

# MSU-Bozeman Cover Crop Research

---

## NPGA Research Panel

**Great Falls, December 5, 2014**

**Clain Jones (994-6076; [clainj@montana.edu](mailto:clainj@montana.edu)),  
Cathy Zabinski (root ecology), Anton Bekkerman (economics),  
and Perry Miller (presenter, 994-5431; [pmiller@montana.edu](mailto:pmiller@montana.edu))**

# MSU legume (pea or lentil) cover crop research since 1999 has found higher grain yields and/or protein after cover crops when:

---

1. Seeding winter pea (vs spring pea)
2. Seeding spring legumes early (vs late)
3. Terminating legumes at first bloom (vs pod)
4. Tilling cover crop (vs spraying)



Why?

More N fixed (1)

More time for soil water to be recharged and N to become released from residue (1, 2, 3)

Faster N release and fewer N losses (4)

# Questions still to be answered

---

- Do cover crop mixtures improve yield, protein, and soil health more than legume-only?
- Do yield and soil health benefits increase with number of cover crop cycles?



## Study 1: Cover crop cocktails, one 2-year cycle, four site years

---

- Objective: Determine effects of “functional groups” within mixed cover crops on plant yield and soil health
- 2 sites in Triangle (Dutton and Conrad), 2 sites in Gallatin Valley (Amsterdam and Bozeman)
- Monitored 7 farm fields as well

# Plant Functional Groups & Species

## Nitrogen Fixers



Spring Pea  
*Pisum sativum*



Common Vetch  
*Vicia sativa*

Lentil  
*Lens culinaris*

## Fibrous Root



Oats  
*Avena sativa*



Italian Ryegrass  
*Lolium multiflorum*

Proso millet  
*Panicum miliaceum*

## Tap Root



Safflower  
*Carthamus tinctorius*



Purple Top Turnip  
*Brassica rapa*

## Brassica



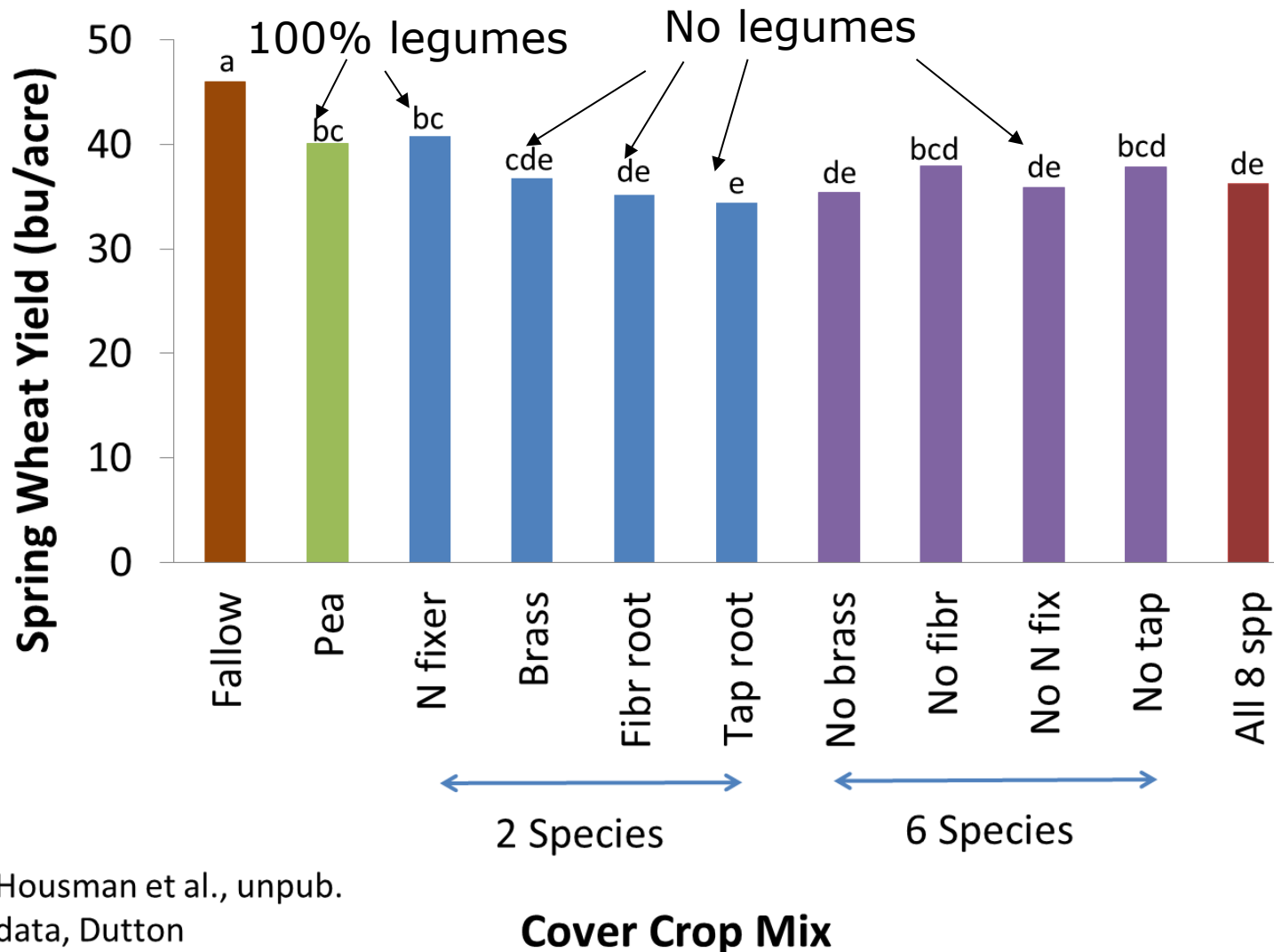
Daikon radish  
*Raphanus sativus*



Camelina  
*Camelina sativa*

Winter Canola  
*Brassica napus*

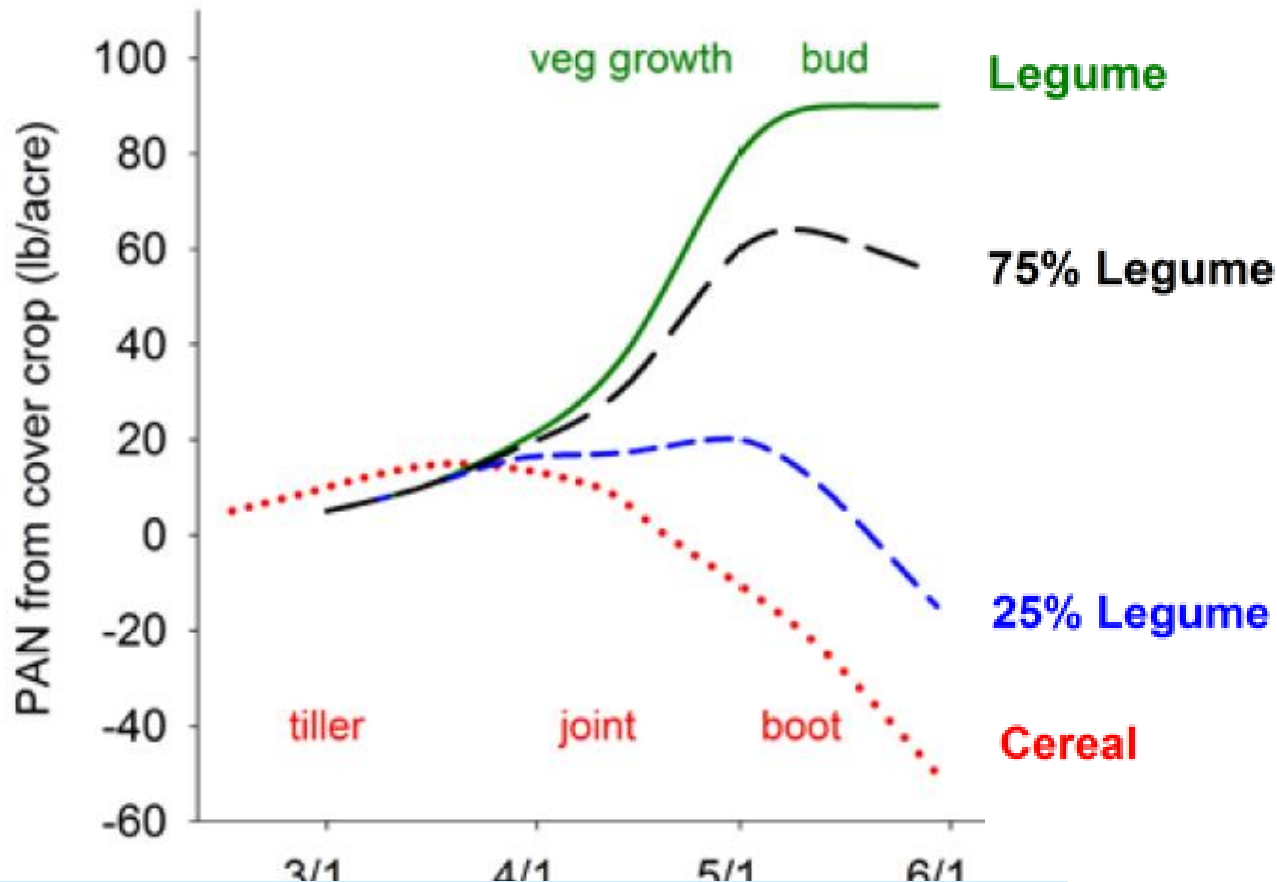
# Effect of cover crop treatment on spring wheat grain yield at Dutton (2014)



Housman et al., unpub.  
data, Dutton



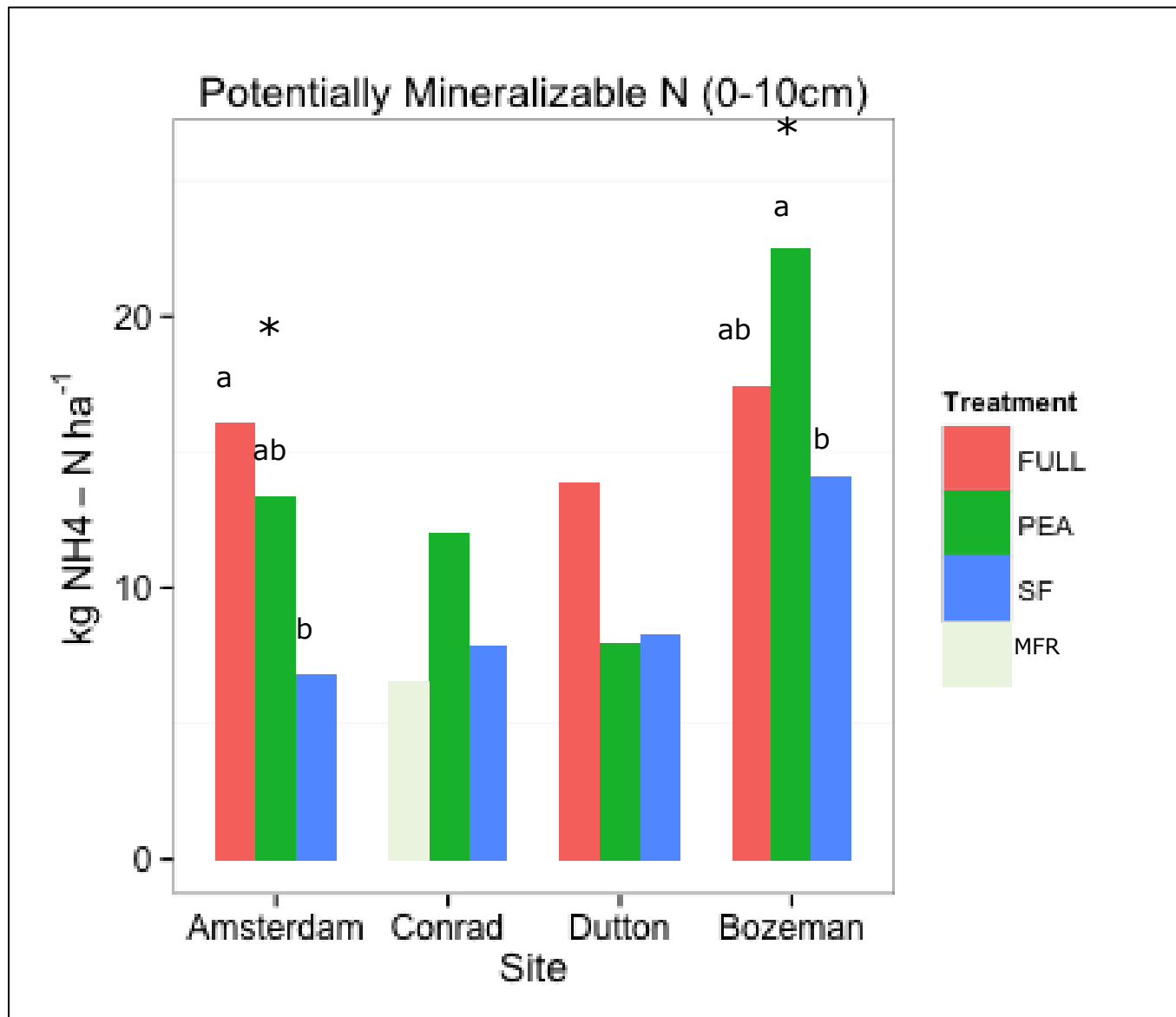
# Percent legume and termination timing affects plant available N (PAN)



**Take home:** Legume % less than 50 can result in low available N esp if terminated late

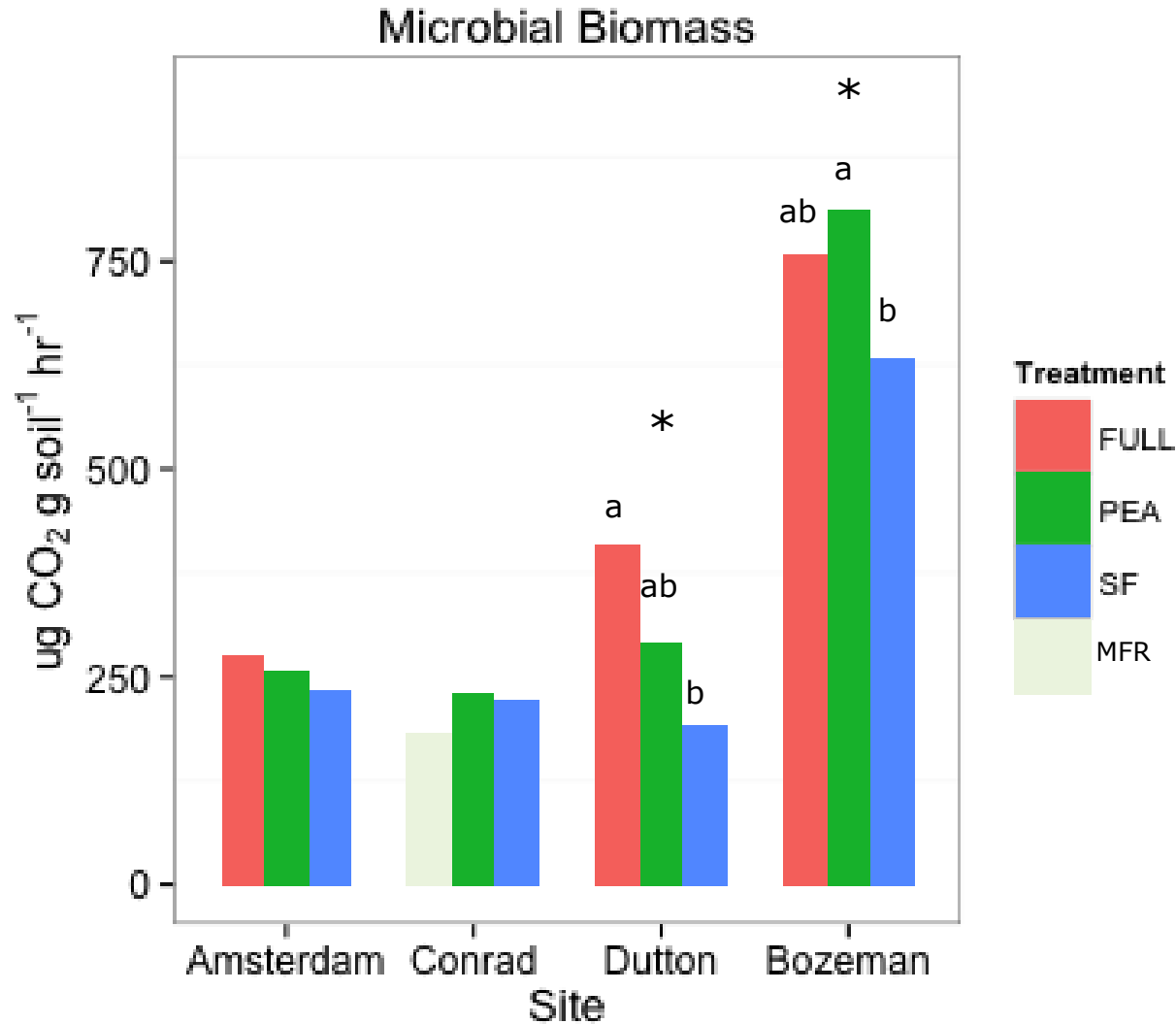
Willamette Valley, Oregon  
Sullivan and Andrews, 2012

# Potentially Mineralizable N

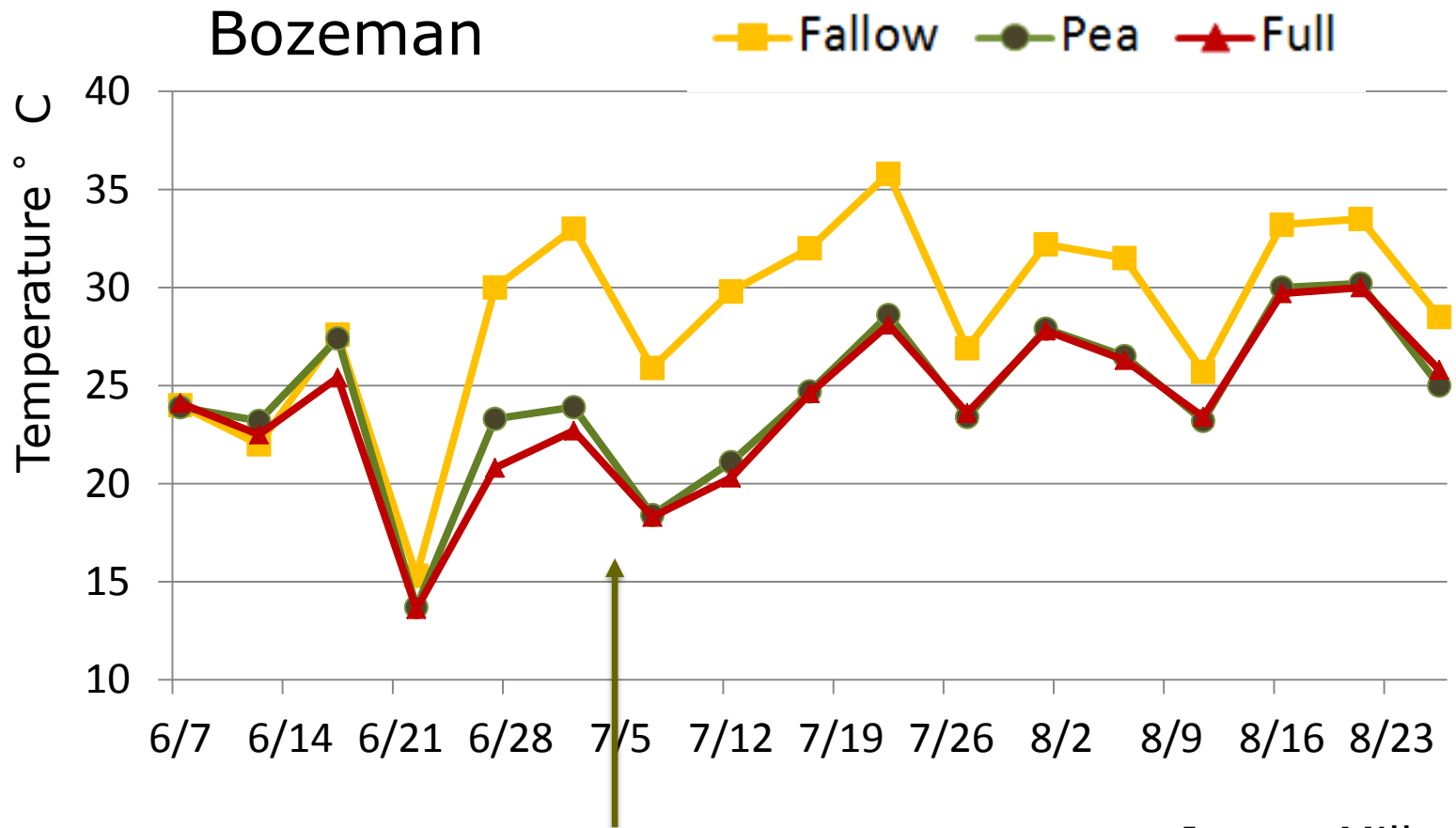




# Microbial Biomass



# 2013 Soil Temperature study (2 inch)



Cover crops terminated on 5 July

Jones, Miller, et al. unpublished



## Study 1 : Take home messages on yield and soil quality

---

- After one cycle, spring wheat grain yields higher after pea and N fixers than most other mixes.
- Relatively minor soil health differences; not unexpected given only one cycle.



## Study 2: Eight-year, plot study

---

- Objective: Determine long-term effects of legume-containing rotations vs. fallow on subsequent wheat mainly in no-till.
- ~16 inch annual precip. (4 miles west of Bozeman)



## Study 2. Experimental Design

---

- Unique feature is deep, uniform silt loam soil and relatively abundant winter precip. to recharge soils
- Focus here on No-till pea forage/legume cover crop-wheat vs. fallow-wheat
- Spring or winter wheat planted in even years. 2010 was wettest of wheat years, 2012 record drought.
- 2 N rates: Full (3 lb available N/bu) and  $\frac{1}{2}$  N
- NO differences in wheat yield between CC and fallow in 2004, 2006, and 2008.





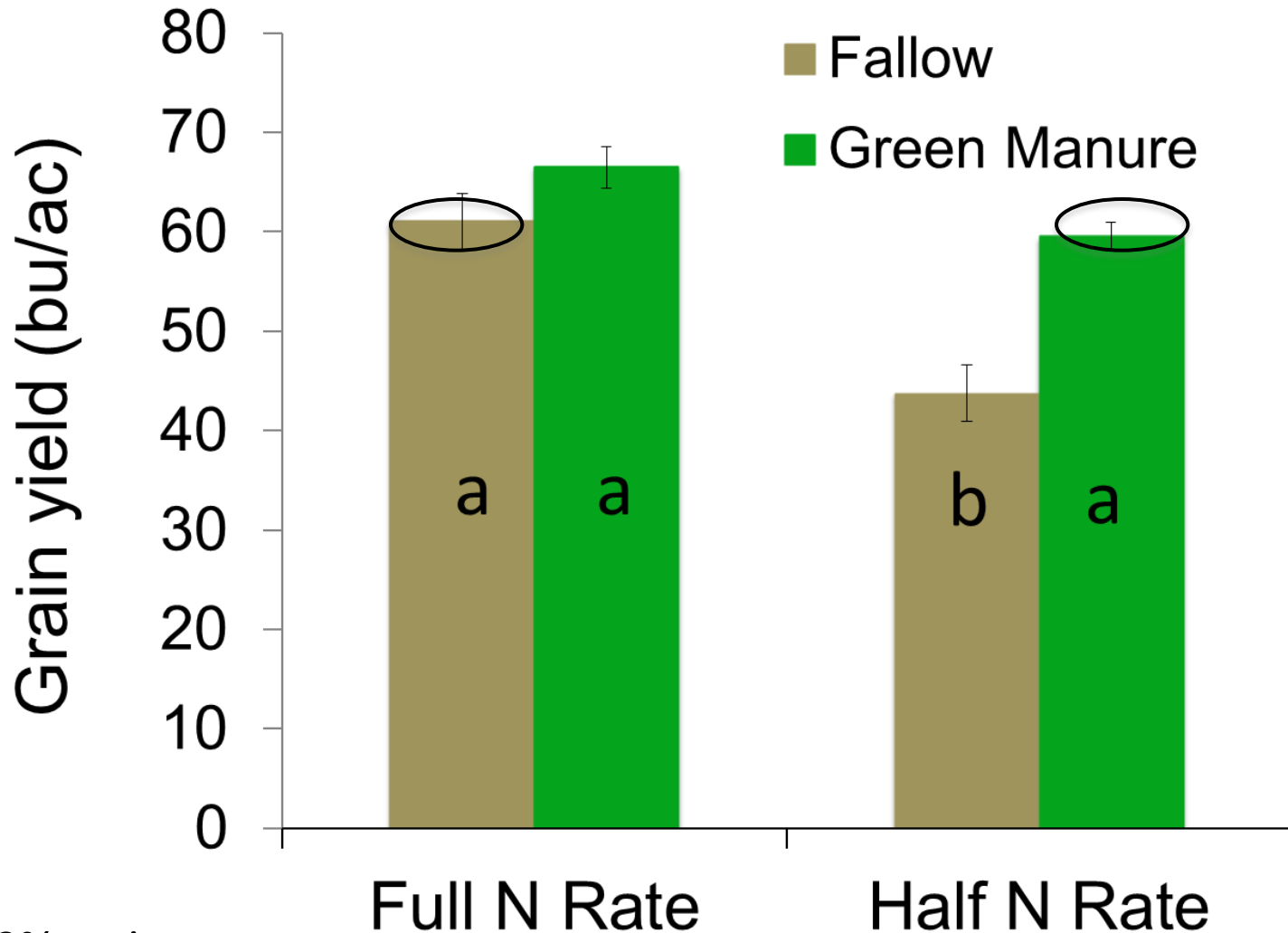
Legume or  
fallow year



Wheat year



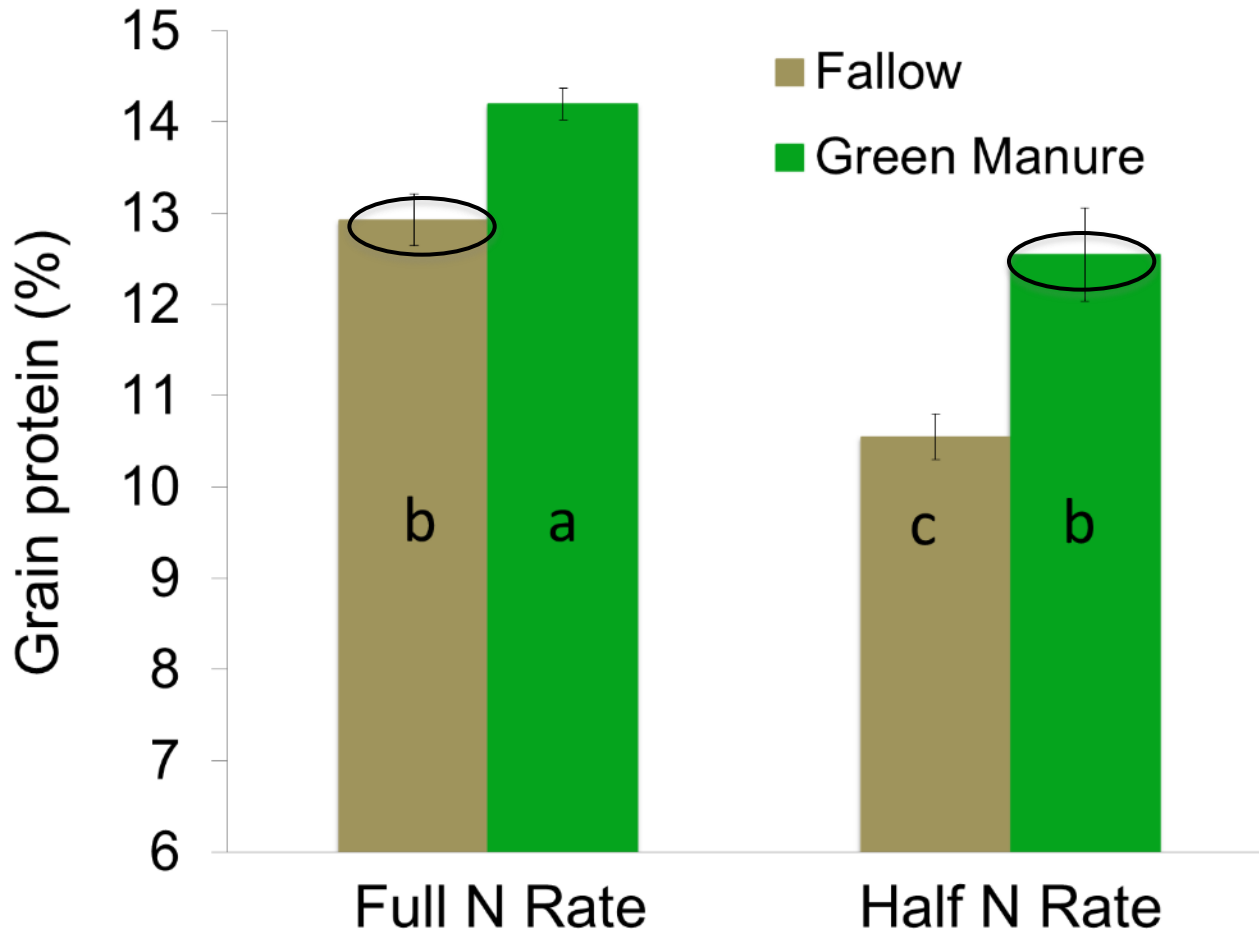
# Study 2: 8 year plot study, Grain yield in 8<sup>th</sup> year (2010 - wet)



@ 12% moist



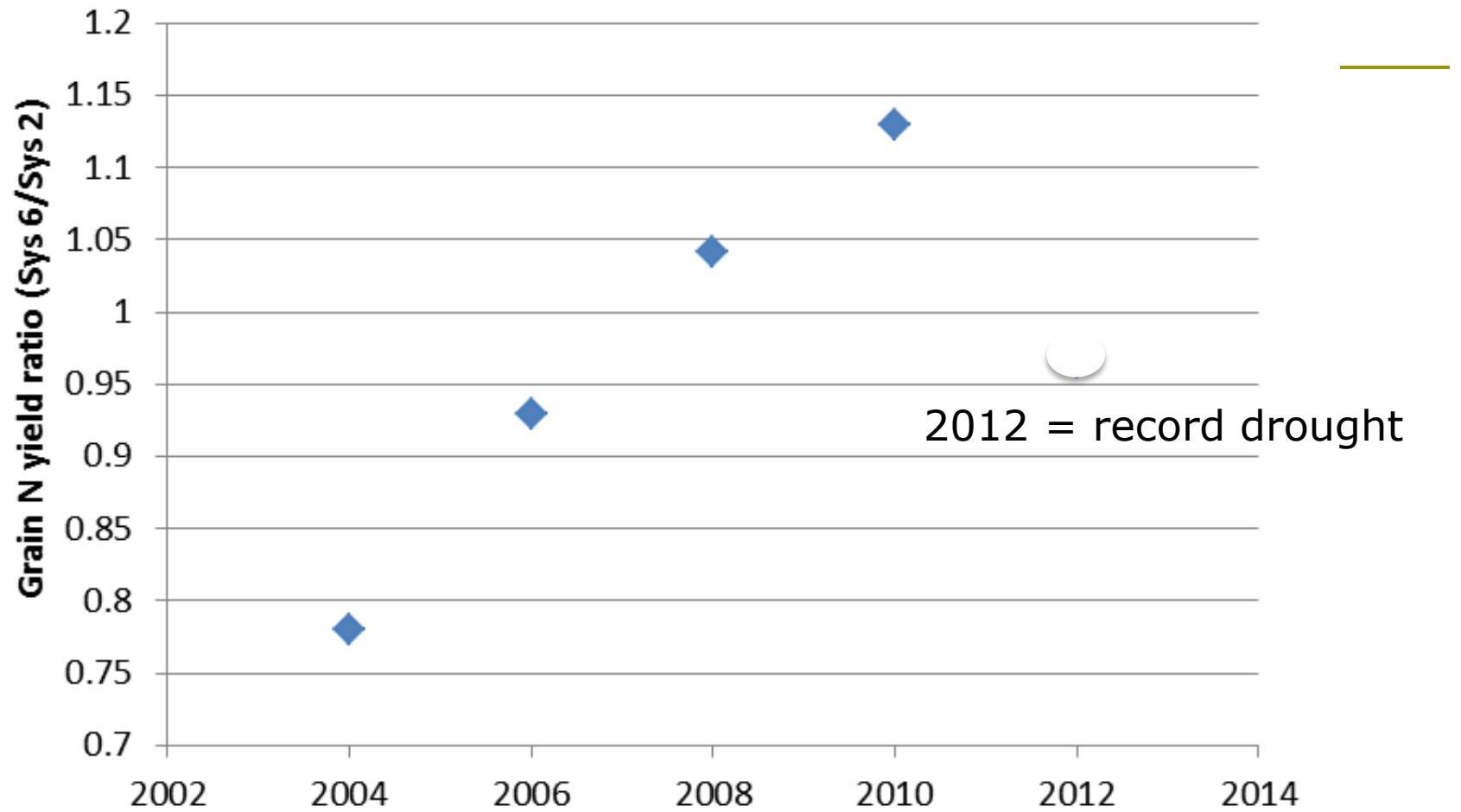
# Study 2: 8 year plot study, Grain protein in 8<sup>th</sup> year



* N fertilizer rates	<i>Fallow-Wheat</i>	<i>LGM-Wheat</i>
Full N rate (lbs/ac)	124.00	83.00
Half N rate (lbs/ac)	39.00	0.00



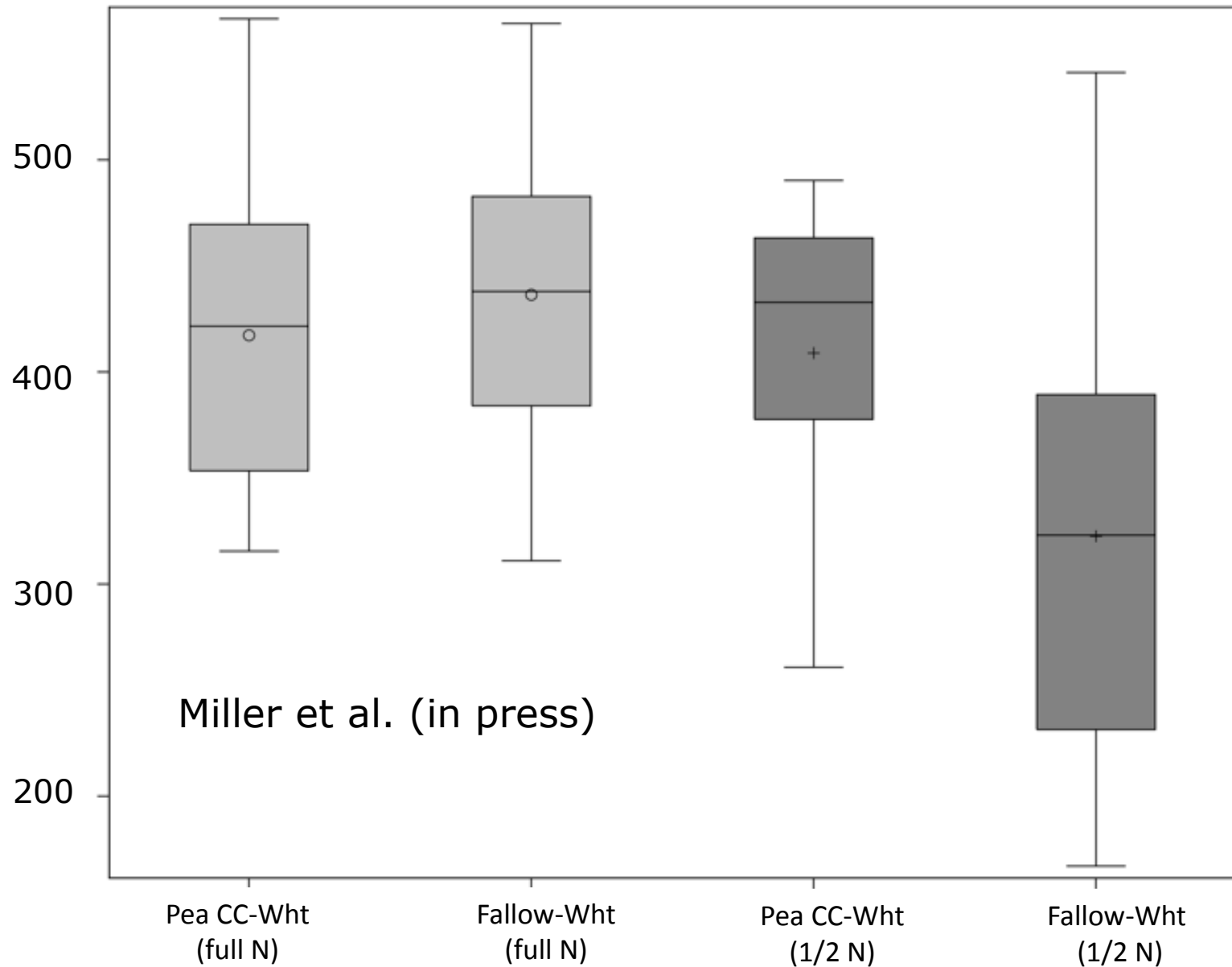
# Change in soil N over time





# Study 2 Economics (2009 – 2012)

4 yr Average Discounted Present Value of  
Net Returns (\$/ac)





## Study 2: Take home messages

---

- In the first 3 cycles, wheat grain yield was not higher after legume than after fallow.
- After 4 two-year cycles, wheat grain yield and protein were higher after legume CC than after fallow.
  - Higher than normal precipitation in 2010 likely 1) increased release of available N from an increased organic N pool, and 2) made N limiting to growth.
  - Over 100 lb N/ac was saved in 2010 following legume cover crop compared to fallow!
- 4-yr economic returns were more stable with cover crop (less dependent on N rate) during wet and record drought years

# Acknowledgments

---

- USDA – AFRI
- USDA – WSARE
- NRCS – CIG
- Montana Fertilizer Advisory Committee
- Montana Wheat and Barley Committee
- Numerous landowners
- Susan Tallman
- Meg Housman
- Ann McCauley
- Jeff Holmes



# Questions?

For additional information on soil fertility topics including information on cover crops, see

<http://landresources.montana.edu/soilfertility>