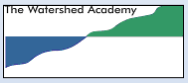
Improve Water Quality by Using Cover Crops and Other Conservation Practices

Webcast sponsored by EPA's Watershed Academy



Tuesday, March 25, 2014

1:00pm – 3:00pm Eastern

Instructors:

Dr. Hans Kok, Coordinator, Indiana Conservation Cropping Systems Initiative

Dan Towery, President, Ag Conservation Solutions

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Webcast Logistics

- **To Ask a Question** – Type your question in the "Questions" tool box on the right side of your screen and click "Send."
- **To report any technical issues** (such as audio problems) – Type your issue in the "Questions" tool box on the right side of your screen and click "Send" and we will respond by posting an answer in the "Questions" box.

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Overview of Today's Webcast

- Nutrient cycling and Soil Health
- Conservation Practices including Cover Crops
  - Types of cover crops
  - Case Studies
  - Environmental benefits to US watersheds

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Water Quality, Cover Crops & Conservation

- Part 1: Background (Dan)
- Part 2: Soil Basics (Hans)
- Part 3: Cover crop basics (Hans)
- Part 4: Question and Answer (Dan/Hans)

Dan Towery
Ag Conservation Solutions
(765) 490-0197
Dan@AgConservationSolutions.com

Hans Kok
Agriculture Consultant
HansKokLLC@gmail.com
(208) 596-2618

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Part 1: Background

Dan Towery

Dan Towery
Ag Conservation Solutions
(765) 490-0197
Dan@AgConservationSolutions.com

Hans Kok
Agriculture Consultant
HansKokLLC@gmail.com
(208) 596-2618

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These are not Your Grandfather's Cover crops

A Little History

- Cover crops are not new
- Before commercial fertilizer cover crops and hay fields were plowed and used as “green manure” (natural fertilizer)
- Historically planted on sandy fields or steep fields to reduce soil erosion – then tilled

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1950 – 1990

- Crop rotation intensified
- Intensive tillage used
- Soils very slowly degraded
  - –< organic matter
  - –<aggregate stability
  - –> compaction
  - –> runoff

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1980 - present

- < Moldboard plowing
- > But multiple tillage trips
- Cover crops used in South but usually tilled in very early spring
- No-till acres increased but still low

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Last 10 years

- Cover crop acres have increased but still low adoption
- > last 10 years in Great Plains
- > last 5 years in Midwest, East and South

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Yields continue to increase but soils have slowly degraded

- Yields continue to increase
  - Improved genetics
  - Improved & larger machinery – tractors, planters, sprayers, combines
  - Commercial fertilizer
  - Biotechnology
  - Fewer but larger farms

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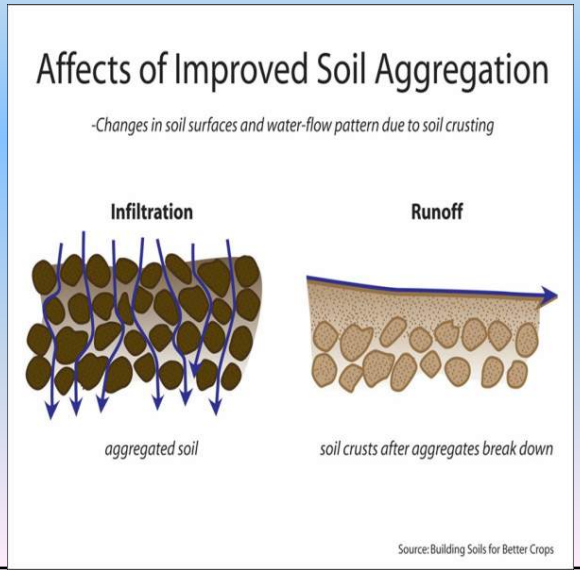
Degraded soil: cannot function at the highest level



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Cropland – Water Quality

- Main issues
  - –Sedimentation
  - –Nitrogen
  - –Phosphorus

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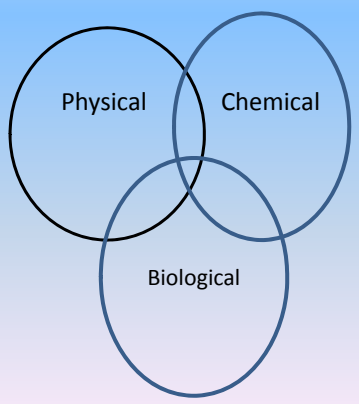
Soil Properties

- Physical
- Chemical
- Biological



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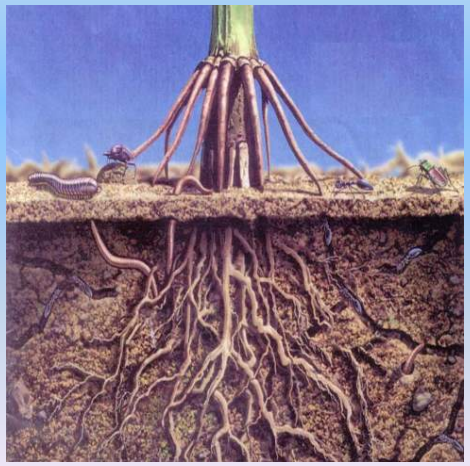
The Hidden Half of Agriculture



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Fertilizer Management – Old School

- Nitrogen – cheap insurance
  – don't be short
- Phosphorus – like money in the bank

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Nitrogen Losses in Corn

- We have a leaky system
- Only 40-60% of Nitrogen applied ends up as grain
- Most of the leaching occurs during the fall and early spring months when the soil is fallow in the typical corn-soybean rotation of the U.S. Midwest

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Most Cropland Soils are Leaky

- Soil texture and rainfall affect how leaky
  - Nitrates in the soil profile may be leached with high rainfall events
- Nitrogen management also affects how much is lost

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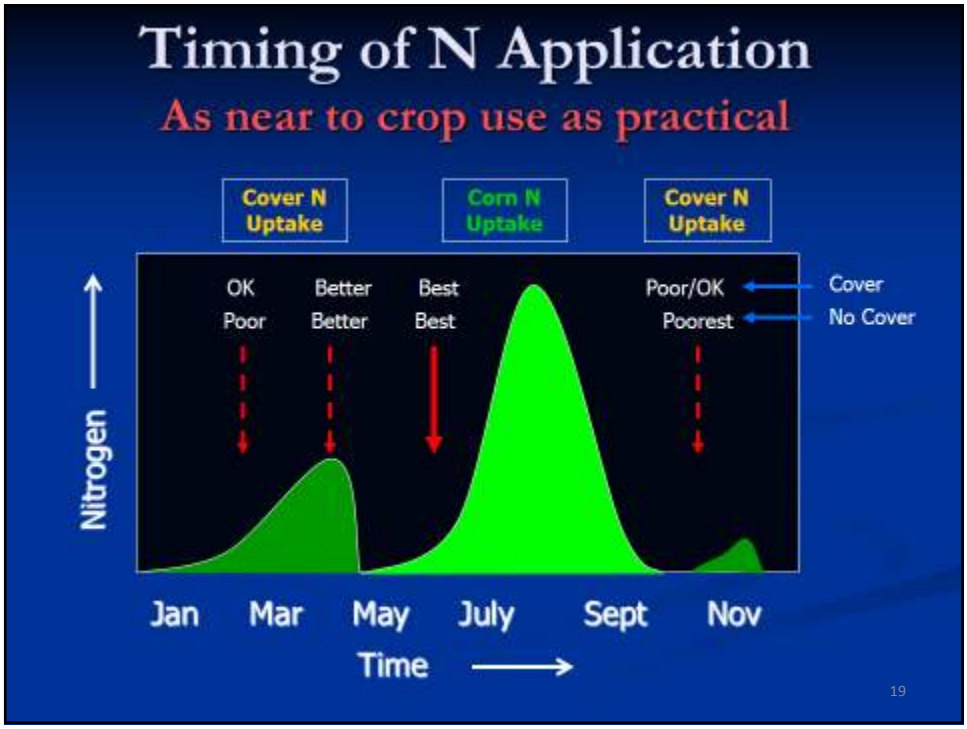

Cover Crops & Nitrate Loss

Literature summary of nitrate N leaching reduction from winter cover crops

-30 to 81% reduction

- Factors affecting N loss
  - -rainfall amount & timing
  - -soil type
  - -amount of N in soil profile
  - -biomass of cover crops

(Kaspar and Singer, 2011- adapted from Sharpley and Smith, 1991)

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Iowa Total Nitrate Loss 2002-2008

	Nitrate N lost	
	7 yr total lbs/ac	7 yr ave. lbs/ac
Corn-Soybean	321	**46**
Corn-Soybeans with Cereal Rye	136	**20**
		56% reduction

2002-2004 Kaspar et al.
J of Environ Quality
36:1503-1511

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Fertilizer Management - Now

- 4 R's
  - Right Source
  - Right Time
  - Right Amount
  - Right Place

Specific details vary depending on multiple factors and management decisions.

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Fall Applied Manure & Cover Crops

- N recovered for cash crop without a cover crop is typically only **15-20%**
- N recovered for cash crop with a cover crop is typically **40-50%**

* Some of the N is in a form that is not immediately available.

Data from Penn State University Agronomy Guide

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Nitrogen Management

- Is all about risk and how to reduce it
- Cover crops if managed properly can scavenge Nitrogen in the soil profile or can fix Nitrogen (legumes)

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Cover Crop Reduces Total P Losses

- Literature summary
  - 54 to 92% reduction in total P
  - +8 to 50% reduction in soluble P
  - Soluble P in cover crop residue at time of decomposition can increase soluble P loss

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Questions?

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Water Quality, Cover Crops & Conservation

Part 2: Soil Basics

Hans Kok

Dan Towery
Ag Conservation Solutions
(765) 490-0197
Dan@AgConservationSolutions.com

Hans Kok
Agriculture Consultant
HansKokLLC@gmail.com
(208) 596-2618

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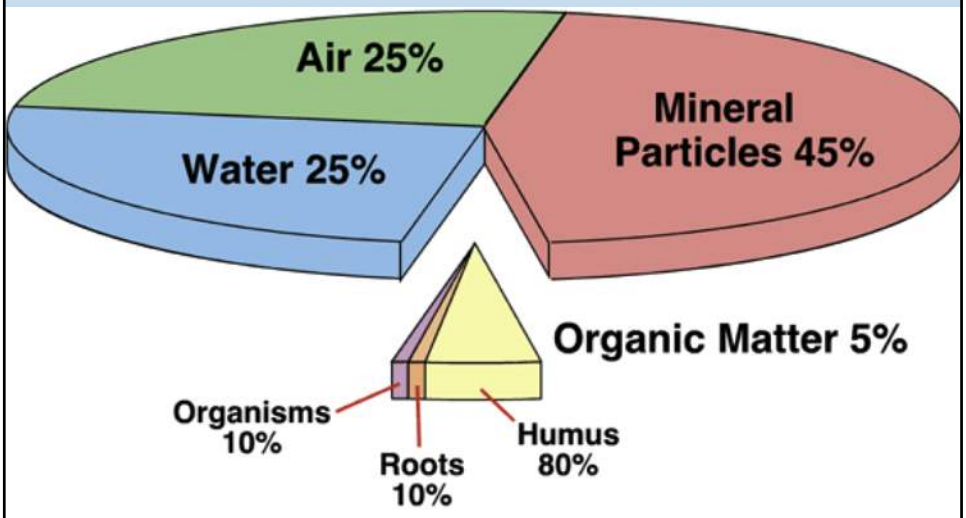
Soil is made of:



Soil: Half something, half nothing

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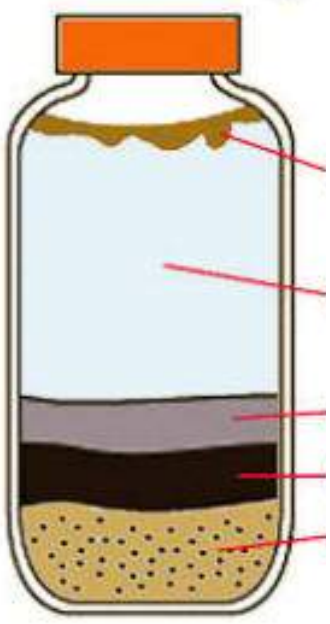
Soil Particles



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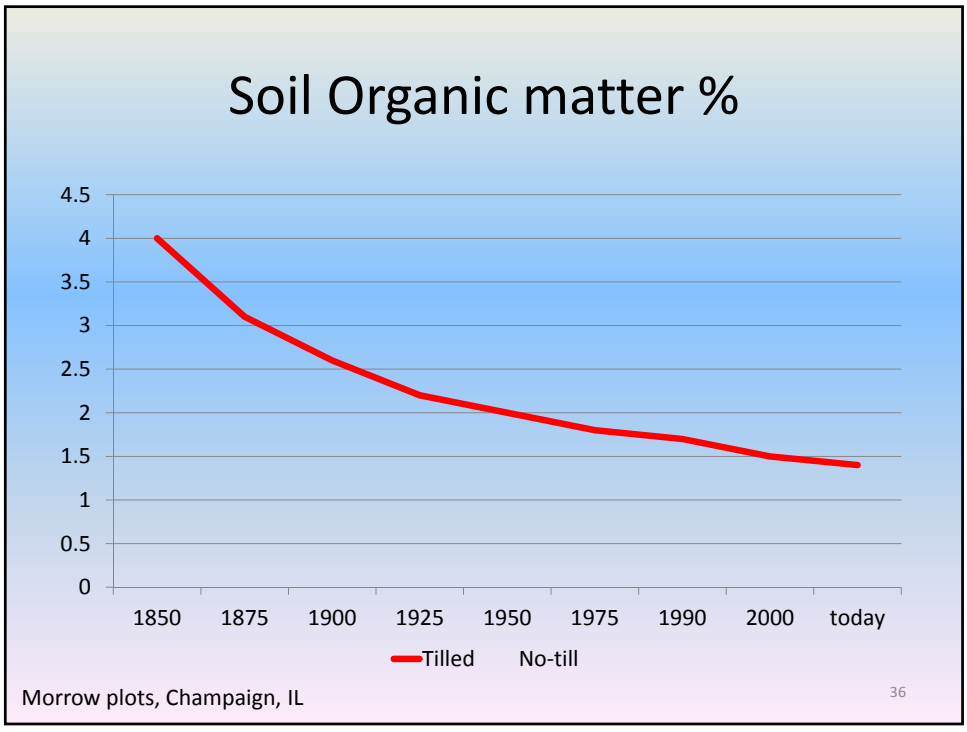
How did we get from THIS
to THIS??
Same soil, side-by-side samples


Soil Organic matter %
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1850
1875
1900
1925
1950
1975
1990
2000
today
Tilled
No-till
Morrow plots, Champaign, IL
36

Tillage effects on Soil Biology

- Intensive tillage results in soils dominated by bacteria
- Soil bacteria are not as good for soil aggregation
- Results:
  - Sealed soil surface,
  - increased runoff,
  - more compaction
- Disturbed soil pores

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No-till effects on Soil Biology

- ✓ Primarily fungi
- ✓ Decompose residue
- ✓ Bind soil particles
- ✓ Compete with pathogens
- ✓ Mycorrhizae, fungal hyphe

Hyphae expand effective rooting volume

Non-mycorrhizal root
(full tillage)

Water and nutrient extraction zone

Mycorrhizal root
(low-tillage)

Water and nutrient extraction zone

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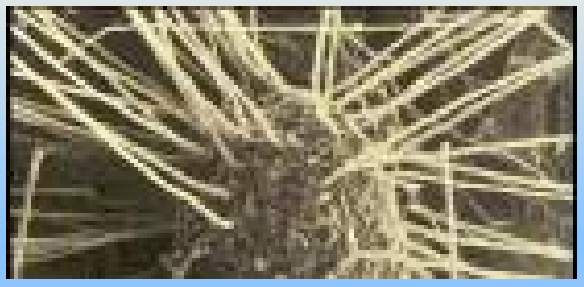

Wheat Seedling

100 X Magnification

Pictures by Mycorrhizal Applications Inc.

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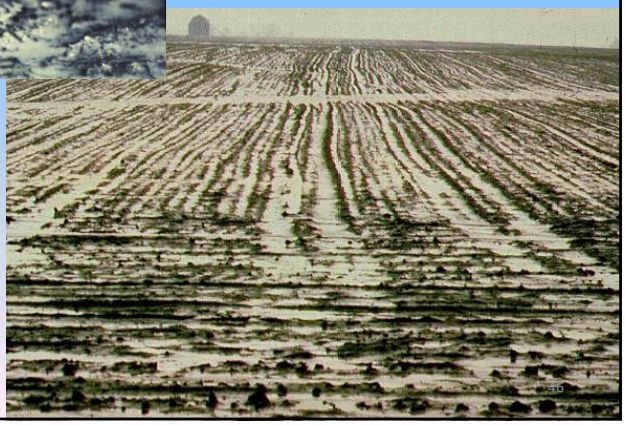
No-till - Soil Biology

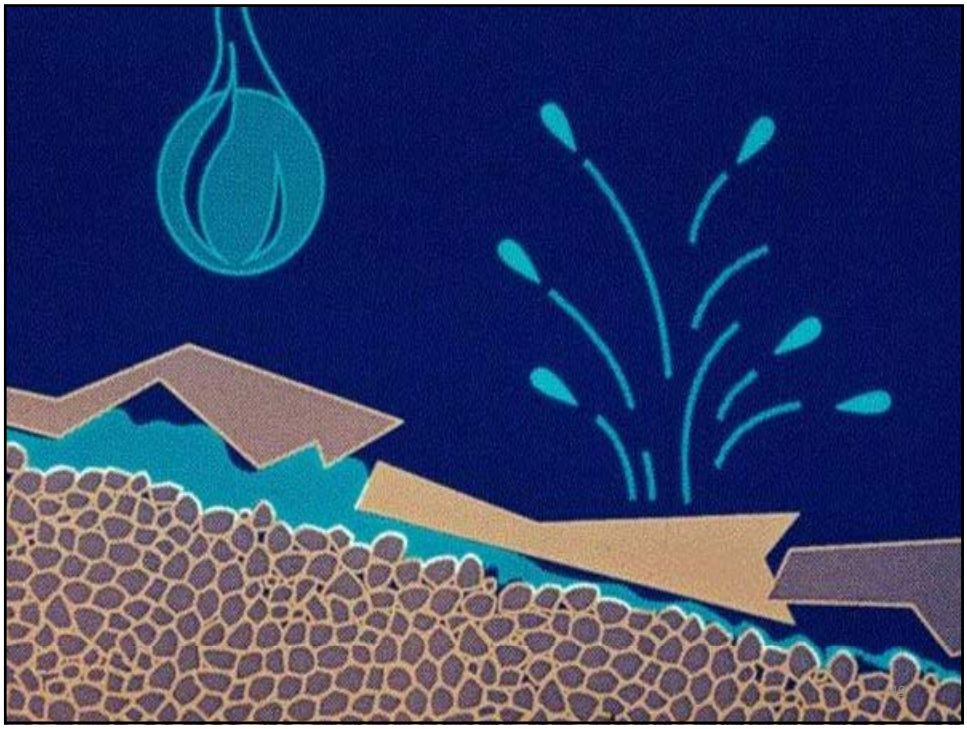
- ✓ Less disturbance
- ✓ Substantial increase in the number of earthworms
- ✓ May take several years
- ✓ Improves water infiltration
- ✓ After earthworm population increases excess residue is no longer a problem

Photo Odette Menard, Min of Ag Food and Fish, Quebec, Canada

We accept this degraded resource as ‘normal’



Tillage results:
Runoff
Erosion
Compaction
Crusting




Rain simulator: splash erosion

Soil under no-till

Good aggregate stability
Mainly fungi
Many earthworms

Soil under tillage

Low aggregate stability
Mainly bacteria

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Soil Health Testing

- Earthfort – microscope
- Ward Labs – Fatty acid assay
- Cornell – Mix of physical, biological, chemical
- Solvita – mineralizable N plus P and K

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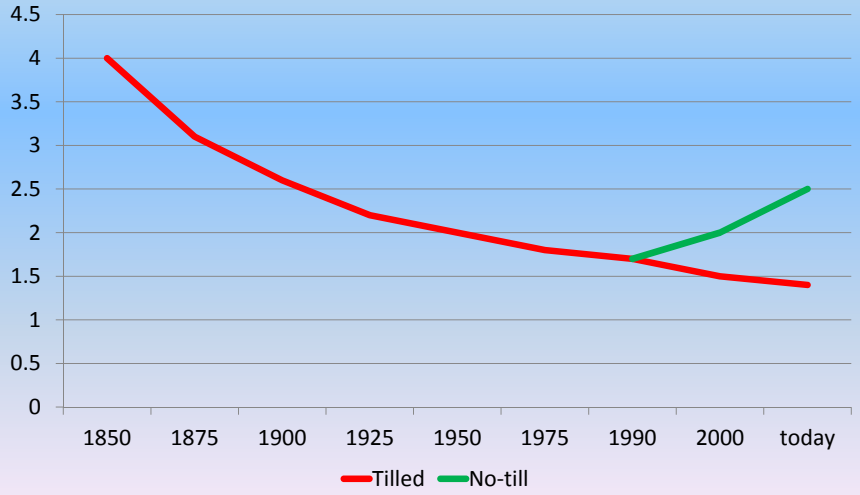
Soil Organic matter %



Morrow plots, Champaign, IL

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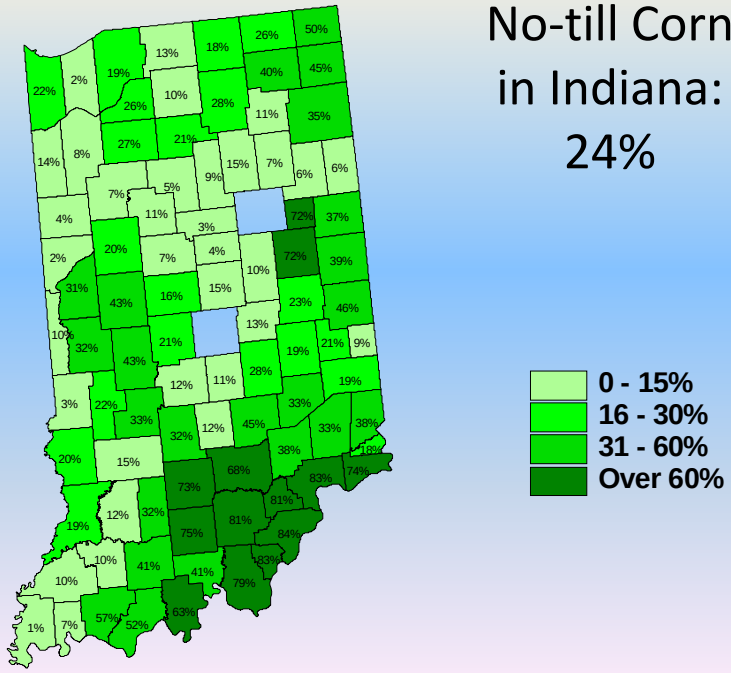
No-till Corn in Indiana: 24%



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Reduce Soil Disturbance!

Strip-till in terminated or living cover crop Photo Kevin Kuehn, ETS

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Diversity is the key

- Reducing tillage helps the soil 'heal'
- Mulch-till, Strip-till, No-till
- What else can we do?
- Our crop rotations are not diverse:
- Corn-corn-corn
- Corn-soybeans-corn
- Cover crops can add the diversity

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Questions?

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Water Quality, Cover Crops & Conservation

Part 3: Cover Crop Basics

Hans Kok

Dan Towery

Ag Conservation Solutions

(765) 490-0197

Dan@AgConservationSolutions.com

Hans Kok

Agriculture Consultant

HansKokLLC@gmail.com

(208) 596-2618

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What is a Cover Crop?

- Something grown between corn and soybeans
- Often planted after corn or soy harvest
- Sometimes planted in the standing corn/soy

- Grasses like annual ryegrass and cereal rye
- Brassicas like turnips and radish
- Legumes like clovers and peas
- Mixes

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What can Cover Crops do?

- Weed control; prevent nutrient robbing
- Carry-over nutrients left in soil; otherwise lost
- Produce nitrogen (limited in northern states)
- Forage for haying/grazing
- Erosion protection, increase infiltration
- Increase water holding capacity, rooting depth
- How many months do we use our soils?
- Catch solar energy, keep soil alive;
- Up to 7 extra months

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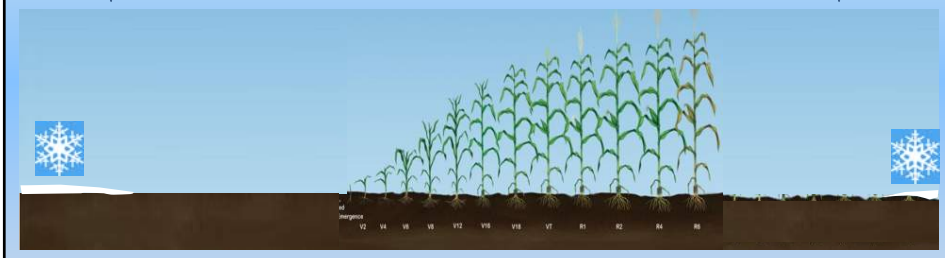
5 months of crop
(corn or soybean)

7 months of unused solar energy



Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Double the amount of time something grows in the field

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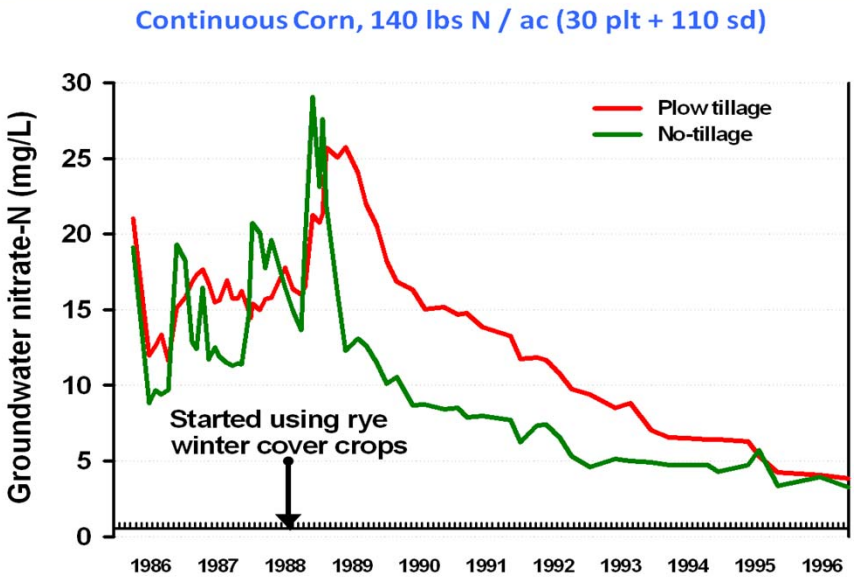
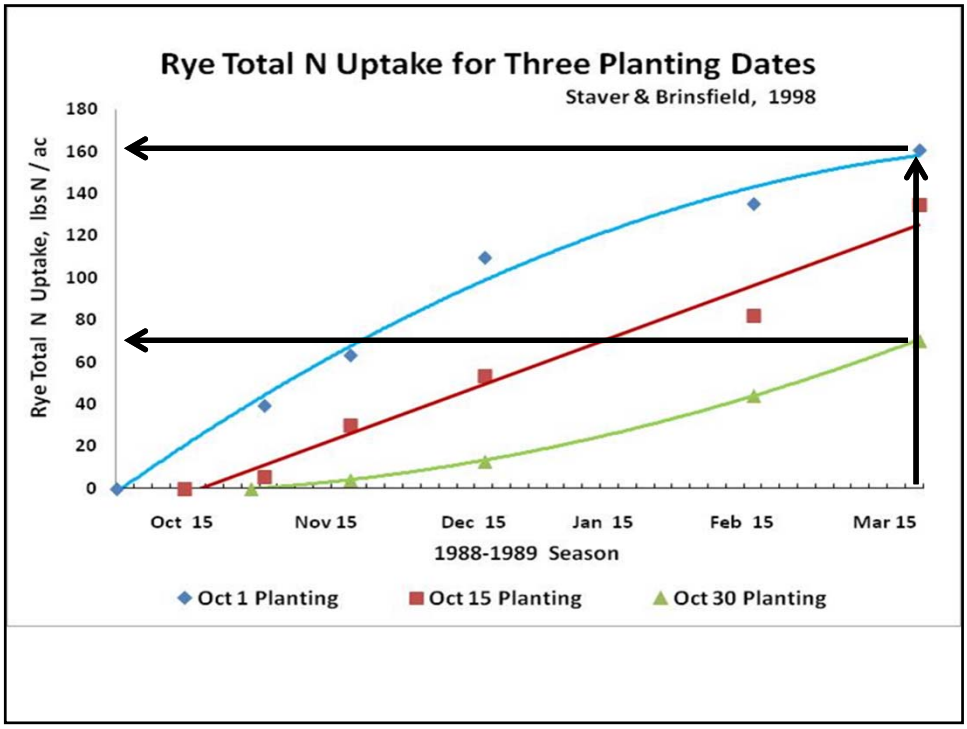
Shallow Groundwater Nitrate-N Concentration after beginning Cereal Rye Cover Crop



Staver, K.W. and R.B. Brinsfield. 1998


Rye Total N Uptake for Three Planting Dates
Staver & Brinsfield, 1998
Rye Total N Uptake, lbs N / ac
180
160
140
120
100
80
60
40
20
0
Oct 15
Nov 15
Dec 15
Jan 15
Feb 15
Mar 15
1988-1989 Season
Oct 1 Planting
Oct 15 Planting
Oct 30 Planting

Planting into Cereal Rye Cover Crop

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What cover crop to use

Grasses

1. Cereal rye
2. Annual ryegrass
3. Oats
4. Triticale
5. Wheat

Legumes (need Inoculants!)

1. Crimson Clover
2. Austrian winter pea

Brassicas

1. Oil seed radish
2. Canola or rape
3. Turnip

Mixes

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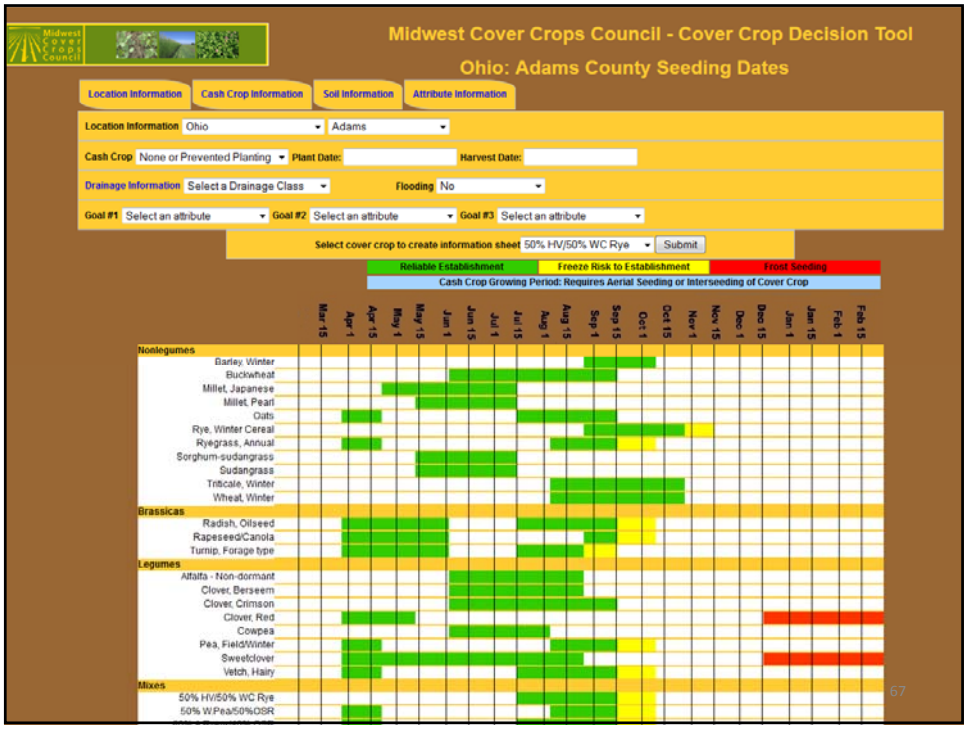
Midwest Cover Crops Council - Cover Crop Decision Tool
Ohio: Adams County Seeding Dates
Location Information
Cash Crop Information
Soil Information
Attribute Information
Location Information Ohio Adams
Cash Crop None or Prevented Planting Plant Date: Harvest Date:
Drainage Information Select a Drainage Class Flooding No
Goal #1 Select an attribute Goal #2 Select an attribute Goal #3 Select an attribute
Select cover crop to create information sheet 50% HV/50% WC Rye Submit
Reliable Establishment
Freeze Risk to Establishment
Frost Seeding
Cash Crop Growing Period: Requires Aerial Seeding or Interseeding of Cover Crop
Mar 15 Apr 1 Apr 15 May 1 May 15 Jun 1 Jun 15 Jul 1 Jul 15 Aug 1 Aug 15 Sep 1 Sep 15 Oct 1 Oct 15 Nov 1 Nov 15 Dec 1 Dec 15 Jan 1 Jan 15 Feb 1 Feb 15
Nonlegumes
Barley, Winter
Buckwheat
Millet, Japanese
Millet, Pearl
Oats
Rye, Winter Cereal
Ryegrass, Annual
Sorghum-sudangrass
Sudangrass
Triticale, Winter
Wheat, Winter
Brassicas
Radish, Oilseed
Rapeseed/Canola
Turnip, Forage type
Legumes
Alfalfa - Non-dormant
Clover, Berseem
Clover, Crimson
Clover, Red
Cowpea
Pea, Field/Winter
Sweetclover
Vetch, Hairy
Mixes
50% HV/50% WC Rye
50% W.Pea/50%OSR
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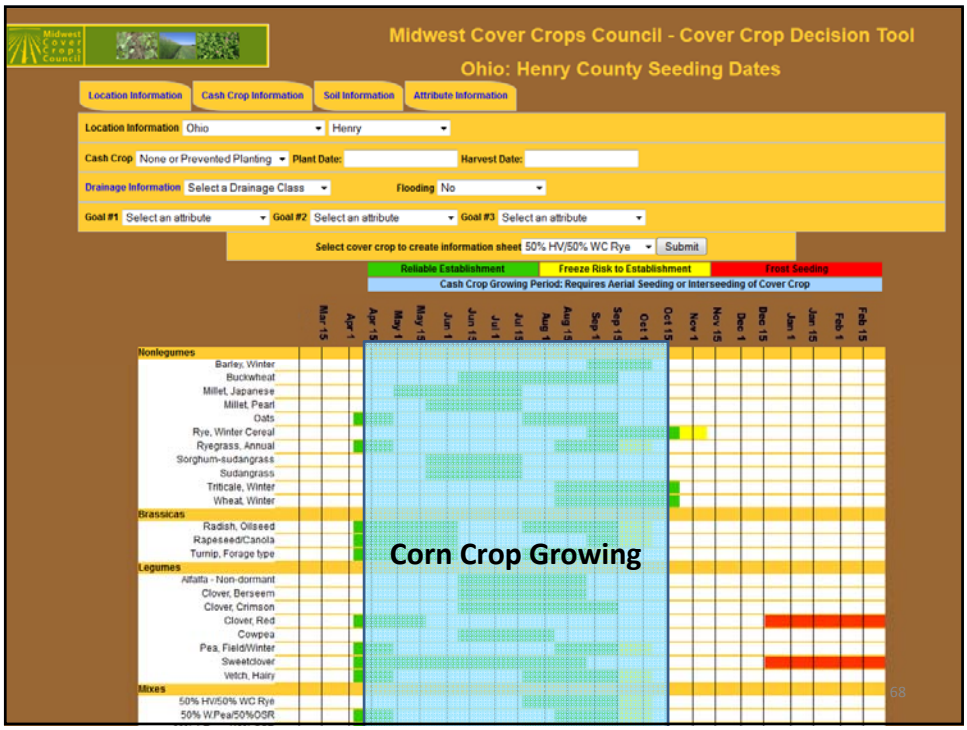
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Rye, Winter Cereal
Ryegrass, Annual
Sorghum-sudangrass
Sudangrass
Triticale, Winter
Wheat, Winter
Brassicas
Radish, Oilseed
Rapeseed/Canola
Turnip, Forage type
Legumes
Alfalfa - Non-dormant
Clover, Berseem
Clover, Crimson
Clover, Red
Cowpea
Pea, Field/Winter
Sweetclover
Vetch, Hairy
Mixes
50% HV/50% WC Rye
50% W.Pea/50%OSR
Corn Crop Growing
68

Date of Planting: Annual Ryegrass

September 15 October 15

On Nov 4: 11” growth vs 2” growth

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Seeding Options

Drilling or planting is best

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Seeder on ‘vertical tillage tool’

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Seeder on ‘vertical tillage tool’


Mike Shuter, Frankton, IN

Mike Shuter, Frankton, IN 1600 Feet of Hose


What Cover Crop to use? Single species (crimson clover)


Cocktail Mixes
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What Cover Crop to use?

What is the purpose of the cover crop?

- Scavenge left-over nutrients like Nitrogen
- Fix/produce Nitrogen
- Reduce compaction
- Reduce soil erosion
- Build soil organic matter
- Reduce weed pressure
- Grazing or forage

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How Cover Crops Improve Soil Health

- Increase pore space in root zone
- Improve infiltration and drainage
- Cover crop pores are more stable than tillage induced pores



Soil Health

- It resonates with farmers
- Improving their soils instead of just reducing soil erosion

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Soil Health Principals

(same as Conservation Agriculture)

1. Minimize soil disturbance
2. Keep the ground covered year round
3. Keep a living root growing as much as possible
4. As much diversity as possible

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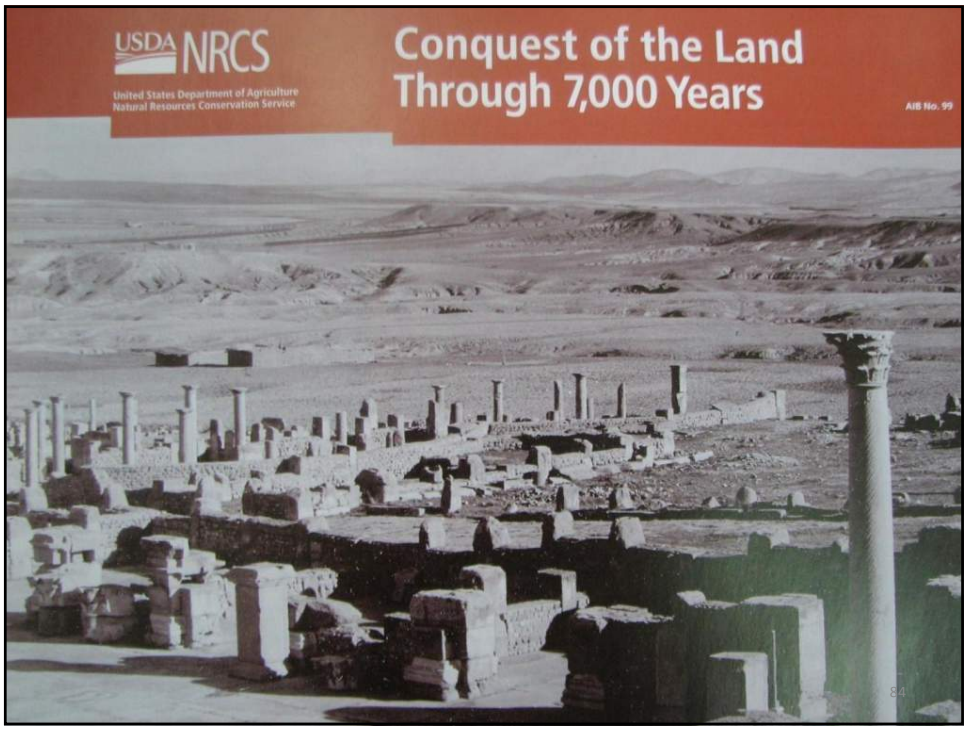
Keep Something Growing Every Day Possible

- Imitate Mother Nature

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Next Watershed Academy Webcast

EPA

The Watershed Academy

Living Shorelines
May 14, 2014

Information will be posted at
www.epa.gov/watershedwebcasts

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http://water.epa.gov/learn/training/wacademy/upload/2014-03-25-certificate.pdf

You can type each of the attendees names into the PDF and print the certificates.

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