



UNIVERSITY OF MINNESOTA

Driven to DiscoverSM

Institute of Ag Professionals

Proceedings of the

2015 Crop Pest Management Shortcourse &

Minnesota Crop Production Retailers Association Trade Show

www.extension.umn.edu/Ag-Professionals

Do not reproduce or redistribute without the written consent of author(s).

Winter Oilseeds as “Cash” Cover Crops for Sustainable Crop Production

Russ Gesch, Frank Forcella, Carrie Eberle, Jane Johnson,
and Matt Thom

USDA-Agricultural Research Service-NCSCRL

Morris, Minnesota, USA



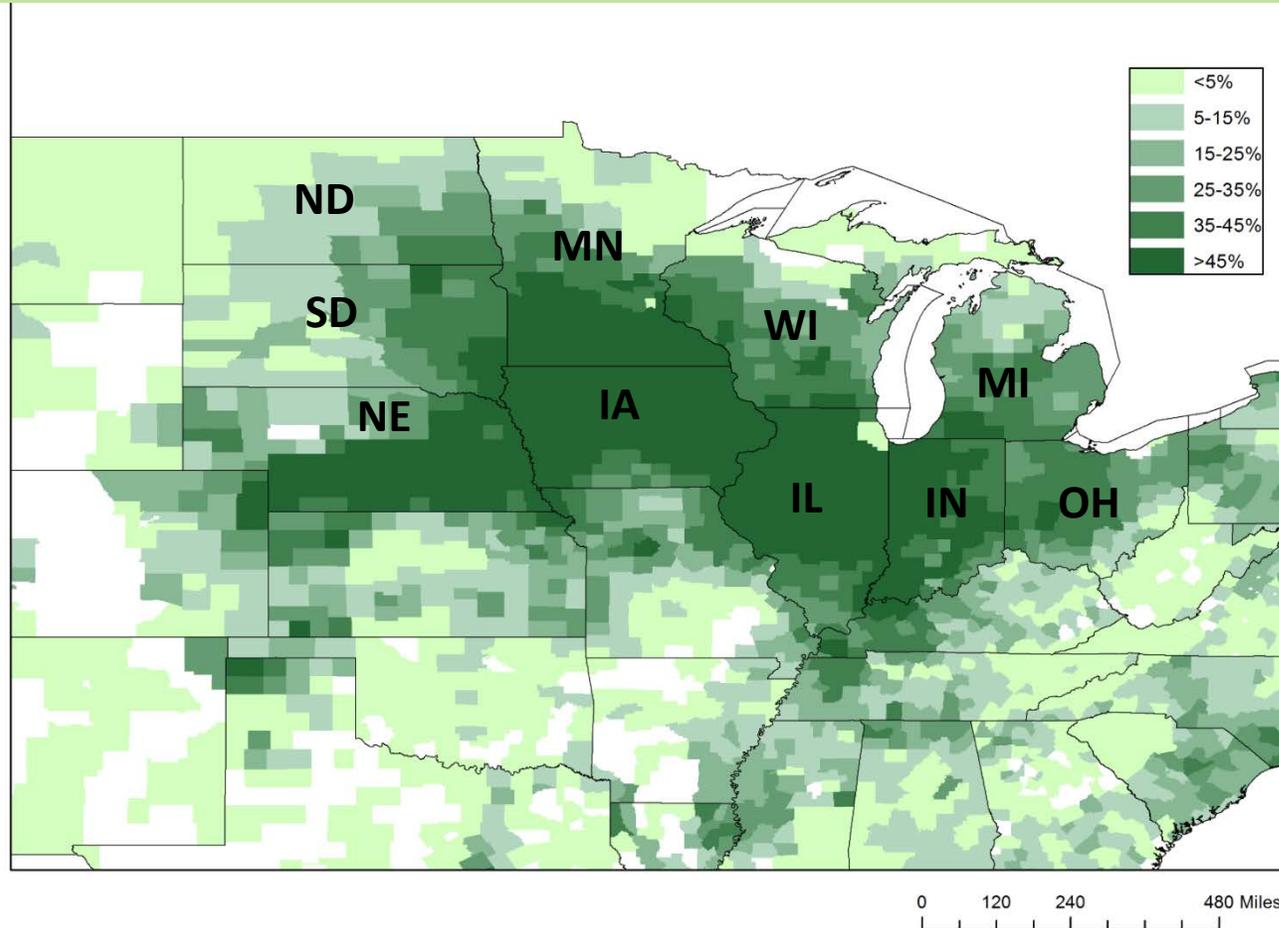
Outline

- Threats to agriculture sustainability
- Sustainably intensified agriculture
- Dual cropping winter annual oilseeds with food and forage crops
- Ecosystem services provided by winter oilseeds
- Summary

Concerns Threatening Agriculture Sustainability

- Increased population growth – Food security
- Urbanization – Loss of productive lands
- Balancing food, feed, fiber and fuel production
- Climate change - Loss of resources
- Lack of diversity across the agricultural landscape

Corn Belt Region



2011-2015 ~ 69 million acres of corn & 54 million acres of soybean annually

Acres of corn harvested for grain as percent harvested cropland acreage in 2012. From USDA-NASS

1978

1997

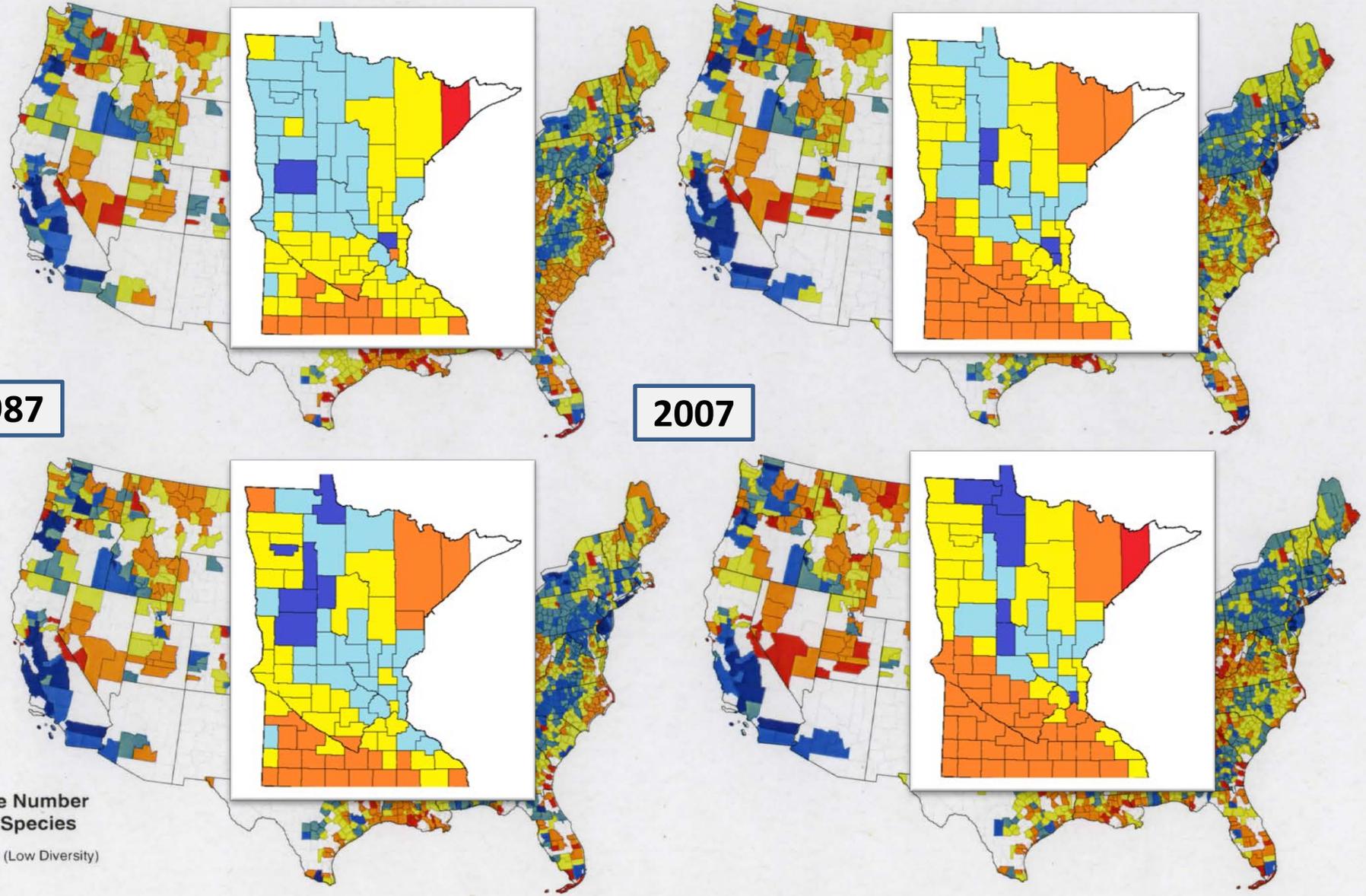
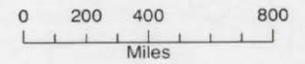
1987

2007

Effective Number of Crop Species

- 1 - 2 (Low Diversity)
- 3 - 4
- 5 - 6
- 7 - 8
- 9 - 12
- >12 (High Diversity)

Countries with <20% cropland*

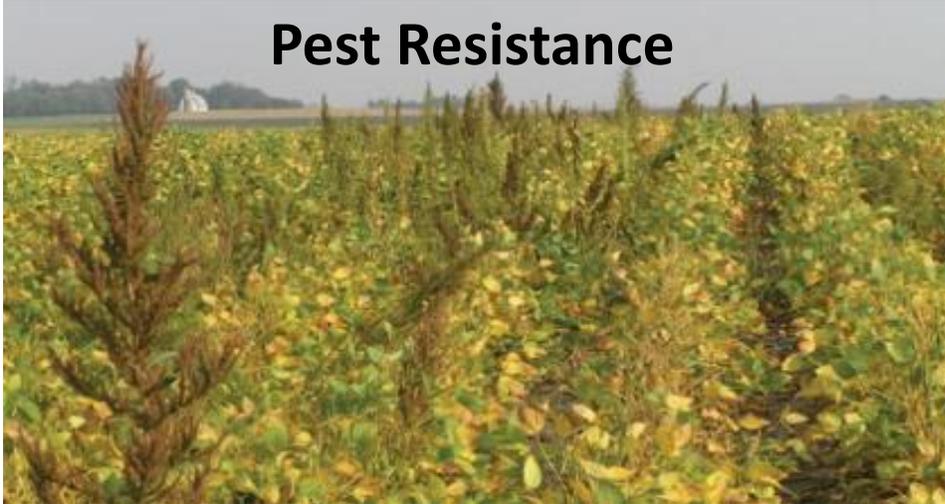


Cropping Diversity of Contiguous U.S.

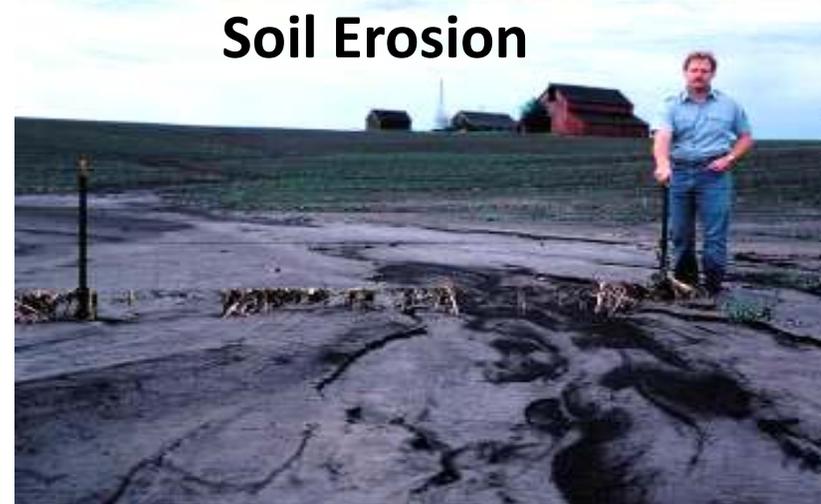
By Gramig & Forcella

Issues Surrounding Loss of Diversity

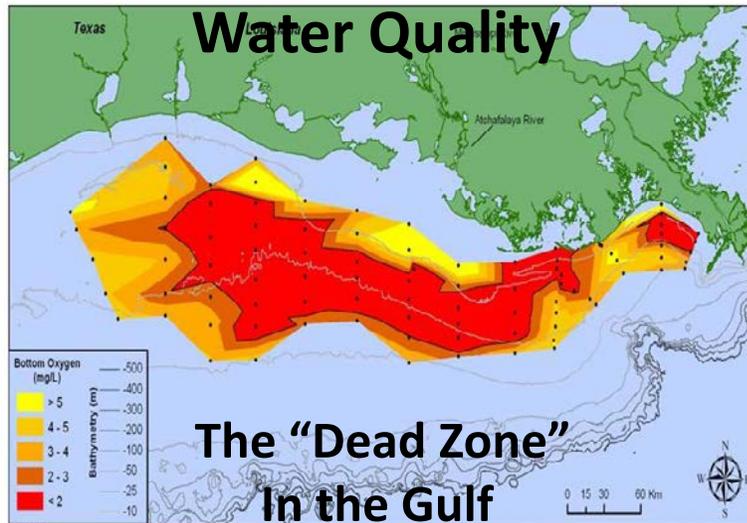
Pest Resistance



Soil Erosion



Water Quality



Data source: N.N. Rabalais, Louisiana Universities Marine Consortium, R.E. Turner, Louisiana State University
Funded by: NOAA, Center for Sponsored Coastal Ocean Research

CCD



Climate Change Source or Sink ?



Potential Solutions to Increase Sustainability and Add Diversity

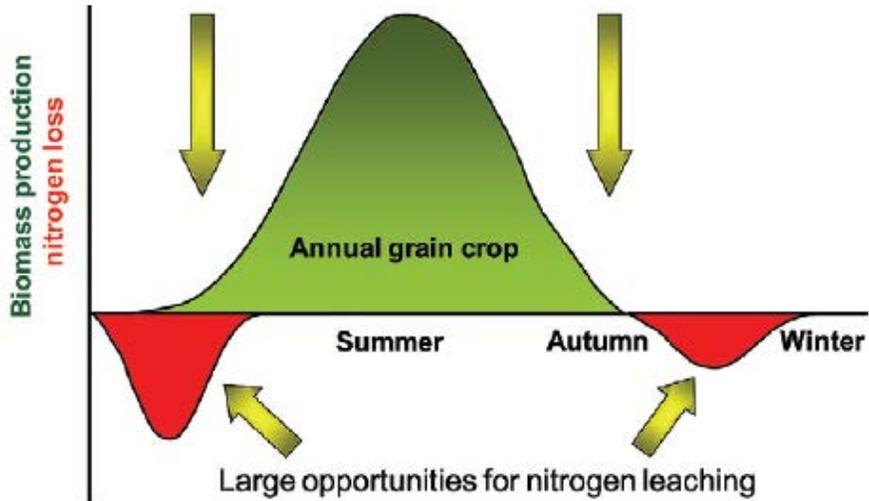
- “Sustainably Intensified Agriculture”
 - Increasing production on existing arable lands while minimizing negative environmental impact and sustaining food production
 - *Conventional* – Improved crop genetics, increased but efficient use of inputs
 - *Spatial* – Strategic placement of cultivated and natural systems
 - *Temporal* – Increased number of crops in a given time period – includes **double** and **relay** cropping

Cover Crops and Dual Cropping

(Corn Belt Region)

Mono-crop

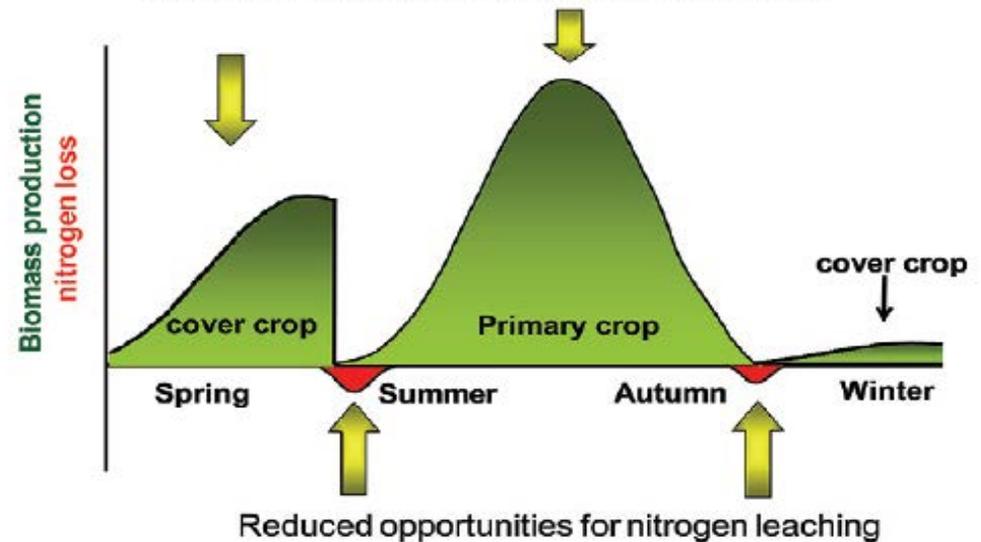
A) Missed opportunities for crop production



Heggenstaller et al. 2008, Agron. J.

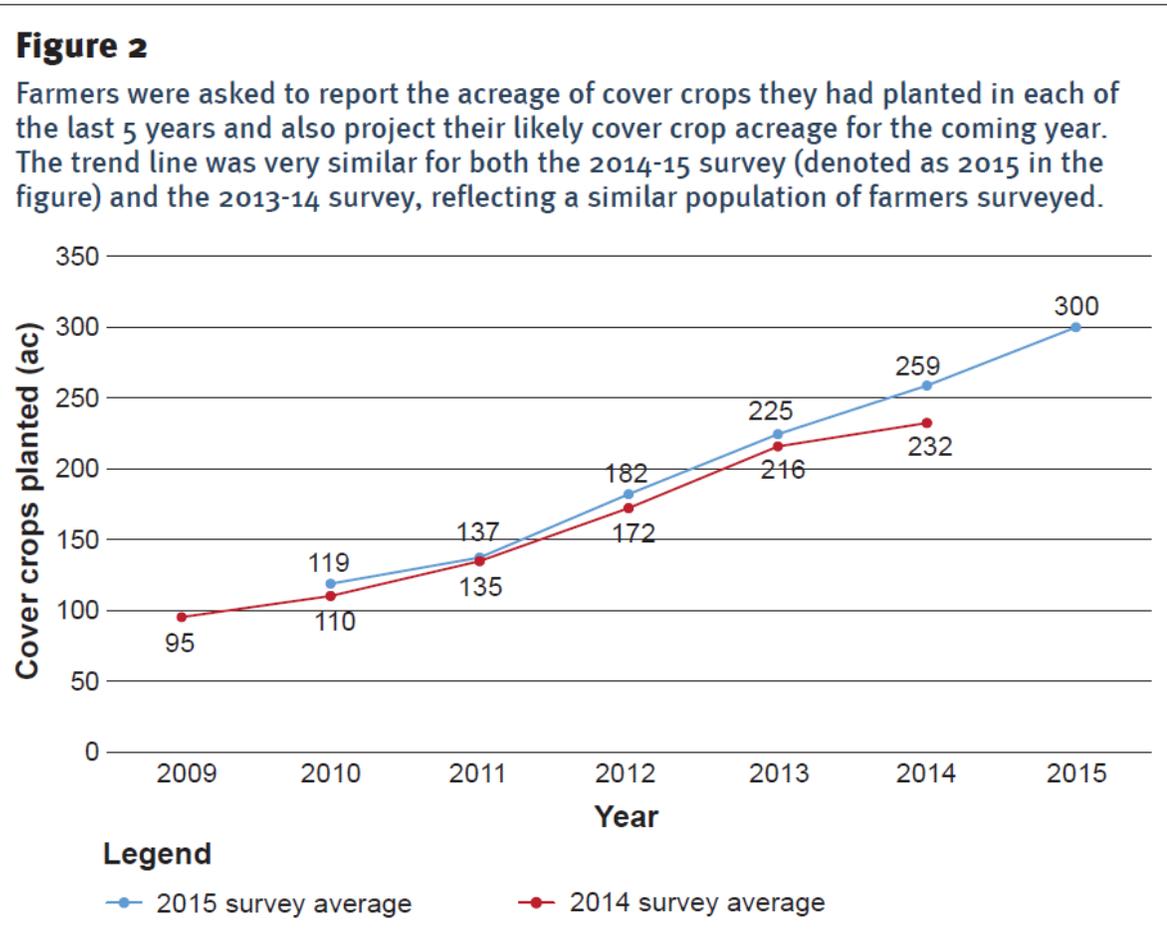
Dual-crop

B) More opportunities for crop production



Progress and perspectives with cover crops: Interpreting three years of farmer surveys on cover crops; *JOURNAL OF SOIL AND WATER CONSERVATION* NOV/DEC 2015—VOL. 70, NO. 6

Authors: Rob Myers and Chad Watts



Top 8 cover crop benefits farmers want

1. Increased soil organic matter
2. Reduced soil erosion
3. Reduced soil compaction
4. Control weeds
5. Provide a N source
6. Scavenge N
7. Increase primary crop yields
8. Economic return

There were several others with lower priority to farmers

Challenges of Cover Crops for Upper Midwest

- Short growing seasons
- Cold and freezing tolerance
 - Very few options, especially for winter annuals
- Economics – direct return

Oilseed Cash Cover Crops for Bioenergy or Food Uses

- Winter camelina (*Camelina sativa*) and pennycress (*Thlaspi arvense*)
- Good seed oil content: 32-42%
- Short life cycle
- Excellent winter survivability



Industrial uses



Food Uses



Double and Relay Cropping Soybean with Camelina





5 Harvest cover over soybean



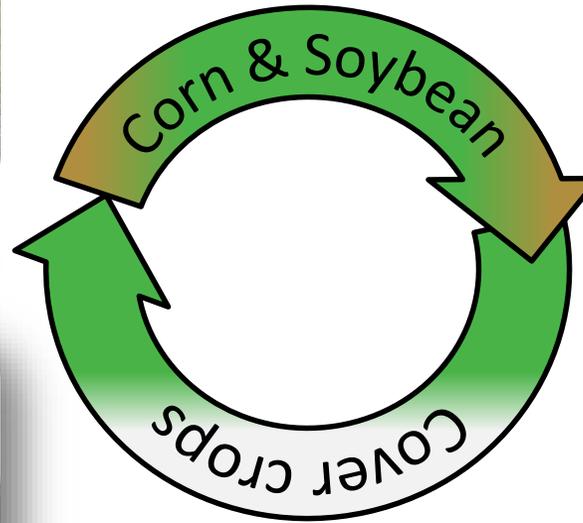
6 Summer crop grows



1 Plant cover crop in corn



4 Plant soybean into cover crop



3 Cover crop lies dormant



2 Harvest corn over cover crop



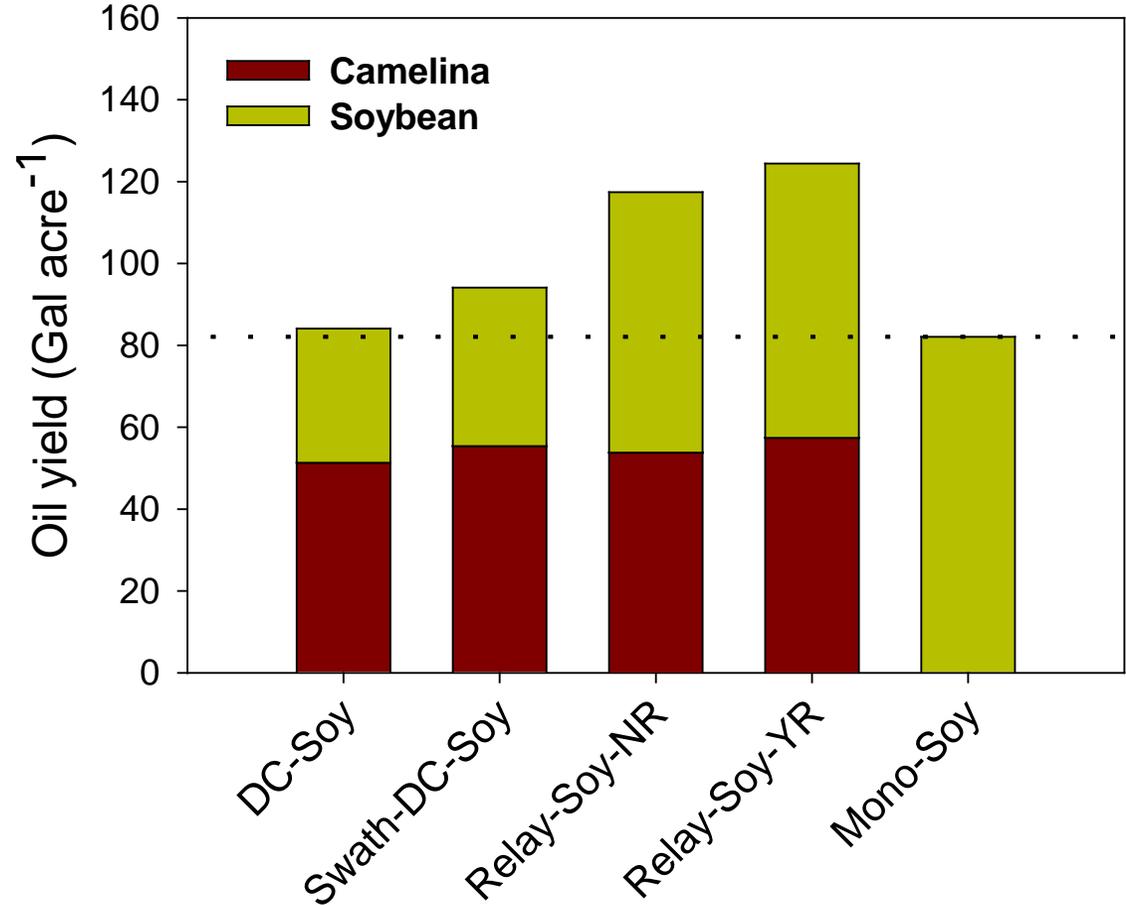
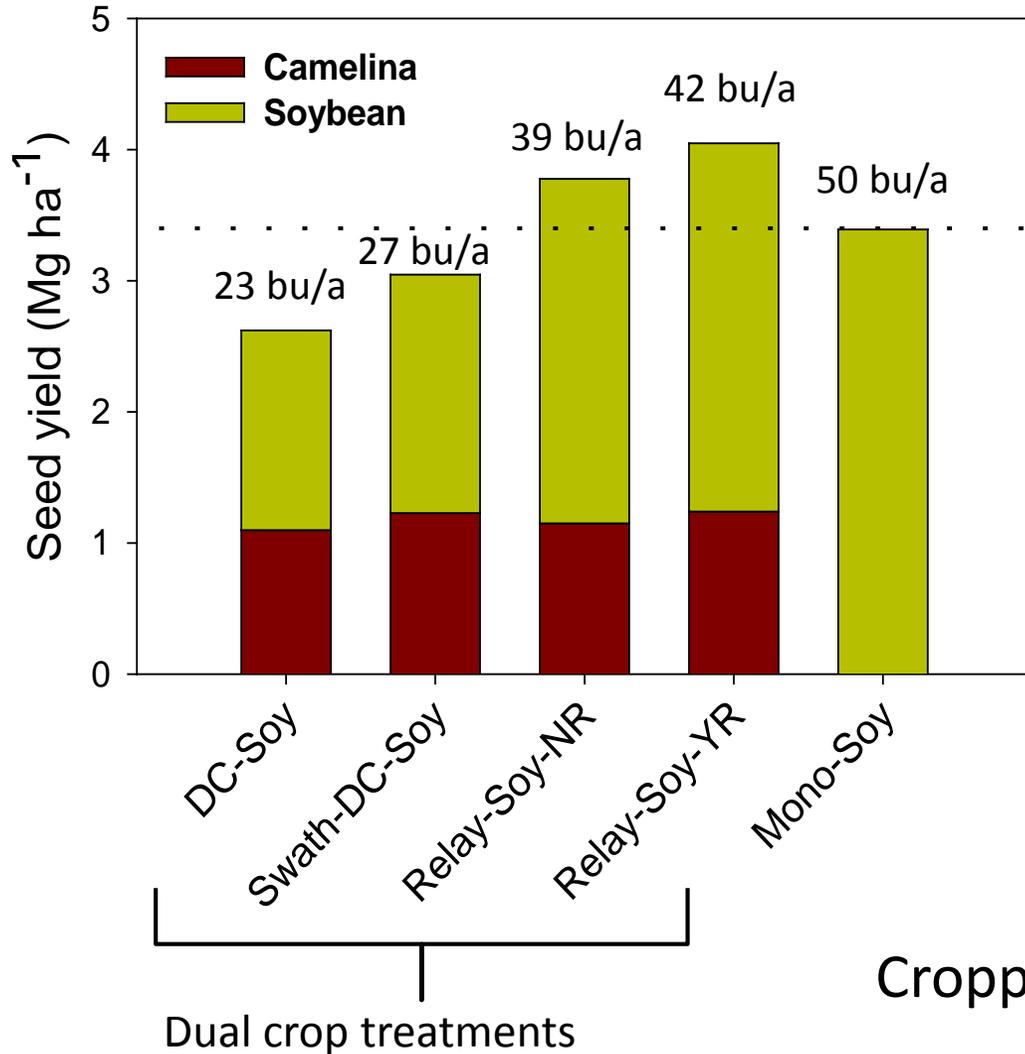
Establishment in Corn

- Planting methods
- Planting date and seeding rate
- Effect of residue after harvest



Dual Crop Winter Camelina and Soybean

Morris, MN 2010 and 2011



Economics – Dual Cropping with Camelina

Cropping treatment	Total APV	Net APV	Total gross income	Net return	Breakeven camelina price
	-----\$ acre ⁻¹ -----				\$ lb ⁻¹
Double crop	542 c	266 b	467 c	190 b	0.45
Swath/Double crop	621 b	326 b	541 b	247 b	0.38
Relay/no glyphosate	750 a	482 a	650 a	383 a	0.26
Relay/use glyphosate	798 a	521 a	697 a	420 a	0.21
Full-season soybean	630 b	480 a	576 b	426 a	NA

APV = Approximate processed value = Estimate of the total product value to an oilseed crusher.

Growing Season Water Use

Precipitation + Soil Water Storage – 2010-2011

Cropping Treatment	Water Use (inches)			WUE (lb/acre/inch)	
	Season total	Camelina	Soybean	Camelina	Soybean
Double Crop	19.8 a	4.5	15.3 b	221	102 d
Swath/double crop	19.0 b	3.8	15.2 b	357	111 cd
Relay/use glyphosate	19.1 ab	3.9	15.2 b	301	136 bc
Relay/no glyphosate	19.4 ab	4.8	14.6 b	231	145 b
Full-season soybean	18.3 c	NA	18.3 a	NA	192 a

Dual Cropping Camelina-Forage Sorghum (2012-2013)

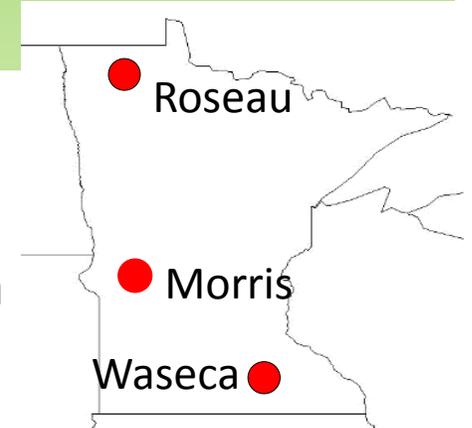
Cropping treatment	Biomass DW (Tons/acre)		
	Morris, MN	Prosper, ND	Carrington, ND
DC-Sorghum	3.2 c	2.1 c	0.9 c
Relay-Sorghum	4.6 b	4.4 bc	1.4 c
Sorghum-DSD	4.5 b	5.6 b	2.6 b
Sorghum-NSD	7.6 a	8.0 a	4.2 a
Annual Precip. inches	26	23	20

*We have also successfully double cropped millet and sunflower following winter camelina

Ecosystem Services Provided by Winter Annual Oilseed Crops

Retention of N & P in Cropping Systems and Water Quality

Cover crops = winter rye, tillage radish, winter camelina, and pennycress (no-till wheat & conv. till) - The primary crop is soybean



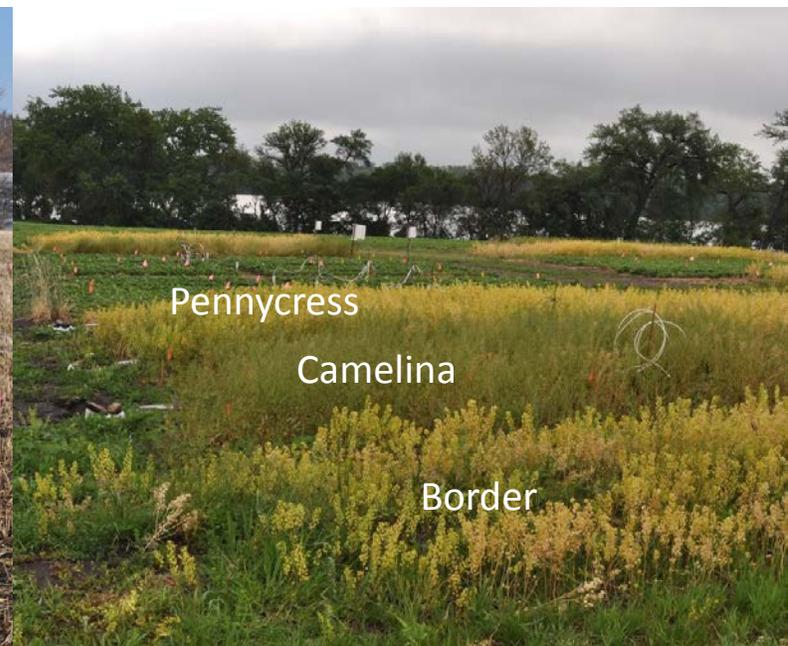
Fall 2014



Early spring 2015



June 2015





Pennycress



Camelina



Rye



Radish

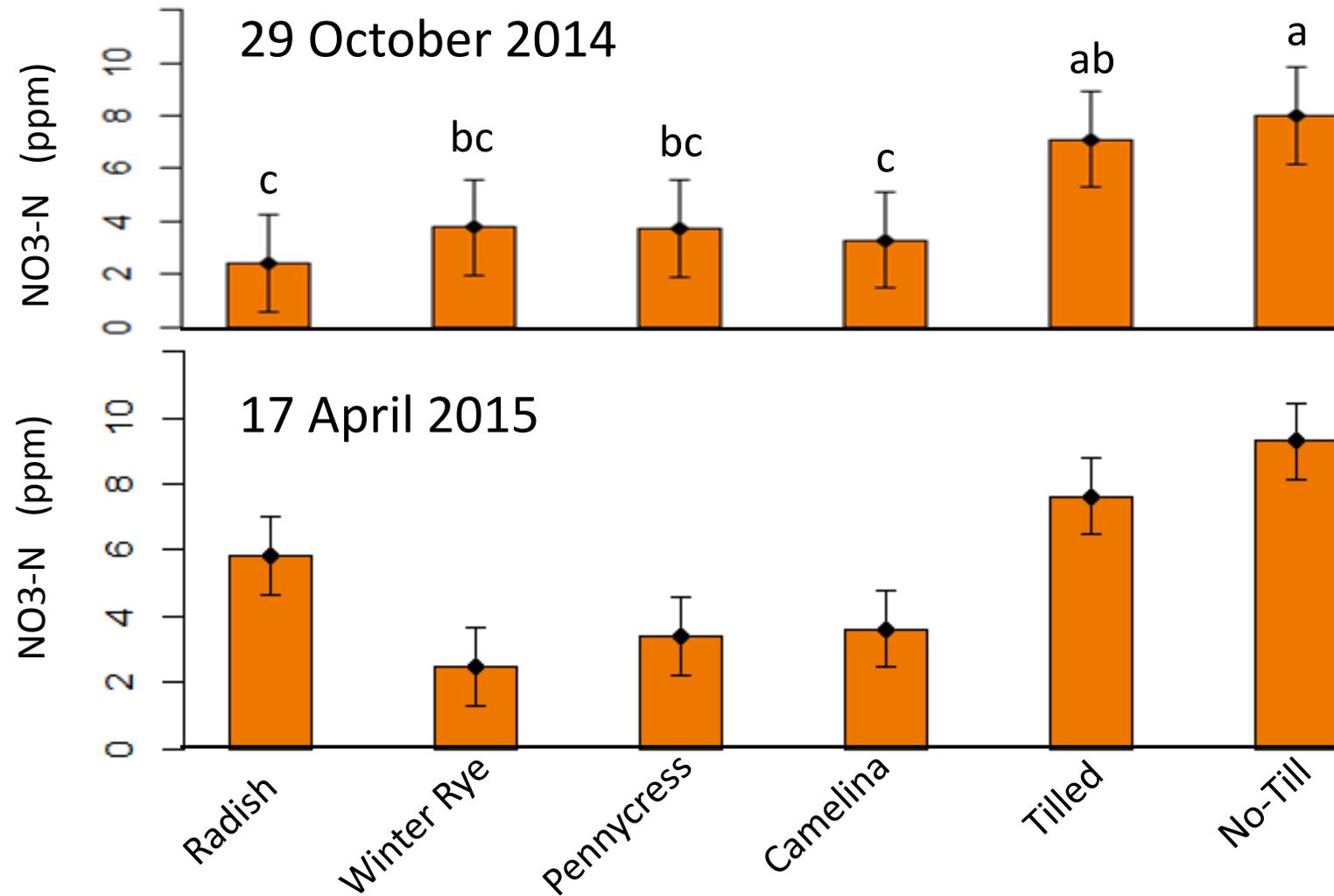


Controls

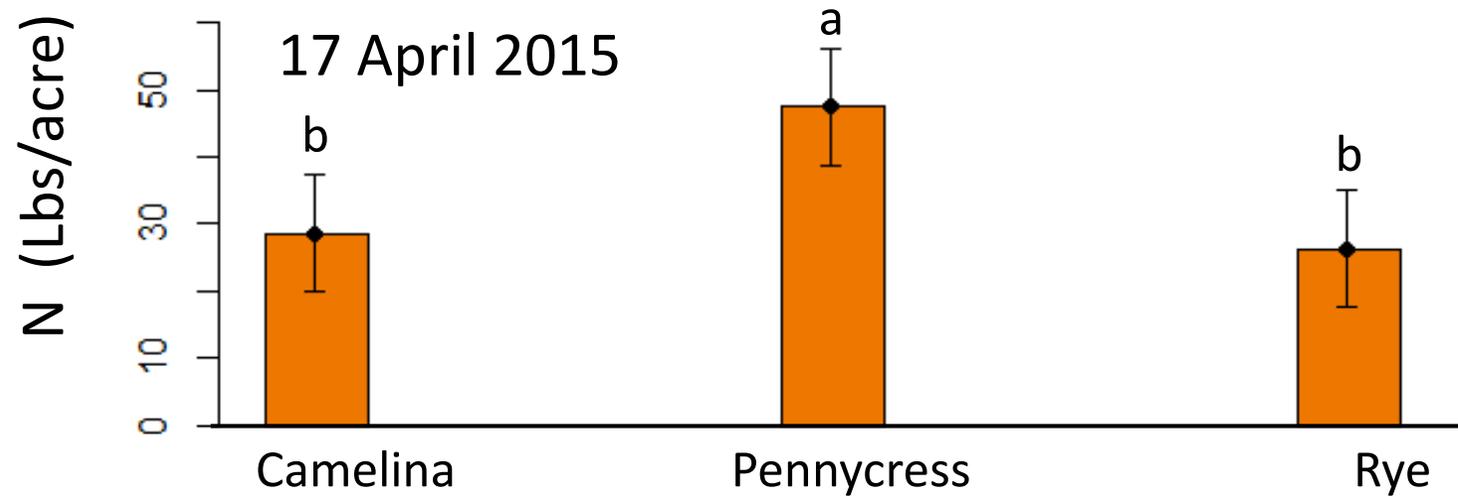
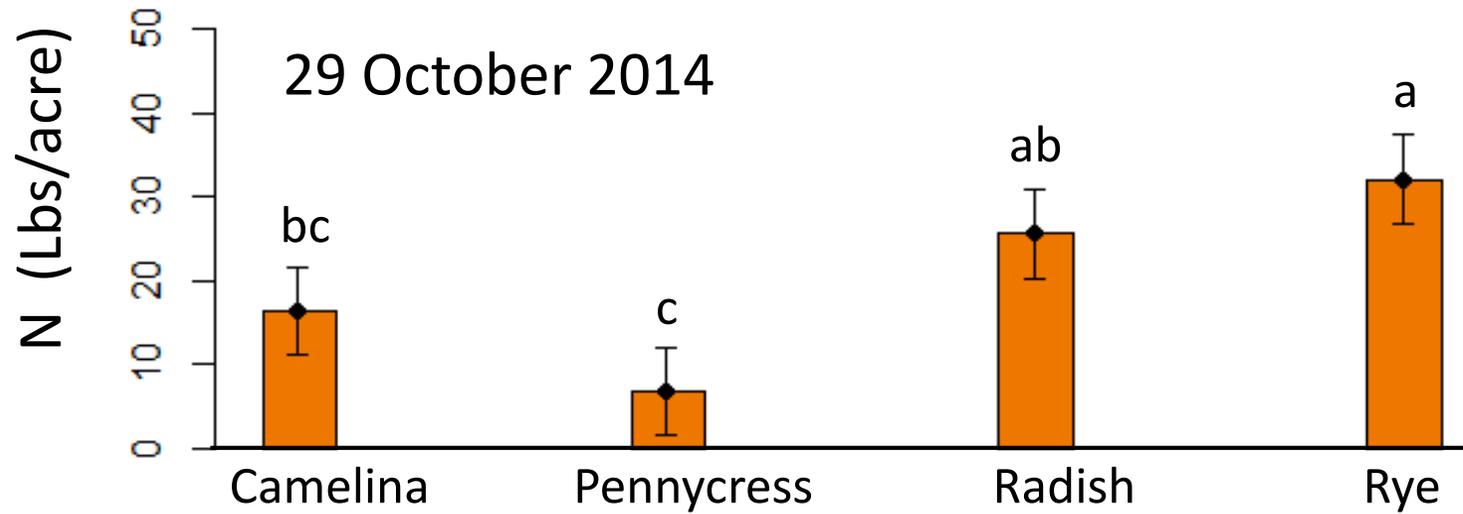
No-till and Conventional-till Fallow



Soil NO₃-N Content in Morris (0-12" depth)



Biomass N Content



Spring Water Erosion

Runoff Water Samples, 17 May 2015

Rye

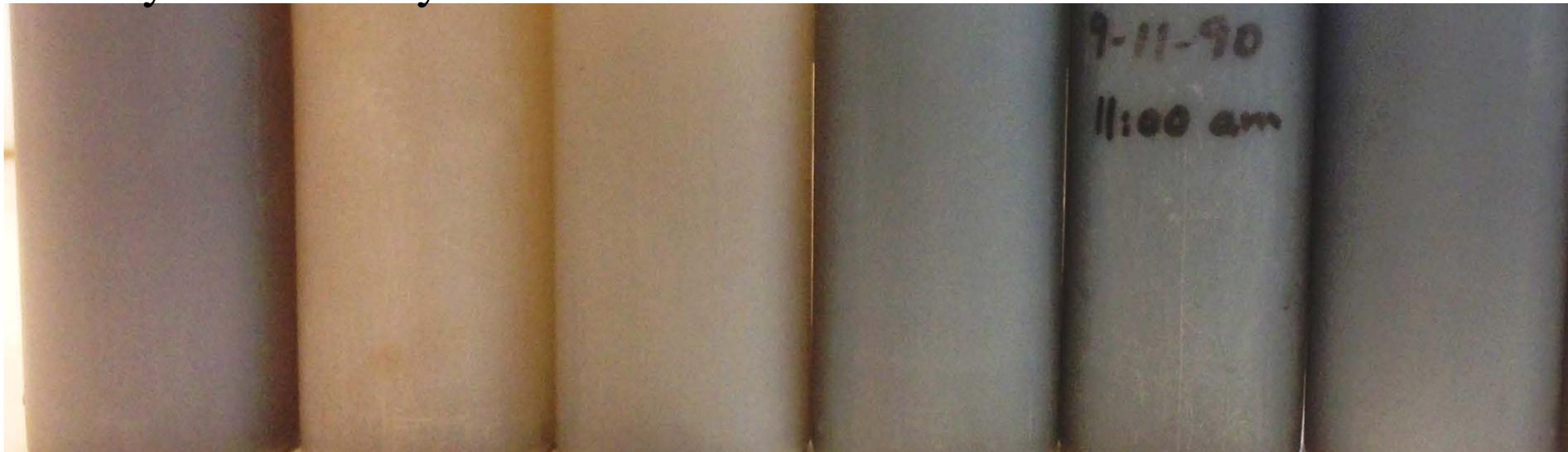
Pennycress

Camelina

No Till

Tilled

Radish



Weed Control Provided by Winter Oilseeds



Weed biomass g/m²

Experiment site	Pennycress seeding rate		
	0 lbs/acre	6 lbs/acre	11 lbs/acre
Rosemount MN	97.7 a	4.4 b	4.0 b
Lamberton MN	38.9 a	6.3 b	6.2 b
Waseca MN	74.6 a	1.4 b	1.1 b

From: Johnson et al. 2015,
Agronomy Journal 107:532-540.

Honey bees are big business in Minnesota

132,000 hives and 8 million lbs of honey in 2014



Eagle Bend, MN

Trucks haul many thousands of transient colonies of honey bees back to Minnesota from the West and Gulf Coasts in spring. At that time there is little for the bees to eat.





Pennycress flowers attract honey bees and provide much needed nectar in early spring.



Camelina flowers attract bees and syrphid flies. Fly larvae voraciously eat soybean aphids.

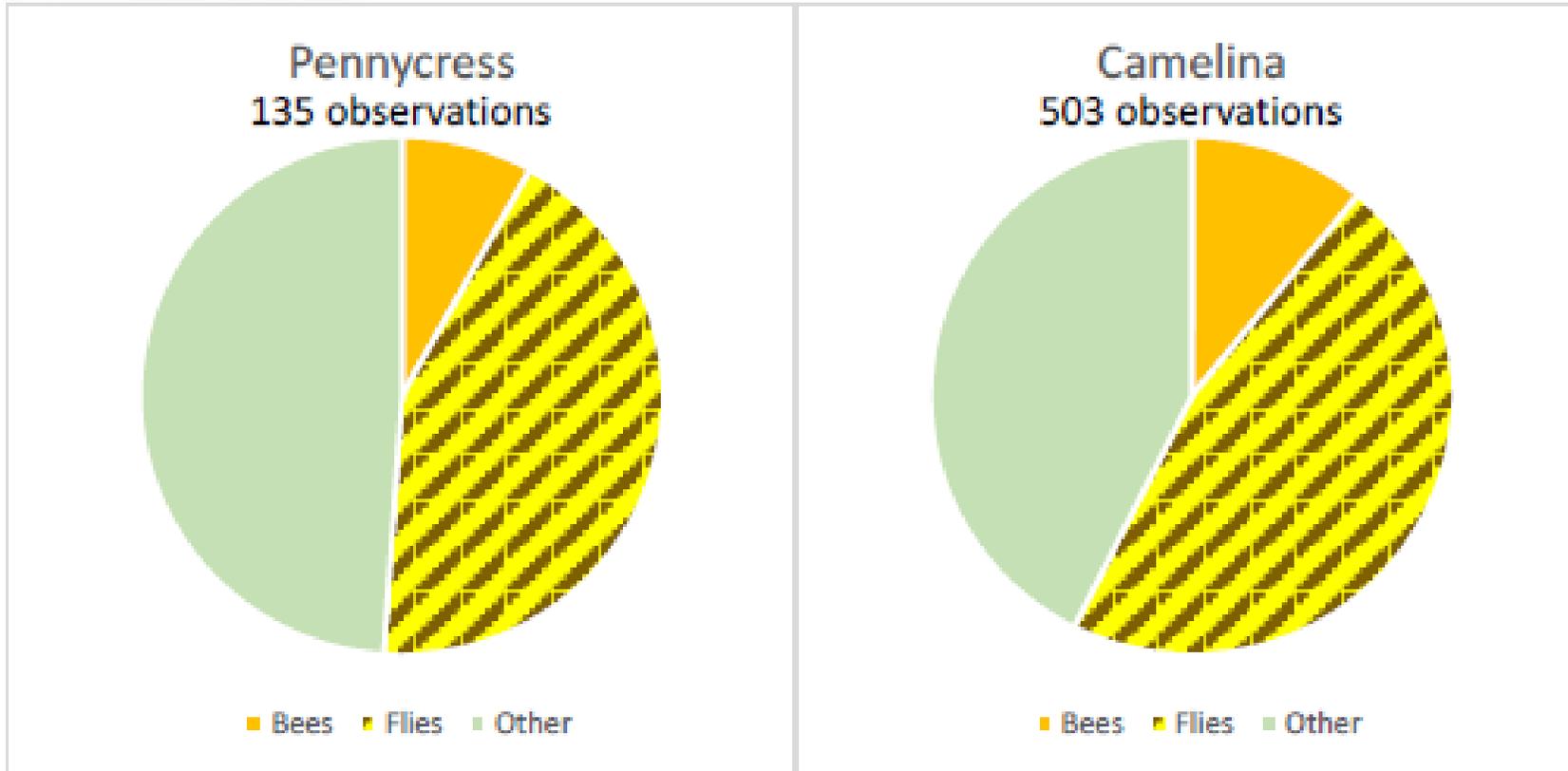
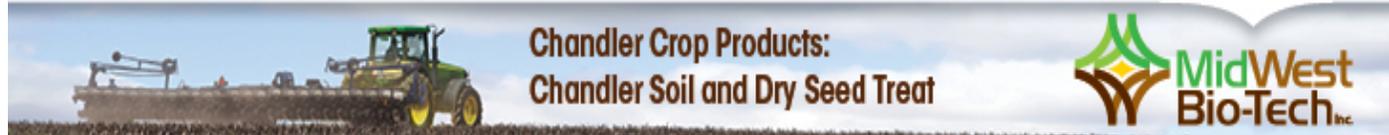


Figure 2. Pennycress and winter camelina attract pollinators during anthesis. Bees, including honey bees and bumble bees, use these resources, as do syrphid flies. The “Other” category includes butterflies and beetles.

NO-TILL
The No-Till Authority Since 1972 **FARMER**

Higher yields come naturally

Since 1981 • Erie, Illinois



Chandler Crop Products:
Chandler Soil and Dry Seed Treat



Camelina Cover Crops a Boon for Bees

November 25, 2015 | Posted in [Cover Crops](#), [Water Management](#)

Source: [USDA-Agricultural Research Service](#)

Once considered a weed, camelina is finding favor in some parts of the country as a soil-protecting winter cover crop...

Link to article <http://www.no-tillfarmer.com/articles/5246-camelina-cover-crops-a-boon-for-bees>

Summary

- Winter oilseeds WC & PC can serve as cash cover crops while helping to diversify cropping systems
- Dual cropping winter oilseeds can fit in corn-soybean-small grain systems and is economically viable
- Dual cropping winter oilseeds is a way to sustainably intensify crop production and produce bioenergy without loss of food security.
- WC & PC as cover crops provide ecosystem services
 - Sequester N & P
 - Prevent soil erosion
 - Control weeds
 - Provide habitat and nutrition for pollinators and other beneficial insects