Green manures for organic production: A Prairie-centric literature review with broad outcomes

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Andrew M. Hammermeister

September 21, 2016

What is a Green Manure?

A crop that is planted to improve soil fertility, without intent to harvest a product

Legumes

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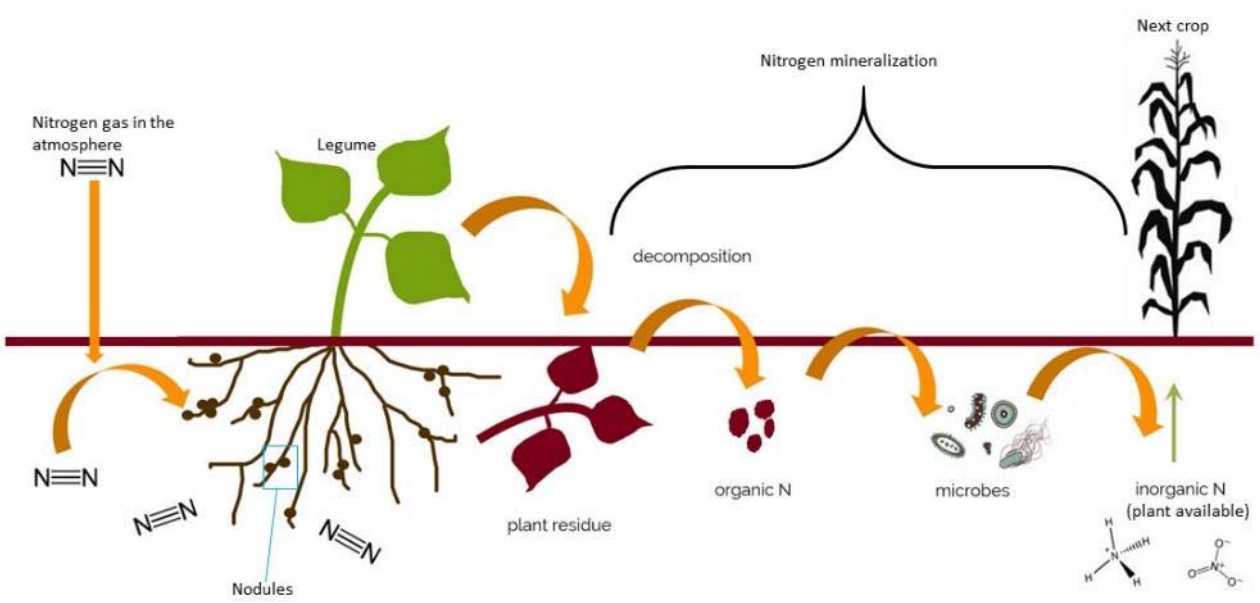
Important source of nitrogen for organic producers

What is a Green Manure?
And, Why are They Important?



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Important source of nitrogen for organic producers

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Barriers to Green Manure Uptake

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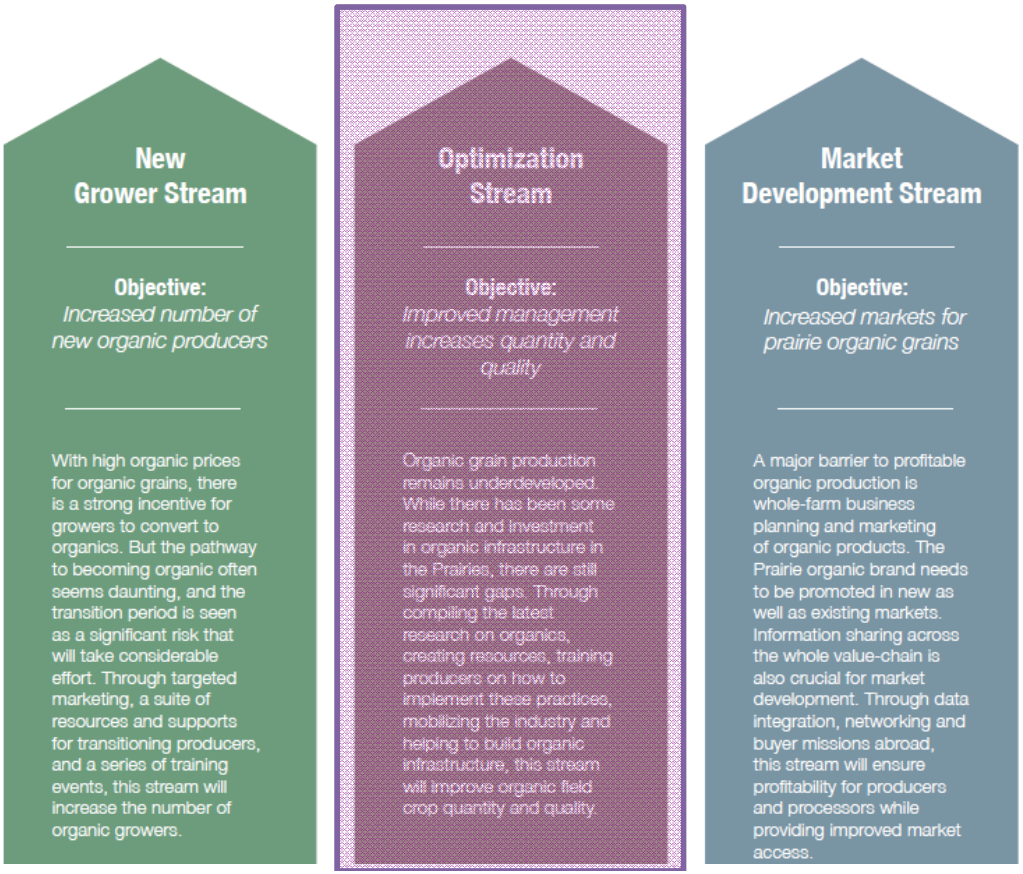
Purpose of the Review

prairie organic grain initiative

To achieve resiliency and stability while growing the organic sector in the Prairies by focusing on both quantity and quality of organic grains and developing relationships across the value chain.



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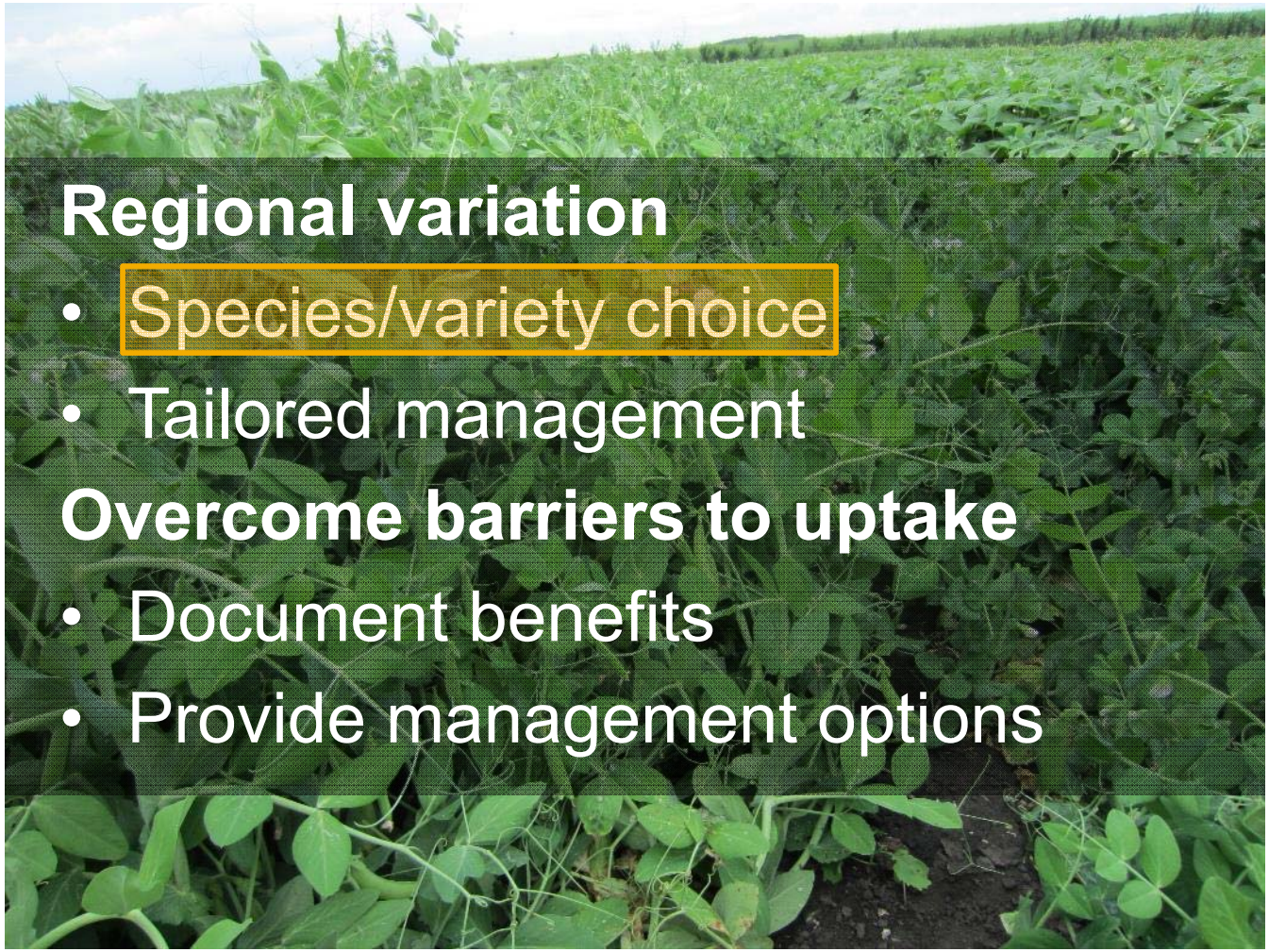
Scope of the Review

- Research conducted over the last 35 years on the Canadian Prairies and adjacent US Northern Great Plains
- 56 Prairie-region studies were included in the review
- Included both organic and non-organic studies
- Coincided with surveys of informational needs

Overarching Topics



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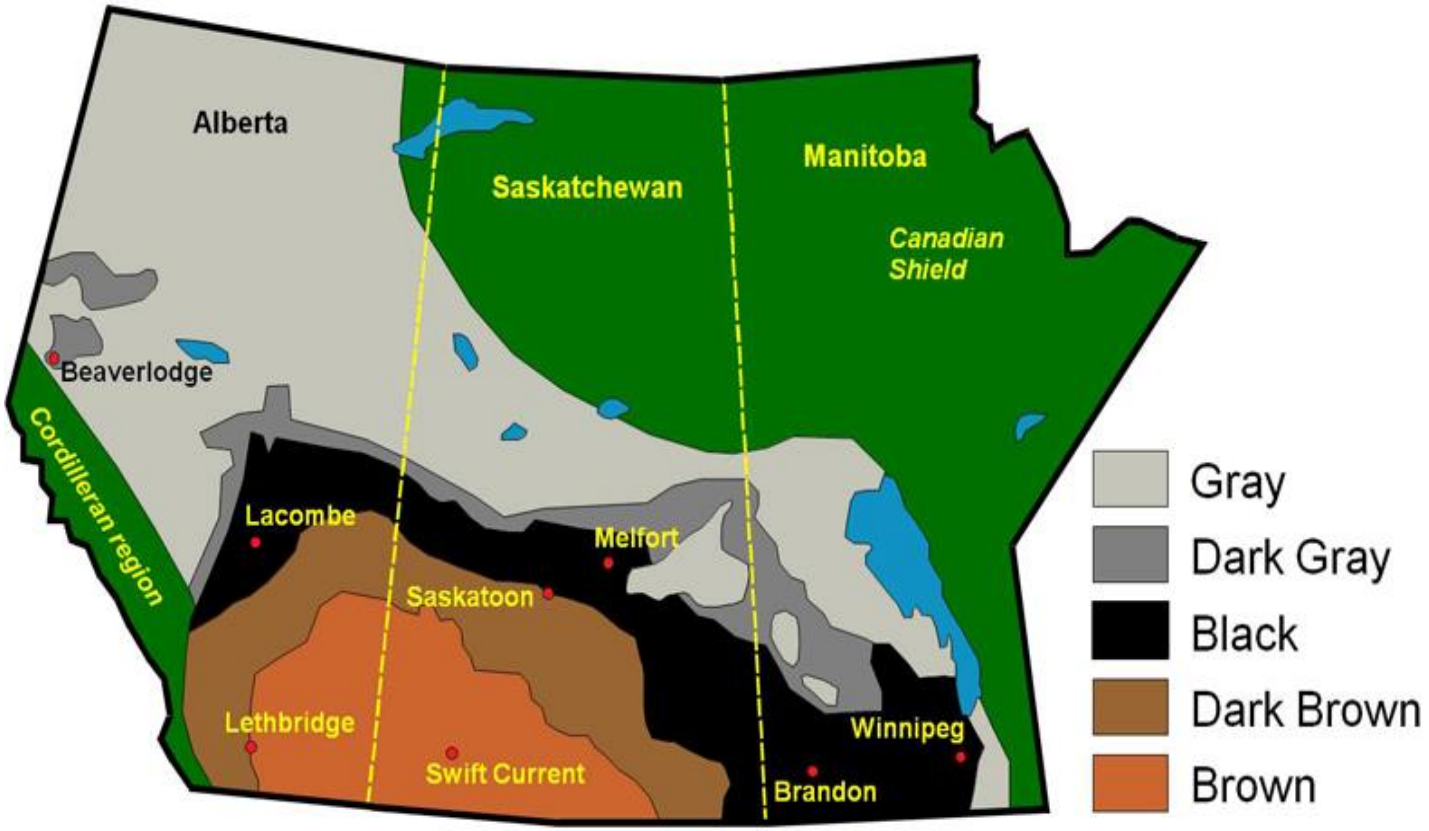
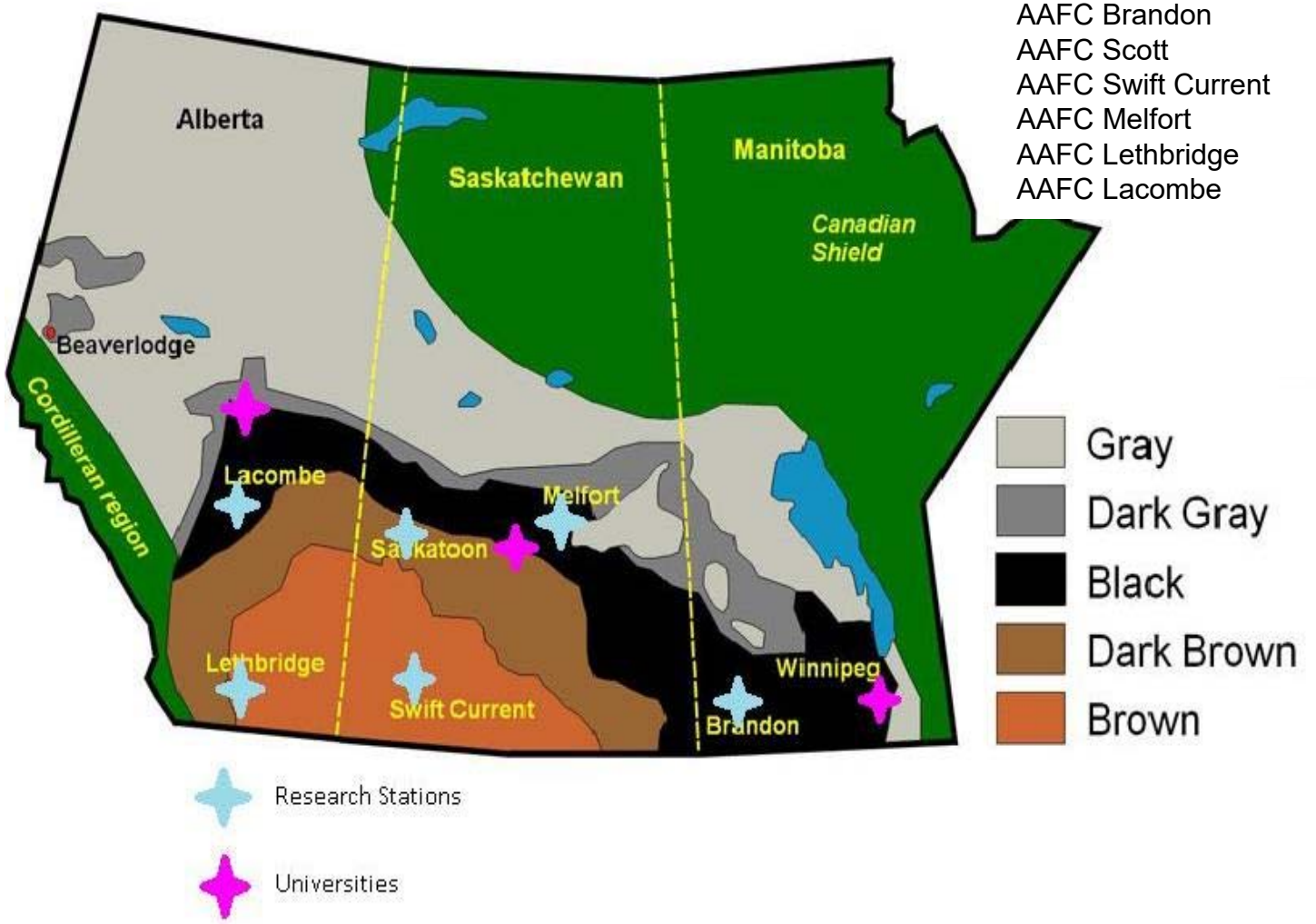
Regional Variation



Regional Variation

Research Locations
University of Manitoba
University of Alberta
University of Sask
AAFC Brandon
AAFC Scott
AAFC Swift Current
AAFC Melfort
AAFC Lethbridge
AAFC Lacombe



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From POGI EnviroScan

Regional Variation: Species Choice

Badaruddin & Meyer 1989, 1990
Biederbeck et al. 2005, 1998, 1996, 1993
Biederbeck & Bouman 1994
Blackshaw et al. 2001, 2010
Bowren et al. 1969
Brandt 1996
Bullied et al. 2002
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Cicek et al. 2014, 2015
Foster 1990
Halde & Entz 2014
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Hoyt & Leitch 1983
Kelner & Vessey 1995
Kröbel et al. 2014
Lawley & Shirtliffe 2004
McCartney & Fraser 2010
Miller et al. 2011
Moyer et al. 2007
O'Donovan et al. 2014
Rice et al. 1993
Rick et al. 2011
Shirtliffe & Johnson 2012
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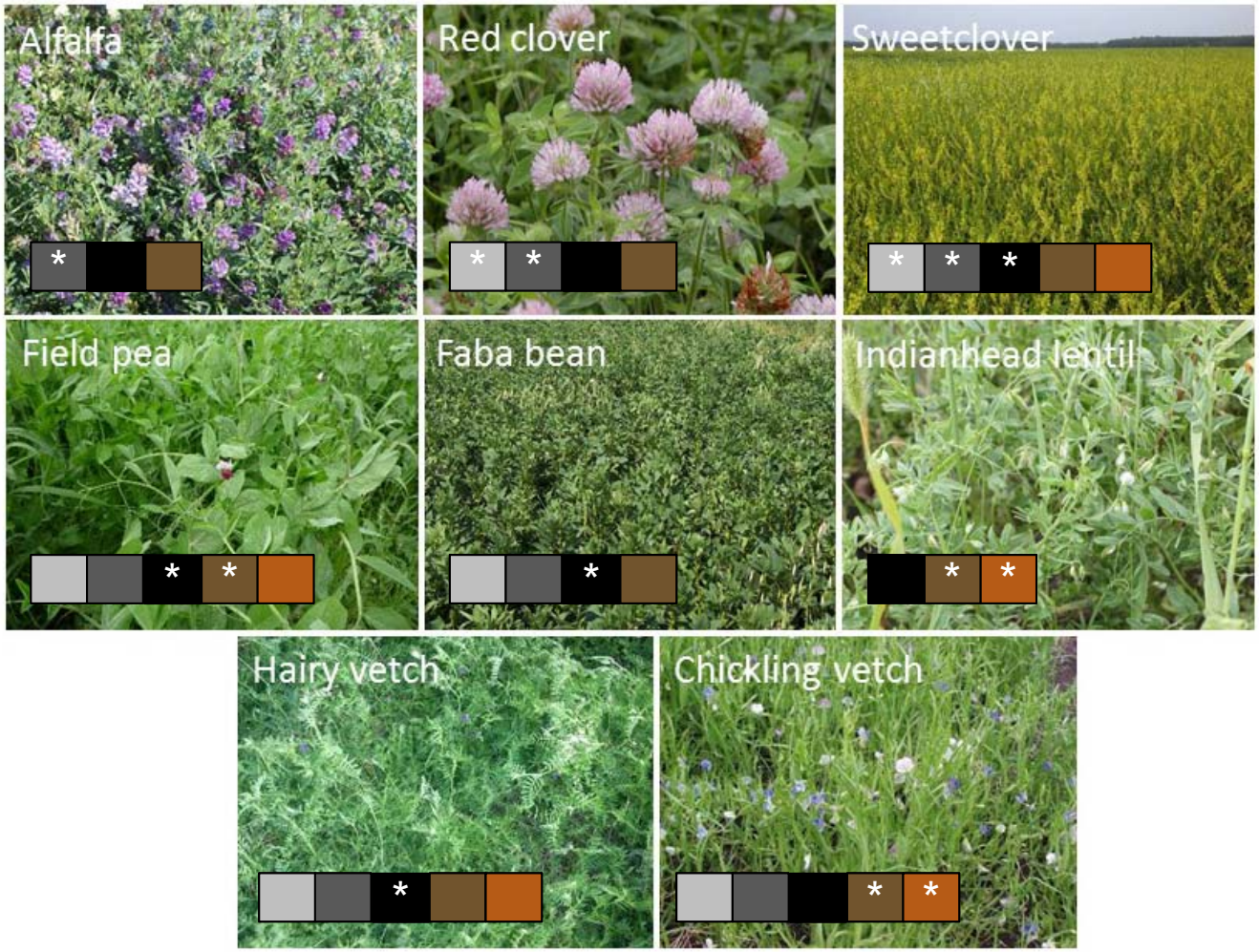
Vaisman et al. 2014
Zentner et al. 1996, 2004



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Overarching Topics

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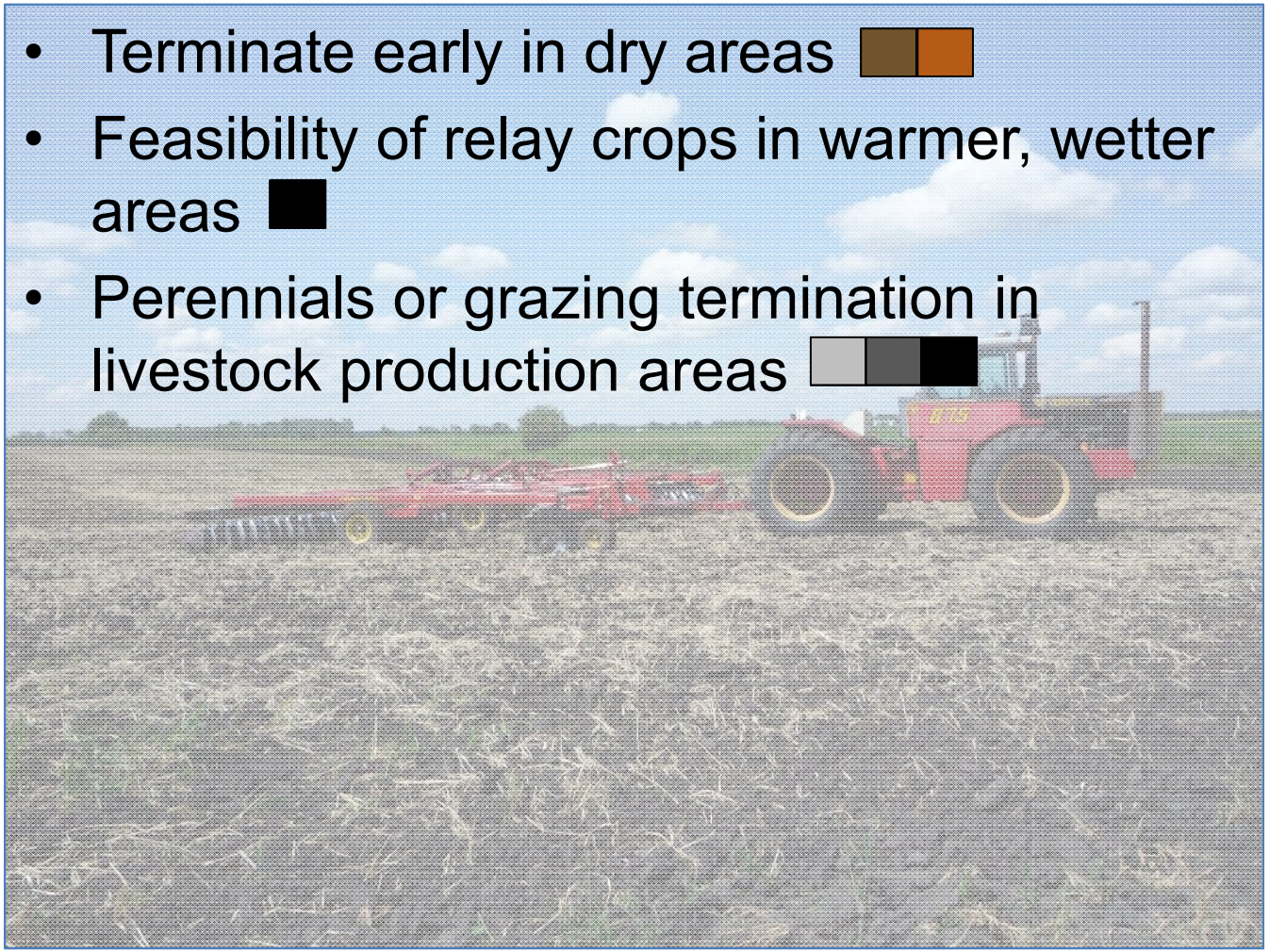
Regional Variation – Management



Foster 1990
Miller et al. 2011
Pikul et at. 1997
Thiessen Martens et al. 2001
Woodley et al. 2014
Zentner et al. 1996, 2004

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Overarching Topics

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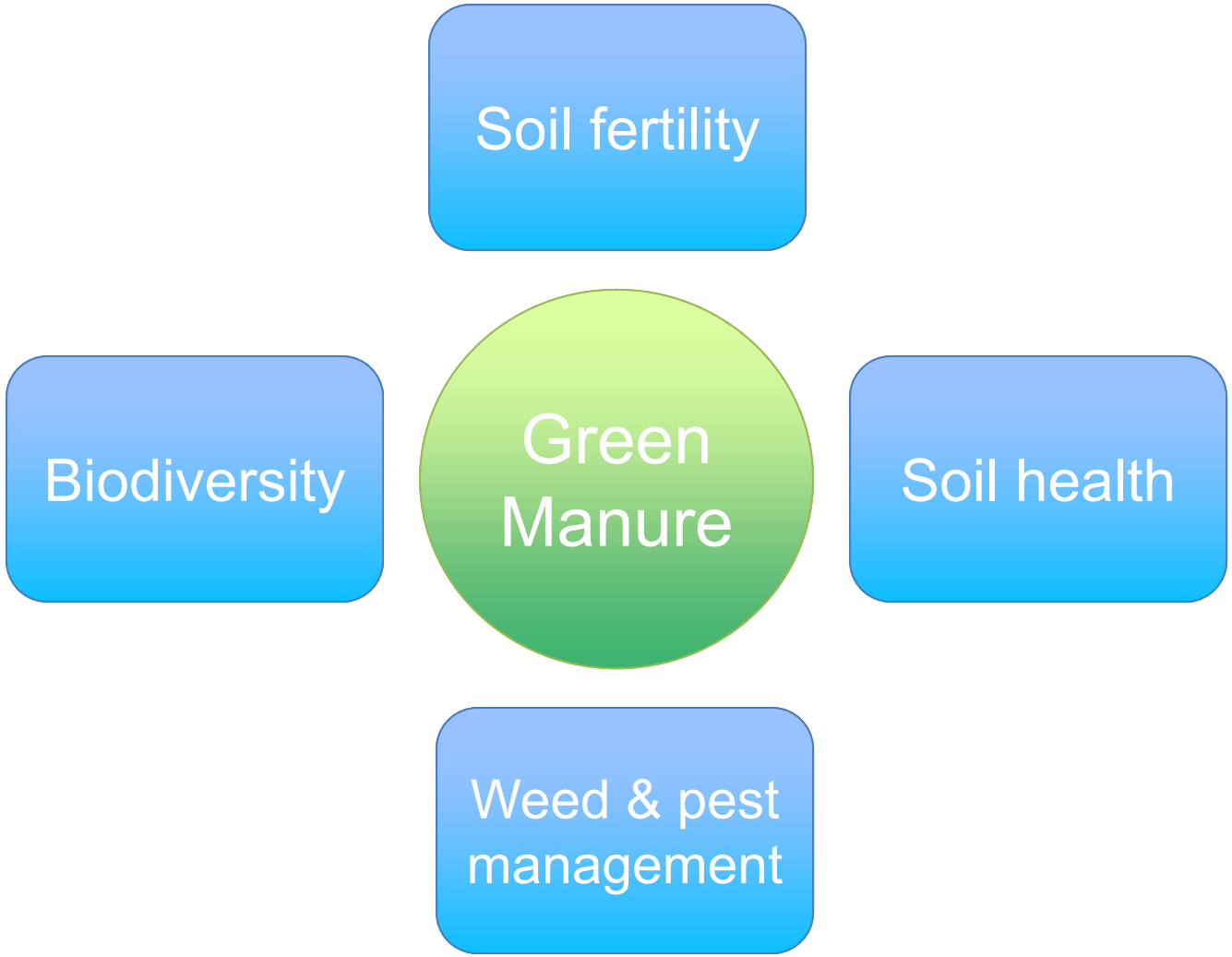
Green Manure Benefits



Green Manure Benefits: Soil Fertility

Biomass
Species variation
Management

Biodiversity

Green Manure

Soil health

Weed & pest management

Baddarudin & Meyer 1989, 1990
Biederbeck et al. 1993, 1996
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Green Manure Benefits: Soil Fertility

Biodiversity

Green Manure

Soil health

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Woodley et al. 2010
Zentner et al. 1996, 2004, 2006

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Green Manure Benefits: Soil Health

Biodiversity

Green Manure

Weed & pest management

Soil biology
Active organic matter
Soil resilience

Biederbeck et al. 1998, 2005
Biederbeck at el., 1998
Lupwayi et al., 1998
Lynch, 2014
Mahli et al. 2009
Miller et al, 2008

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Green Manure Benefits: Weeds/Pests

Biodiversity

Green Manure

Disrupt cycles
Allelopathy
Competitiveness

Biederbeck et al. 1993
Biederbeck & Bouman 1994
Blackshaw et al. 2010
Cicek et al. 2014, 2015
Halde et al. 2014
Lawley & Shirtliffe 2004
Miller et al. 2011
Moyer et al. 2007
Shirtliffe & Johnson 2012
Vaisman et al. 2014

Green Manure Benefits: Biodiversity

Green Manure

Support of beneficials
Diversification of rotations

Overarching Topics

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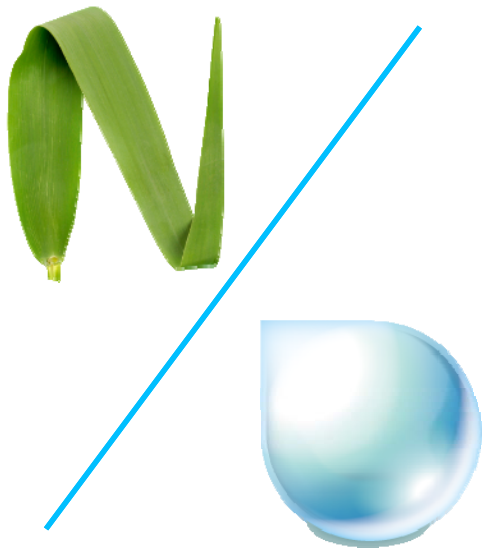
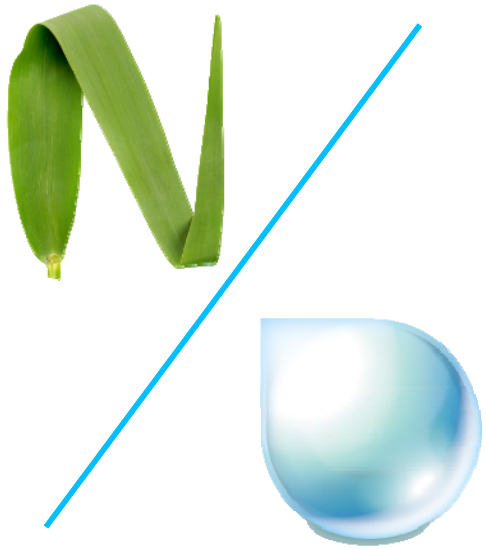
Green Manure Management

- Often a balance between nitrogen supply and moisture conservation



Green Manure Management

Rotation Design



Blackshaw et al. 2010
Campbell et al. 1991
Carr et al. 2013
Cicek et al. 2014, 2015
Entz et al. 2002
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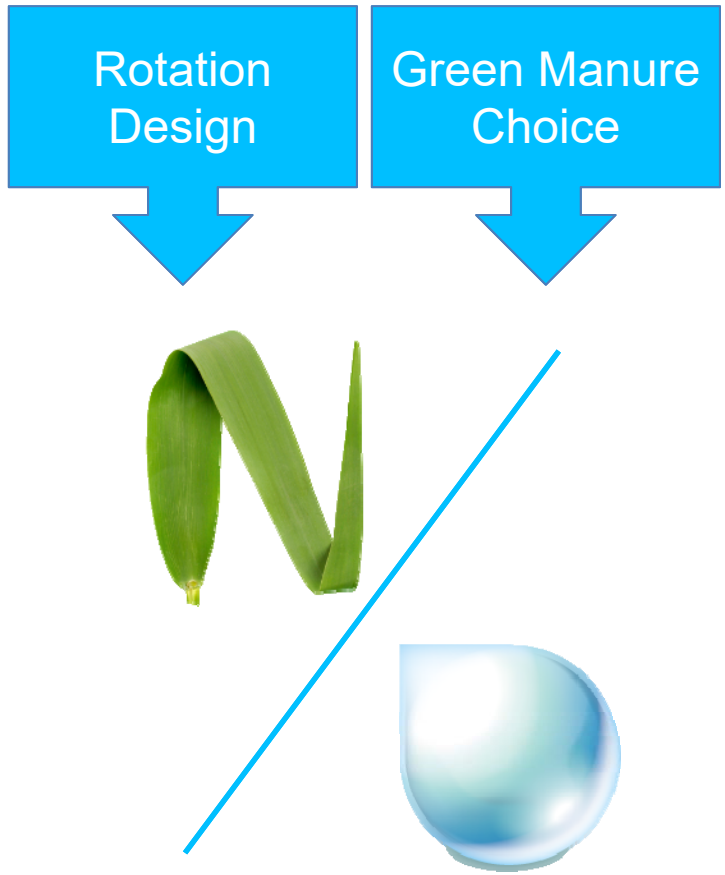
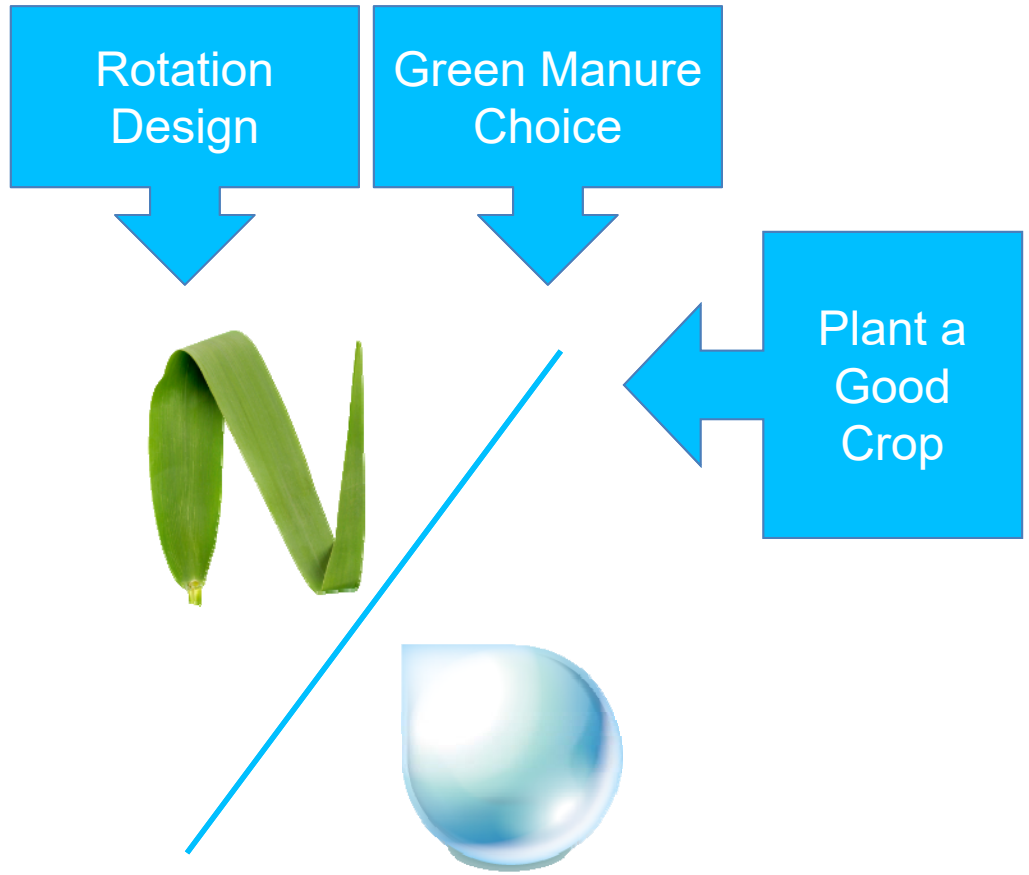
Green Manure Management

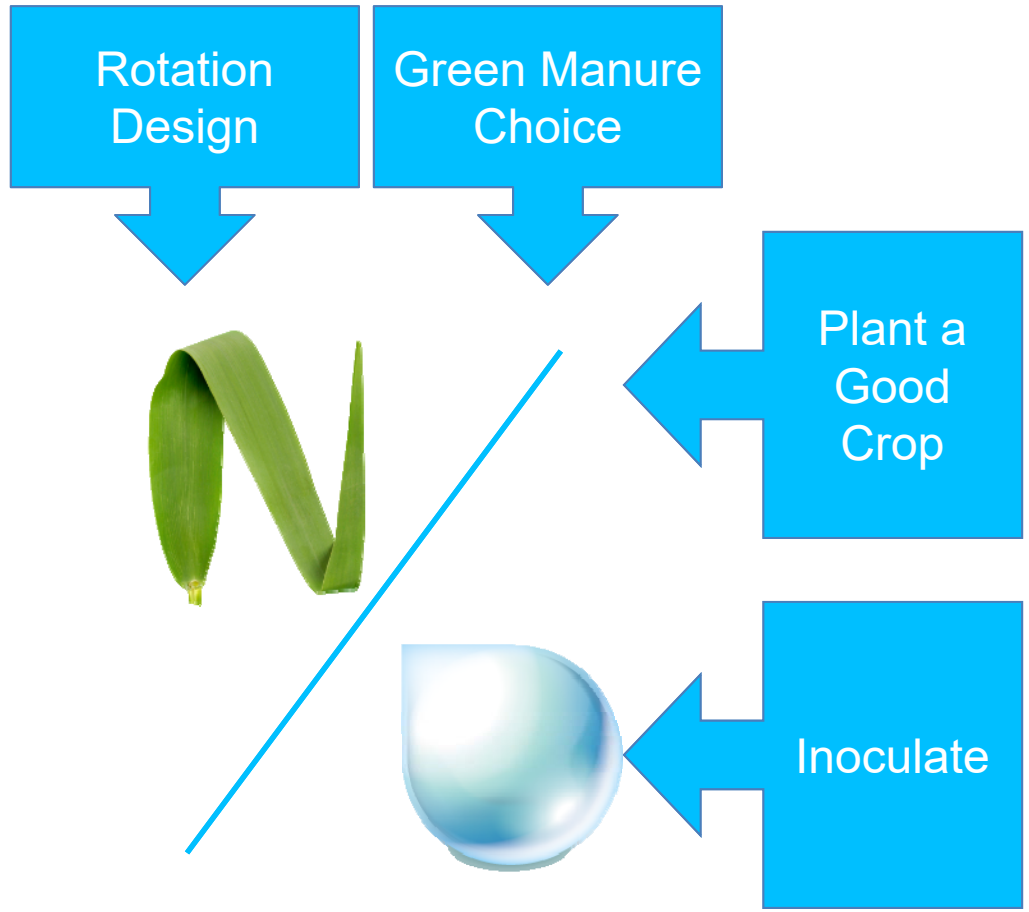


Green Manure Management



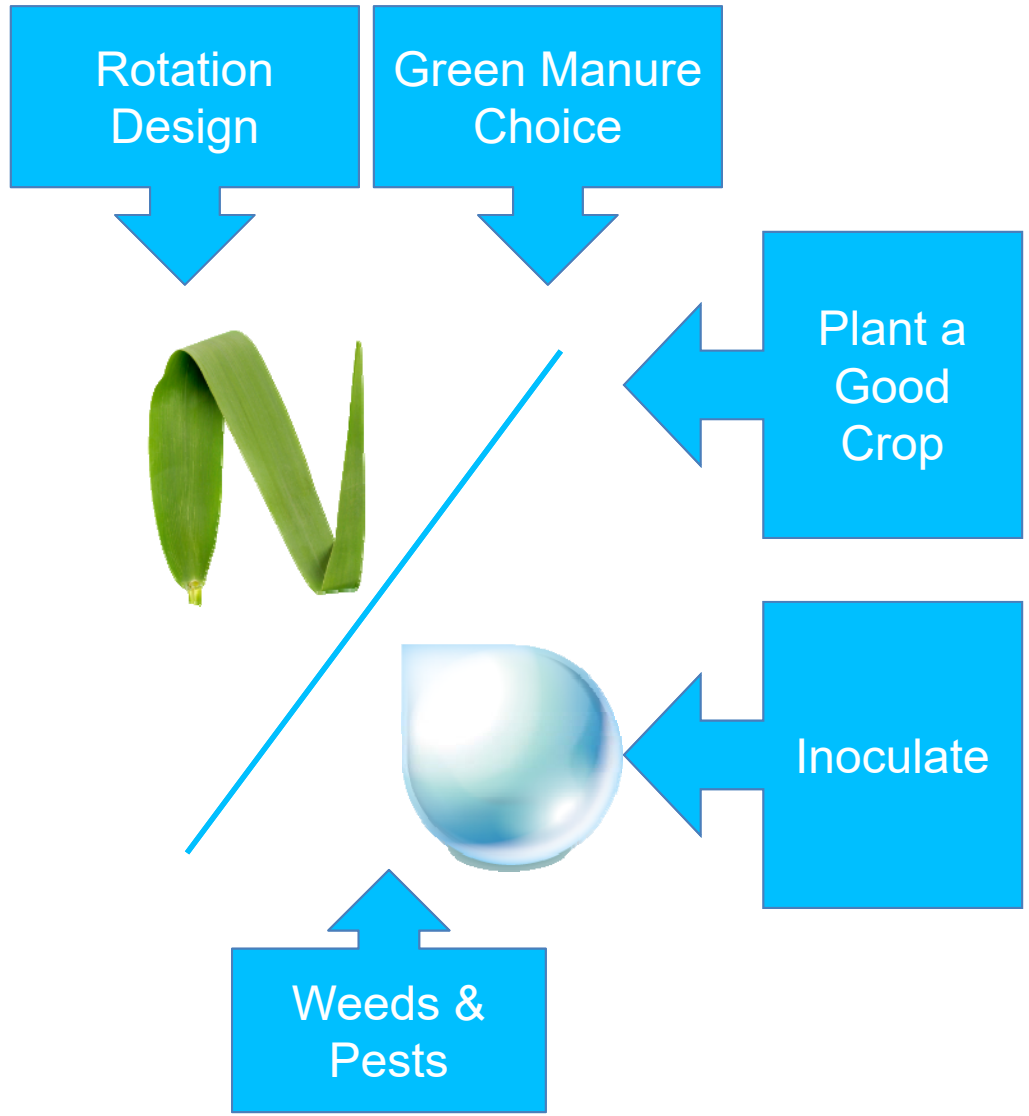
Lawley and Shirtliffe 2004

Green Manure Management



Biederbeck et al. 1993

Green Manure Management



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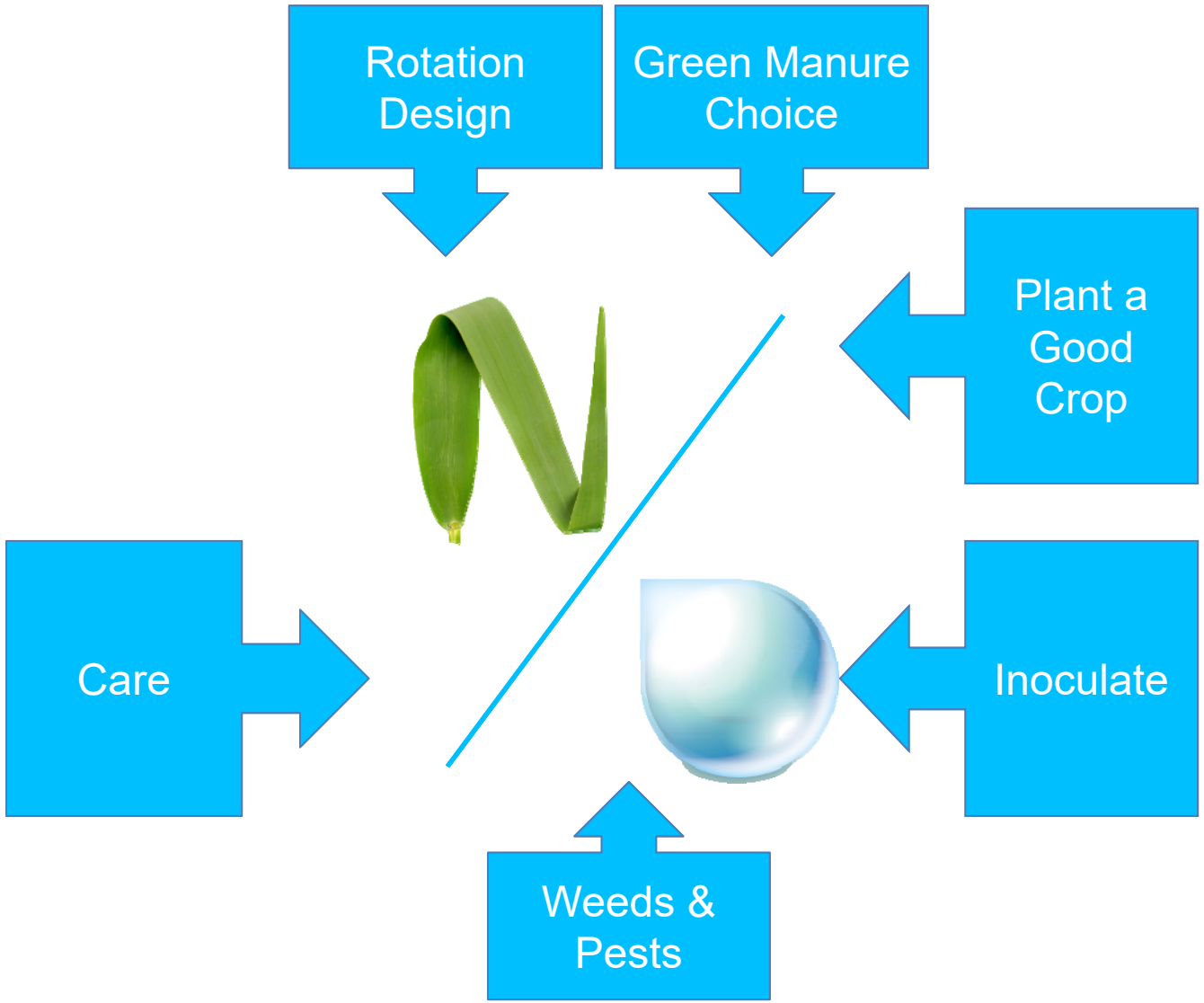
Green Manure Management



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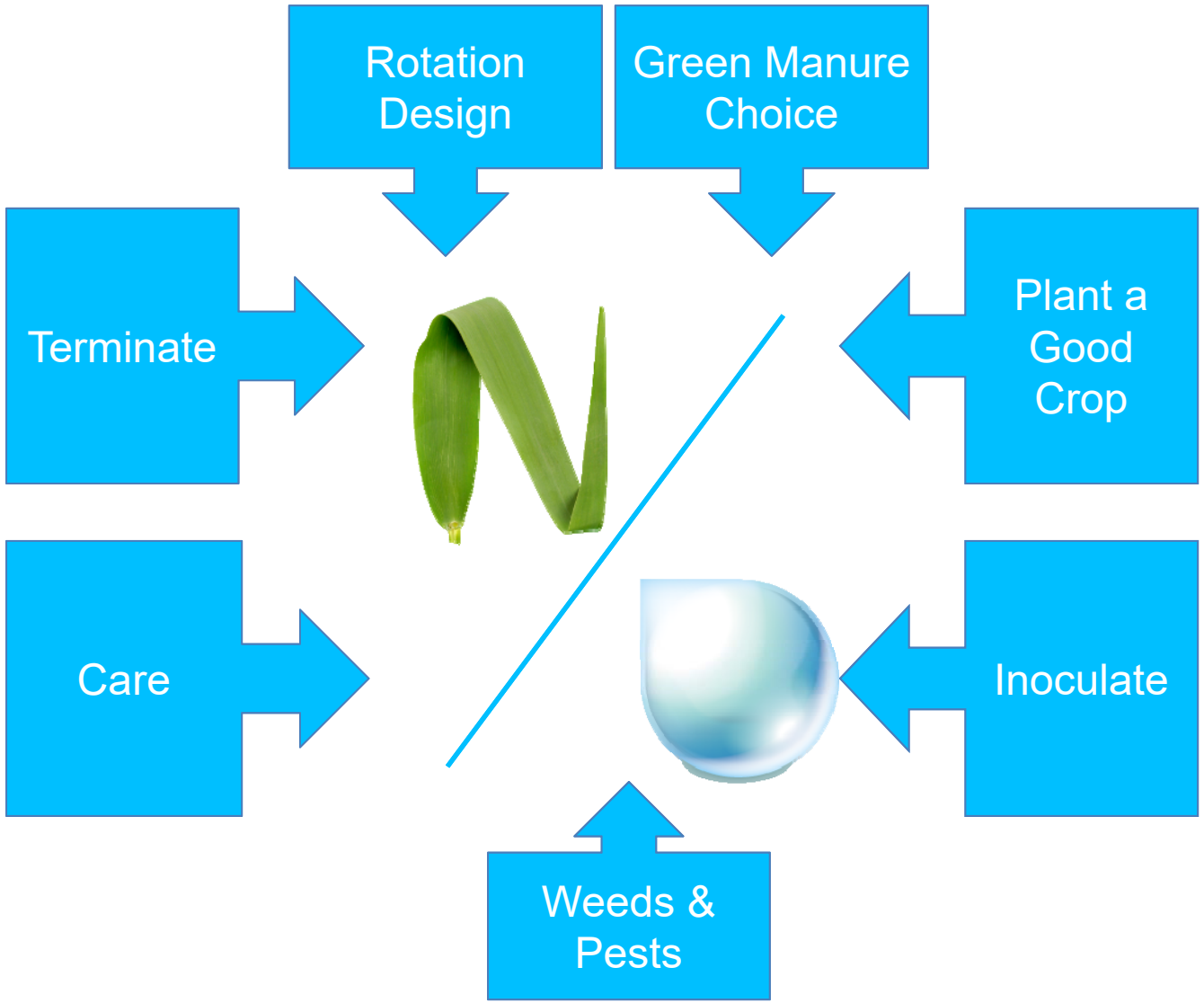
Green Manure Management



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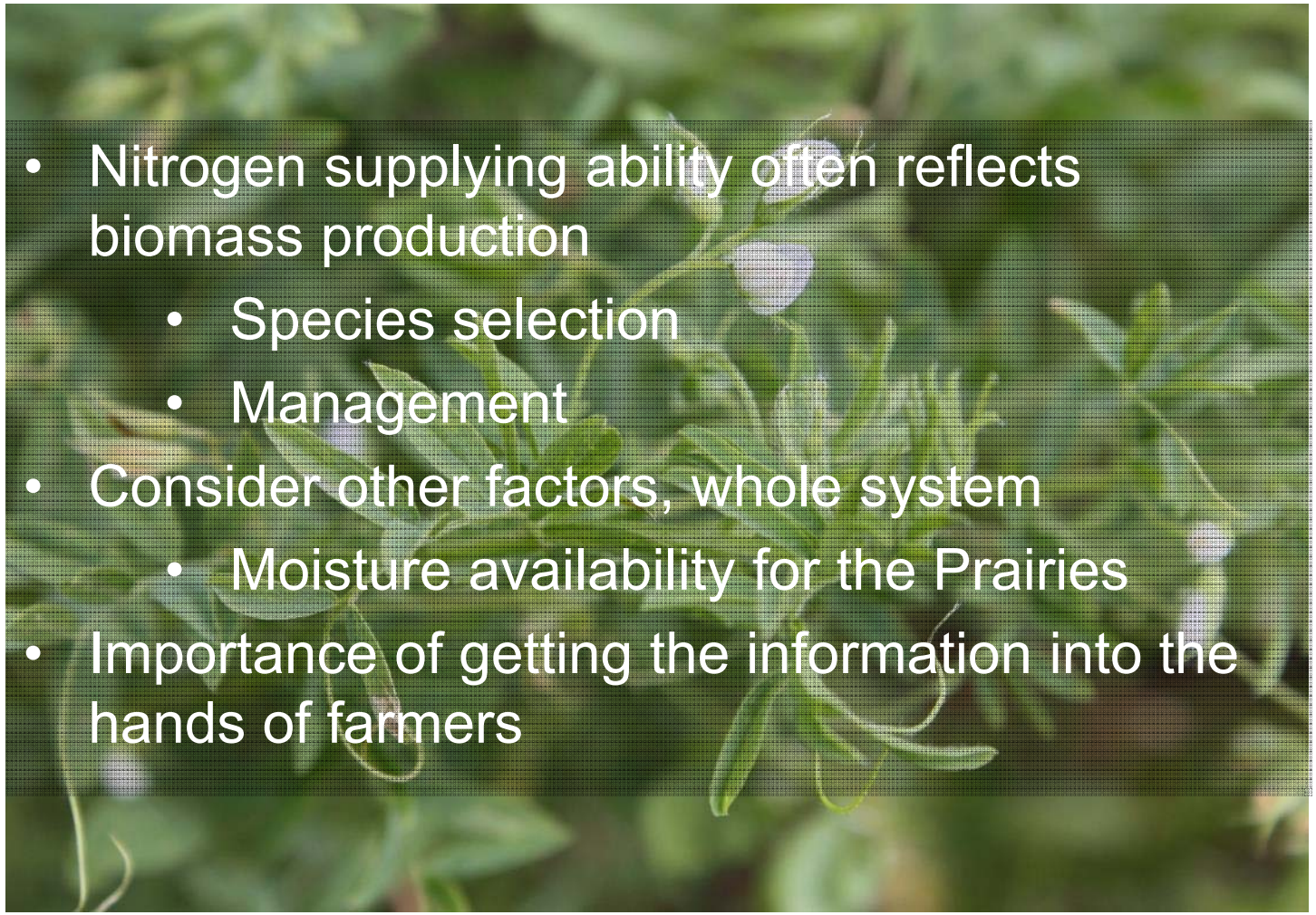
Summing it Up



- Nitrogen supplying ability often reflects biomass production
  - Species selection
  - Management
- Consider other factors, whole system
  - Moisture availability for the Prairies
- Importance of getting the information into the hands of farmers

Thank you

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Questions?

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Regional Variation: Species Choice

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SUITABILITY OF COMMONLY USED GREEN MANURE LEGUMES TO THE MAIN PRAIRIE SOIL ZONES (PDF DOWNLOAD)

Suitability of commonly used green manure legumes to the main Prairie soil zones.

	Brown	Dark Brown	Black	Dark Gray	Gray
Alfalfa	Not recommended *High water use*	Ok *Adapt management to reduce water use*	Ok	Best suited	Not recommended *Low tolerance of excessive soil moisture or flooding*
Red clover	Not recommended *High water use*	Ok *Adapt management to reduce water use*	Ok	Best suited *Tolerant of high moisture, but may be a short-lived perennial in cold regions*	Best suited *Tolerant of high moisture, but may be a short-lived perennial in cold regions*
Sweetclover	Ok *Adapt management to reduce water use*	Ok *Adapt management to reduce water use*	Best suited	Best suited	Best suited
Indianhead lentil	Best suited *Adapt management to reduce water use*	Best suited	Ok	Not recommended *Does not perform well under higher moisture conditions*	Not recommended *Does not perform well under higher moisture conditions*
Field pea	Ok *Adapt management to reduce water use and expect lower biomass*	Best suited *Performs well, but high seed cost*	Best suited *Performs well, but high seed cost*	Ok *Performs well, but higher seed cost than some other options*	Ok *Performs well, but higher seed cost than some other options*
Faba bean	Not recommended *Requires high moisture availability*	Ok *Requires high moisture availability, so may not be suited to all regions*	Best suited *Some indications that faba bean fixes nitrogen even under high soil fertility, but high seed cost*	Ok *Sufficient moisture, but high seed cost*	Ok *Sufficient moisture, but high seed cost*
Chickling vetch	Best suited *Low water use*	Best suited *Low water use*	Ok	Ok	Ok
Hairy vetch	Ok *Be cautious of soil water use and high seed cost*	Ok *Be cautious of soil water use and high seed cost*	Best suited *Abundant biomass and nitrogen, but high seed cost*	Ok *Likely not winter hardy in more northern regions, but can be spring-seeded*	Ok *Likely not winter hardy in more northern regions, but can be spring-seeded*

This table provides information based on typical climate and moisture conditions in the five Prairie soil zones. In atypical years, refer to the recommendations for zones with typical conditions closest to what you are experiencing. For instance, in droughty years in the Black or Gray soil zones, refer to recommendations for the Brown or Dark Brown soil zones.

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