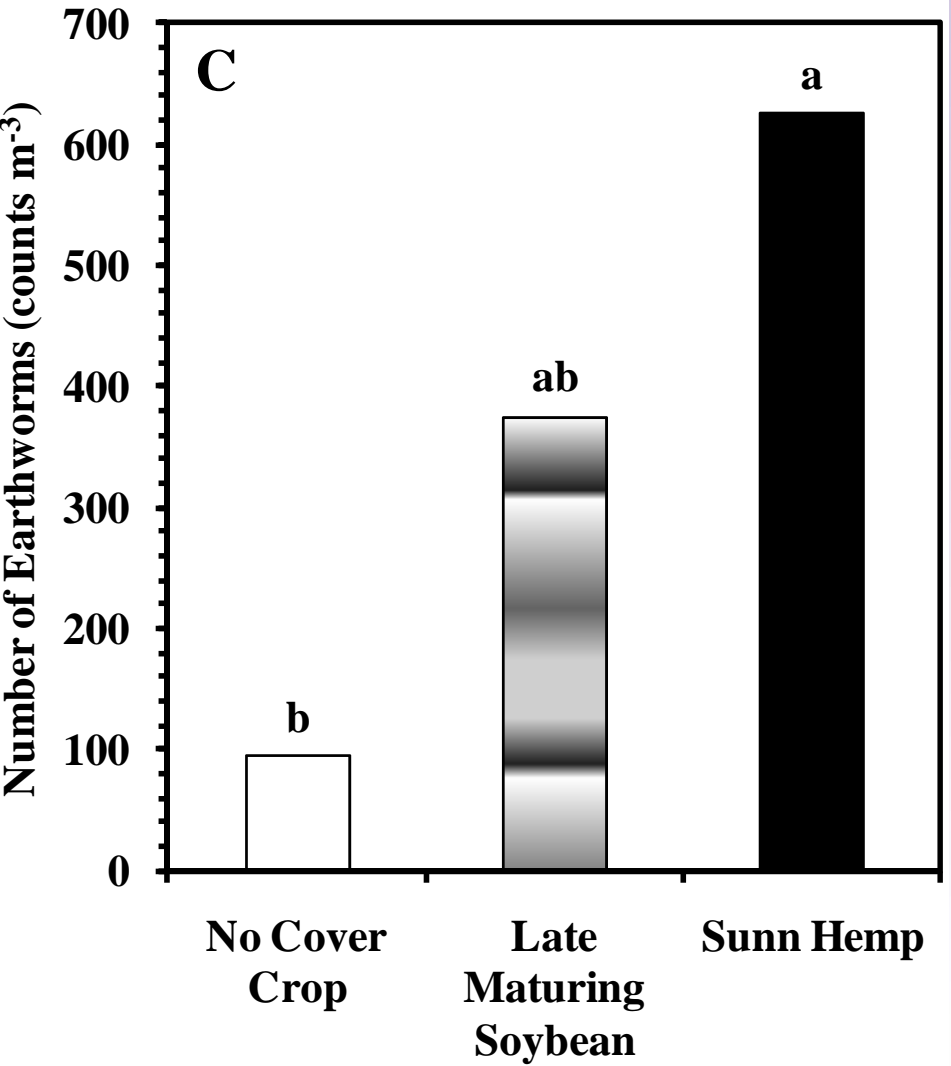
Effects on soils (Hesston)

- Blanco, Mikha, Presley, Claassen (SSSAJ, 2011)



Effects on soils (Hesston)





Earthworm specifics

- Stimulate microbial activity.
 - Earthworms consume microbes, many more microorganisms are present in their feces or casts than what they consume (gut)
 - They fragment and inoculate with microorganisms
 - Available plant nutrients (N, P, & K) tend to be higher in fresh earthworm casts than soil [Edwards et al., 1995]
- Mix and aggregate soil
 - Charles Darwin: earthworms can turn over the top six inches (15 cm) of soil in ten to twenty years.
 - “The plow is one of the most ancient and most valuable of man’s inventions, but long before he existed the land was in fact regularly ploughed, and continues to be thus ploughed by earthworms (1881)

Earthworms and soil quality

- Increase infiltration. Burrows persist and are conduits for water, particularly under heavy rainfall.
- Improve water-holding capacity.
 - Fragment organic matter, and increase soil porosity and aggregation
- Provide channels for root growth, lined with readily available nutrients
- Bury and shred plant residue
 - Incorporating nutrients, reducing stratification

Measuring earthworms and soil quality

- Excavate 1 ft³ of soil in one piece when soil surface is about 50 degrees
- >10 worms or cocoons is usually associated with very healthy soils
- 1-9 is moderate
- ≤1 indicates that the soil is very degraded

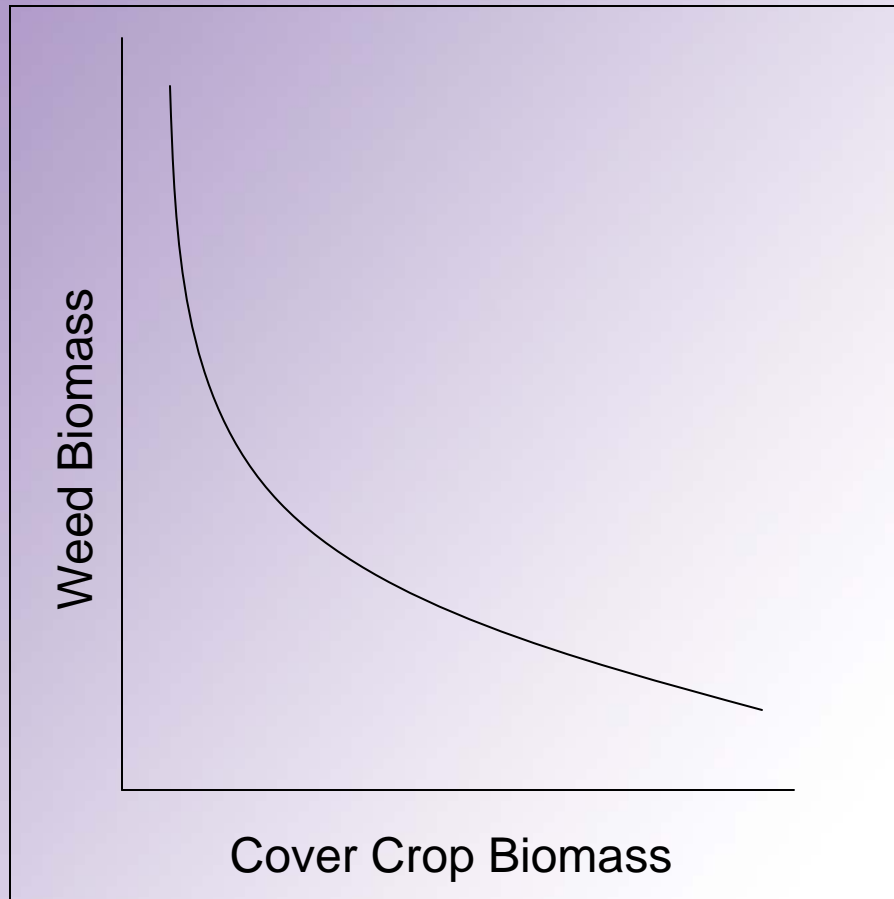
Potential Cost Savings

These are potential cost savings in CASH CROP production from using a COVER CROP.

- Herbicide Savings
- Fertilizer Savings
- Tillage Savings
- Irrigation Savings



Herbicide Savings



Cover crops can potentially provide weed suppression (as a residue mat and from allelopathy), reducing herbicide and spraying costs.

Fertilizer Savings

Cover Crop	Potential N fixation (lbs/ac)	Available N (lbs/ac) *assuming 50% of fixed N	Potential Fertilizer Savings (\$/ac, Price of N is \$0.40/lb)
Crimson Clover	60-150	30-75	\$6-\$15
Hairy Vetch	60-180	30-90	\$6-\$18
Sunn Hemp	100-125	50-62.5	\$10-\$13
Cow Peas	90-150	45-75	\$9-15
Soybeans	60-110	30-55	\$6-\$11

A guideline is to only credit about 50% of the available N (3rd column) when adjusting N application rates for a cash crop. For example, on a hairy vetch cover crop this would mean crediting 15 lbs of N (erring on the low side).

Tillage Savings

- Coupled with conservation-tillage practices, the additional savings from not performing tillage is \$18 to \$37.
- Brassicas (e.g. radishes) can provide “natural tillage” (to a depth of 6” to 14”), depending on the variety used.



of asphalt compactor passes on 8-year no-till soil
in spring, then planted daikon radishes in August 2008



Great resource for “new” covers

- <http://www.ars.usda.gov/Services/docs.htm?docid=20323>

Easier to Google
“cover crop periodic table”

Another one:
Midwest Cover Crops
Council
[http://mccc.msu.edu/
selectorINTRO.html](http://mccc.msu.edu-selectorINTRO.html)

However, can't use their
decision tool for KS (or
IA)

The screenshot shows a web browser window displaying the USDA-ARS website. The page title is "Cover Crop Chart". The main content area is titled "Cover Crop Chart" and contains a grid of colored boxes representing different crop species and their characteristics. The grid is organized into columns and rows, with each cell containing a small image and text. The text on the page explains the chart's purpose and provides instructions on how to use it. The page also includes a search bar, a navigation menu, and a footer with contact information.

Questions

“Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals.”

- Aldo Leopold, A Sand County Almanac

