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

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.
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

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
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

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

1950 – 1990

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

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
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

Degraded soil: cannot function at the highest level
Cropland – Water Quality

- Main issues
  - Sedimentation
  - Nitrogen
  - Phosphorus

Soil Properties

- Physical
- Chemical
- Biological
The Hidden Half of Agriculture

Fertilizer Management – Old School

• Nitrogen – cheap insurance
  – don’t be short
• Phosphorus – like money in the bank
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

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
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)
Iowa Total Nitrate Loss 2002-2008

<table>
<thead>
<tr>
<th></th>
<th>Nitrate N lost</th>
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<tr>
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<td>7 yr total</td>
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<tr>
<td></td>
<td>lbs/ac</td>
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<tr>
<td>Corn-Soybean</td>
<td>321</td>
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<tr>
<td>Corn-Soybeans with Cereal Rye</td>
<td>136</td>
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56% reduction

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

Fertilizer Management - Now

• 4 R’s
  — Right Source
  — Right Time
  — Right Amount
  — Right Place

Specific details vary depending on multiple factors and management decisions.
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)
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

Questions?
Soil is made of:

- Air 25%
- Water 25%
- Mineral Particles 45%
- Organic Matter 5%

Organisms 10%
Roots 10%
Humus 80%

Soil: Half something, half nothing
Soil Particles

- Organic Matter
- Water
- Clay, Very fine
- Silt, Fine
- Sand, Coarse
How did we get from THIS to THIS??

Same soil, side-by-side samples

Soil Organic matter %

Morrow plots, Champaign, IL
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

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

Wheat Seedling

100 X Magnification

Pictures by Mycorrhizal Applications Inc.
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
Soil under no-till
Good aggregate stability
Mainly fungi
Many earthworms

Soil under tillage
Low aggregate stability
Mainly bacteria

Soil Health Testing
• Earthfort – microscope
• Ward Labs – Fatty acid assay
• Cornell – Mix of physical, biological, chemical
• Solvita – mineralizable N plus P and K
Soil Organic matter %

Morrow plots, Champaign, IL

No-till Corn in Indiana: 24%
Reduce Soil Disturbance!

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
Questions?

Water Quality, Cover Crops & Conservation

Part 3: Cover Crop Basics
Hans Kok

Dan Towery
Ag Conservation Solutions
(765) 490-0197
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Agriculture Consultant
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(208) 596-2618
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

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
5 months of crop
(corn or soybean)
7 months of unused solar energy

Double the amount of time something grows in the field

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

Continuous Corn, 140 lbs N / ac (30 plt + 110 sd)

Staver, K.W. and R.B. Brinsfield. 1998
Rye Total N Uptake for Three Planting Dates
Staver & Brinsfield, 1998

![Graph showing Rye Total N Uptake for different planting dates from Oct 15 to Mar 15 in the 1988-1989 season. The graph compares Oct 1 Planting, Oct 15 Planting, and Oct 30 Planting, with the uptake measured in lbs N/ac.]
Planting into Cereal Rye Cover Crop

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
**Midwest Cover Crops Council - Cover Crop Decision Tool**

**Ohio: Adams County Seeding Dates**

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**Select cover crops to create information chart.**

**Midwest Cover Crops Council - Cover Crop Decision Tool**

**Ohio: Henry County Seeding Dates**

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**Select cover crops to create information chart.**
Date of Planting: Annual Ryegrass

- September 15
- October 15

On Nov 4: 11” growth vs 2” growth

Seeding Options

Drilling or planting is best
Seeder on ‘vertical tillage tool’
Seeder on ‘vertical tillage tool’

Mike Shuter, Frankton, IN
What Cover Crop to use? Single species (crimson clover)

Cocktail Mixes
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

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

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
Keep Something Growing Every Day Possible

• Imitate Mother Nature
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Hans Kok
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HansKokLLC@gmail.com
(208) 596-2618
Speaker Contact Information

**Hans Kok, PhD, CCA**  
Agriculture Consultant  
208-596-2618  
hanskokllc@gmail.com

**Dan Towery**  
President  
Ag Conservation Solutions  
2632 N 9th Street Rd, Suite D  
Lafayette, IN 47904  
765-490-0197  
dan@agconservationsolutions.com

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**Living Shorelines**  
May 14, 2014

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