

Cover Crops: Opportunities and Challenges

North American Manure Expo

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Why Cover Crops? Opportunities

- Reduce erosion
- Soil Health: Improve soil microbiology, earthworm activity
- Soil Quality: improve soil tilth, structure, drainage, OM
- Produce and/or recycle/scavenge nutrients
- Reduce nutrient loss
- Manure management aid (Provide application windows)
- Weed suppression
- Provide forage/grazing
- Reduce synthetic fertilizer inputs
- Increase crop yields?



Cover Crop Challenges

- Timing of seeding in relationship to corn and soybean production system (equipment?)
- Herbicide program must allow cover crop
- Cost of cover crop seed
- Spring management/cover crop termination
- Nutrient management component
- Roots plug tile lines?

**“Whether you think you can, or you think you can't--
you're right.” Henry Ford**



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Resources: Herbicides and Cover Crops

- UMN Extension Article: “Managing risk when using herbicides and cover crops in corn and soybean”
April, 2016
- Contains links to publications and tables summarizing herbicide persistence and cover crop tolerances, planting restrictions
- Purdue publication: Residual Herbicides and Fall Cover Crop Establishment; August 2015
<https://ag.purdue.edu/btny/weedscience/Documents/covercropcarryover.pdf>



Resources: Herbicides and Cover Crops

Source: UMN
article,
Managing risk when
using herbicides
and cover crops in
corn and soybeans

- “Herbicide Rotation Restrictions in Forage and Cover Cropping Systems” (http://ipcm.wisc.edu/download/pubsPM/Herbicide-Rotation-Restrictions_FINAL.pdf), by University of Wisconsin Extension (June 2014)
- “Herbicide Use May Restrict Grazing Options for Cover Crops” (<https://store.extension.iastate.edu/Product/Herbicide-use-may-restrict-grazing-options-for-cover-crops>), by Iowa State University Extension (December 2016)
- “Herbicide Options for Planting Forage Cover Crops after Corn and Soybean” (<http://cropwatch.unl.edu/2016/herbicide-options-planting-forage-cover-crops-after-corn-and-soybean>), by University of Nebraska-Lincoln (March 2016).



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Cover Crop Roots in Tile Lines?

- Came up as a problem in some crop fields in 2016.
- Why?
 - ❖ Cover crops planted earlier in 2015
 - ❖ Warmer and longer fall growth
 - ❖ Warmer winter, more growth?
- Purdue University publication entitled, *Agricultural Tile Drains Clogged with Cover Crop Roots?* addresses potential causes and remedies for the problem. Find the publication at <http://bit.ly/29wQLFY>.



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Cover Crop Termination

- Degree of challenge depends upon the cover crop and timing of crop to follow
- Biggest concerns tend to be with cereal rye before corn and annual ryegrass early spring termination
- Good resource: Purdue publication “Successful Cover Crop Termination with Herbicides”
<https://www.extension.purdue.edu/extmedia/ws/ws-50-w.pdf>
- Rolling/crimping



Cover Crops and Nutrient Management



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Soil Susceptibility to Nutrient Loss

- When living plants are not removing nutrients from the soil
- When there are periods of heavy rainfall (water movement)
- When soil absorption sites are saturated/high soil test levels
- When there is over application of nutrients
- When there is surface application of nutrients
- When there is a combination of factors



How do cover crops reduce nutrient losses?

- Increase carbon inputs in the soil. Help to convert highly soluble inorganic nutrients to slower release organic form by coupling the nutrient with carbon
- Increase soil organic matter and provide more cation exchange sites which increase nutrient holding capacity (slow process)
- Cover crops increase mycorrhizal fungus activity, increasing water and nutrient uptake
- Water use (in some situations could be a disadvantage)
- Act as a “trap” crop to store nutrients in plant tissue and roots



Cover Crops: Potential reduction in N loss

Table 1. Literature summary of percent reduction in N leaching losses due to rye or ryegrass winter cover crops. Adapted in part from Meisinger et al., 1991.

Reference	Location	Cover Crop	% Reduction in N leaching
Morgan et al., 1942	Connecticut, U.S.	Rye	66
Karraker et al., 1950	Kentucky, U.S.	Rye	74
Nielsen & Jensen, 1985	Denmark	Ryegrass	62
Martinez & Guirard, 1990	France	Ryegrass	63
Staver & Brinsfield, 1990	Maryland, U.S.	Rye	77
McCracken et al., 1994	Kentucky, U.S.	Rye	94
Wyland et al., 1996	California, U.S.	Rye	65-70
Brandi-Dohrn et al., 1997	Oregon, U.S.	Rye	32-42
Ritter et al., 1998	Delaware, U.S.	Rye	30
Kladivko et al., 2004	Indiana, U.S.	Winter wheat + less fert.	61
Jaynes et al., 2004	Iowa, U.S.	Rye	62
Strock et al., 2004	Minnesota, U.S.	Rye	13

Other winter cover crops and reduction in N loss

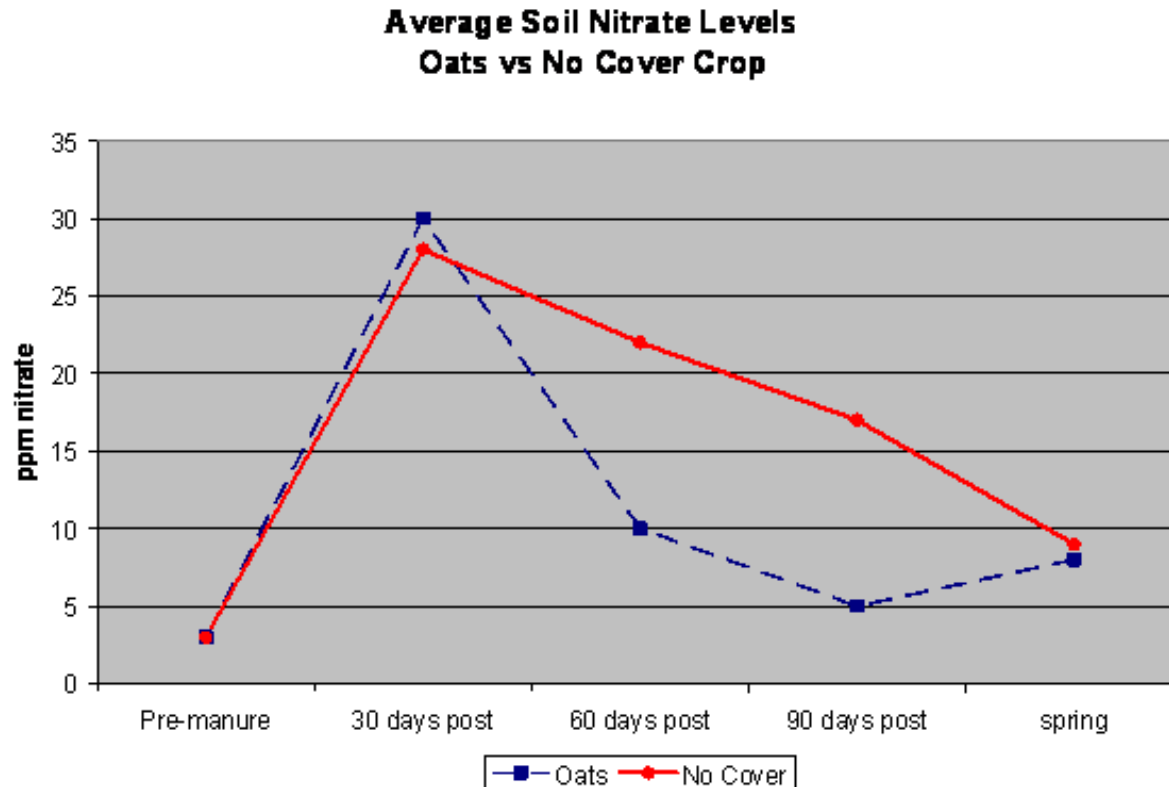
Table 21|2. Literature summary of percent reduction in nitrate N leaching losses due to winter cover crops (adapted in part from Meisinger et al., 1991).

Reference	Location	Cover crop	Reduction in N leaching
Jones, 1942	Alabama	Oats	81%
Jones, 1942	Alabama	Hairy vetch	6%
Chapman et al. 1949	California	Mustard	80%
Chapman et al. 1949	California	Purple vetch	30%
Martinez and Guirard, 1990	France	Ryegrass	63%
Staver and Brinsfield, 1990	Maryland	Rye	77%
Staver and Brinsfield, 1998	Maryland	Rye	80%
McCracken et al., 1994	Kentucky	Rye	94%
McCracken et al., 1994	Kentucky	Hairy vetch	48%
Wyland et al., 1996	California	Rye	65–70%
Brandi-Dohrn et al., 1997	Oregon	Rye	32–42%
Ritter et al., 1998	Delaware	Rye	30%
Rasse et al., 2000	Michigan	Rye	28–68%
Strock et al., 2004	Minnesota	Rye	13%
Kladivko et al., 2004	Indiana	Winter wheat + less fertilizer	61%
Kaspar et al., 2007	Iowa	Rye	61%

USDA/ARS Nutrient Loss Studies

- Agriculture Research Service (ARS) scientists are using root zone water quality models to assess the value of cover crops in mitigating nitrate losses
- Used winter rye cover crops in a corn-soybean rotation
- Ran a simulation for several different planting scenarios at 41 sites across the Midwest from 1961 to 2005:
 - Winter rye was seeded when the cash crop was mature
 - Results indicate the potential to reduce annual nitrate loss in field drainage by about 43%

Cover crop Oats: absorption of soil nitrate after manure application



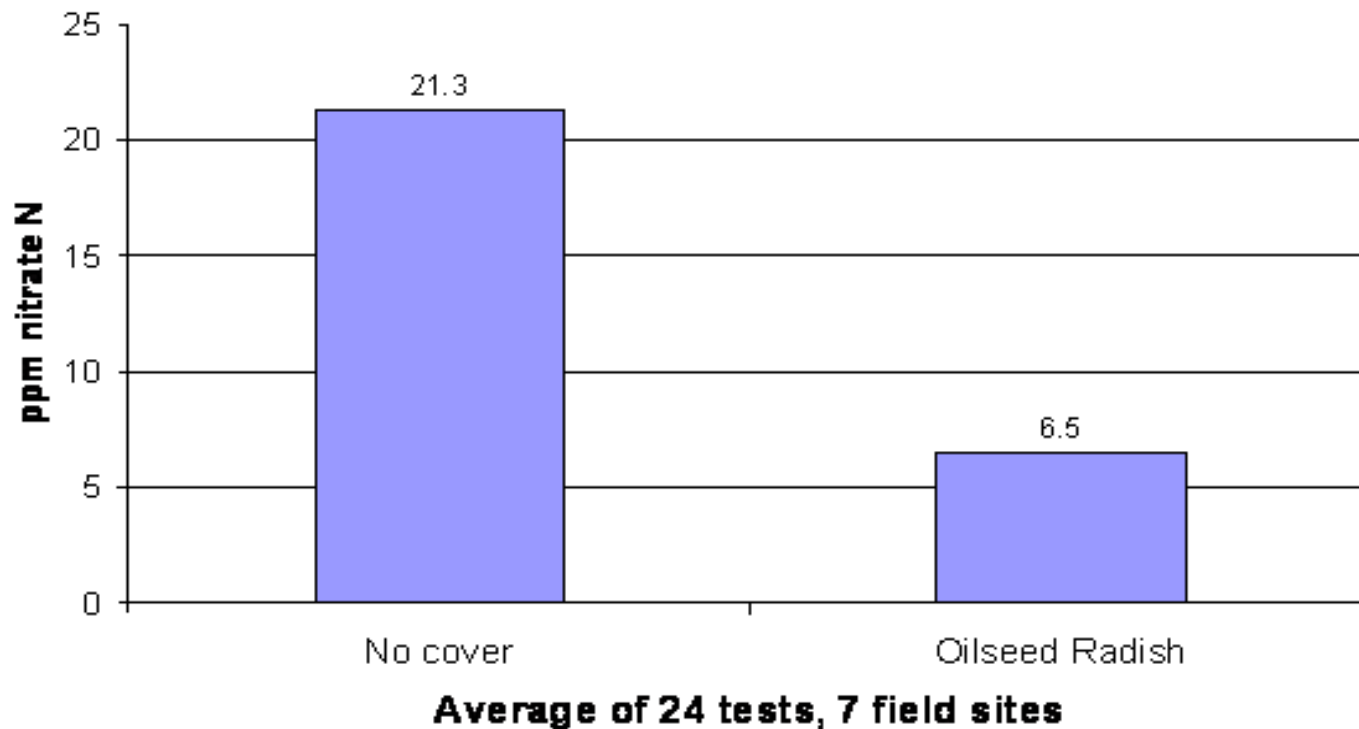
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Journal of the NACAA, July 2010

Oilseed Radish: absorption of soil nitrate after manure application

Fall soil nitrate after manure application



Cover Crops: Potential reduction in P loss

Table 2. Literature summary of percent reduction in total P losses in runoff due to barley, winter wheat, or legume winter cover crops. Adapted from Sharpley et al., 1991.

Reference	Location	Cover Crop	% Reduction in Total P Losses in Runoff
Angle et al., 1984	Maryland, U.S.	Barley	92
Langdale et al., 1985	Georgia, U.S.	Rye	66
Pesant et al., 1987	Quebec, Canada	Alfalfa/timothy	94
Yoo et al., 1988	Alabama, U.S.	Wheat	54

2008 Final Report: Gulf Hypoxia and Local Water Quality Concerns Workshop

Planting a late summer or early fall seeded cover crop can reduce phosphate (P) loss by about 29%.
[Clean Water Iowa publication](#)



Manure Application to Cover Crops



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Manure Application & Nutrient Retention



Manure
Applied to
a Cover
Crop



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4R Nutrient Stewardship and Manure Application

4R Nutrient Stewardship — applying the **right** nutrient source, at the **right** rate, **right** time, and **right** place — is an essential tool in the development of sustainable agricultural systems.



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Source: IPNI

Manure Management: 4 R Perspective

- Right Source: Right source for which nutrient? Are applications being made for nitrogen or phosphorus content?
- Right Rate: Need to know the analysis of the manure, the soil test levels, the crop and crop history and the environmental conditions
- Right Time: Soil conditions, environmental conditions,
- Right Place: based on soil tests, tile drainage? Proximity to public water? Surface or incorporated?



Manure Guidelines: NRCS 590

All Nutrients:

Nutrient planning must be based on current soil, manure, and (where used as supplemental information) tissue test results developed in accordance with The Ohio State University guidance, or industry practice, if recognized by the university.

Manure:

Application rates for manure are to be based on the most limiting factor of nutrient content, volume/weight limitation of the material.

Manure:

Where manure is to be spread on land not owned or controlled by the livestock producer, the nutrient management plan, as a minimum, shall document the amount of manure to be transferred and who will be responsible for the environmentally acceptable use of the manure.



Approved Manure Application Practices



Manure Application Equipment



Grass/sod Injector Unit



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Limitations to Cover Crop Use for Nutrient Management

- Need to be managed so that there is adequate growth to take up and hold nutrients
- Impact on soluble P is more variable: several studies have shown that soluble P can be lost in runoff flowing over plant residues
- Agronomic issues for succeeding crop?
 - Slower soil warmup
 - Increased insect pressure
 - Yield drag? (grass on grass)



Challenge and Opportunity: Planting Dates

If planted early enough, winter cover crops have ample time to scavenge nutrients and incorporate them into their biomass.

The more plant biomass produced in the fall and early spring, the more nitrogen a plant consumes. Once the cover crop is terminated, this nitrogen should become available to the following corn crop.

Source: University of Vermont Extension, Northwest Crops and Soils Program publication “Under Cover: Integrating Cover Crops into Silage Corn Systems”



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Challenge and Opportunity: Planting Dates

While timely planting of cover crops may be difficult to manage with a corn crop, early planting dates are essential for cover crop success. Studies have shown that utilizing a shorter day corn with the addition of a cover crop can lead to higher overall corn yields than longer season corn with bare soil through the winter months

Source: University of Vermont Extension, Northwest Crops and Soils Program publication “Under Cover: Integrating Cover Crops into Silage Corn Systems”



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Overcoming a Challenge: Cover Crop Seeding Technology



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Equipment for seeding cover crops into standing corn and soybeans

Don Birky's seeder in Central IL



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Equipment to help with timeliness of cover crop planting:



Interseeder



Autonomous robot seeder

Timing Help and Equipment: Harvest



Vertical tillage tool with air seeder, no-till farmer article, 2014

Gandy seeder header insert, photo from no-till farmer article 2014



Summary

- Cover crops may help provide some additional windows of opportunity for manure application
- Cover crops can help to reduce nutrient losses
- Cover crops require time to be effective and to produce benefits (**biomass and root structure**)
- Combining cover crops with manure application requires management

