Cover Crops for Nutrient Management

Jim Stute

Rock County *UWEX*

UW Extension
Cooperative Extension

Four Applications

Add N to cropping system

- old practice of “Green Manure”

Retain nutrients in cropping system

- “sponge” excess or easily lost nutrients

Manage levels of soil test nutrients

Enhance nutrient availability

Green Manure

Purpose:

- add nitrogen

Goal:

- fix as much nitrogen as possible
- release it efficiently to the following crop

Desirable attributes:

- legume
- competitive growth
- medium to high yield potential
- degradable biomass
- not an alternate host for disease

Legumes

Forage	Seed, Oil seed
Clovers	**Cowpea (a)**
Berseem (a)	
Red (b,p)	**Field pea (a)**
Crimson (a)	
Subterranean (a)	**Soybean (a)**
White (p)	
Vetches	
Hairy (wa)	
Wollypod (a)	
Chickling (a)	
Medics (a)	
Sweetclover (a,b)	

Lifecycle: a, annual; wa, winter annual; b, biennial; p, perennial

Source: SAN MCCP 3rd ed.

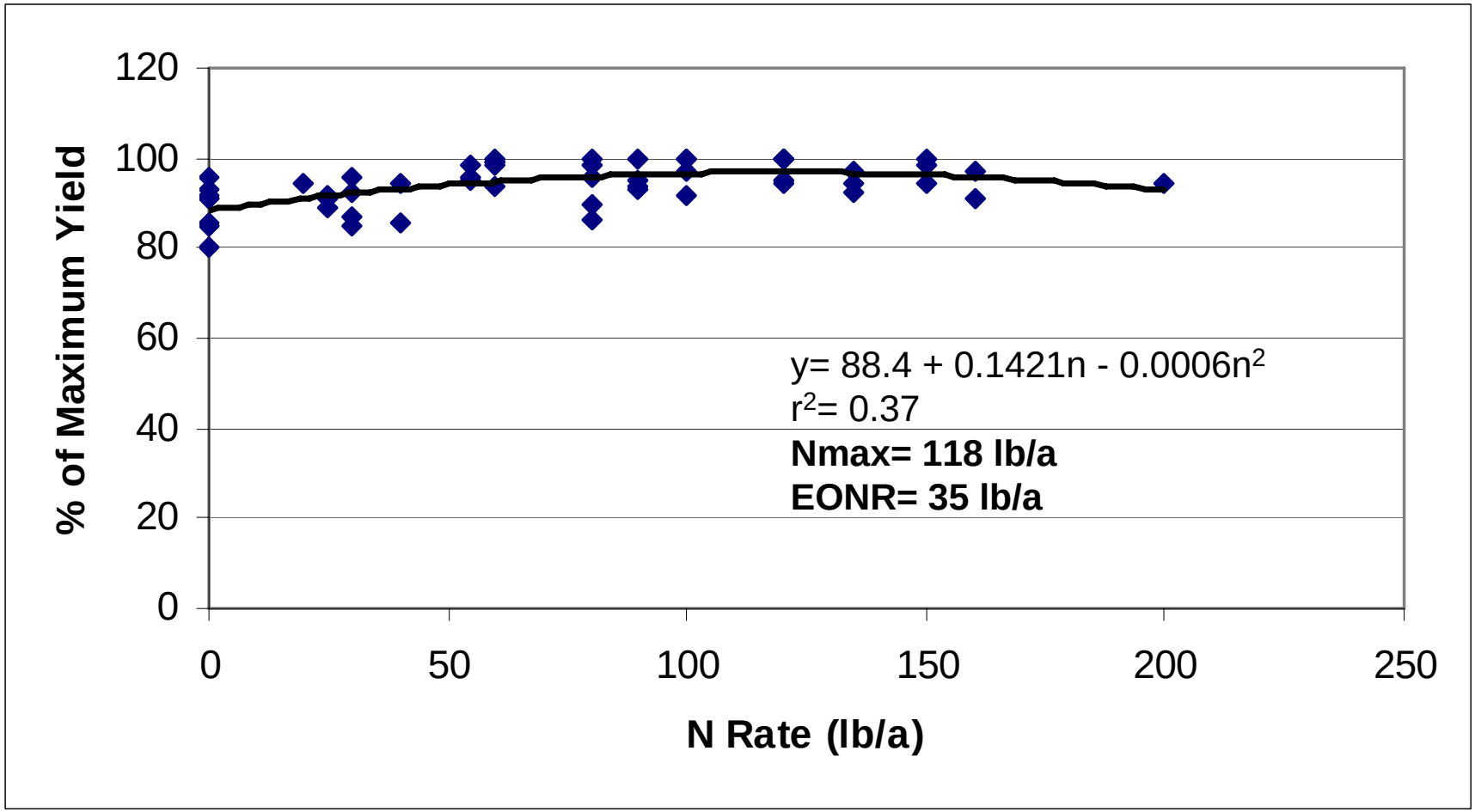
UWEX green manure nitrogen credits

Crop	< 6" growth	> 6" growth
	lb N/a to credit	
Alfalfa	40	60 - 100
Red clover	40	50 - 80
Sweetclover	40	80 - 120
Vetch	40	40 - 90, 110 - 160

Source: A2809


2008 8 26

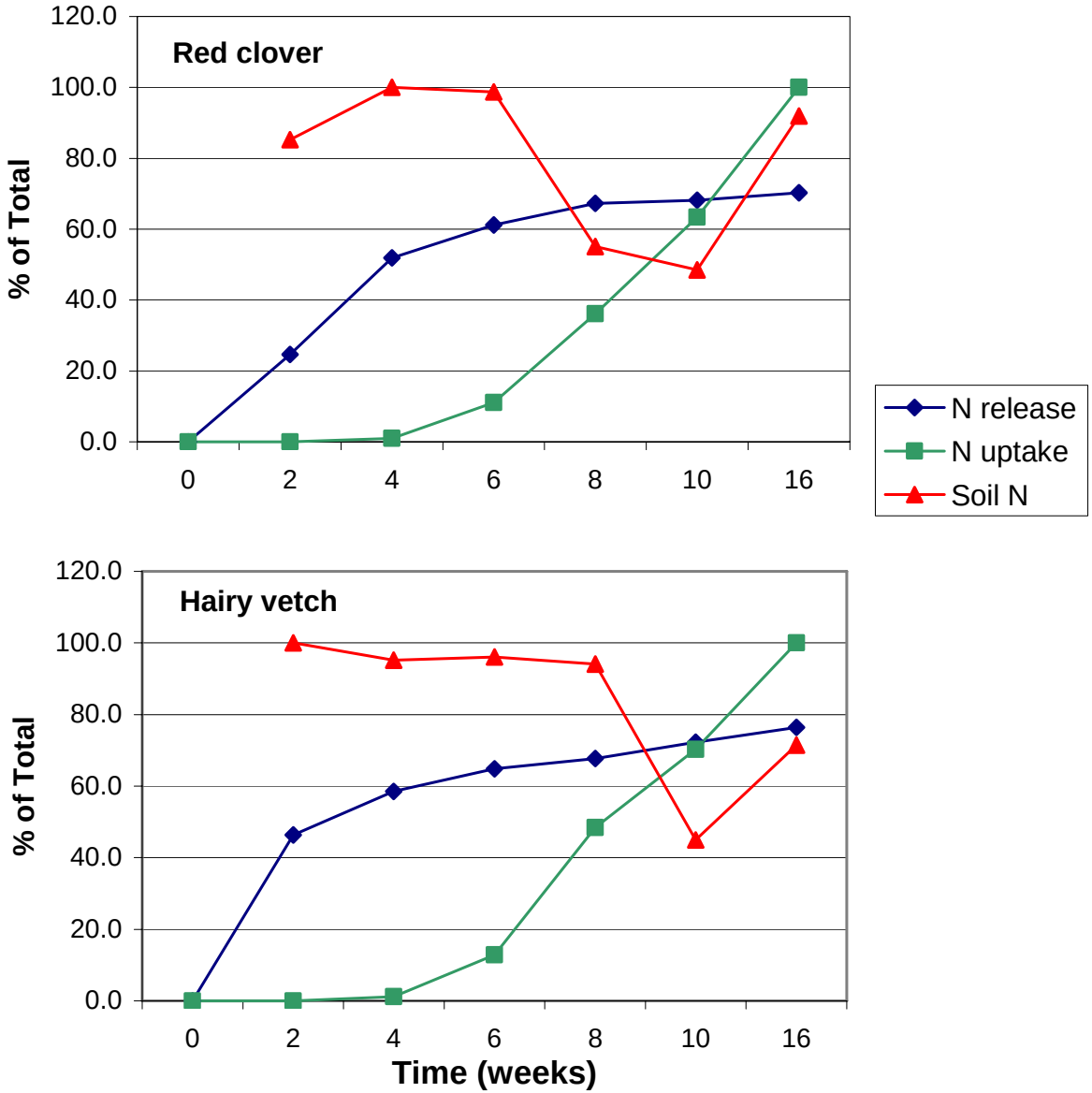
Corn response to additional nitrogen



Source: Unpublished

Trial locations: Belvidere, East Troy, Elkhorn, Lancaster (1995-2001)

Nitrogen Dynamics: mineralization and corn uptake



Adapted from Stute and Posner, 1995, Agron. J.

Medium red clover

October 1

No-till corn

July 1

Nutrient Cycling

Purpose:

- retain nutrients and make available for other crops

Goal:

- “sponge” available/ excess nutrients
- keep “available” nutrients available

Desirable attributes:

- rapid growth
- medium to high yield potential
- degradable biomass
- deep root system
- high nutrient demand

Applications

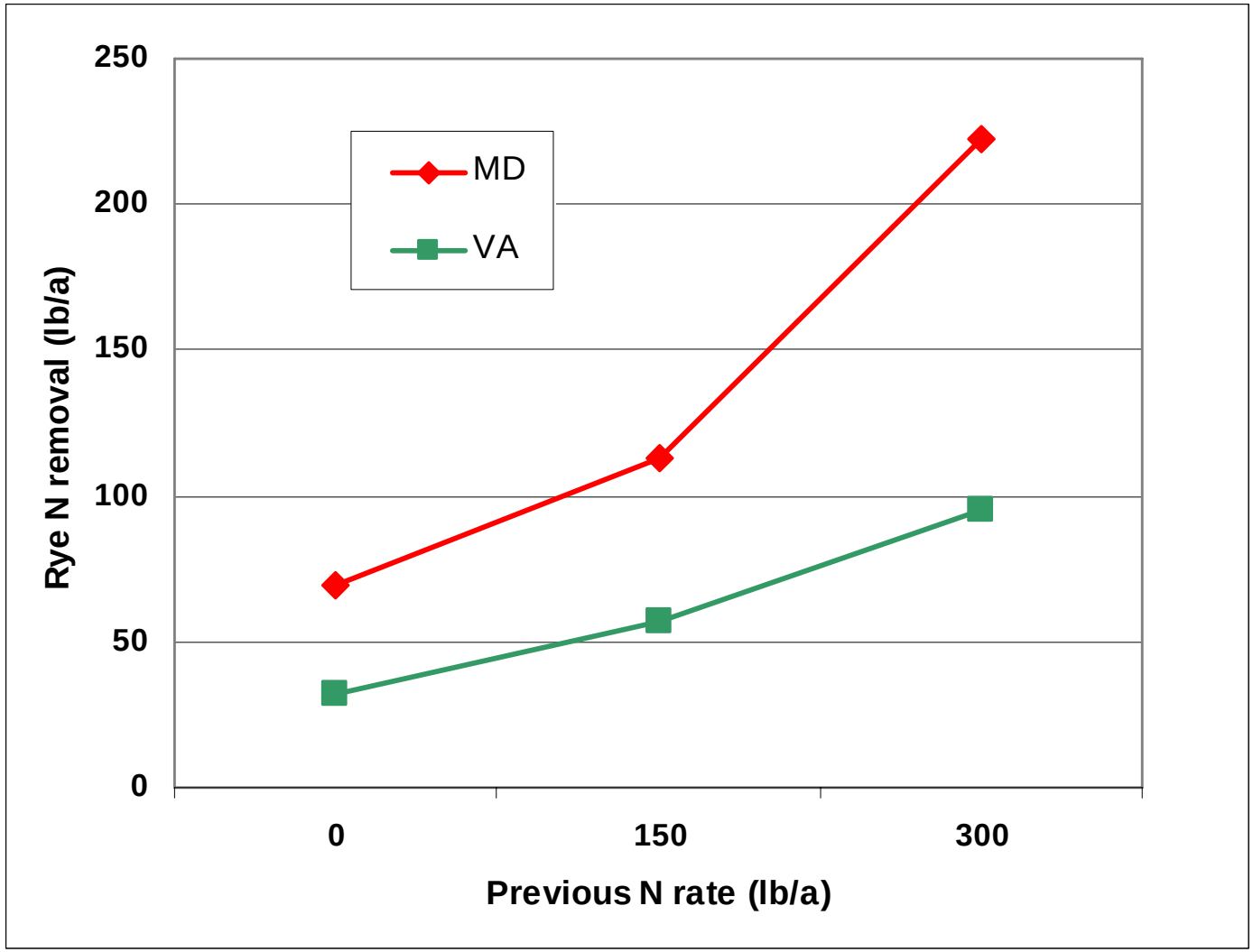
Following high and medium N demand crops

- corn (silage)
- sweet corn
- potato

Following nutrient application to fallow situations
eg. manure after winter wheat

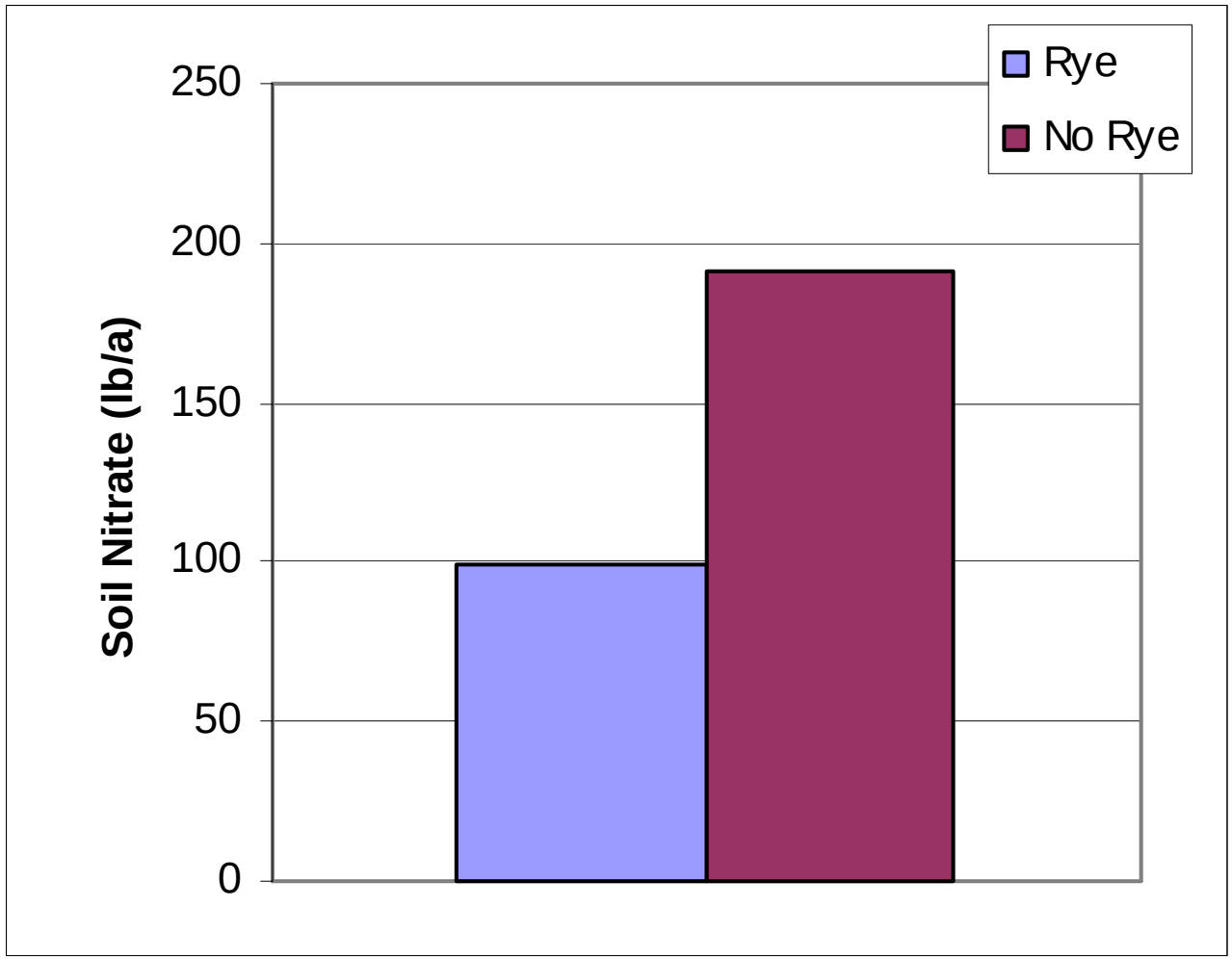
Where organic nutrient sources are used
continued mineralization after harvest

Impact of previous N rate on rye N removal



Sources: Shipley et al, 1991 Agron. J; Ditsch et al, 1993 J. Soil and Water Cons.

Impact of winter rye on soil nitrate measured in spring at Elkhorn, 2002.



Source: Stute, unpublished

Manage soil test nutrient levels

Goal:

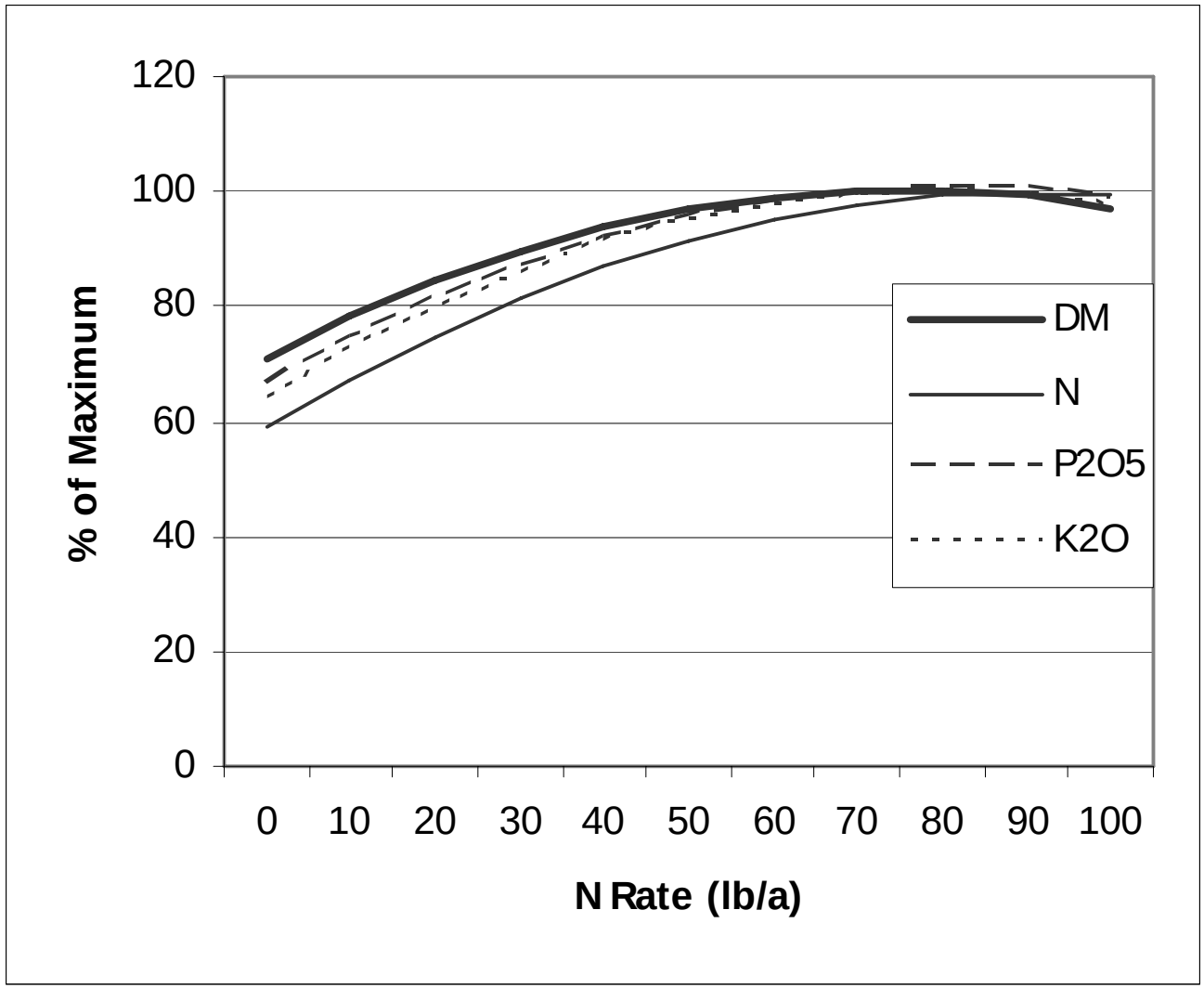
- Maintain or reduce STP by increasing annual removal
- Maintain manure application flexibility

Desirable attributes:

- Same as nutrient cycling
- Must be harvestable


FORD

Impact of nitrogen rate on rye dry matter yield and nutrient removal



Source: Shelley and Stute, 2008, WFAPMC proc.

Impact of rye on nutrient removal for various crops following corn silage, calculated by SNAP Plus (version 1.121) compared to tissue sampling to estimate removal.

Crop Rotation						Annual increase (year 2) with rye	
		P_2O_5	K_2O	Impact of rye			
Year 1	Year 2	balance	balance	P_2O_5	K_2O	P_2O_5	K_2O
SNAP Plus		(lb/a)		(lb/a)		%	
Corn silage	Corn silage	-160	-370				
	Rye - Corn silage	-190	-490	-30	-120	38	65
Corn silage	Soybean	-120	-255				
	Rye - Soybean	-150	-375	-30	-120	75	171
Corn silage	Alfalfa seeding	-105	-290				
	Rye - Alfalfa seeding	-135	-410	-30	-120	120	114
Tissue testing							
Corn silage	Corn silage	-160	-370				
	Rye - Corn silage	-210	-590	-50	-220	63	119
Corn silage	Soybean	-120	-255				
	Rye - Soybean	-170	-475	-50	-220	125	314
Corn silage	Alfalfa seeding	-105	-290				
	Rye - Alfalfa seeding	-155	-510	-50	-220	200	209

Yield goals: corn silage, 21-25 t/a; rye, 2-3.5 t/a; soybean, 46-55 bu/a; alfalfa seeding, 1-2.5 t/a.

Source: Shelley and Stute, 2008, WFAPMC proc.

Enhance nutrient availability

Goal:

- Increase nutrient availability in root zone

Desirable attributes:

- Same as nutrient cycling
- Deep root system
- Effective forming mycorrhizal associations
- Special properties (buckwheat)

Buckwheat

Cover crop applications for field crops

UW Extension
Cooperative Extension

Three Applications

Red clover interseeded with winter wheat

variation: legumes with spring grains

Winter rye after corn silage

Oats after short season crop

Sweet corn is best example

Interseeding red clover in winter wheat

Interseeding red clover with winter wheat

Optimize wheat production!

- Previous herbicide choice
- Population and planting date
- N rate and application timing
- MCPA is only herbicide option

Red clover “frost seeded” in mid-March

- Frost seeding is really “cracked soil surface seeding”

Seed broadcast

- Specialized equipment (spreader on ATV)
- Air-flow applicator during N application
- Double spreading improves stand

Red clover

- Use cheapest seed available
- Medium vs mammoth
- 12 to 15 lb/acre (10 to 12 with optimal conditions)
- Inoculate seed


Herd
SURE-FEED
BROADCASTER
JOHN DEERE

Red clover management

Red clover can be clipped!

- Weed control
- If clover flowers
- Remove diseased tissue
- Manage excessive biomass, especially in NT

Clover should be terminated in fall

- Initiate decomposition
- No moisture concern in spring
- Fall chemical kill more efficient
  - Herbicide translocated
  - Combination of glyphosate and growth regulator
- Facilitate strip tillage

Spring residue management in NT

- “fluffing” speeds soil warming and drying
  - Rotary hoe or “Phoenix” like tool
- Row cleaners necessary?

Corn management

Nitrogen

Starter supplies early season N

- especially important in cool springs

Use UWEX credit as base for supplemental N decision

- 50 to 80 lb/a for >6” growth

Base decision on amount of growth in fall

Response to supplemental N likely in cool springs

PSNT to guide decision

Pests

Scout for secondaries and cutworm

Variant western corn rootworm?

Variations

Clovers and be interseeded with spring grains

Other species can be seeded after small grain harvest

Summer seeding is more risky!

- Moisture
- Shorter time for growth

Berseem clover most likely choice

- Annual lifecycle maximizes growth in time available

Biennials and perennials will produce significant growth the following spring but…

- Soil moisture depletion
- Delayed planting
- N fixation only happens above 52^{o} F

Seeding year legume yield at East Troy, 2007

Legume	Biomass Yield (t/a)	N Yield (lb/a)
Summer seeded		
Berseem clover	1.58	87
Annual sweetclover	1.72	92
Chickling vetch	0.59	31
Spring seeded		
Medium red clover	2.34	113
lsd	0.4	18

Source: Stute, unpublished

Performance of summer seeded legumes in Wisconsin, 1995-2007

Legume	Nitrogen Yield		Site Years of Data
	Mean	Range	
Hairy vetch	85	55 - 147	15
Annual medic	51	23 - 97	9
Berseem clover	56	16 - 111	15
Crimson clover	56	42 - 69	4
Annual alfalfa	30	29 - 30	2

Source: Stute et al, unpublished

2008

2007

Winter rye after corn silage

Winter rye after corn silage

Corn silage

- Watch herbicide selection
- Follow UWEX recommendations for N (?)

Winter rye

- Plant early, before October 10 if possible
- Seeding rate 90 to 112 lb/a, increase after October 10
- 1 to 1.5 inches deep
- Variety unimportant
- No-till if possible

Winter rye after corn silage

Nitrogen management

Apply in spring

Based on harvest management

- No N for unharvested cover crop
- 40 to 60 lb/acre fertilizer N
- 80 lb/acre “creditable” N
- Do not exceed 80 lb/ acre even though removal can exceed 120 lb/a

Harvest management

Harvest at boot stage

Rapid quality decline after boot stage

Watch soil moisture, harvest earlier in dry conditions

Subsequent crop

Alfalfa, soybean preferable to corn

Watch armyworm?

Oats after short season crops

Oats after short season crops

Main crop

- Watch herbicide choice, rotational restrictions

Planting

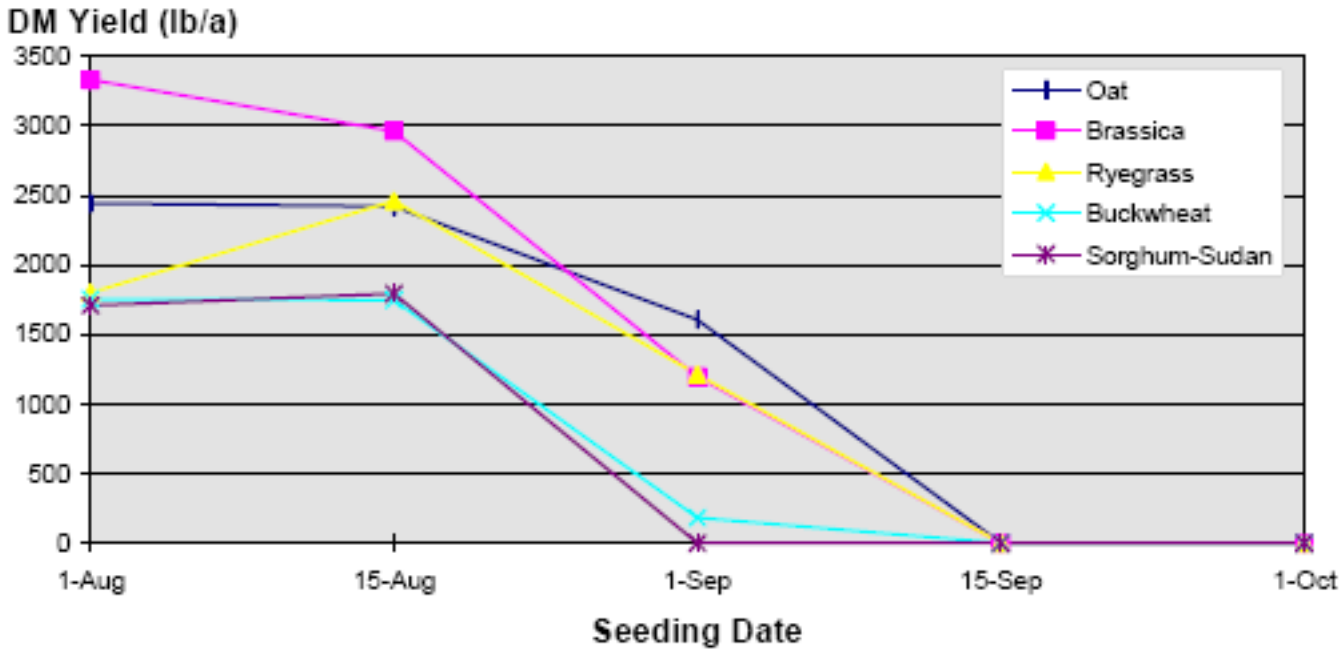
- Date: by September 1 if possible
- Rate: 80 to 96 lb/a, increase with difficult environments

Establishment Possibilities

- No-till
- Broadcast into chopped residue
- Broadcast and incorporate with shallow tillage
- Broadcast following primary tillage

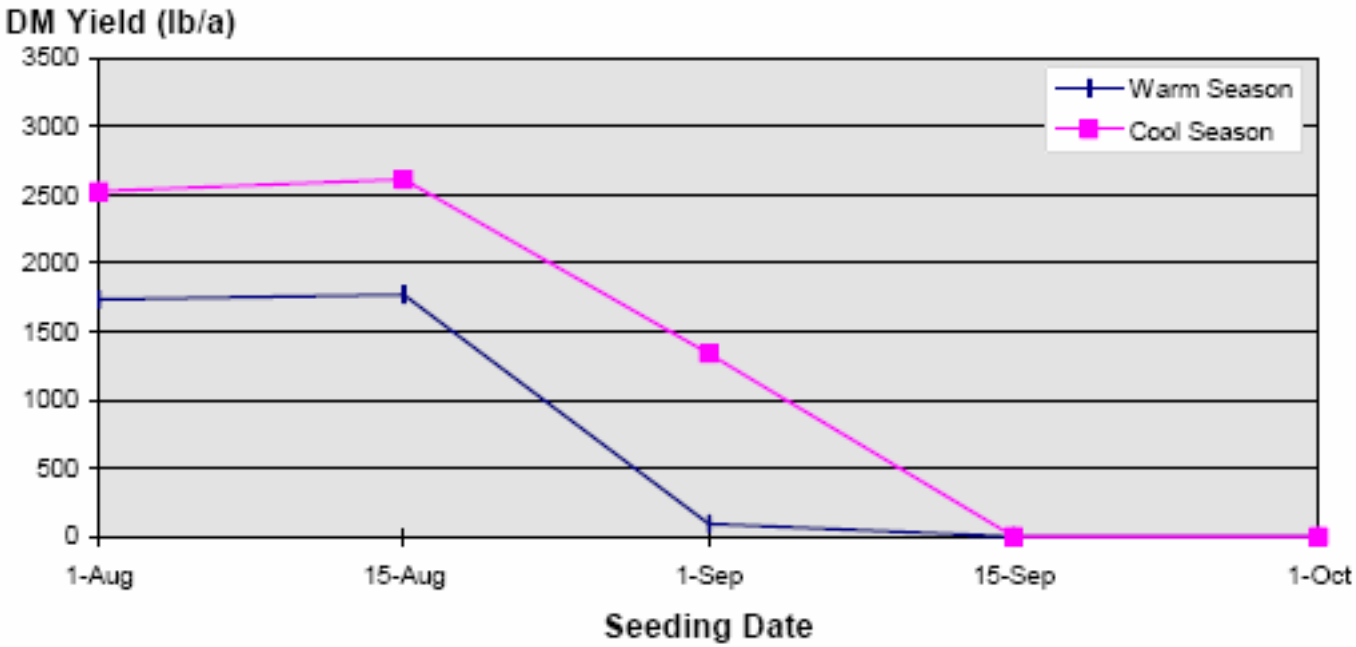
Can be done in conjunction with fertilizer application

Figure 1. Dry matter yield of individual species as affected by seeding date.



Source: Stute, 2000, WFAPMC proc.

Figure 2. Mean DM yield of warm and cool-season species as affected by seeding date.



Source: Stute, 2000, WFAPMC proc.

Publications by application

Red clover in winter wheat

http://www.extension.iastate.edu/Publications/PM2025.pdf

Winter rye after corn silage

http://ipcm.wisc.edu/Publications/tabid/54/Default.aspx

http://www.soils.wisc.edu/extension/wfapmc/2008/pap/Shelley.pdf

Small grain covers after corn and soybean

http://extension.agron.iastate.edu/soybean/documents/PM1999._covercrops.pdf

Kura clover living mulch for corn

http://extension.agron.iastate.edu/soybean/production_kuraclover.html