


Cover Crops to Improve Soil Health

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Cereal rye, SE Indiana

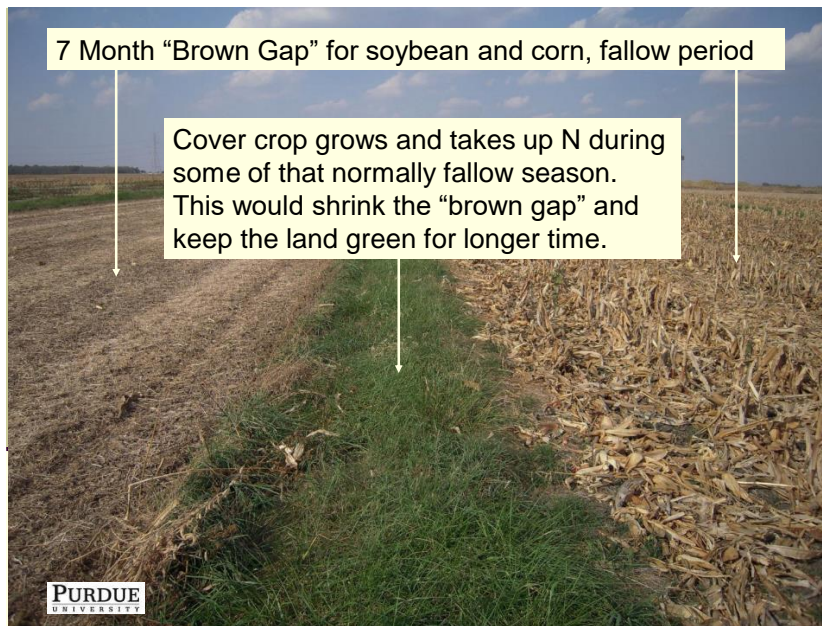
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Rationale for cover crops

- A living, growing plant at times of year when we normally have nothing growing.
- Capture sunlight, feed soil organisms, sequester carbon, trap and recycle nutrients, improve soil health
- Make better use of the resources and time available!



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Cover crops are part of a system!

- Different potential benefits and challenges for each type of cover crop
- Must adapt cropping system, including nutrient mgmt, NT (tillage) system, manure, pest mgmt, crop rotation
- Learning curve—need to do homework!

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Characteristics of healthy soil

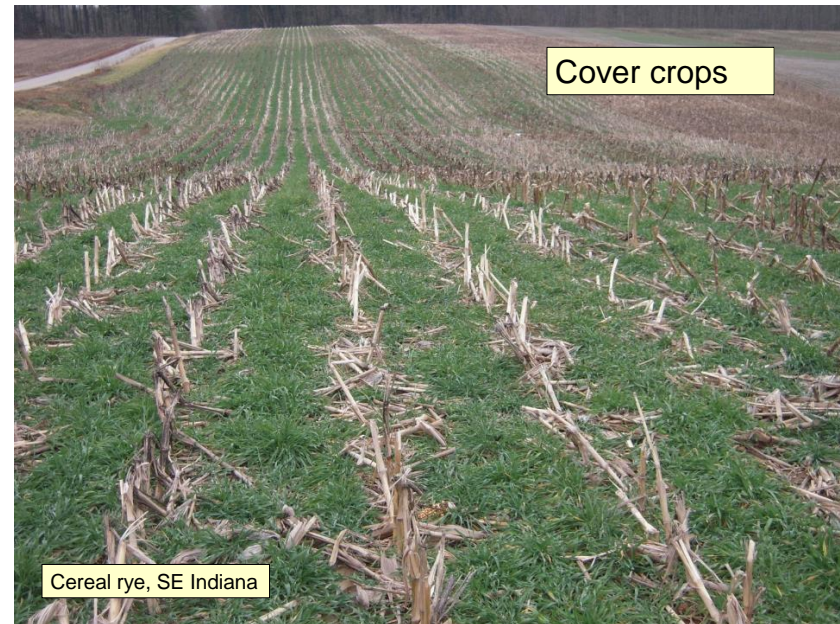
- Good water infiltration
- Adequate water retention, storage
- Resistance to erosion, crusting
- Filtering capacity
- Good rooting depth
- Trafficability
- Adequate aeration
- Nutrient availability

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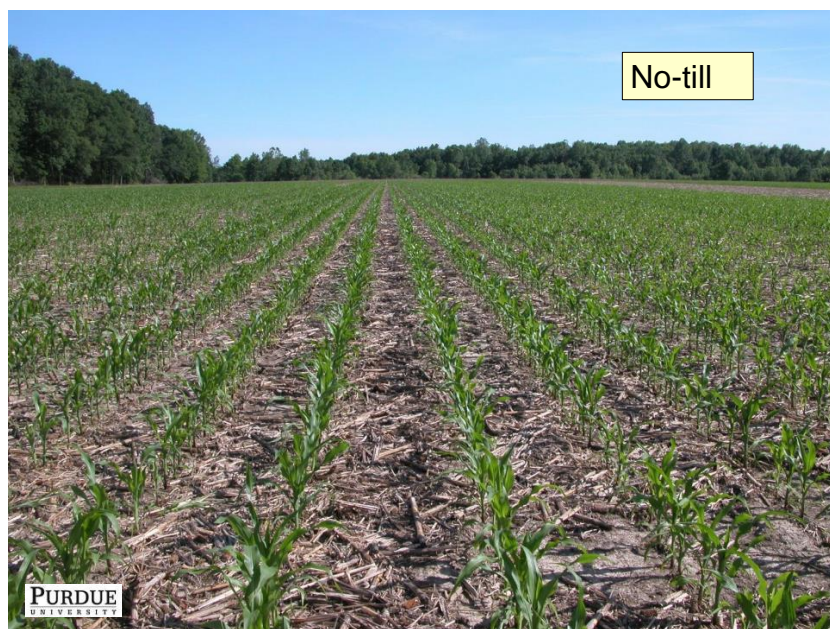
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Why are you planting a cover crop?

- What is the main purpose?
- What are the resource concerns?
- The main purpose(s), affect:
 - Selection of cover crop(s)
 - Management of cover crop(s)

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What are the potential benefits?

(What are your main goals?)

- Nitrogen scavenger
- Nitrogen producer (legume)
- Reduce erosion
- Improve soil quality– aggregation, infiltration, soil biological activity, rooting depth
- Increase soil organic matter (sequester C)
- Conserve soil moisture
- Recycle nutrients
- Weed control, pest suppression, extra forage
- **Increase crop yields over long-term, and decrease year-to-year variability in yields**

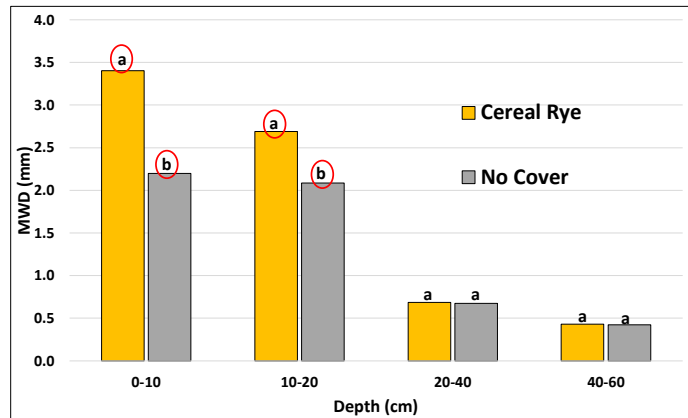
Soil physical properties improved

- Aggregation (esp. fibrous-rooted)–
 - roots enmesh particles
 - exudates feed microbes; they produce “glues”
- Porosity, permeability (esp. tap-rooted)
 - Deep roots, macropores, → aid water infiltration, aeration, rooting
- Soil surface protected, plus better aggregation→ less crusting or erosion
- Roots give strength to soil for trafficability

Aggregate Stability

SEPAC 2015

J.D. Rorick, M.S. Thesis, 2016



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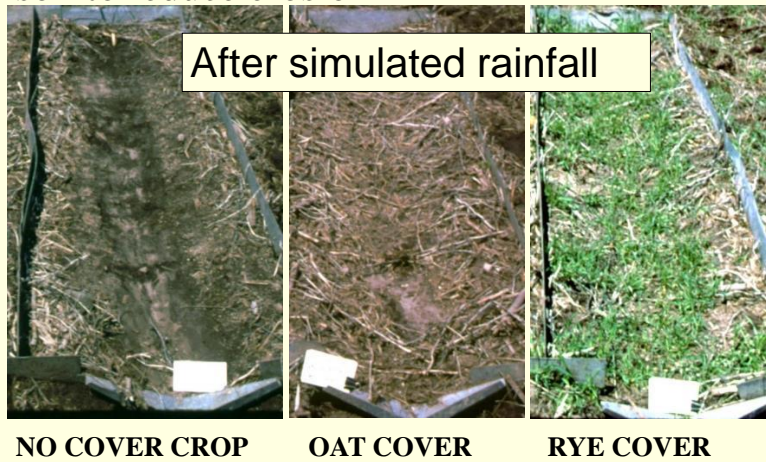
Cover Crops and No-Till Soil Structure



T. Kaspar, Iowa

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Classic purpose of cover crops—cover the soil to reduce erosion



Tom Kaspar, Iowa

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Corn silage land with and without a cereal rye cover crop



Tom Kaspar, Iowa

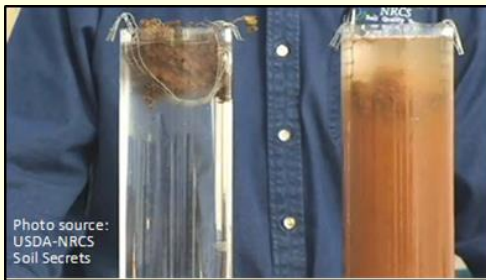
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Roots or shoots?

- When building soil quality, esp. with NT, the cover crop **ROOTS** are probably more significant than the shoot growth
- Still need good shoot growth for erosion control, mulch effects for moisture conservation, weed suppression, etc.



Why is improved soil health important for stormwater?



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Turning Soils into Sponges

How Farmers Can Fight Floods and Droughts



- Report analyzed 150+ field experiments from six continents, incl perennials, cover crops, NT, others. Continuous living cover was best strategy.
- Increased water infiltration, decreased runoff, increased soil water holding capacity **(more water for crop use including in drought years; less runoff and flooding in wet and dry years)**

Basche, A., 2017

www.ucsusa.org/food-agriculture/advance-sustainable-agriculture/turning-soils-sponges#.Whr5m1WnHIU

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Of course there's a limit!

- Once the soil is saturated, and water table is at the surface, little difference at that moment in surface runoff.
- But healthy soils will remain more stable even under exceptionally wet conditions, and recover faster.
- Spring 2019 was extremely challenging!
- Need healthy soils along with other practices, to deal with storm water issues



Muddy runoff from conventionally tilled corn field
June 23, 2017, Gibson Co., IN
Photo credit: SW Indiana USDA-NRCS





Clear runoff from cover-cropped, no-till soybean field
 June 23, 2017, Gibson Co., IN
 Photo credit: SW Indiana USDA-NRCS



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Clear runoff from cover-cropped, no-till soybean field.
 Note muddy water in foreground, clear water running off field.
 June 23, 2017, Gibson Co., IN
 Photo credit: SW Indiana USDA-NRCS



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Let's look at the N scavenging benefit of cover crops.....

- Even well-managed corn and soybean fields have nitrate losses to tile drains that pose water quality problems as well as an economic loss to the producer

Department of Agronomy

<https://www.agry.purdue.edu/drainage/>

SEPAC Drainage Research

Home

Yields

Water Quality

Layout & Design

Publications

Related Links


Agricultural Drainage

Water Quality Field Station

Experimental Drainage Plots

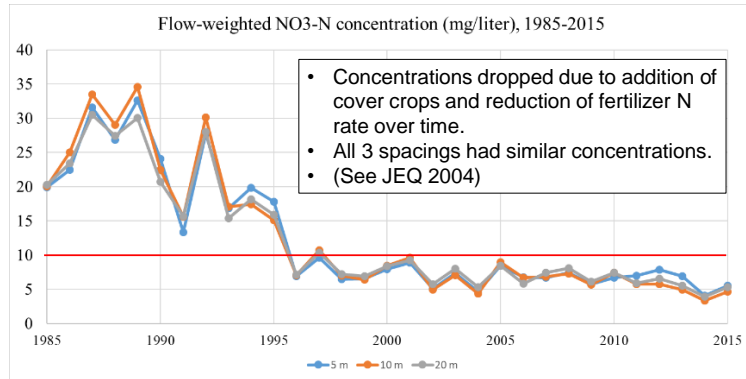
The Experimental Drainage Field at the Southeast Purdue Agricultural Center (SEPAC) was initiated in 1983 by researchers in Purdue's Departments of Agronomy and Agricultural & Biological Engineering.

The original goal of the project was to evaluate the effectiveness of modern subsurface drainage practices on both soil drainage and crop yield, on a soil that was traditionally not subsurface- ("tile-") drained. Additional goals were added with time and included study of nitrate and pesticide leaching into drain water as well as impacts of drainage and agronomic management practices on soil quality.

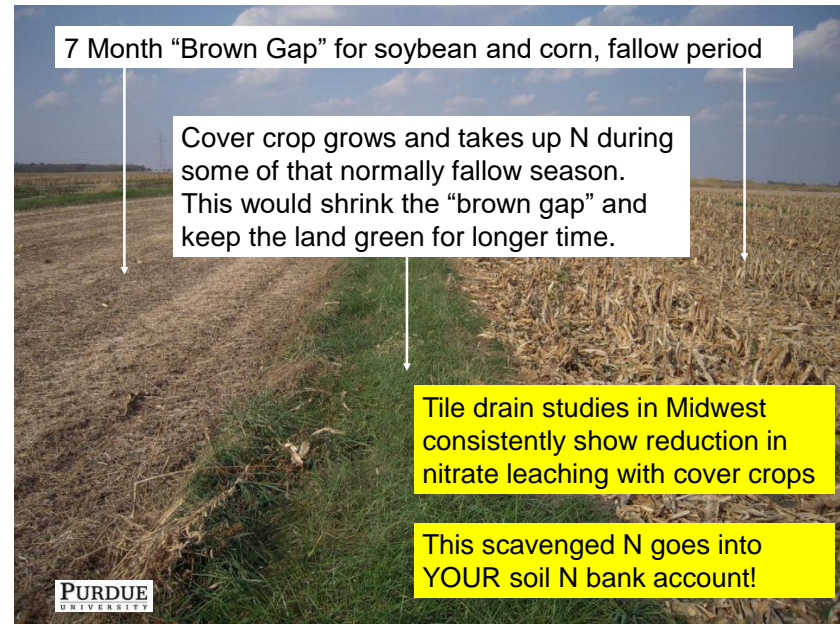


The Experimental Drainage Plots are located on **Clermont Silt Loam** at the **Southeast Purdue Agricultural Center (SEPAC)**, near Butteville, IN

SE PAC Drainage Site



See Extension publication and video, at www.agry.purdue.edu/drainage/



How select cover crops?

- What is your main purpose?
- What is your cropping / tillage system?
 - Current cash crop and next cash crop?
 - No-till, strip till, or other systems?
- What time windows are available?
- Want winter-hardy or winter-kill?
- How will you seed the cover crop?
- Soil types, climate, drought, manure, herbicide carryover, or other local considerations?

[MCCC tool can help with these!](#)

Details are very important!

- Not all cover crops work equally well for different purposes
 - Select the proper cover crop(s)
 - Manage those covers for intended purpose (ie, same cover can be managed differently—termination time, seeding rates, alone or in mix,)

Some considerations

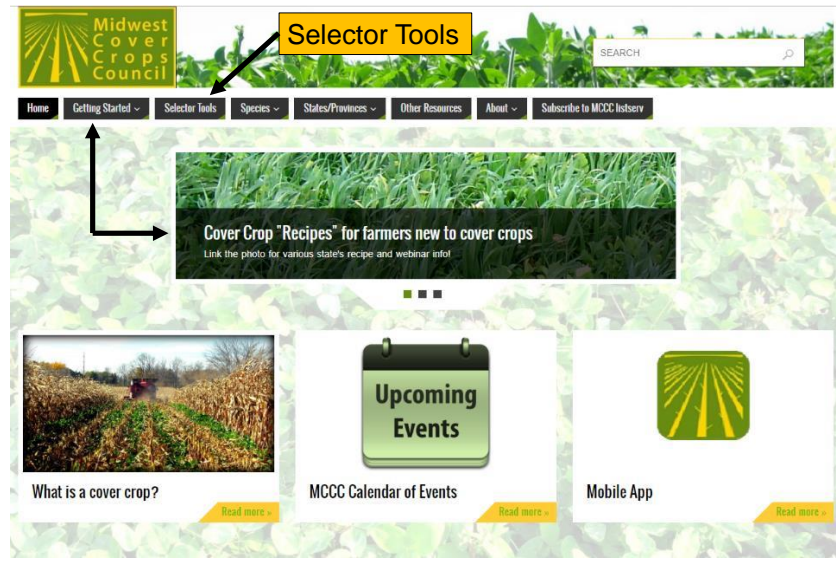
- Want covers that winter-kill, or those that grow again in spring?
- If alive in spring, when terminate? (how tall, or growth stage, or biomass, or weather, or cash crop, or purpose)
- Single species, or mixtures?
- If you're in a watershed with P concerns, then want at least one species that doesn't winter-kill, for ex.

Three main categories of cover crops have different effects

- Grasses
- Brassicas
- Legumes



www.midwestcovercrops.org



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South Dakota, all county ave

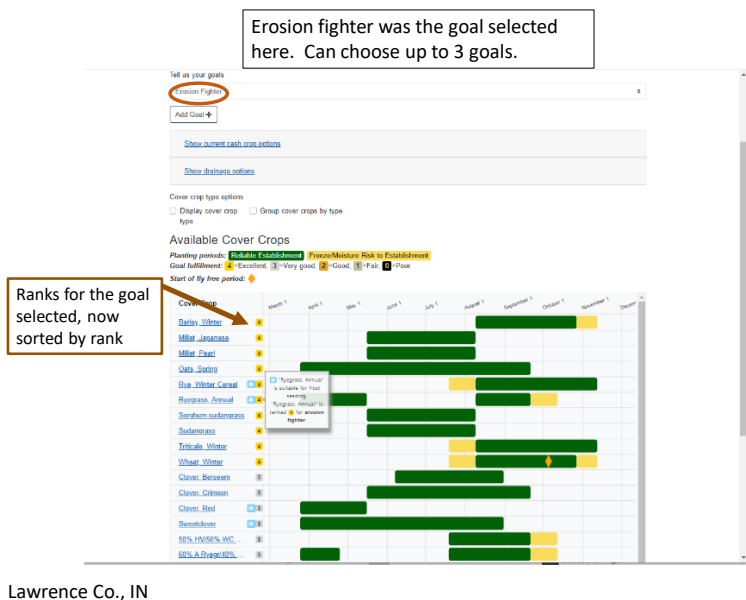
www.midwestcovercrops.org
Cover crop decision tool

Available Cover Crops

Planting periods: **Variable Establishment** **Freeze/Moisture Risk to Establishment**
Suitable for frost seeding: **Yes**

Cover Crop	Type	April 1	May 1	June 1	July 1	August 1	September 1	October 1	November 1
Barnyard_Scorpion	Grasses		█	█	█	█	█	█	
Corn	Grasses		█	█	█	█	█	█	
Millet_Foxtail	Grasses		█	█	█	█	█	█	
Millet_Pearl	Grasses		█	█	█	█	█	█	
Millet_Proso	Grasses		█	█	█	█	█	█	
Oats	Grasses		█	█	█	█	█	█	
Eye_Winter_Congo	Grasses		█	█	█	█	█	█	
Bromegrass_Annual	Grasses		█	█	█	█	█	█	
Sudangrass	Grasses		█	█	█	█	█	█	
Tall_Wheatgrass	Grasses		█	█	█	█	█	█	
Teff	Grasses		█	█	█	█	█	█	
Triticale_Spring	Grasses		█	█	█	█	█	█	
Triticale_Winter	Grasses		█	█	█	█	█	█	
Wheat_Spring	Grasses		█	█	█	█	█	█	
Wheat_Winter	Grasses		█	█	█	█	█	█	
Alfalfa_Soft_Tolerant	Legumes		█	█	█	█	█	█	
Clover_Crimson	Legumes		█	█	█	█	█	█	
Clover_Red	Legumes		█	█	█	█	█	█	
Cowpea_Dry_Beans	Legumes		█	█	█	█	█	█	
Lentils	Legumes		█	█	█	█	█	█	
Peas	Legumes		█	█	█	█	█	█	

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How to get started?

- Many farmers and crop advisors are interested in using cover crops
- Many reasons, incl. soil health, N scavenging, erosion control, weed suppression
- But how to start? Many options, for species and management. Sometimes overwhelming.
- These “recipes” are aimed at new cover crop users, to learn basic mgmt., get experience, w/ relatively low risk. Then many other options possible after learning basics.



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Cover Crop "Recipes"



SOUTH DAKOTA COVER CROP RECIPE MCCC-135

Post Corn, Going to Soybean: Use Cereal Rye

The publication is intended to provide a starting point for growers who are new to growing cover crops. While specific practices may vary between different cover crop types, the information provided is intended to be a general guide.

Introduction

With many farmers focused on cash crops, cover crops are often overlooked. However, cover crops can provide many benefits to the soil and the farm. Cover crops can help improve soil health, reduce erosion, and provide a source of organic matter. They can also help with weed control and provide a source of nitrogen for the next crop.

Post Small Grains, Going to Soybean or Corn: Use a Cool-Season Mix

The publication is intended to provide a starting point for growers who are new to growing cover crops. While specific practices may vary between different cover crop types, the information provided is intended to be a general guide.

Introduction

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Publication numbers:

- MCCC-135
- MCCC-136

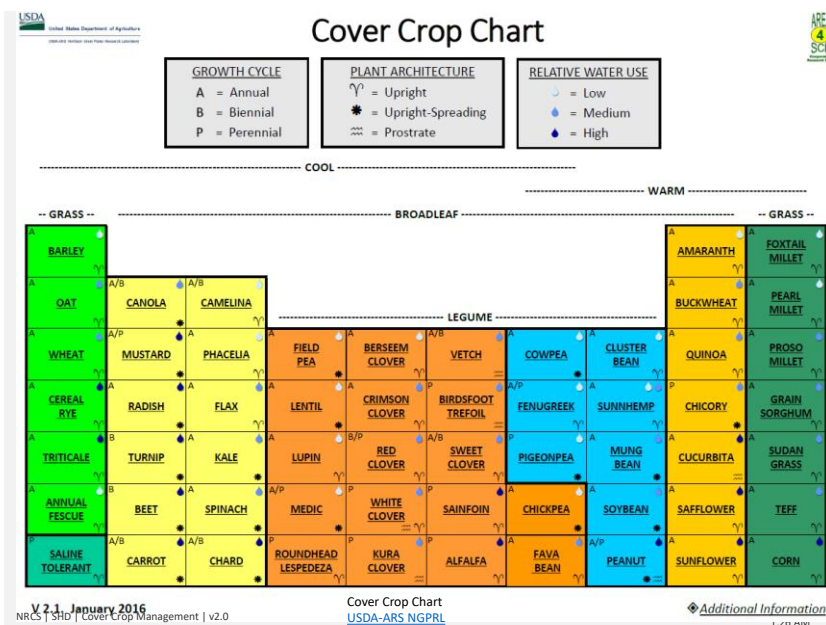
Available at www.midwestcovercrops.org
go to "getting started" tab

Recipes now available for all states in Midwest, plus Ontario and Manitoba



- Cereal rye (*Secale cereale* L.) often chosen because most winter-hardy and widely adaptable across northern regions

Cereal rye, SE Indiana



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Lots of variations on the theme!

- As farmers and advisors gain more experience with managing cover crops on their soils, more complex systems can be implemented.
- If have wheat in rotation and not double-crop, can seed bigger mix (“cocktail mix”) after wheat, for great diversity of plants and roots.
- Can add crimson clover, cereal rye, to oats/daikon radish before corn.
- Corn silage; seed corn; other short-season crops

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If cover crops and no-till are so good, why isn't everyone using them?

- Short-term costs, often no short-term economic gain
- **Site specific; details matter; steep learning curve**; time constraints; negative local “history”
- **Technical assistance and education needed**
- Still some R&D needed to optimize systems for diff soils, crops, regions

How do we measure soil health?

- Integrated soil health tests are new
 - Biology is especially difficult to assess
 - Physical properties also difficult
 - Fertility (chemical) tests well established for decades
- Once measured, what does it mean?
 - Biology not well understood—so many organisms, interactions, redundancy, dynamic changes w/ weather, food,



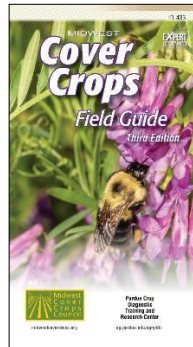
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The image shows a collage of resources related to soil health:

- USDA United States Department of Agriculture** logo and **Natural Resources Conservation Service** text.
- Google: NRCS Soil Health** search results showing various articles and videos.
- unlock the SECRETS OF THE SOIL** logo.
- PROFILES IN soil health** article featuring Jiminy Emmons, a farmer from Nowata County, Oklahoma, who has 2,000 acres of land with cover crops like wheat, alfalfa, canola, cover, and sorghum.
- PROFILES IN soil health** article featuring Julie Taylor, a farmer from the Fairfield Bench, Oklahoma, who has 510 acres of land with cover crops like sorghum, winter wheat, and hairy vetch.
- unlock THE SCIENCE OF SOIL HEALTH** logo.
- Farming Changes Focus on Soil Health** article.
- A list of benefits on the right side:
 - Raised awareness
 - Expanded demand for system adapted information
 - Raising many good questions
- Disclaimer at the bottom: *This information is provided as a public service and constitutes no endorsement by the USDA-NRCS of any service, supply, or equipment listed. The USDA-NRCS does not make pesticide recommendations.*

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Resources



3rd Edition available!

Purdue Extension Education Store
www.edustore.purdue.edu

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**Check out the “recipes” under Getting Started tab!
 Including video/webinar of Indiana recipes
 explained in detail!**

Also Google
 North Central SARE, for many
 resources on cover crops,
 sustainable ag

Speaker contact:
kladivko@purdue.edu