Why Plant Cover Crops in Wisconsin Crop Rotations?

Kevin Shelley,

UW Nutrient Management Program

Jim Stute,

UWEX Rock County

COLLEGE OF AGRICULTURAL & LIFE SCIENCES

UW Extension

What is a “Cover Crop?”

A crop grown to provide soil cover between harvest and planting of commodity or feed crops, usually not for harvest, for the purposes of:

- Protecting soil from erosion
- Preventing or reducing water and nutrient runoff
- Improving soil quality – Physical, biological, chemical
- Fixing and/or scavenging nutrients
- Weed management – Physical or allelochemical suppression
- Supplemental forage

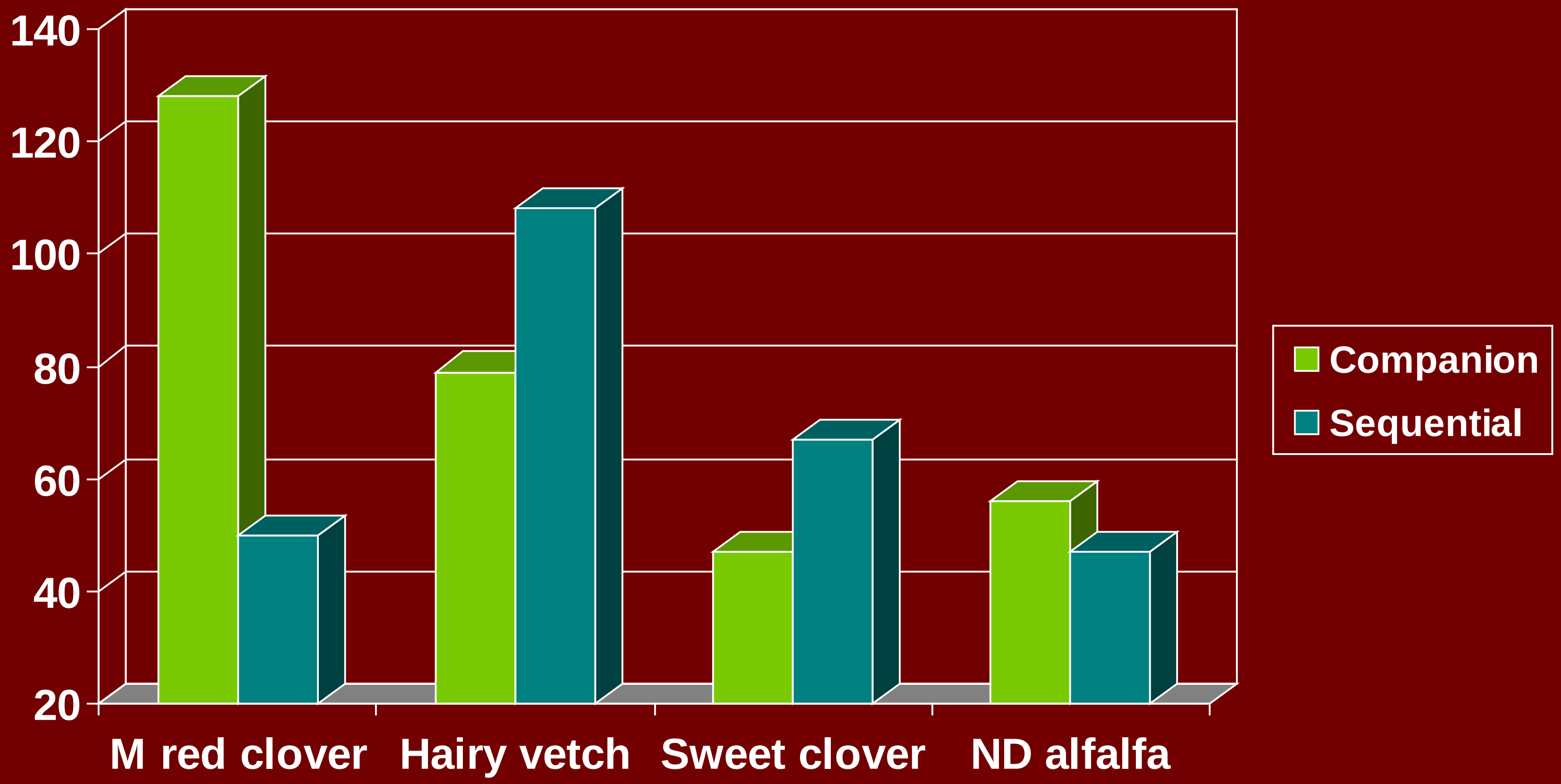
Cover crop examples

Crops for which affordable seed is usually available

- Legumes
  - Hairy vetch
  - Chickling vetch
  - Sweet clovers
  - Red clovers
  - Berseem clover
  - Crimson clover
  - Field pea
  - Cow pea
- Non-legumes
  - Oats or Barley
  - Annual ryegrass
  - Winter (cereal) rye
  - Winter wheat
  - Buckwheat
  - Sorghum-sudangrass
  - Forage/tillage radish

Total nitrogen produced from legume cover crops planted with oats

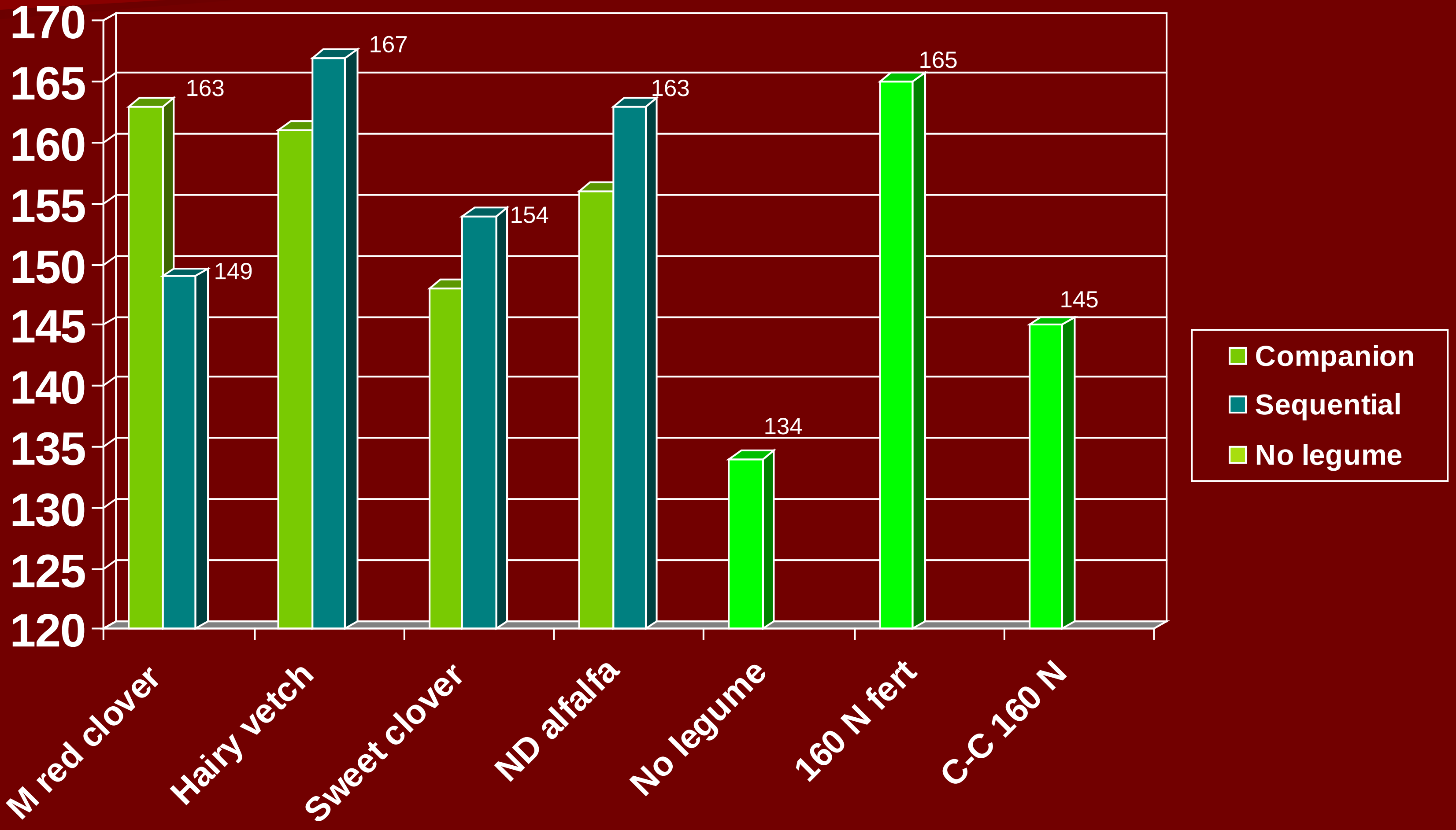
Arlington R.S. 1989-92



Source: J. Stute and J. Posner, 1995

Yield of corn following legume cover crops planted with oats – no N fertilizer added

Arlington R.S. 1990-93



Source: J. Stute and J. Posner, 1995

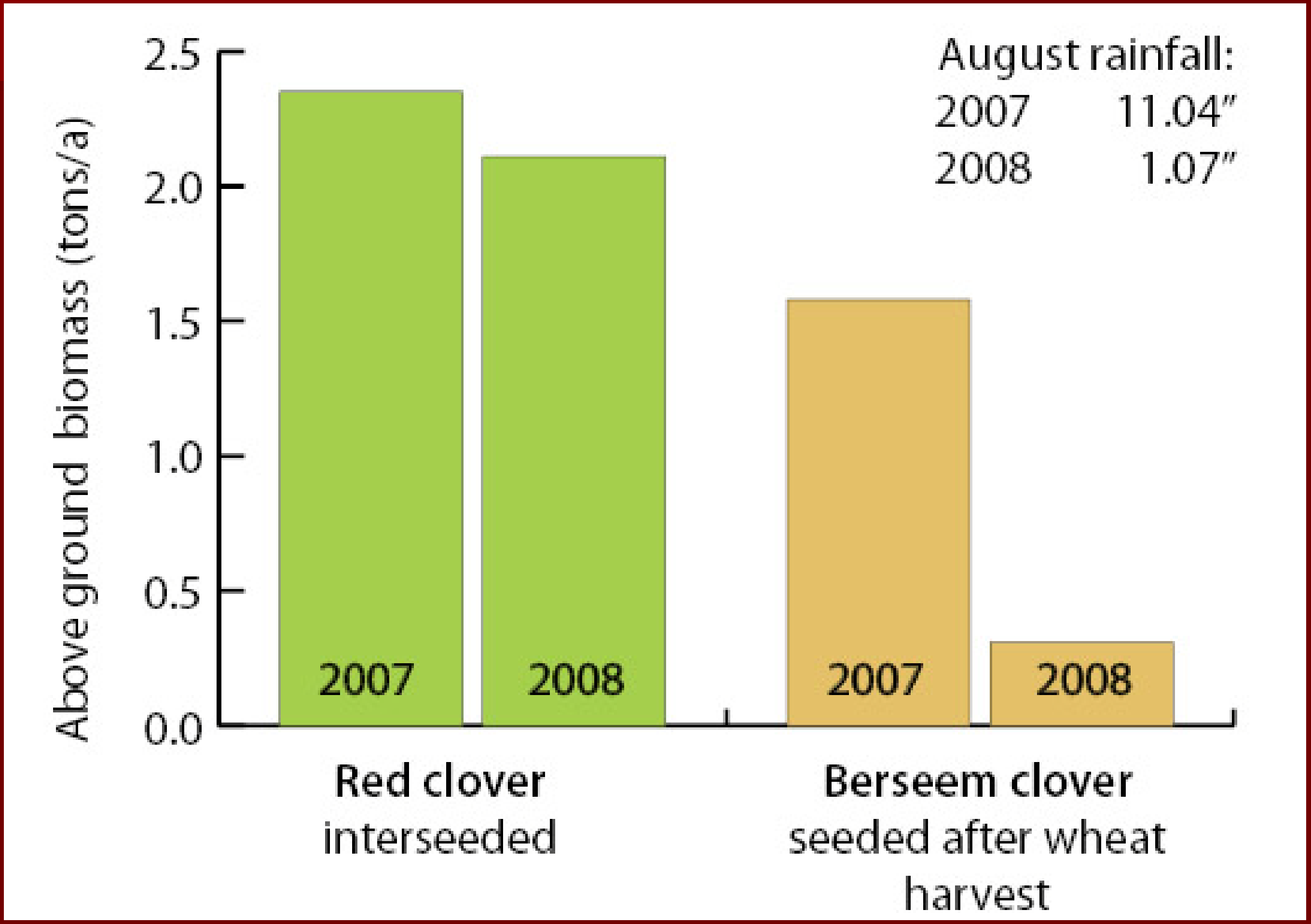
Legume herbage N accumulation for cover crops seeded with or after winter wheat in WI, 1991 - 2008

	Nitrogen Yield (lb/a)		Site Years
Legume	**Mean**	**Range**	**of Data**
Over-seeded			
Red clover	90	21 - 214	23
Seeded after harvest			
Hairy vetch	85	55 - 147	15
Crimson clover	56	42 - 69	4
Berseem clover	54	16 - 111	16
Annual sweetclover	54	15 - 92	2
Annual medic	51	23 - 97	9
Chickling vetch	35	31 - 38	2
Annual alfalfa	30	29 - 30	2

Data from various sources, Compiled by J. Stute and K. Shelley, 2008


Chickling Vetch
"AC Greenfix"
60 DAP
2007

Impact of August rainfall on biomass yield



Stute, 2009

Clover over-seeded in winter wheat

N Credits from Green Manures

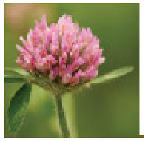
Cover crop planted and killed within a year.

Alfalfa*	60-100 lb N/acre
Red Clover*	50-80 lb N/acre
Sweet clover*	80-120 lb N/acre

**Use 40 lb N/acre credit if less than 6” of growth before tillage. Use upper end of range for spring seedings that are plowed under the following spring; use low end for fall seedings.*

http://

ipcm.wisc.edu



Frost Seeding Red Clover in Winter Wheat

Jim Stute, University of Wisconsin (UW) Extension, Rock County
Kevin Shelley, UW Nutrient and Pest Management Program

Grow your own nitrogen

If you plant winter wheat, you have an opportunity to "grow" your own nitrogen (N) to help manage input costs and accrue soil quality benefits. The age-old practice of green manuring, especially in conjunction with wheat, can produce significant creditable N for corn the next year. It also protects the soil and may be eligible for cost share under local and Federal conservation programs.

Multi-year research in Wisconsin has demonstrated that red clover (*Trifolium pratense*) is the most productive and reliable legume choice for green manuring if interseeded into winter wheat in early spring (table 1). Interseeded red clover captures the entire growing season which helps maximize nitrogen credits. Seeding clover or other forage legumes after wheat harvest is more risky due to the potential for dry conditions and a shorter growing season. Delayed germination and slow growth frequently limit seeding year yield and N production when seeded after wheat harvest. Adequate rainfall in August is critical for producing acceptable yield for summer seedings (figure 1). Red clover offers the additional advantage of being a non-host for soybean cyst nematode, a problem with many of the other legume cover crop options.

Figure 1. Impact of August rainfall on clover biomass yield. Stute, 2009

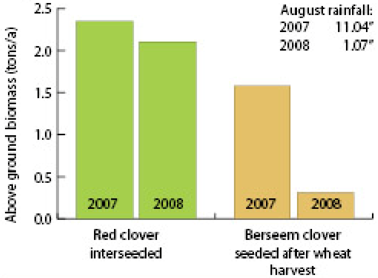


Table 1. Above ground biomass yield for cover crops seeded with or after winter wheat in Wisconsin, 1991-2008. Various sources, published and unpublished data from WI, 1991-2008.

Legume	Above Ground Biomass Yield Mean* (tons/a)	Range	Site Years of Data
Interseeded			
Red clover	1.70	0.33 - 3.26	24
Seeded after harvest			
Hairy vetch	1.37	0.67 - 2.16	10
Crimson clover	0.83	0.69 - 0.97	2
Berseem clover	1.00	0.31 - 1.58	9
Annual sweetclover	0.88	0.18 - 1.72	3
Annual medic	1.00	0.51 - 1.94	8
Chickling vetch	0.49	0.39 - 0.59	2
Annual alfalfa	0.39	0.38 - 0.40	2

*N yield does not necessarily correspond to creditable N.

Red clover in September. In addition to nitrogen credits, it provides season-long soil cover.

For more information, contact Kevin Shelley at (800) 994-5853.
This publication is available from the Nutrient and Pest Management Program. email: npm@hort.wisc.edu
phone: (608) 265-2660 website: ipcm.wisc.edu I-0209-3C

Non-legume cover crops

Tillage Radish

K. Shelley

"Bio-tillage"

http://www.tillageradish.com/

http://

ipcm.wisc.edu

Planting Winter Rye after Corn Silage:

Managing for Forage

Jim Stute, University of Wisconsin (UW) Extension, Rock County
Kevin Shelley, UW Nutrient and Pest Management Program
Dwight Mueller, UW Arlington Agricultural Research Station
Tim Wood, UW Lancaster Agricultural Research Station

Why Plant Rye?

Winter rye (*Secale cereale*) can be used as a cover crop after corn silage to protect against soil erosion, and in parts of Wisconsin is recommended by conservation planners. Properly managed, it has multiple uses and benefits beyond conservation, including forage production, nutrient management and weed suppression. It can also provide a hedge against weather related forage shortage caused by alfalfa winterkill or drought.

This publication focuses on using rye as an early-season forage crop. However, when rye is managed for optimum forage production, conservation and nutrient management benefits will also be achieved. Except where otherwise noted, the information presented is based on trials conducted at research stations at Arlington, Lancaster and Janesville, WI from 2004 to 2006.

Forage Production

Rye, planted in the fall, can produce substantial dry matter (DM) yield the following spring, often without undue planting delay for the following crop. Rye harvested at boot stage typically produces DM yield in the 2 to 3 ton per acre range at quality levels acceptable for many animal production groups (Table 1).

Table 1: Rye forage yield, quality and nutrients removed by harvest.

	Average	Range
Yield (ton/acre)	2.37	1.34–3.88
RFQ	180	149–205
CP (%)	16.2	13.3–19.0
ADF (%)	27.6	24.6–31.4
NDF (%)	52.2	47.2–56.7
P (%)	0.39	0.29–0.48
K (%)	3.05	2.10–4.37
Nutrient removal (lb/acre) dry matter basis, harvested at boot stage		
N	121	69–178
P_2O_5	42	29–71
K_2O	178	110–344

Rye field cut and windrowed on a Rock county farm.

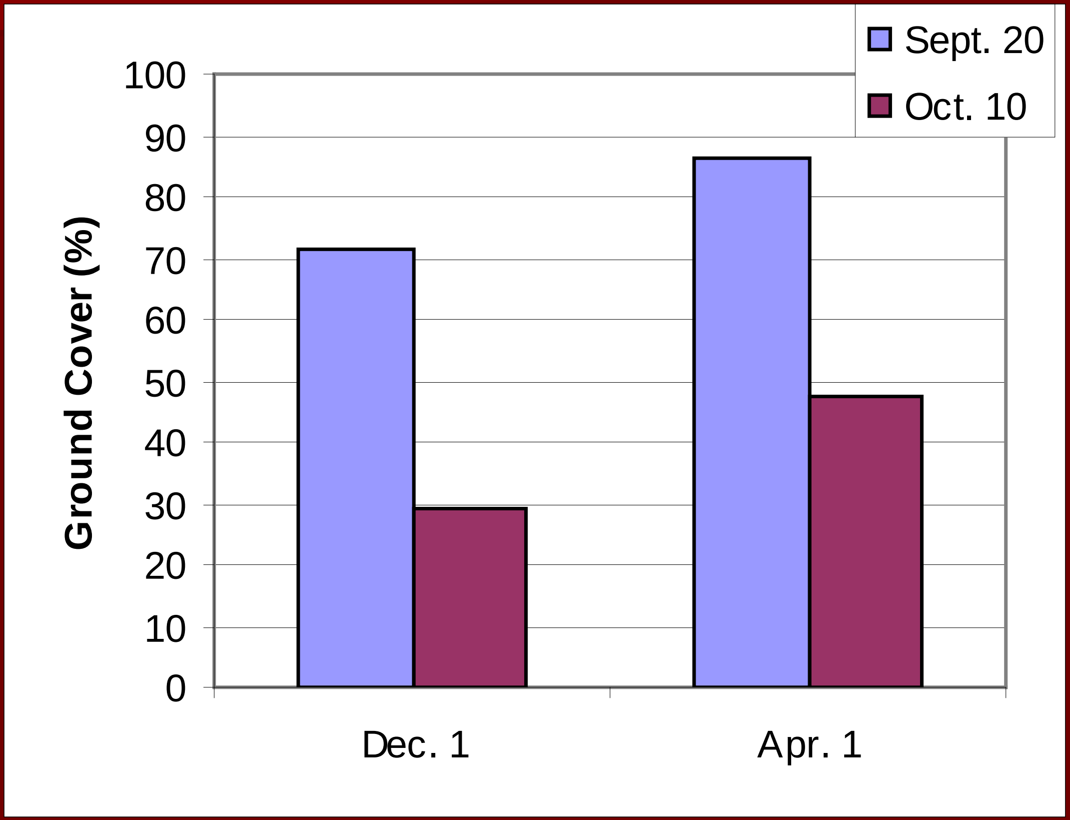
Factors Affecting Rye Forage Yield and Quality

Planting: Rye should be planted as soon after corn silage harvest as possible. In southern Wisconsin, rye planted in mid-to-late September produces higher forage yield, and tends to mature slightly earlier the next spring. However, yield potential does not significantly decline until about October 10 (Figure 1). Later planting results in less soil cover going into winter, thus reducing soil protection (Figure 2). However, rye grows rapidly in spring and acceptable forage yield can usually be achieved with later October planting.

Rye planted at different planting dates, Oct. 10 (left) and Sept. 20 (right). Photo taken the following April.

Extension WISCONSIN NPM

Effect of rye planting date on soil cover



Averages from replicated trials, Janesville, 2003-04. Seeding rate =112 lbs/acre.

SNAP Plus (RUSLE2) estimated soil loss, PI

Kidder silt loam

Crop rotation: O/A-A-A-CS-CS

Manure applied @ 12,000 GPA for O/A, CS and CS

2-6% slope	T	RUSLE2 t/ac	PI
No cover crop	5	1.8	2.9
Small grain cover crop	5	1.6	2.7
6-12% slope			
No cover crop	5	4.2	6.2
Small grain cover crop	5	3.5	5.1

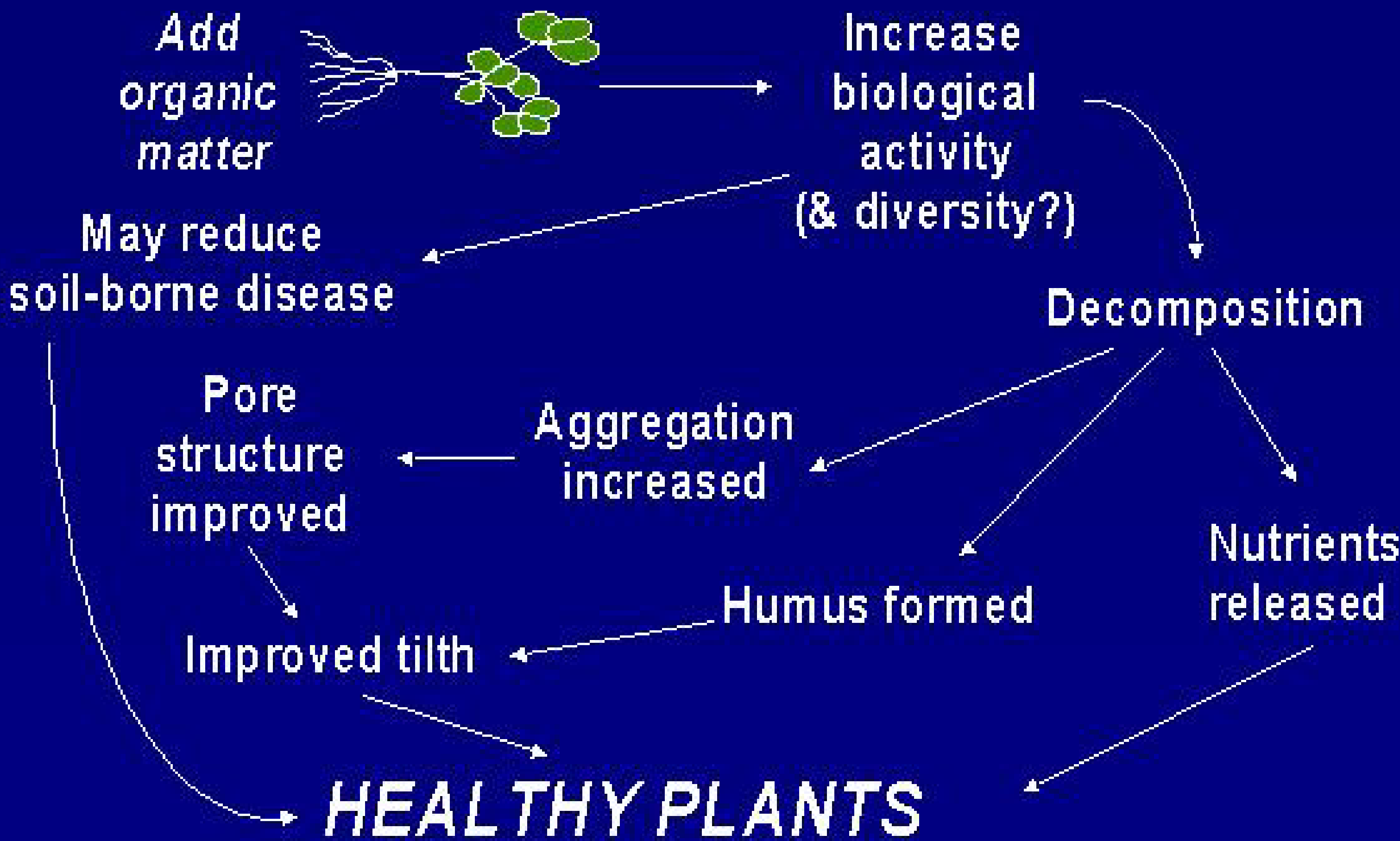
Estimated dry matter in the field
(above ground) – various sources

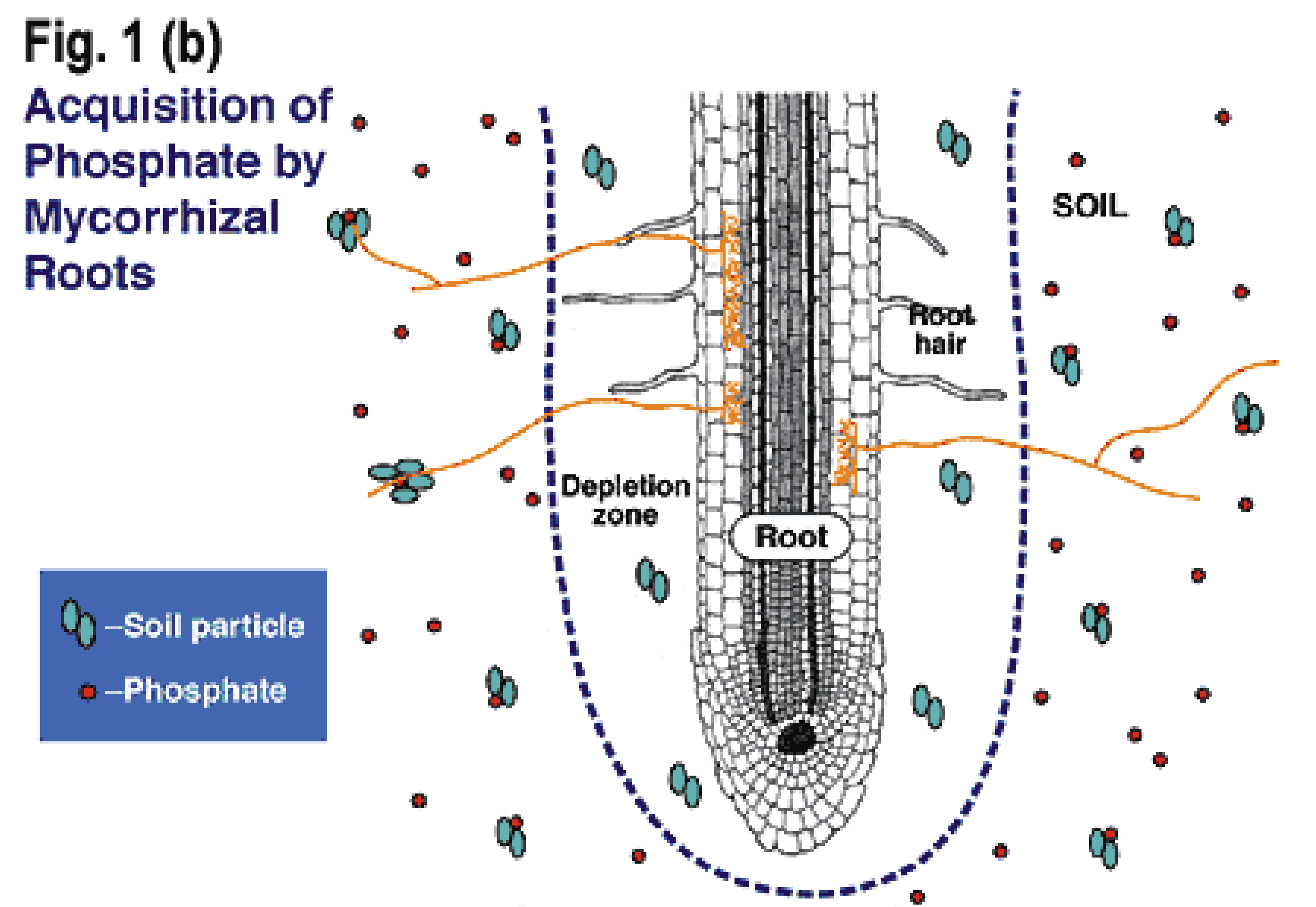
	lbs DM per-acre
Crop residues	
– Corn (grain)	>5,000
– Soybeans	<2,000
– Winter wheat (straw removed)	2,000
– Corn silage	<1,000
Cover crops	
– Med red clover	3,000
– Hairy vetch	3,000
– Berseem clover	2,000
– Winter rye	>1,000

Carbon to Nitrogen (C:N) Ratios of Organic Materials

Material	C:N Ratio
Leg cover crops	10:1 – 15:1
Young rye plants	14:1
Rye at flowering	20:1
Rye, past pollination	35:1
Corn residue	60:1
Grain straw	80:1
Sawdust	300:1

Effects of OM additions





Roots with mycorrhizae

Source: Harrison et al 1999

Why plant a cover crop?

1. Economics
2. Environmental stewardship

Economics:

$ Costs < $Returns

Evaluating Cover Crop Economics

What are the added costs?

- Seed
- Seeding, flail shredding
- Termination (extra herbicide or tillage passes)
- Management

What are the returns?

- Fixed or scavenged nitrogen
- Weed control
- Yield increase with subsequent crop (+/-)
- Conservation program compliance and/or cost share

UW Extension
Cooperative Extension

What are the returns?

- Short term (1-2 years)
  - Directly applied to the immediate or next crop
- Long term (cumulative effects)
  - Harder to assess
  - Soil protection and quality improvements
    - OM content, aggregation, structure, density, porosity
  - Enhanced nutrient cycling and improved nutrient utilization efficiencies
  - Higher productivity/yield potential
  - Improved water quality

Evaluating Cover Crop Economics

What are the risks?

- Cover crop failure
- Impact on subsequent crop
  - Soil moisture
  - Insects/ diseases
  - Allelopathy
  - Nitrogen immobilization
  - Crop insurance eligibility
- Forage quality (if harvested)

Conclusions

- Cover crops can provide ecological, conservation and agronomic benefits in certain niches within Wisconsin crop rotations;
- Economic returns can be positive when management efficiencies are achieved and long term productivity benefits are realized;
- Public conservation programs are important to enabling adoption

Conclusions

- Start small, do your homework and know the risks;
- More research and education to understand potential uses and benefits of cover crops is needed;
- UWEX Cover Crops workgroup, with assistance from USDA SARE, has formed for this purpose.

Thank You!

Kevin Shelley

UW Nutrient and Pest Management Program

1-800-994-5853

Jim Stute

UW Extension Rock County

608-754-5696


Rye as an early-season forage?
Double cropped with
Corn, soybeans, wheat

Rye forage yield and quality

	Average	Range
Yield (ton DM/acre)	2.37	1.34–3.88
RFQ	180	149–205
CP (%)	16.2	13.3–19.0
ADF (%)	27.6	24.6–31.4
NDF (%)	52.2	47.2–56.7
P (%)	0.39	0.29–0.48
K (%)	3.05	2.10–4.37

* Results from 11 trials (site years) at Arlington, Lancaster and Janesville, 2004-06.

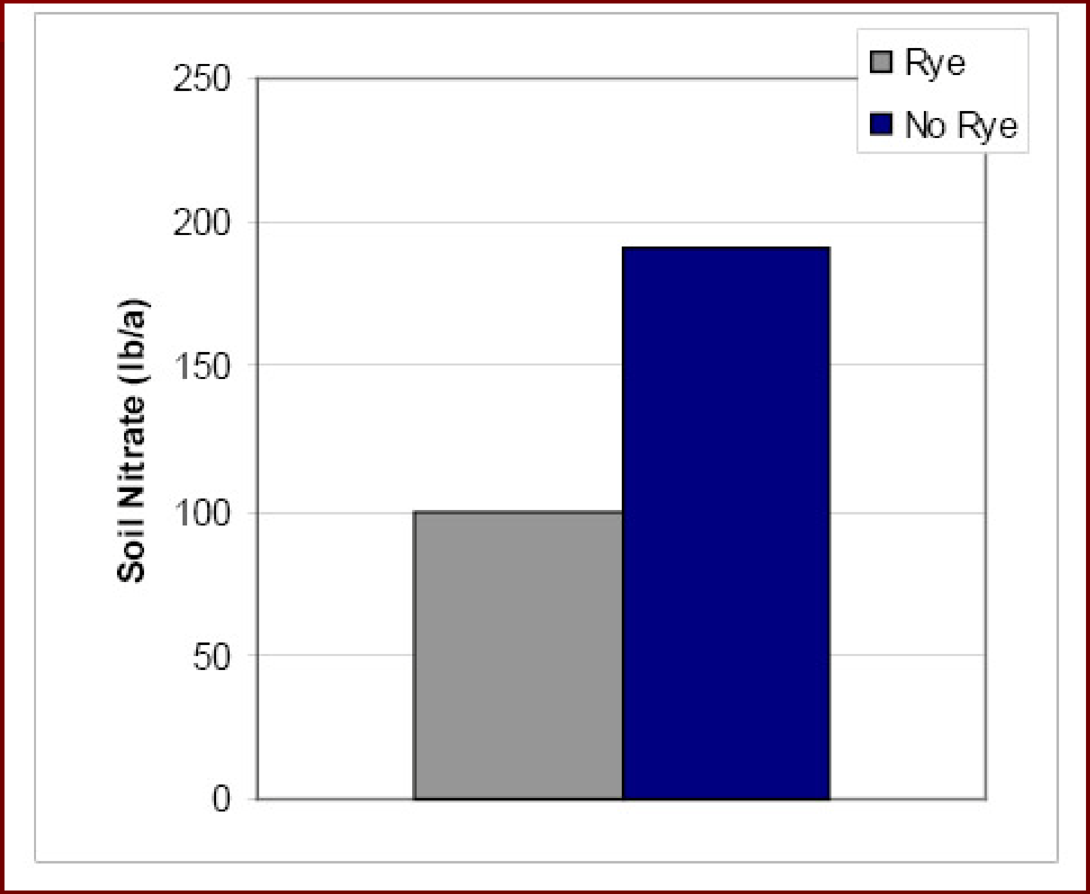
Rye nutrient management opportunities

Nutrient removal (lb/acre) dry matter basis, harvested at boot stage:

	Average	Range
N	121	69–178
P2O5	42	29–71
K2O	178	110–344

Results from 11 trials (site years) at Arlington, Lancaster and Janesville, 2004-06.

Soil profile NO_3^- measured in spring following fall application of 40 tons/ac dairy manure



Measured at rye forage harvest, Janesville, 2004-06