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<http://organictransition.umn.edu/>

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Cover Crops

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Cover Crops

- I. Introduction
- II. Benefits
- III. Cover Crop Options
- IV. Meeting Your Goals
- V. Establishment & Termination
- VI. Rotations
- VII. Economics
- VIII. Conclusion





What Is a Cover Crop?

“Crops including grasses, legumes and forbs for seasonal cover and other conservation purposes.”

- Natural Resources Conservation Service

What Is a Cover Crop?

- Typically planted after cash crop harvest
- May also be used in fallow years
- Reduces time when soil is bare
- Also called *plowdown* or *green manure*
- Plant material is incorporated rather than exported






Cover Crops on Organic Farms

- Not required for organic, but valued in rotations
- Contribute to biological approach to pest, weed, and disease management





Cover Cropping in Organic Systems

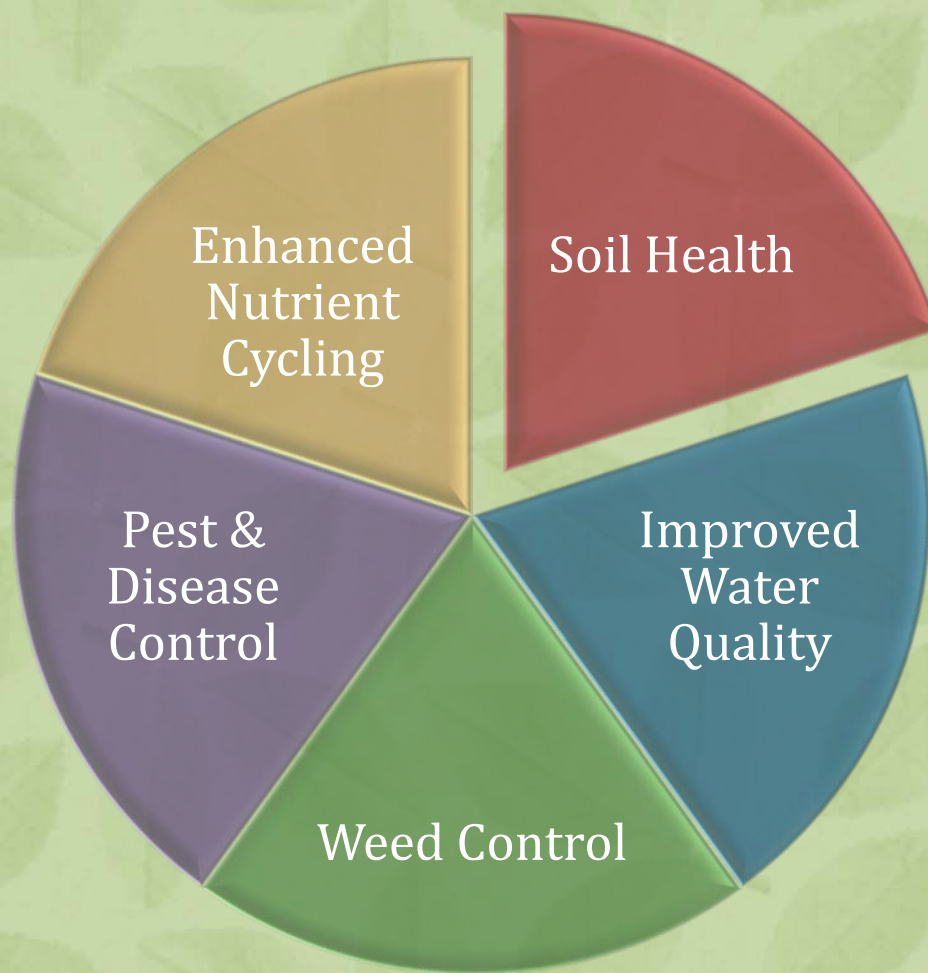
1. Reduce erosion from wind and water
2. Increase soil organic matter content
3. Capture and recycle or redistribute nutrients in the soil profile
4. Promote biological nitrogen fixation
5. Weed suppression
6. Soil moisture management
7. Minimize and reduce soil compaction

Cover Crops

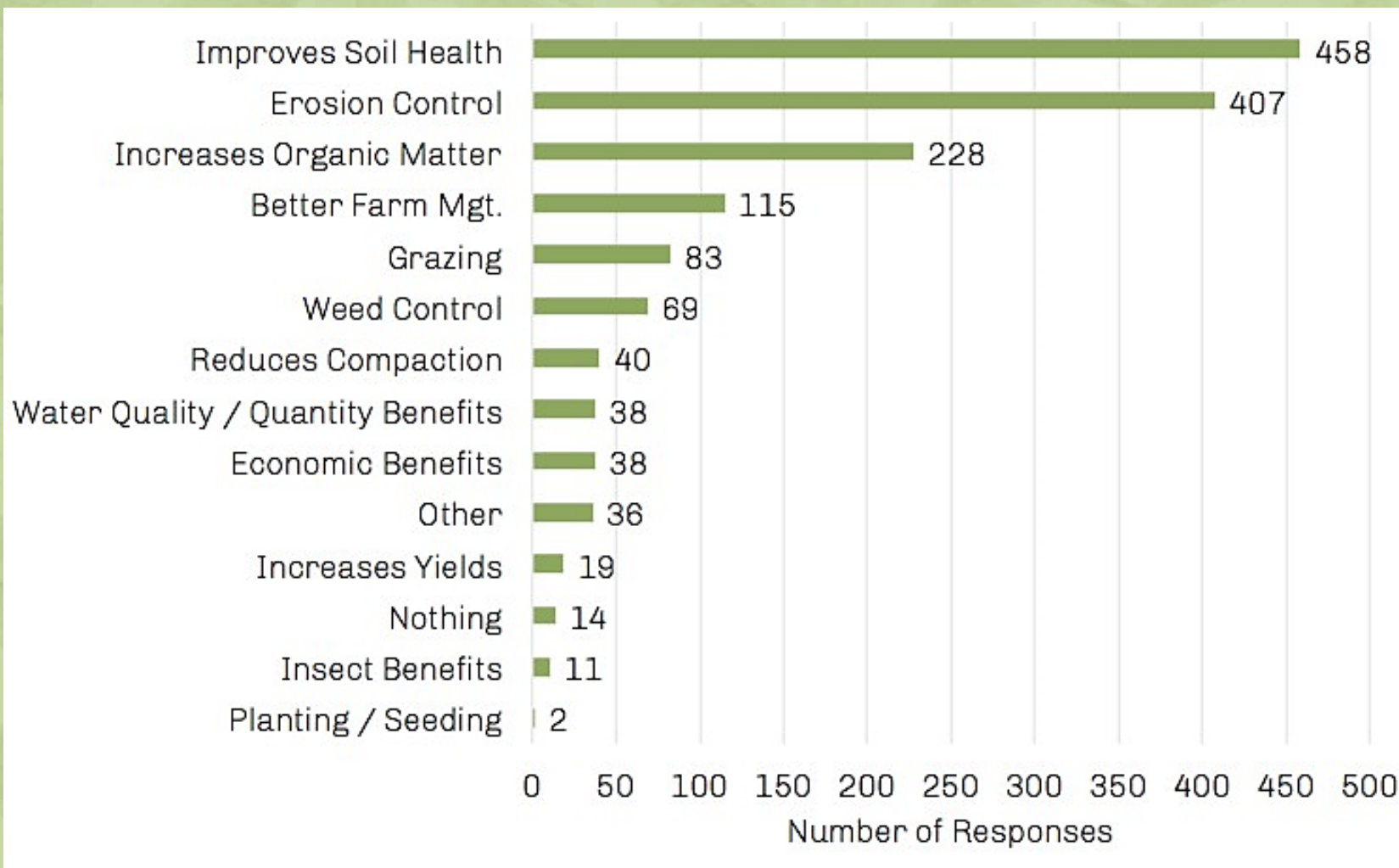
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Benefits of Cover Cropping



“Name the single biggest benefit you receive from cover crops...”

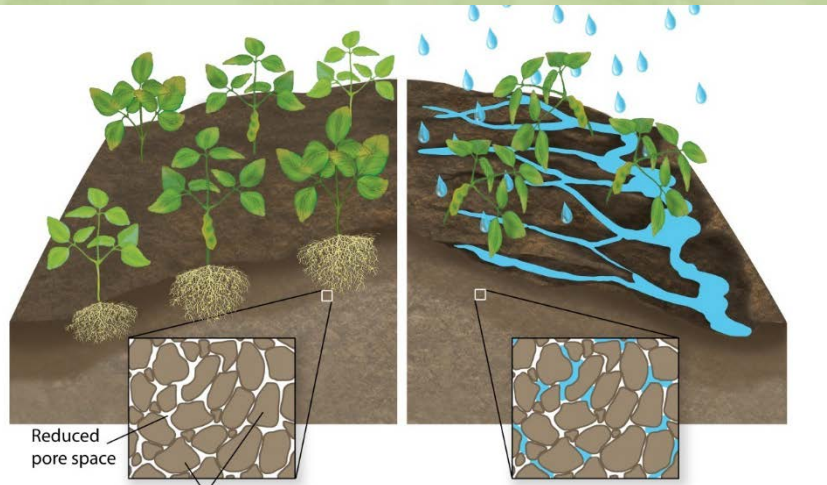


Soil Health: Increased Organic Matter

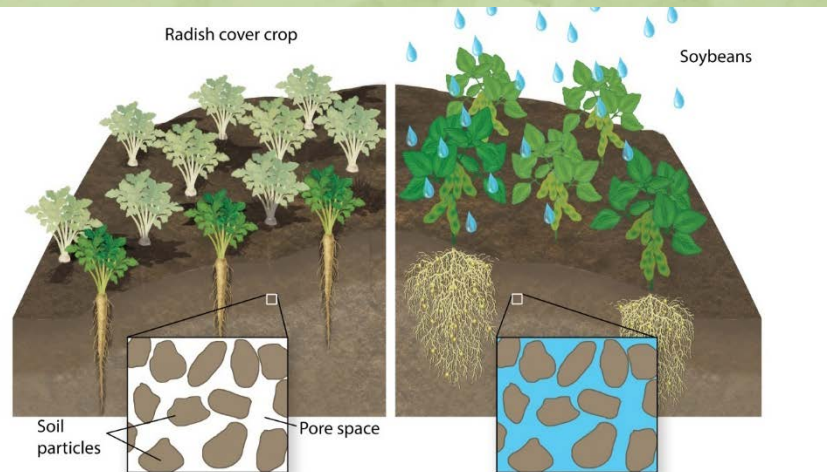
- Incorporating cover crops adds biomass
- Biomass is processed by microbes into soil organic matter



Soil Health: Improved Water Infiltration & Retention



Soil compacted by continuous cropping

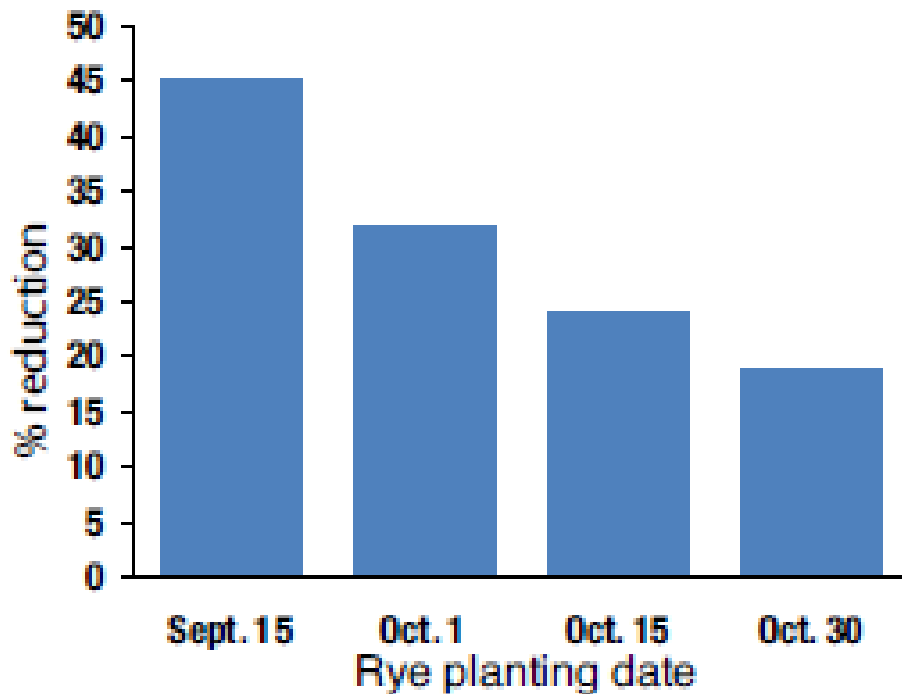


Soil with radish cover crop

Cover crop roots penetrate deep into soil, creating pathways for water infiltration

Improved Water Quality

Reduction in nitrate leaching with rye cover cropping



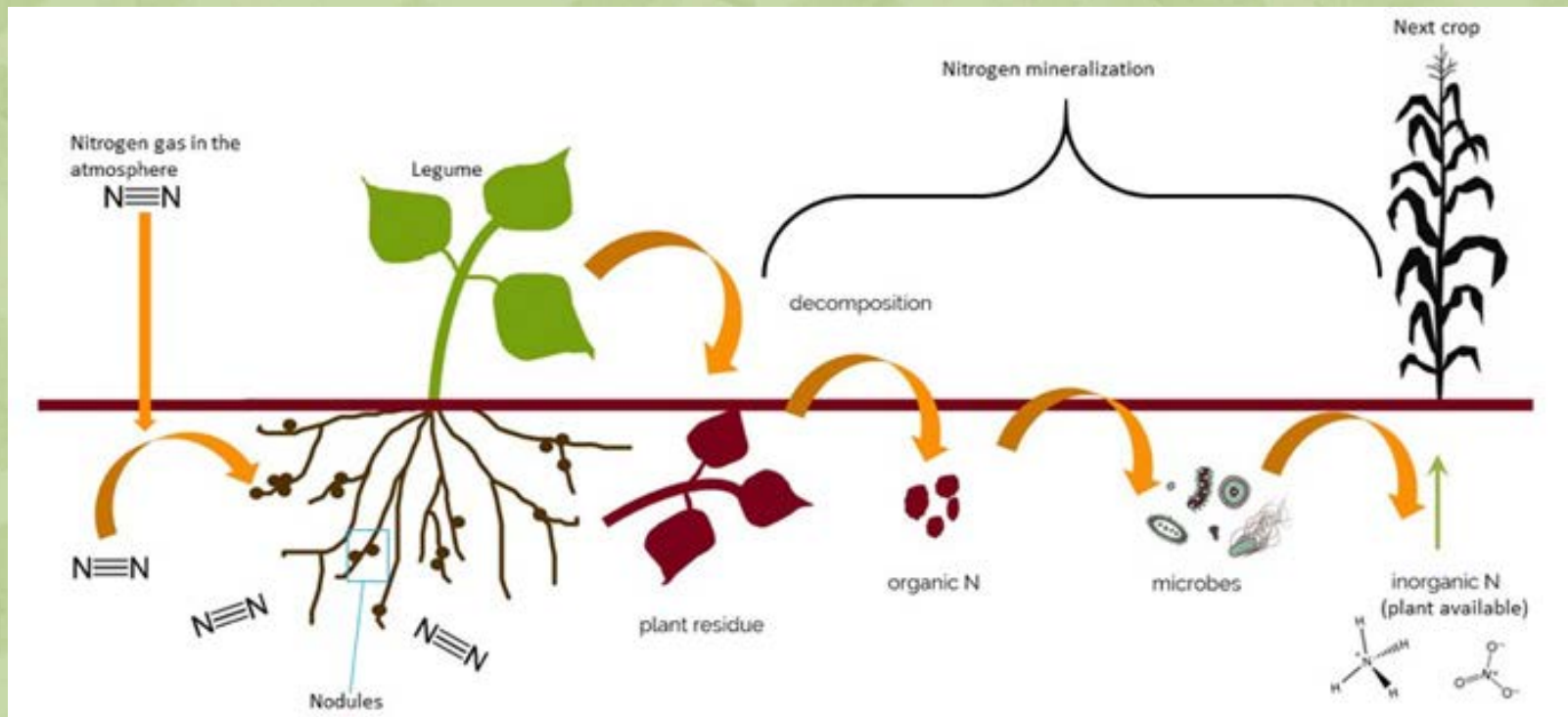
Adapted from Feyereisen et al., 2006



- Reduced sediment runoff
- Retention of nutrients on farm

Improved Nutrient Cycling

- Nutrient capture and/or biological N fixation
- Increased microbial activity leading to faster residue cycling



Weed Control



Pest and Disease Control

Summer 1

Soybeans
Before Cover
Crop



Fall 1

Cereal Rye Cover Crop



Summer 2

Soybeans
After Cover
Crop



Cover Cropping for Pollinators and Beneficial Insects



Cover Crop Risks

- Increased management, labor, and seed costs
- Depletion of soil moisture or nutrients
- Interference with cash crop establishment
 - Cooler soil temperatures
 - Excessive residues
 - Allelopathy



Hairy vetch cover crop overgrowing corn cash crop

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Cover Crop Species



Winter rye and hairy vetch mix

Cover Crop Characteristics

- Legume, grass, or broadleaf
- Overwintering vs. winter-killed



Cover Crops for Northern Environments

- Constraints: short growing seasons, harsh winter conditions
- Most commonly used include:
 - Winter rye
 - Annual ryegrass
 - Spring oats
 - Hairy vetch
 - Red clover
 - Brassicas



Winter Rye

- Cool-season annual grass
- Very winter-hardy
- Suppresses weeds
- Can be used for spring grazing or harvested for grain
- High water use



Annual Ryegrass

- Quick to establish, even at cool temperatures
- Winter-kills; no need to terminate
- Provides winter soil protection and spring water infiltration
- Moderate water use



Spring Oat

- Quick-growing in fall
- Winter-kills
- Moderate water use
- Inexpensive, low risk
- Can be seeded into standing soybean



Hairy Vetch

- Strong nitrogen fixer
- Overwinters, though somewhat unreliably
- Low-medium water use



Red Clover

- Short-lived perennial legume
- Often grown as forage, but can be used as cover crop
- Can be underseeded with small grains
- Good winter-hardiness
- Nitrogen source



Brassicas

- Mustards, turnips, rapeseed/canola, radishes
- Rapid fall growth, then winter-kill
- Tender biomass degrades quickly
- Sometimes used as biofumigants



Cover Crop Mixtures

- Common two-species mixtures are hairy vetch/winter rye and peas/oats
- May be difficult to get all components to establish



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Selecting Cover Crops Based on Your Farm's Goals

Cover Crop Goal	Winter Cover Crop
Nitrogen source	Hairy vetch, red clover
Nitrogen scavenging	Winter rye
Provide soil organic matter	Winter rye
Erosion control	Winter rye, oats, annual ryegrass
Improved soil structure	Brassicas
Control weeds	Hairy vetch, winter rye, oats, annual ryegrass, brassicas
Lessen disease pressure	Brassicas
Provide nectar and habitat for beneficial insects	Hairy vetch, red clover, brassicas, buckwheat

Nitrogen Fixers and Scavengers

- Legumes fix atmospheric N
- Should be planted with appropriate *Rhizobium* inoculant
- Grasses and broadleaves can scavenge N



Nitrogen Credits from Cover Crops

Crop	< 6" growth	> 6" growth
Alfalfa	40	60-100
Red clover	40	50-80
Hairy vetch	40	40-90



Laboski & Peters, 2012

Building Soil Organic Matter

- High biomass crops
- Winter-hardy to enable spring growth
- Recalcitrant (slow to degrade) materials



Erosion Control

- Crops with dense root systems
- Thick, fast-growing stands



Eroded topsoil

Improved Soil Structure

- Strong, deep-penetrating crop roots



Weed Control

- Dense canopy-forming crops
- Crops with allelopathic effects

COVER CROP	WEEDS INHIBITED
Brassicas	Pigweeds
	Shepardspurse
	Green foxtail
	Kochia
	Hairy nightshade
Winter rye	Barnyardgrass
	Wild oat
	Dandelion
	Crabgrass
	Barnyardgrass
Hairy vetch	Common ragweed
	Lambsquarters
	Common chickweed
	Redroot pigweed
	Wild carrot
	Knotweed

Hairy vetch cover crop. St. Paul, MN
Moncada & Sheaffer, 2010

Disease Control

- Interrupt pathogen growth environment by planting non-host species
 - Choose cover crops from different families than major crops
- Brassicas may have limited suppressive effect on fungal pathogens



Habitat for Beneficial Insects

- Flowering crops feed pollinators and attract predatory insects



Midwest Cover Crop Selection Tool



Midwest Cover Crops Council Cover Crop Decision Tool

NEW UPDATE!

HOVER OVER
COVER CROP,
CLICK TO
REVIEW THE
INFORMATION
SHEET.

Location	Cash Crop	Soil	Attribute
	None or Prevented Planting ▼	Plant Date: <input type="text"/>	Harvest Date: <input type="text"/>
Cash Crop	Select a drainage ▼	Flooding? <input type="text"/>	<input type="text"/>
Drainage #1 information	Goal #2	Goal #3	Select an attribute ▼
	Select an attribute ▼	Select an attribute ▼	

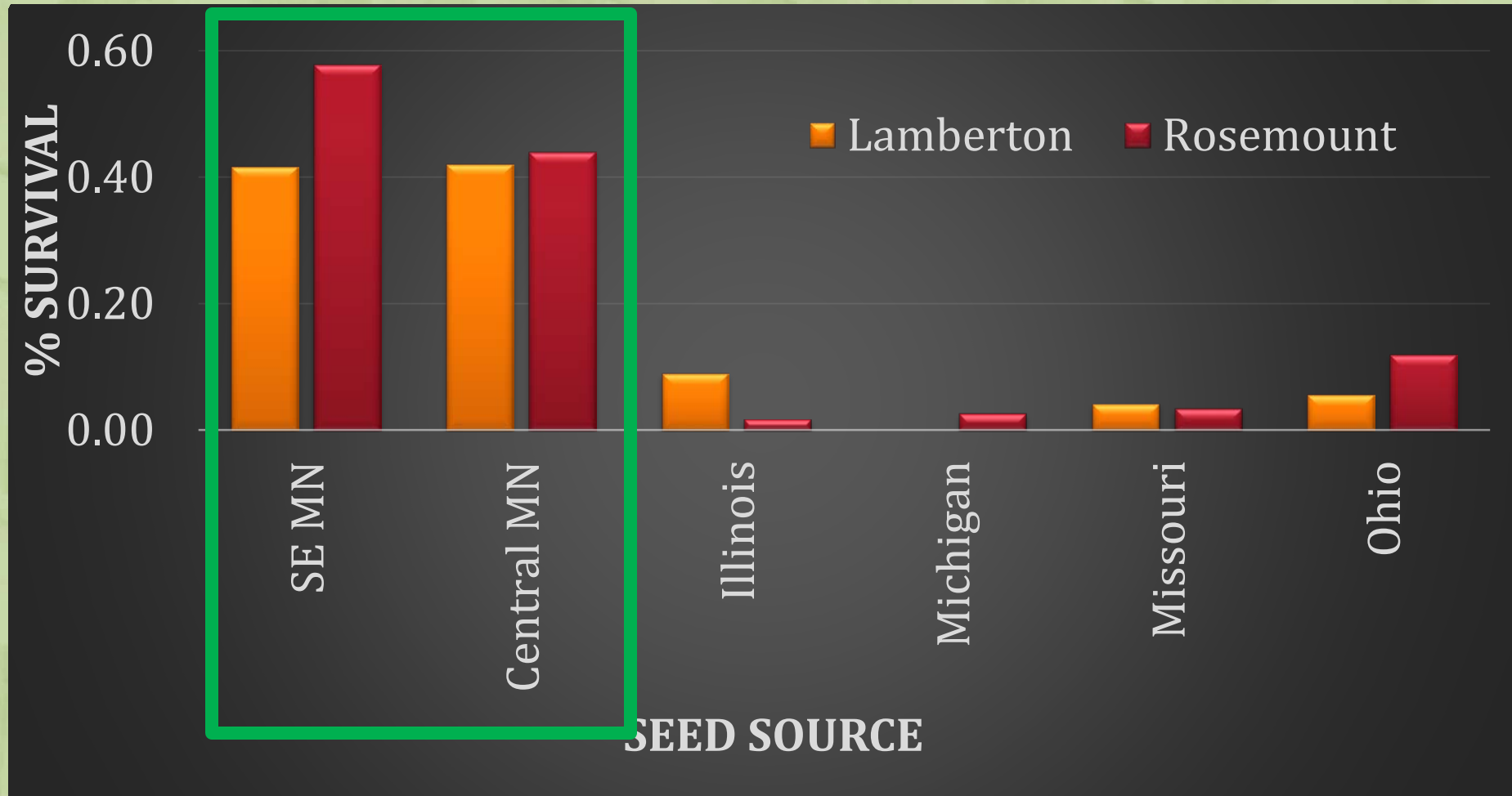
<http://mccc.msu.edu/covercroptool/covercroptool.php#>

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Seed Sourcing



Establishing Cover Crops

	Minimum germination temperature	Establishment window			
		July	August	September	October
Winter rye	34				
Annual ryegrass	40				
Spring oat	38				
Hairy vetch	60				
Red clover	41				
Brassicas	40-45				

Midwest Cover Crops Council

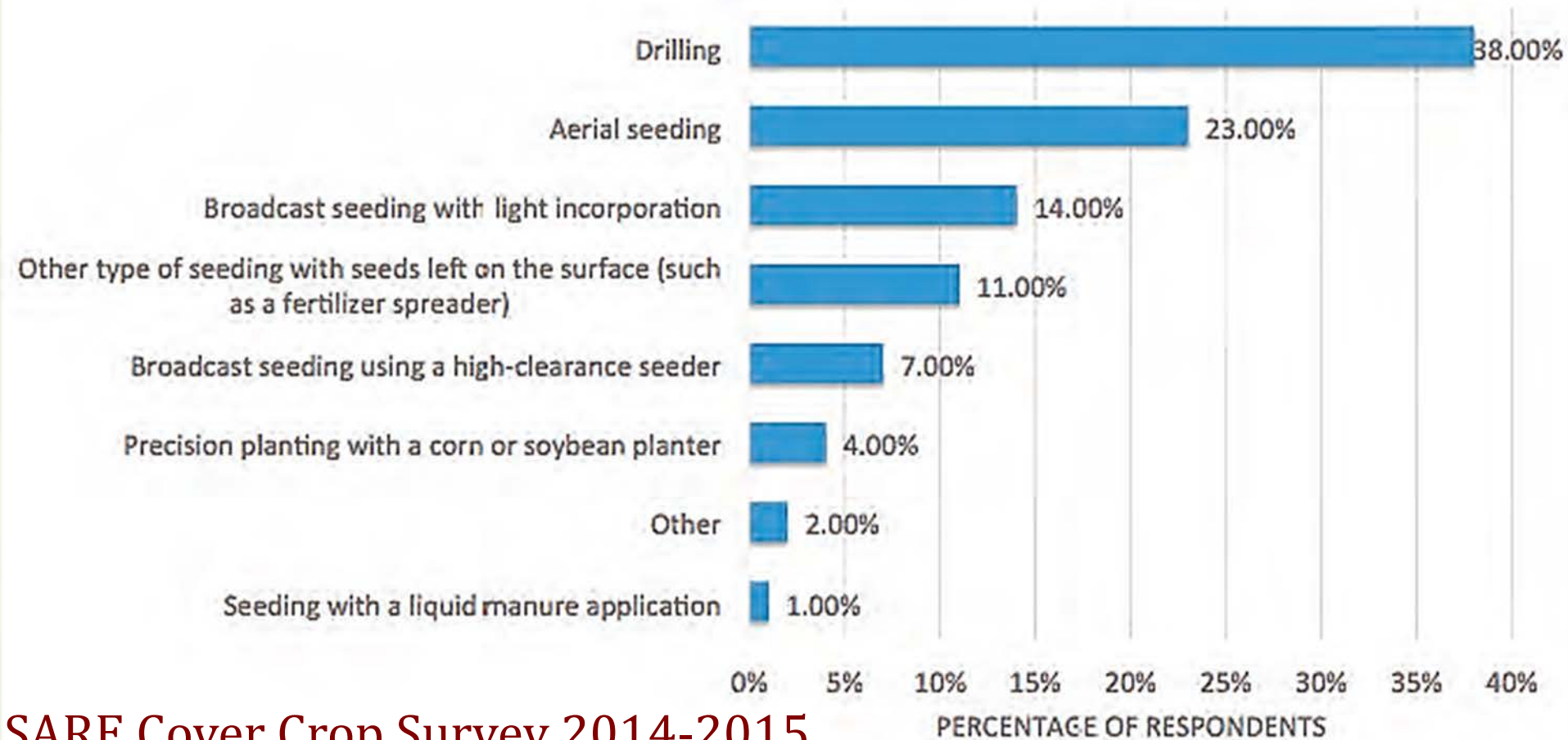
	Establishment is reliable
	Establishment is possible, but risky

Planting Methods



- Drilling
- Broadcasting
 - With or without incorporation
- Aerial or overhead seeding
 - Generally better for smaller-seeded crops

Planting Methods



SARE Cover Crop Survey 2014-2015

Methods Matter!

Broadcast



Broadcast & Incorporate



Seeding Rates

	Seed rate (lb/A)	
	Broadcast	Drilled
Winter rye	90-160	60-120
Annual ryegrass	20-30	10-20
Spring oat	100-140	80-110
Hairy vetch	25-40	15-20
Red clover	10-12	8-10
Brassicas	8-30, depending on species	5-13, depending on species

SARE, 2007

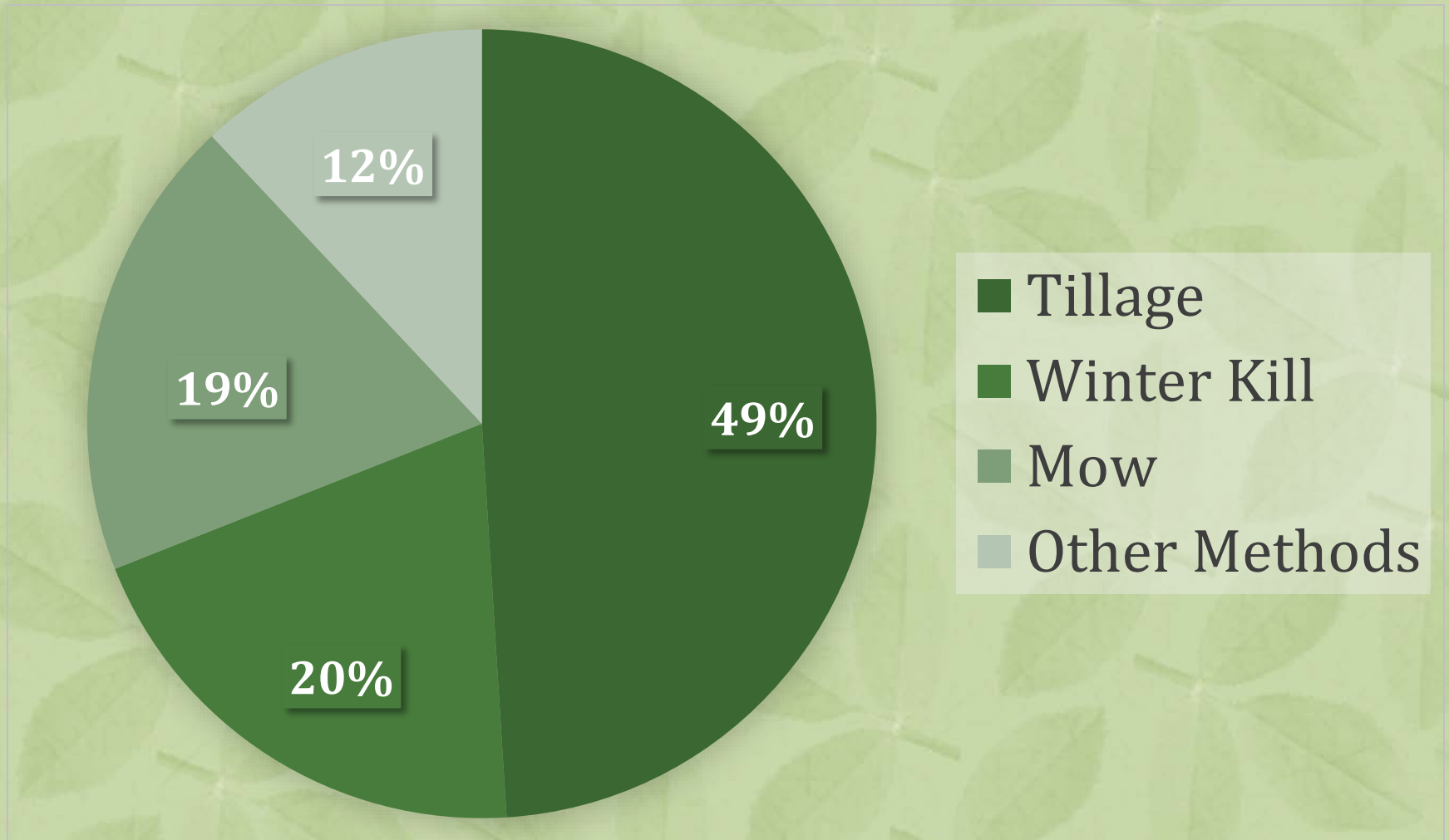
Terminating Cover Crops

- Achieving full kill
- Preventing damage from residues to following crop
 - Allelopathy
 - Planting interference





Preferred Termination Methods



Termination

Termination options		Risk of regrowth
With incorporation	Moldboard plow	Low
	Chisel plow	Moderate
No incorporation	Disking	Moderate
	Flail chop	Moderate
	Rotary mow	High
	Roll and crimp	High

Establishing the Following Crop



Soybean in winter rye
residue

- Terminate cover crops before desired planting date
 - 1 week if incorporated
 - 10 days if surface residue
- Some crops (e.g. soybean) tolerate fresh cover crop residue well



Cover Crops in Organic No-Till



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Cover Crops in Rotation

Corn-soybean with rye cover

Year 1 – Corn-rye

Year 2 – Soybean

Good option during transition





Typical Rotations

Corn-soy-small grain with rye and vetch covers

Year 1 – Corn-rye

Year 2 – Soybean

Year 3 – Small grain-hairy vetch

Legume provides N for subsequent corn crop

Typical Rotations

Corn-soy-small grain with underseeded clover

Year 1 – Corn

Year 2 – Soybean

Year 3 – Small grain
underseeded with red
clover



Quote from a Farmer...

“ We raise short-season crops. For us, that has meant raising *organic dry edible beans, sweet corn, or peas*. It allows us to raise **more cover crops** that get closer to full biomass production before termination.”

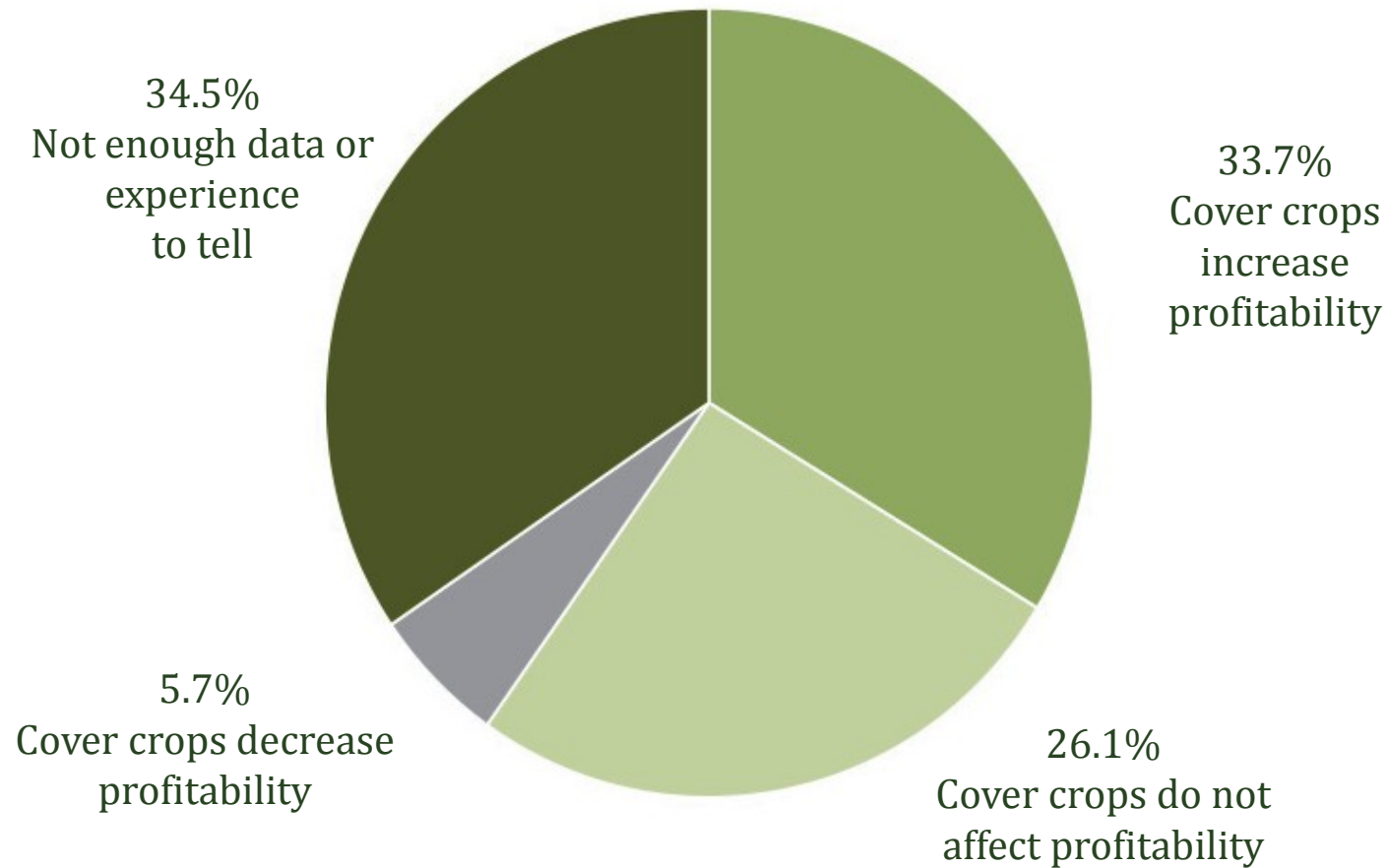
– *Jon Luhman, Dry Creek Farms, MN*

Cover Crops

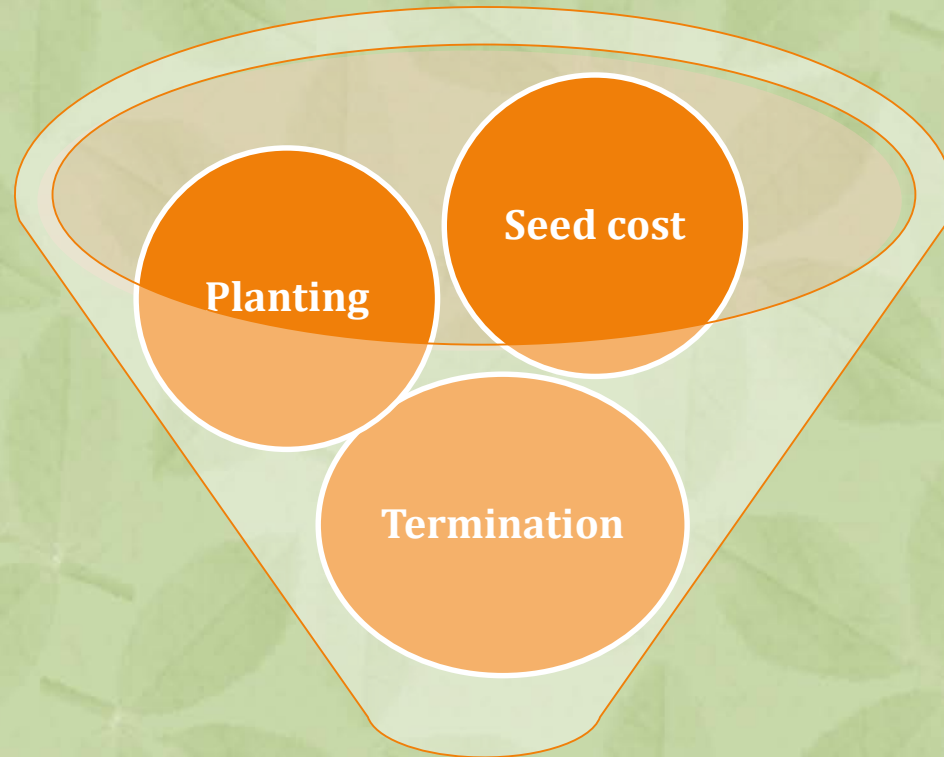
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Cover Crop Profitability

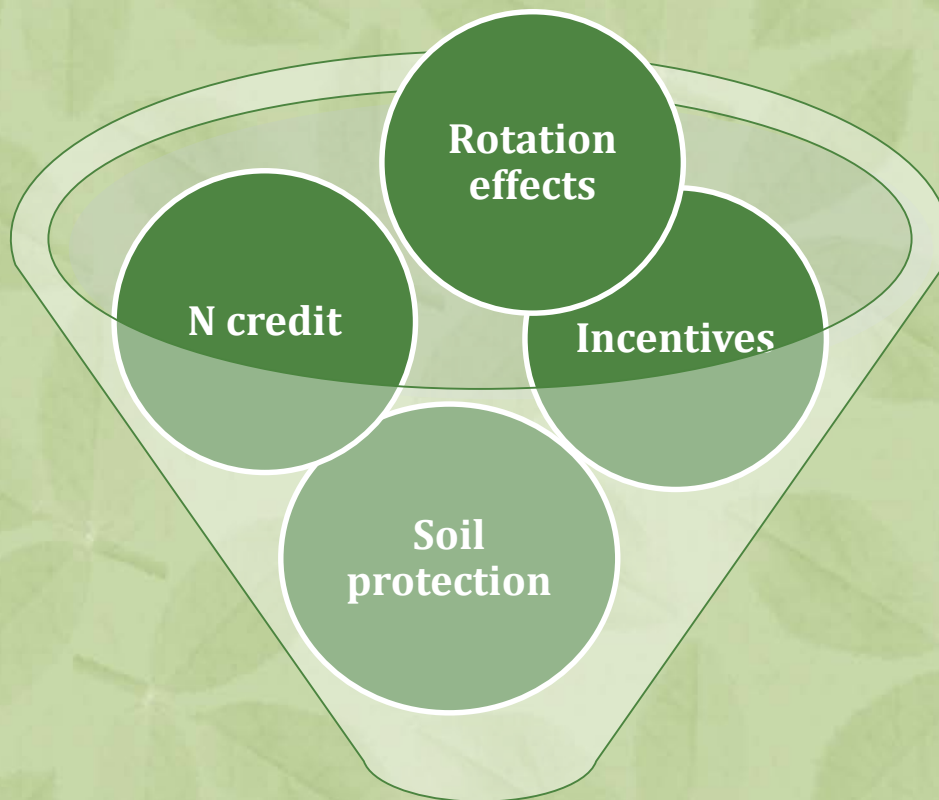


Cover Crop Costs



**Estimated cost of
establishing cover crops**

Cover Crop Returns



**Economic returns to
cover cropping**

Cropping Systems Calculator

Cropping Systems Calculator: Continuous Living Cover

Number of Acres of Whole Farm	500
Number of Acres to Change	40

Years in Rotation	Original	2
	New	6

Original Crop Plan				New Crop Plan			
	Crop 1	Crop 2	Crop 3		Crop 1	Crop 2	Crop 3
Year 1	Corn			Year 1	Corn	LateSeasonCoverCrop	
Year 2	Soybeans			Year 2	Soybeans		
				Year 3	SpringWheat	AlfalfaHay	
				Year 4	AlfalfaHay		
				Year 5	AlfalfaHay		
				Year 6	AlfalfaHay	Grazing	



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Average Yearly Costs and Returns from the Two Rotations

Returns are seen as wages for the farm owner in this tool and aren't factored into labor costs.

Total Overhead Expenses	Per Acre	Whole Farm			
	\$ 148.59	\$ 74,294.62			
	Original Crop		New Crop		Percent Difference
	Per Acre	Total	Per Acre	Total	
Total Crop Expenses	\$387.77	\$15,510.80	\$546.58	\$21,863.14	41%
Total Crop Income	\$524.08	\$20,963.03	\$694.93	\$27,797.10	33%
Other Income	\$53.07	\$2,122.77	\$42.30	\$1,692.04	-20%
Returns to Management	\$40.79	\$1,631.43	\$42.06	\$1,682.43	3%

-Percent difference shows the percent increase in the new crop when compared to the old crop

<https://landstewardshipproject.org/forms/cscdownload>

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Conclusions

- Clarify your primary goals or objectives of the cover crop
- Identify the best time and place for a cover crop in your system
- Choose well-established practices
- Experiment on small acreage
- Investigate funding opportunities



Cover Crop Funding Opportunities

- Environmental Quality Incentives Program (EQIIP)
- Conservation Stewardship Program (CSP)
- Contact your local Extension or NRCS office for currently available opportunities

Resources - Tools

- **MCCC's Cover Crop Selection Tool (link):**
<http://mccc.msu.edu/covercroptool/covercroptool.php>
- **Chippewa 10% Project's Cropping Systems Calculator:**
<https://landstewardshipproject.org/forms/cscdownload>
- **SARE publications: Managing Cover Crops Profitably:** <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>



Additional Resources

- [Midwest Cover Crops Council](#)
- [Forever Green Initiative](#)
- [Green Lands Blue Waters](#)
- [Land Stewardship Project](#)
- [Rodale Institute](#)
- [Managing Cover Crops Profitably](#)
- [NRCS](#)
- [SARE](#)
- [Albert Lea Seed](#)

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