

COVER CROPS IN MONTANA: Research Experience – Perry Miller

Professor – Sustainable Cropping Systems

Colleagues: Clain Jones, Cathy Zabinski, Jeff Holmes

Students: Susan Tallman, Meg Housman, Bo Walker, Kristi D'Agati

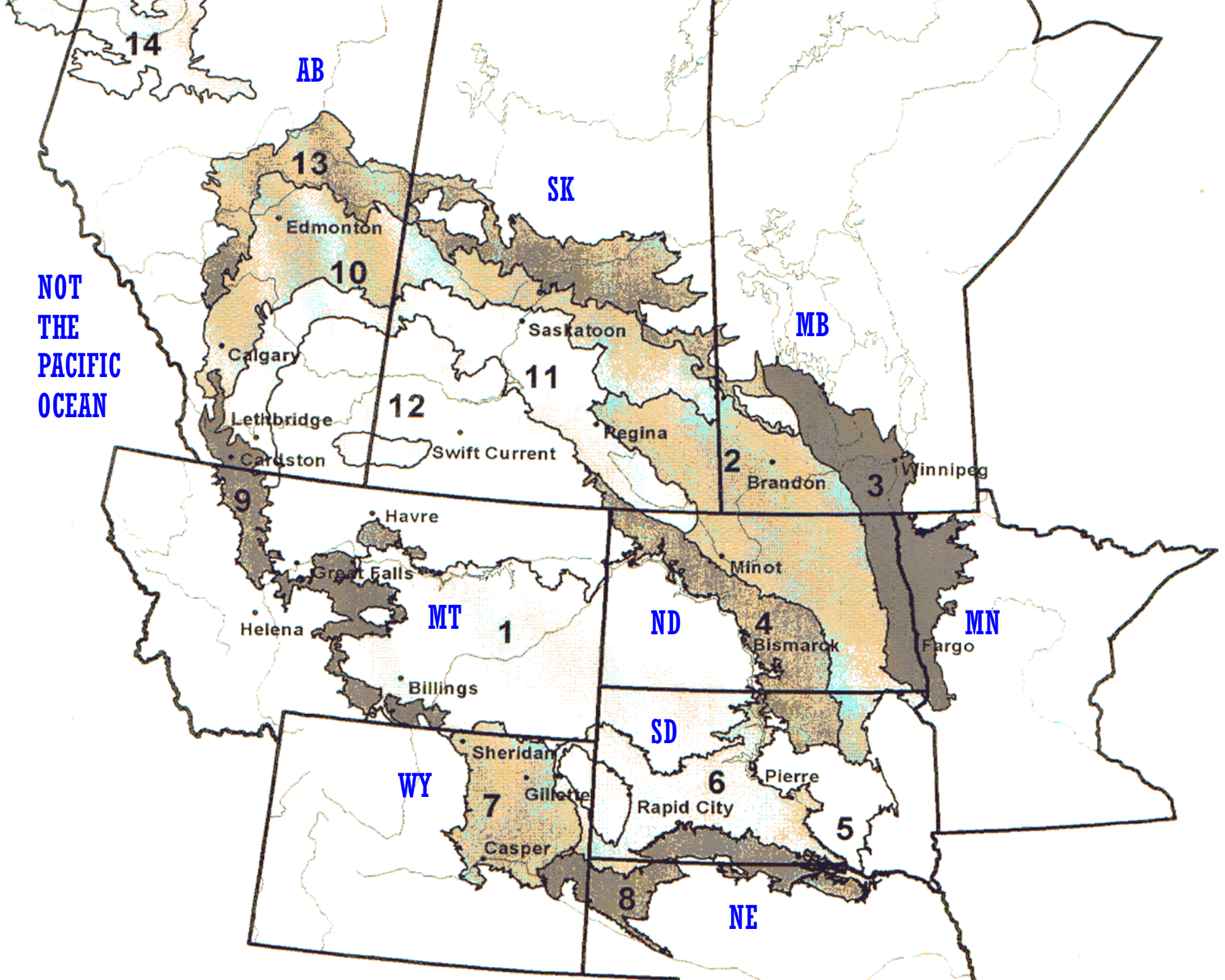


**Amsterdam, MT
July 7, 2014**



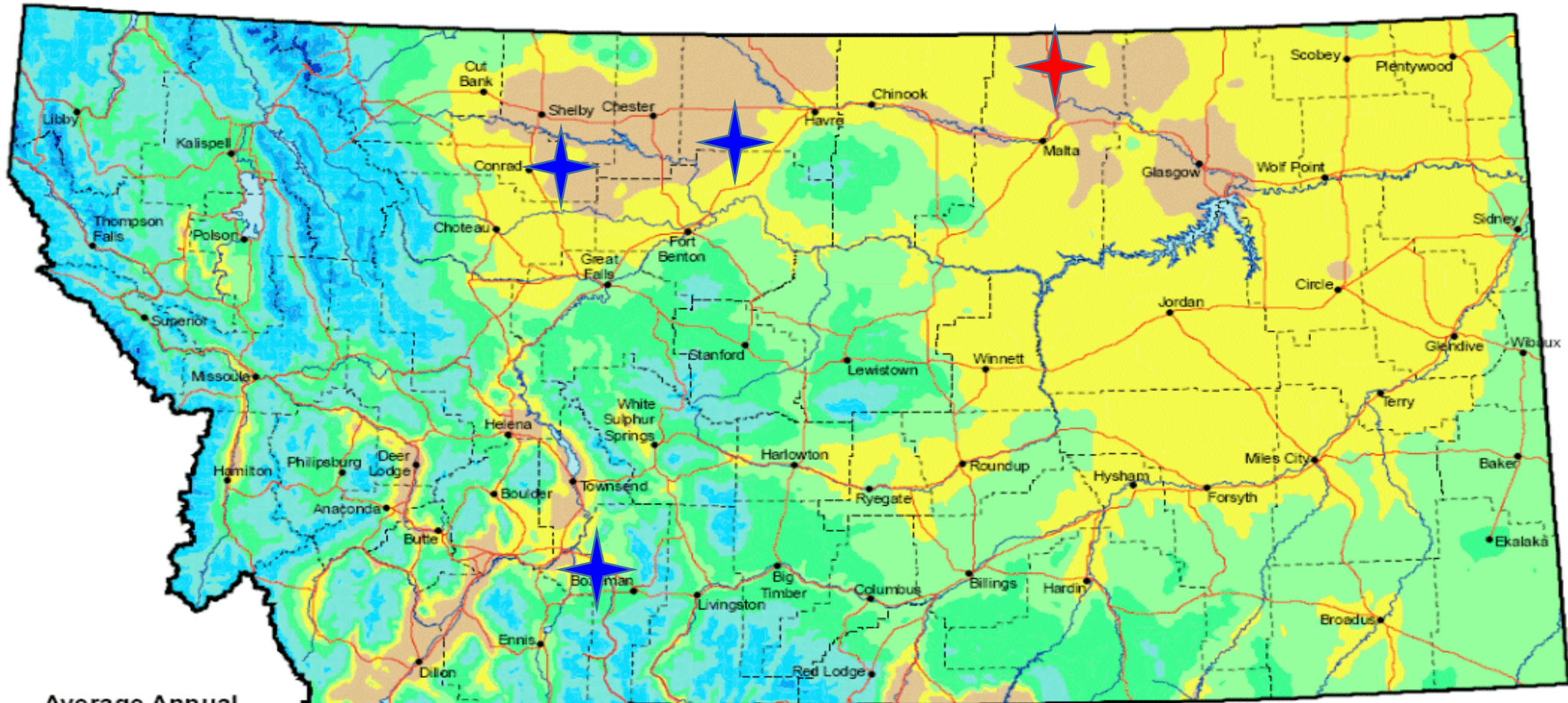
Agroecoregions of the Northern Great Plains

- Padbury et al.
1996 Agronomy Journal



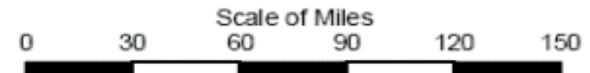
Montana

Average Annual Precipitation, 1971-2000



Average Annual Precipitation, Inches

	6-12		22-34
	12-14		34-60
	14-16		60-85
	16-22		Over 85



This precipitation map was created by PRISM software, based on data from the National Climate Data Center, NRCS Snotel stations, and USGS Digital Elevation Models.
 Copyright © 2004, PRISM Group, Oregon State University, <http://www.prismclimate.org>

Cover Crop Biomass



Photo: Steve Spence

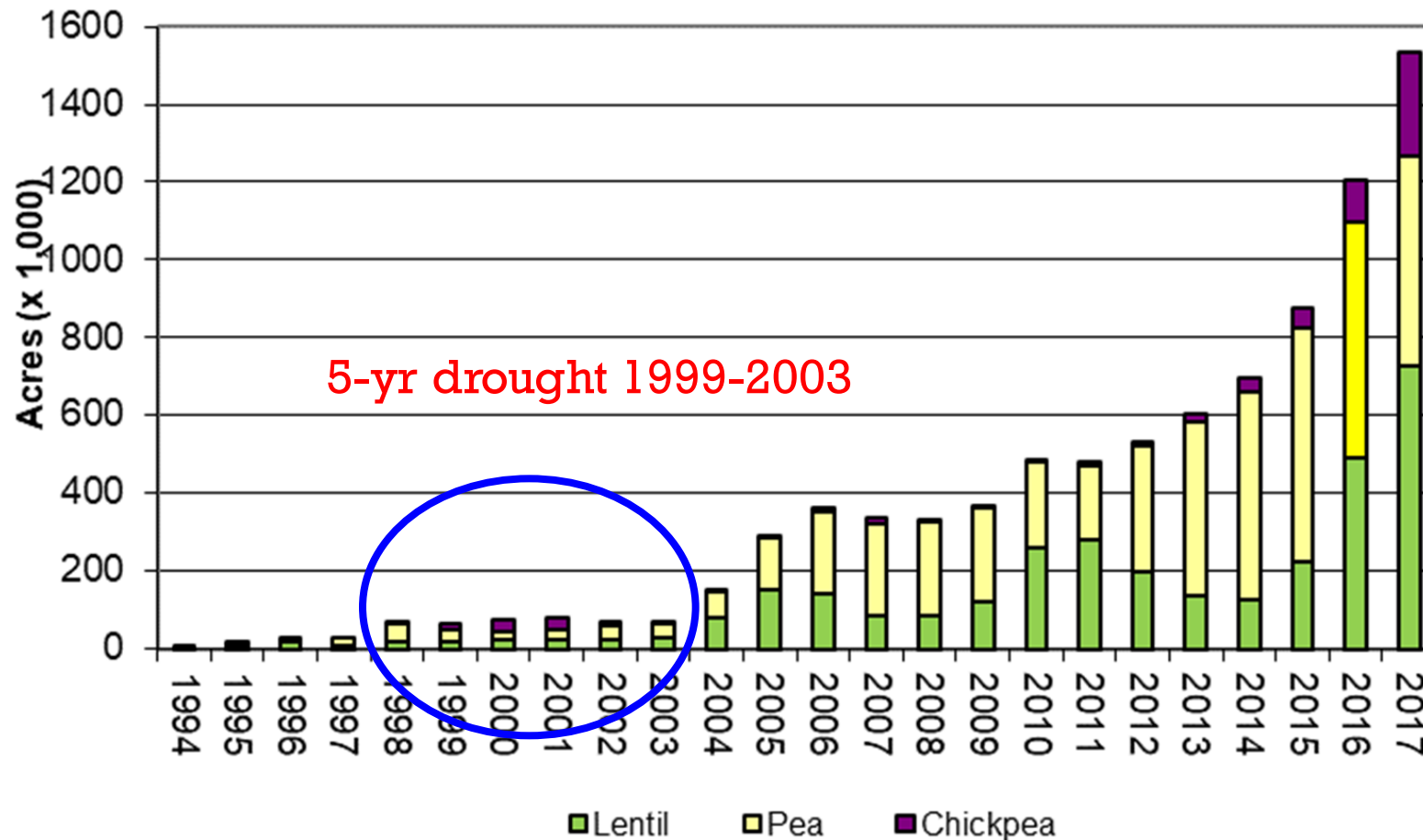


Photo: Land Stewardship Project

My research angle on covers?

- No-till (more water) + Pulse Crops to Increase Profitability

Montana pulse crop production 1994 - 2017

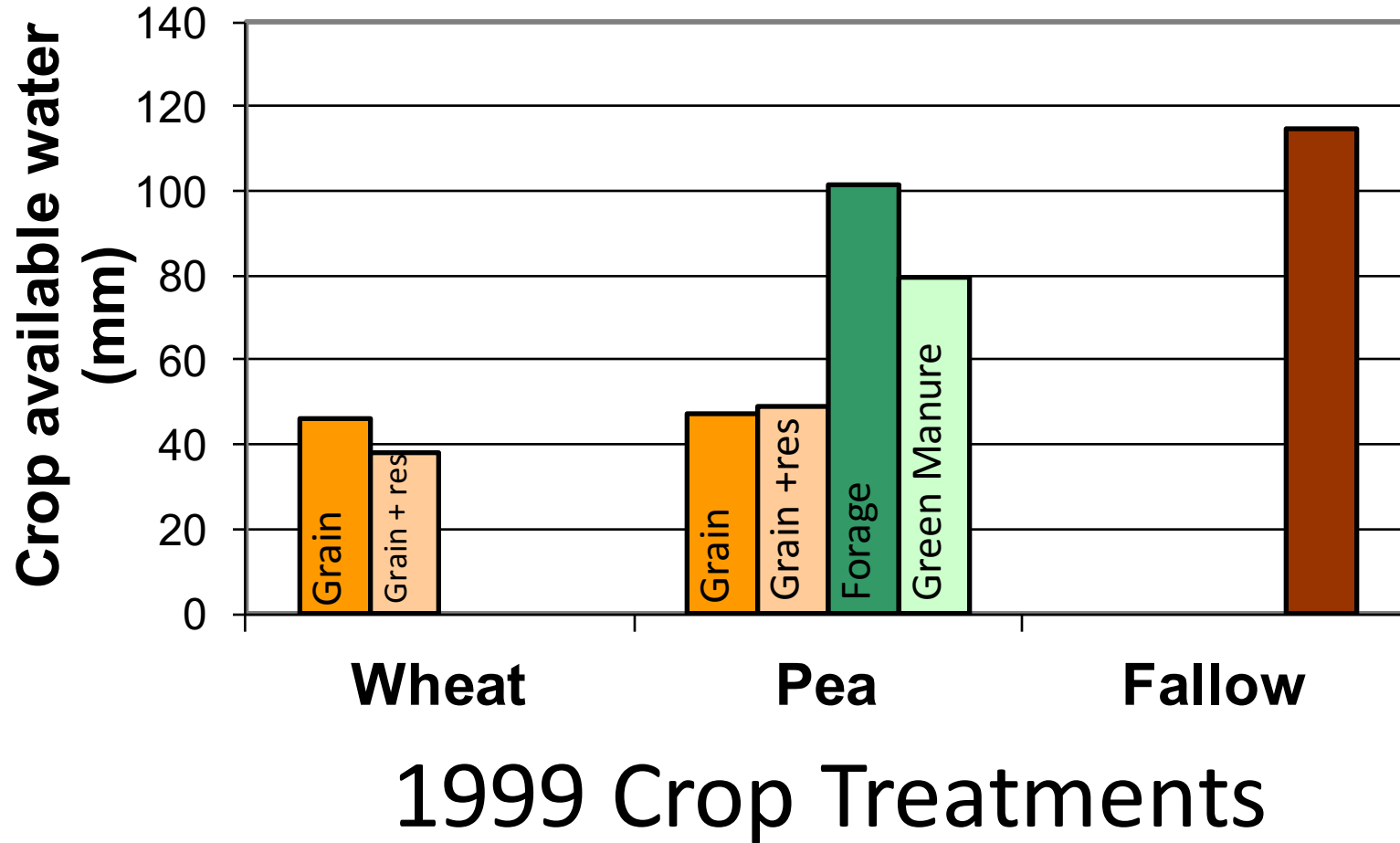


My research angle on covers?

- No-till (more water) + Pulse Crops to Increase Profitability
 - But annual cropping too risky in some places and some times
 - Instead, can we grow a cover crop during summerfallow, do some good for the soil, and not use up too much soil water?
 - And could forage harvest improve economics? (Kent Wasson)

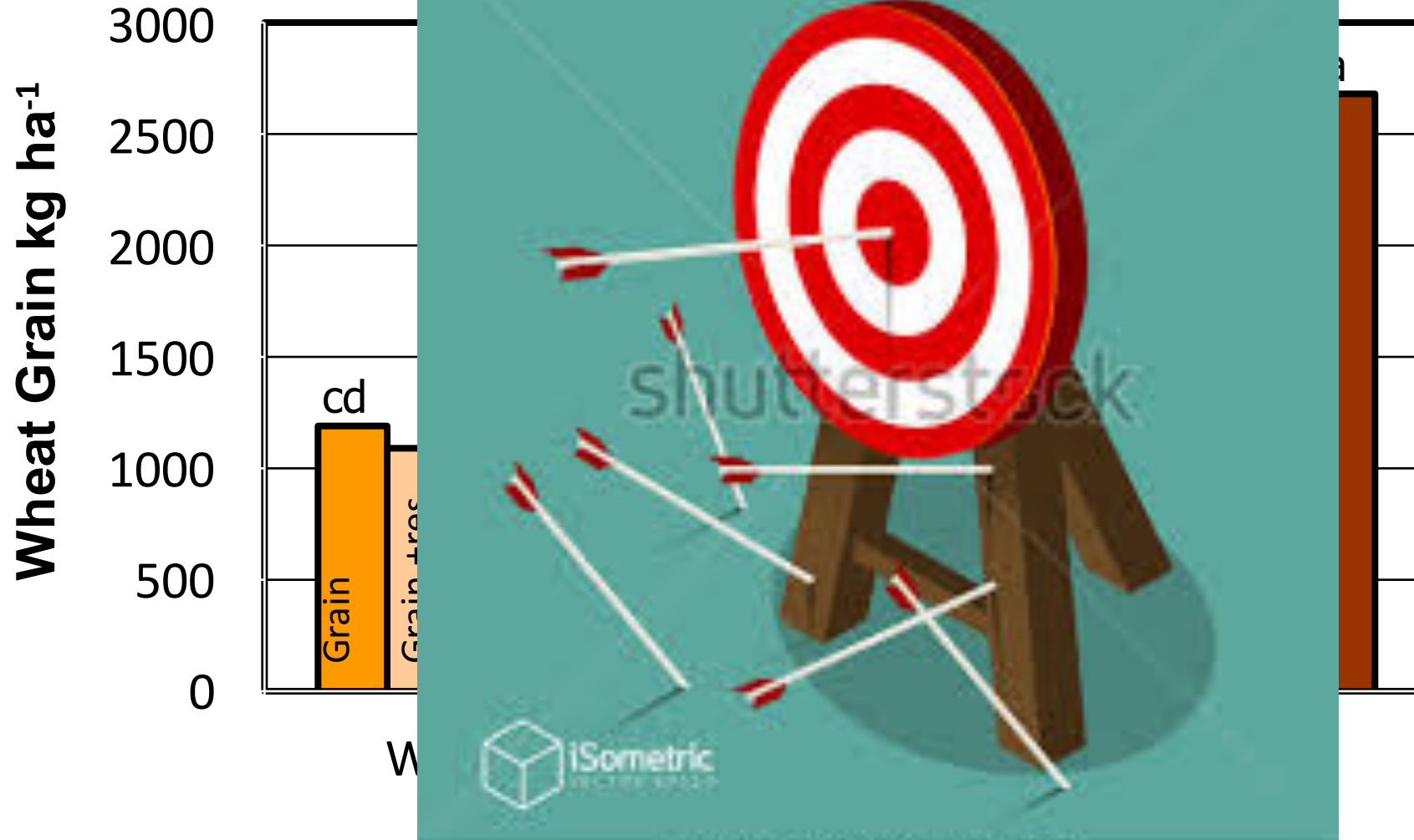
With bloom termination, legumes grow with little net water use, especially when cut for forage

Havre, MT - April, 2000



Conserved soil water drove grain yield

Havre, MT - 2000





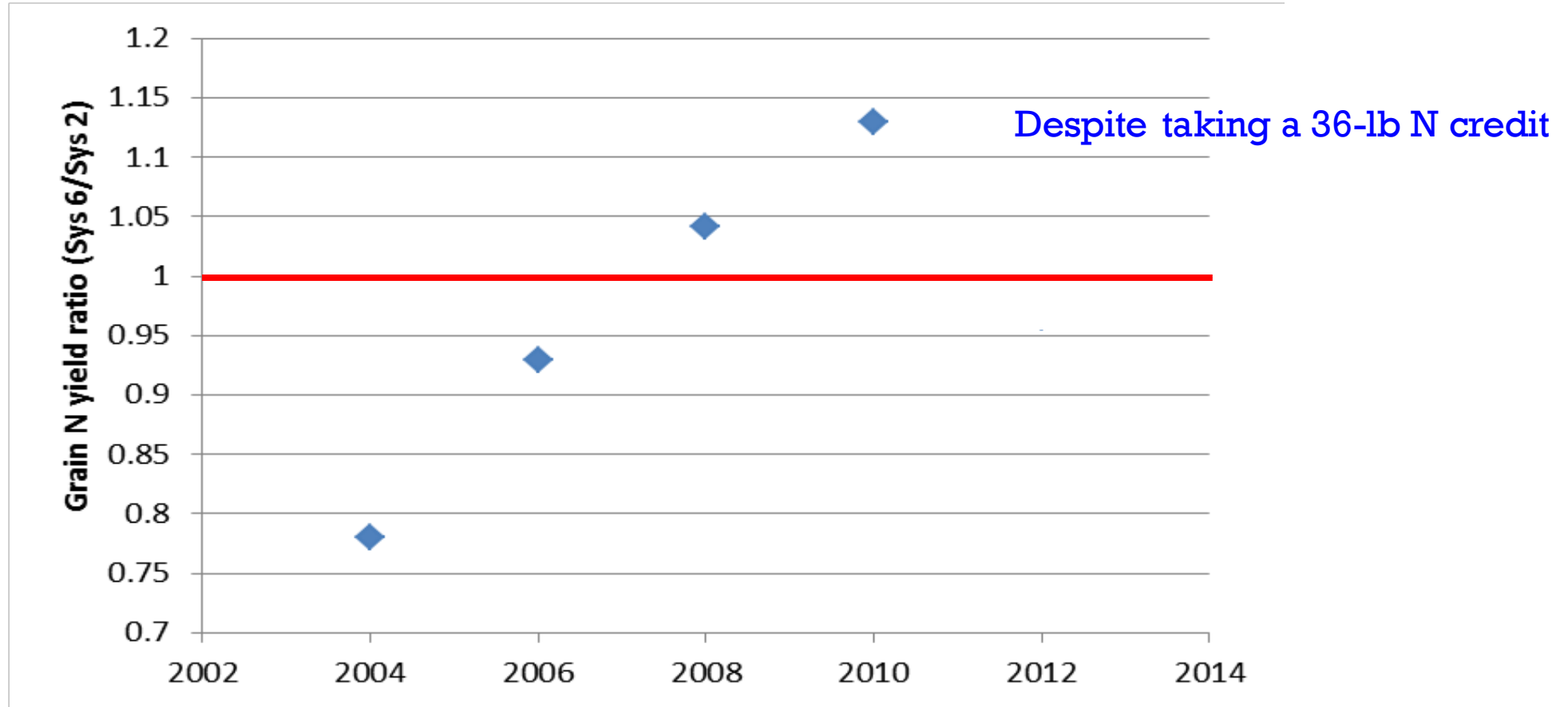
**Started long-term study at Bozeman in 2002.
Focused on pea in rotation with wheat.
Included pea-hay and pea-cover treatments.
Also tilled and chem fallow controls.**



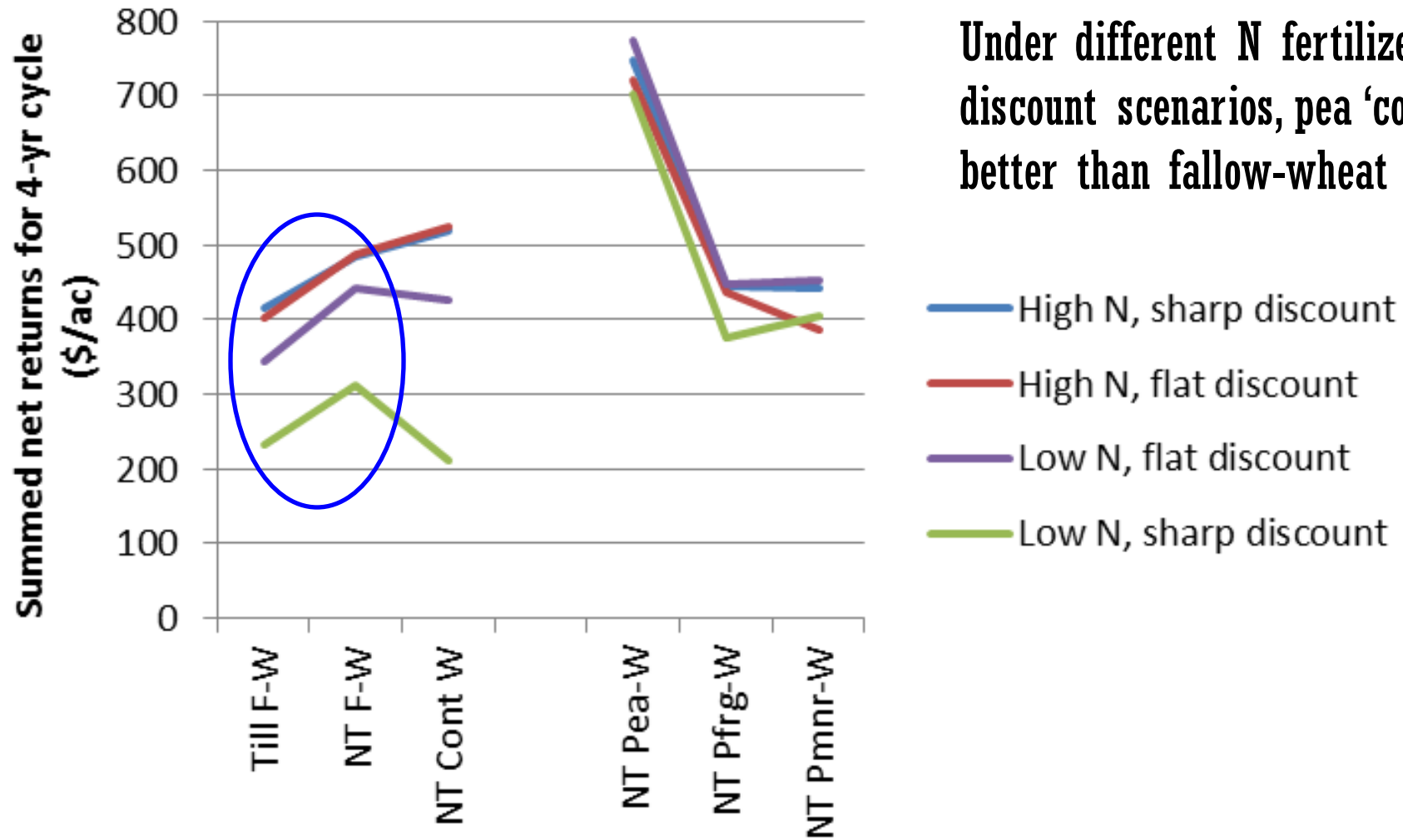
July 2, 2013

16-inch precip zone

Change in soil N supply over time; pea hay (Sys 6) vs chem fallow (Sys 2)



Economics? Summed net returns 2009 - 2012

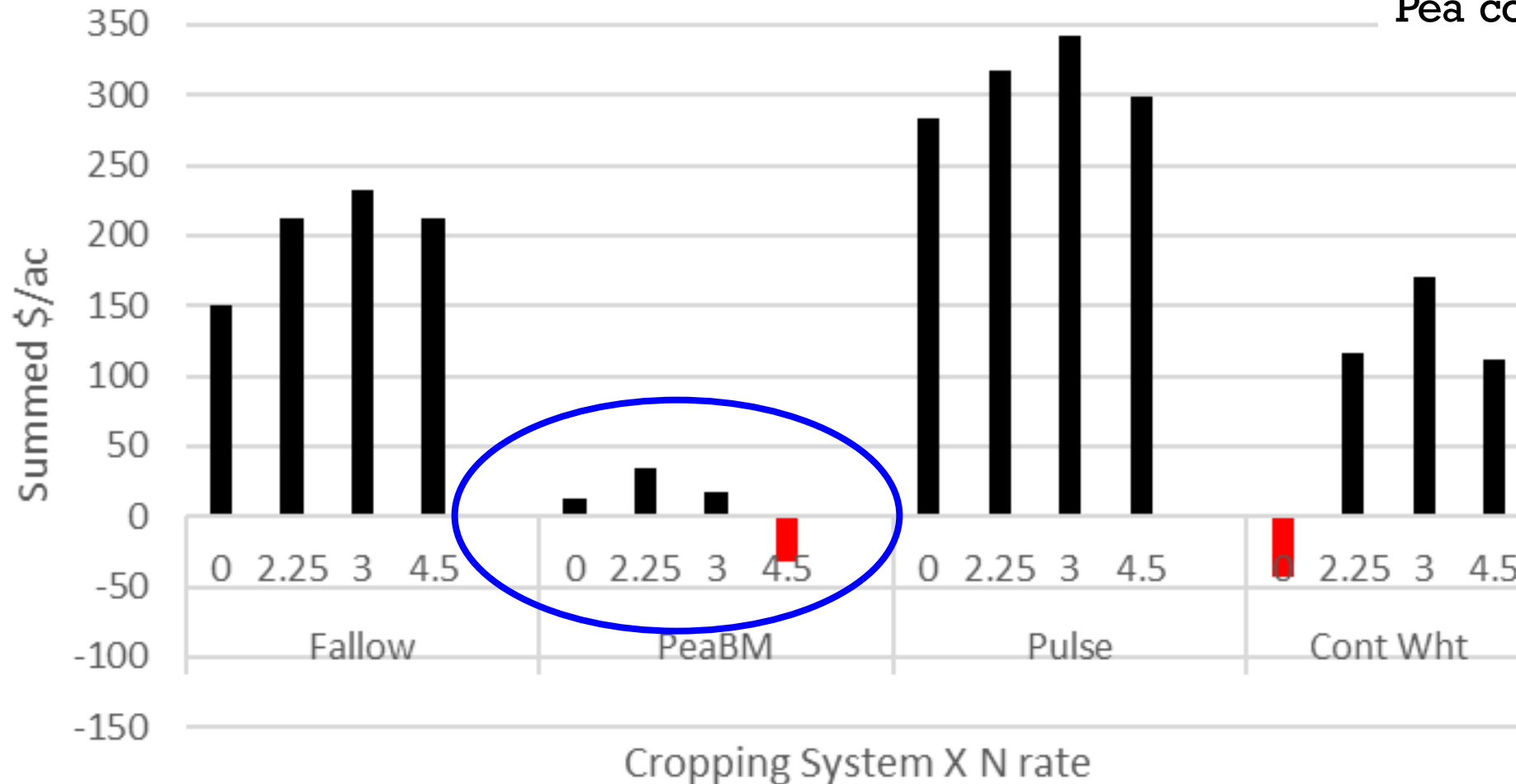


Miller P.R., A. Bekkerman, C.A. Jones, M.A. Burgess, J.A. Holmes and R.E. Engel. 2015. Pea in rotation with wheat reduced uncertainty of economic returns in southwest Montana. *Agron. J.* 107:541-550. doi:10.2134/agronj14.018

In 12-inch precip zone? Big Sandy, MT – Not So Good

2012-17 Cumulative Net Returns - Flat Discount

Pulse-wheat system
most profitable;
Pea cover least



Cover Crop Mixes? No Data

Fundamental Questions:

What can polycultures do that sole cover species can't?

- **pea cover control (trading water for Nitrogen)**

Do different plant functional groups affect soil properties differently?

- **Biological, Chemical, and Physical soil attributes**
- **Long-term assessment**

Begun with WSARE Funding,
Continued with checkoff funding

Cover Crop Mixes? Functional Groups

Nitrogen Fixers



Spring Pea
Pisum sativum



Lentil
Lens culinaris

Fibrous Root



Oats
Avena sativa



Canaryseed
Phalaris canariensis

Tap Root



Safflower
Carthamus tinctorius



Purple Top Turnip
Brassica rapa

Brassica



Daikon radish
Raphanus sativus



Winter Canola
Brassica napus

Cover Crop Management Study: 8-yr

Treatment groups:

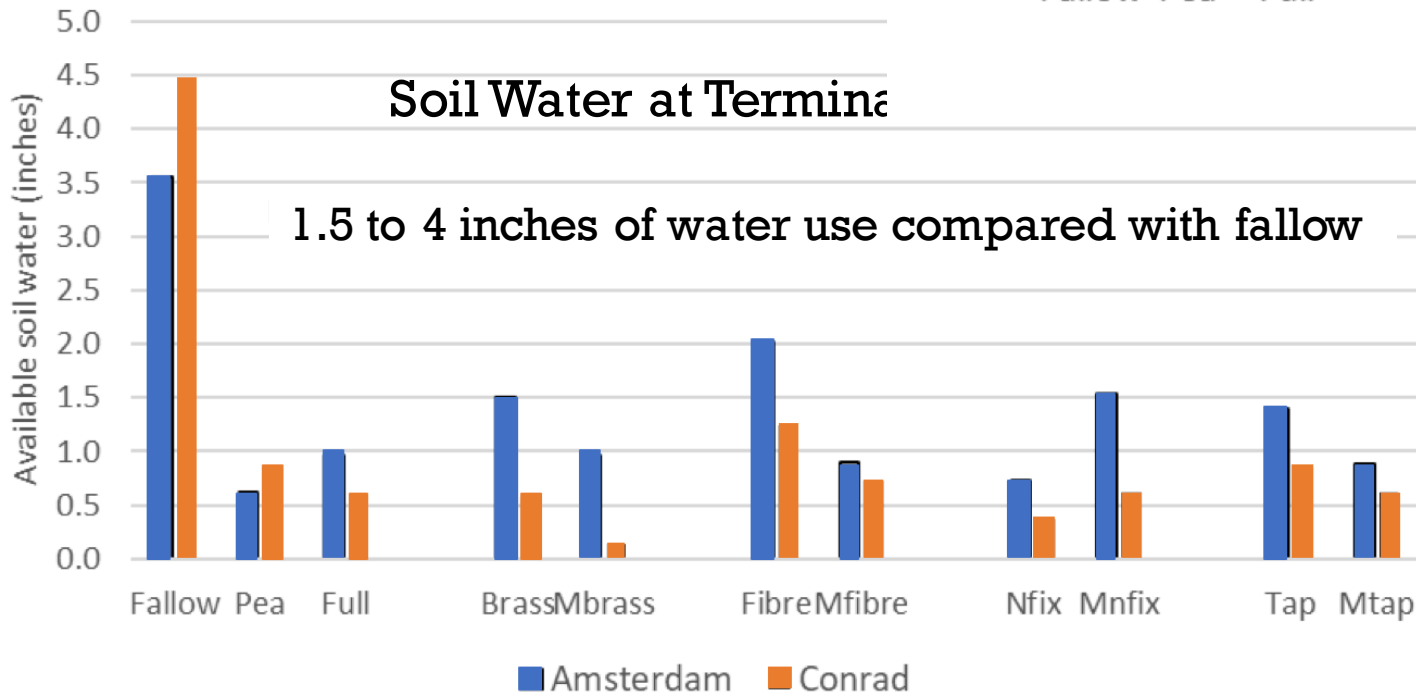
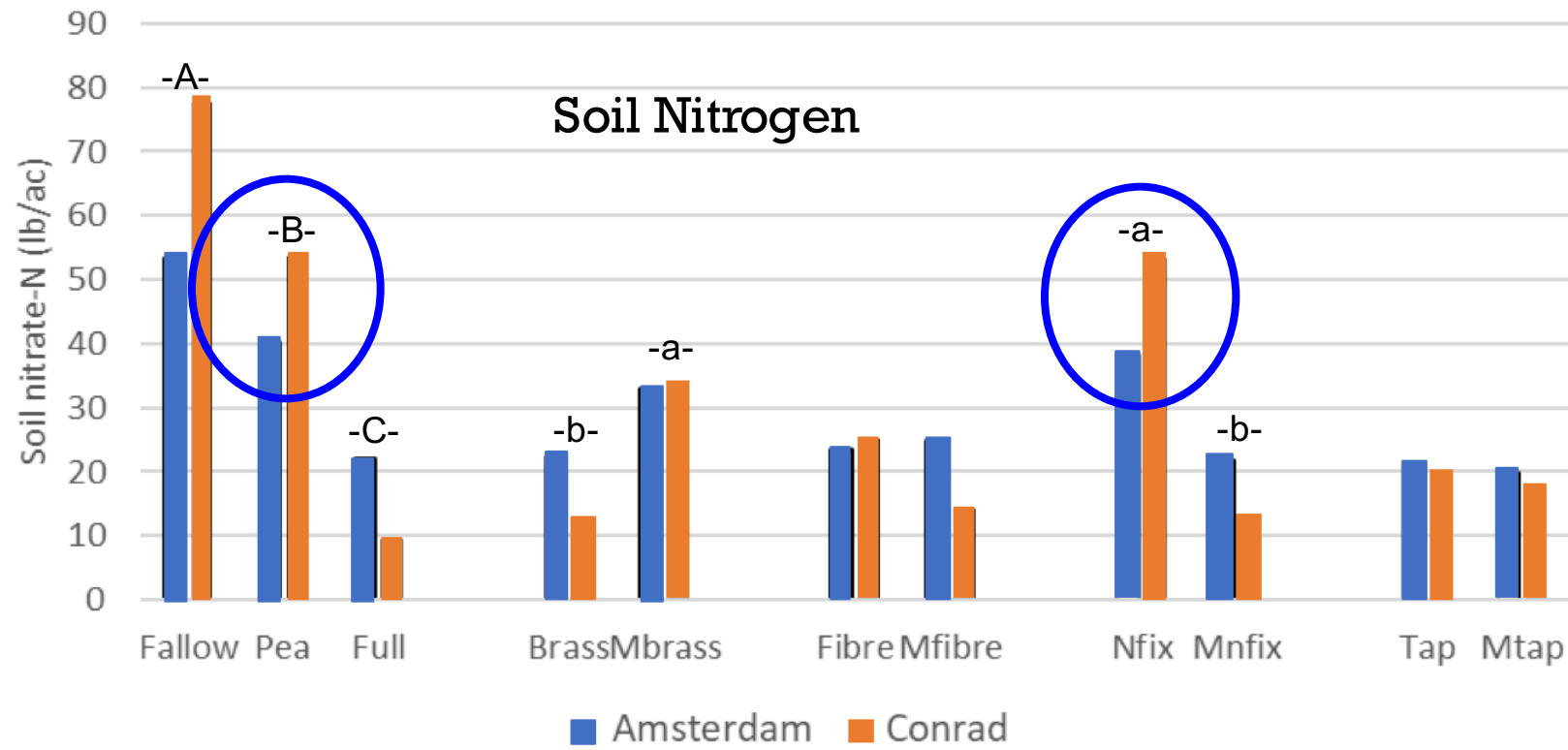
1. Chemical fallow
2. Pea
3. Full mix
4. Nitrogen fixers
5. Fibrous roots
6. Tap roots
7. Brassicas
8. Full mix minus nitrogen fix
9. Full mix minus fibrous root
10. Full mix minus tap roots
11. Full mix minus brassicas



Anything separating
from the herd?



Preliminary Results:

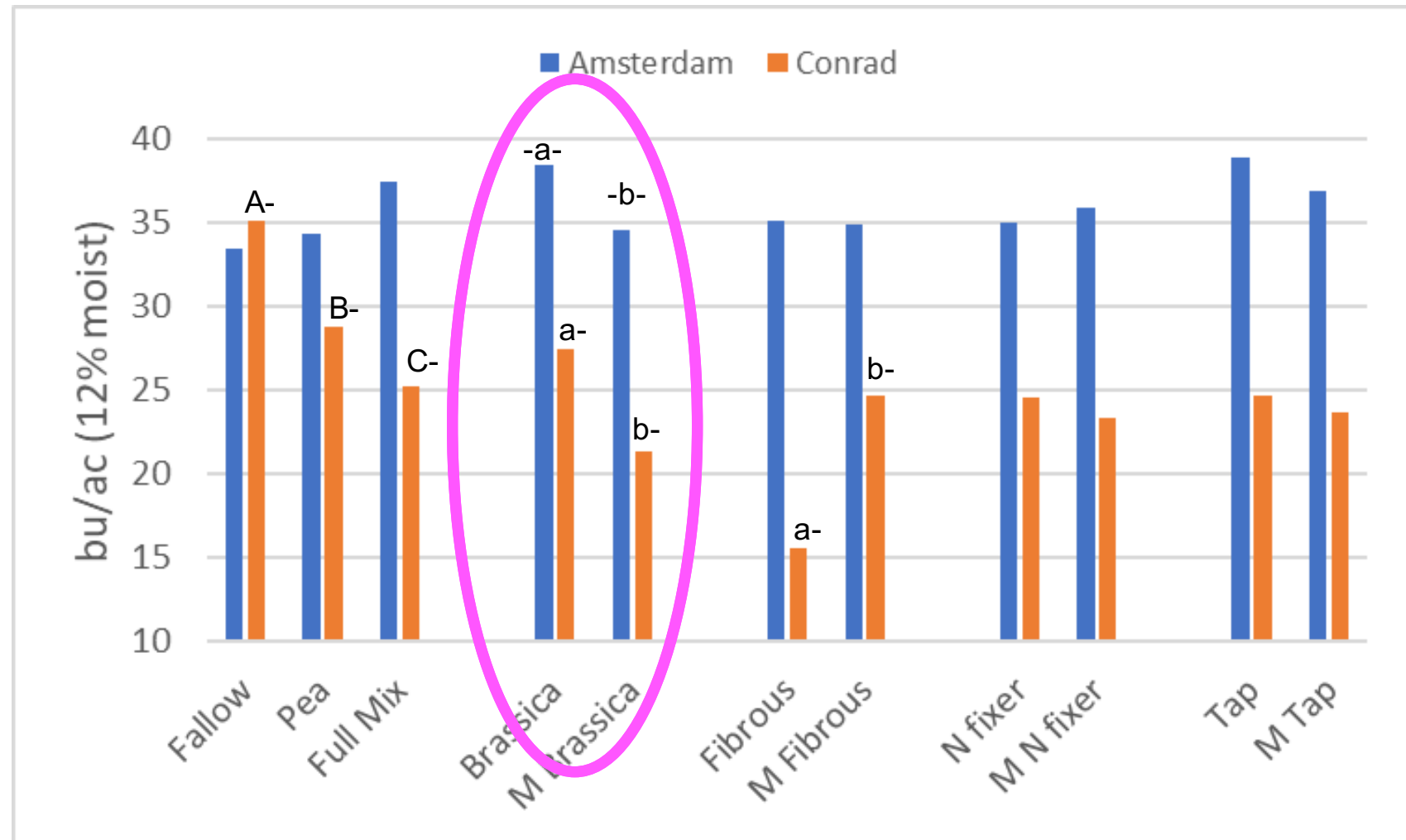


Soil water and nitrate-N at cover crop termination (July 2016)

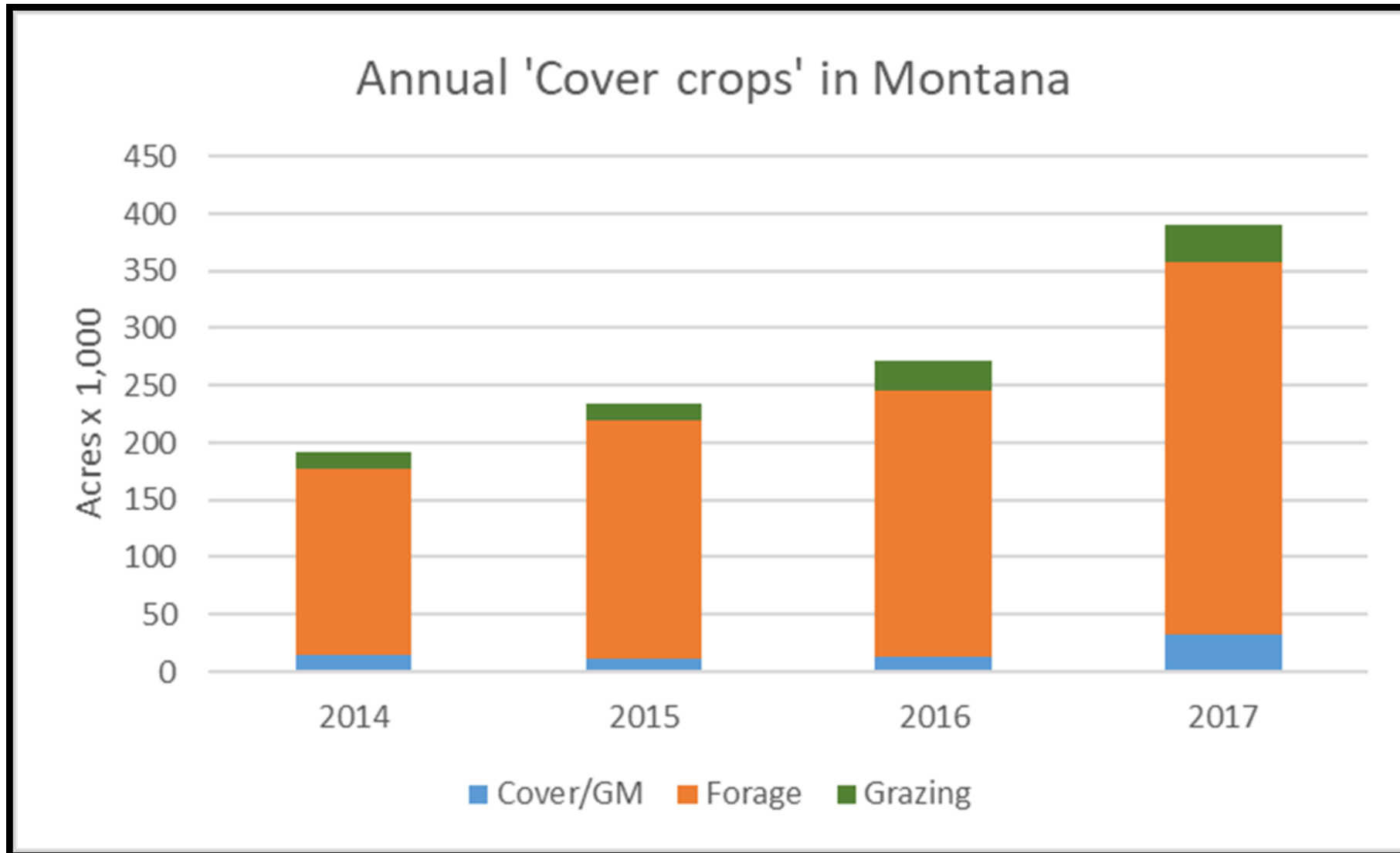
Preliminary Results:

- Brassica story?

Wheat yield response to cover crop 2017



What are Montana farmers doing with covers?



Grazing effects on soil parameters?

- In short-term grazing studies, seeing some concern
- Long-term study at MSU-NARC (Havre, MT – Darrin Boss & Maryse Bourgault) will provide more robust data
- But what really matters, is what guys like Kent think!



Outline 17 minute talk

- Map of northern Plains – Padbury AER
 - Map of Montana – my research sites; Kent’s farm
 - Challenge in MT is double-edged – low biomass limits soil change, and stored soil water is liquid gold (photo of Bismarck vs Bozeman Biomass)
- Come from no-till diversified Cropping systems perspective – first researcher in semiarid northern Plains to aggressively explore pulse crops in rotation with wheat – 1.6 million ac of pulses in Montana in 2017 – but not always so certain this would happen
 - 5-yr drought (1999-2003) questioned whether we could grow pulses much in dryland Montana
 - led me to ‘green fallow’ alternatives using legumes (mainly pea) to trade water for N, and hopefully increase soil quality
- Covers: 1 immediate short-term hit and then a whole lot of misses, both in research plots and ESPECIALLY on-farm
 - Started a long-term study at Bozeman in 2002
 - Had first heard about plant mixtures from Jill Clapperton (soil ecologist) at AAFC Lethbridge in mid 2000s but a local farmer asked enough questions for us to pursue a grant – Western SARE 2012, and he and another farmer have encouraged us to look at soil effects over a longer term
 - NO RESEARCH. Clain Jones (soil fertility specialist), Cathy Zabinski (underground microbial ecologist), and myself (agronomist) decided to ask FUNDAMENTAL questions: (theoretical approach)
 - What are the effects of mixed plant communities vs sole pea (our standard) and chem fallow in no-till systems?
 - Lots of questions. Big one is what seeding rates to use
 - Do different plant functional groups have different and measurable effects on biological, chemical, or physical soil parameters?
 - And how long does it take? WSARE funded for first four years (two cover crop cycles) and an in-state fertilizer group has funded annually for next three (and hopefully one more) I view the soil quality issues as akin to ‘buying land’ ... buy your neighbor’s field or buy your own. But have to know 1) investment costs, 2) time required, and 3) increased returns lifetime.
- What are MT farmers doing with covers?
 - Consensus shows FORAGE VALUE IS KEY (mostly hay, but some grazing too) MT graph
 - We have preliminary research showing slight retardation of soil parameters when grazed vs just sprayed out and left on soil.
 - Kent Wasson

Seeding rates – simple 4-way mix

- Barley ~ 20/ft²
- Turnip ~ 4/ft²
- Pea ~ 8/ft²
- Canola ~ 16/ft²



Seeding rates – let everybody play

