Cover Crop Effects on Soil Quality and Subsequent Yield

Ag Agent Update

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Today's objective

- Present soil quality and yield results from two MSU plot studies

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

- Objective: Determine effects of “functional groups” within mixed cover crops on yield and soil health
- All terminated with herbicide at first pea bloom

Study Sites

3 on-farm
conventional
1 university land

3 yr minimum no-till

Year	Amsterdam, Conrad	Bozeman, Dutton
2012	cover crop	--
2013	wheat	cover crop
2014	cover crop	wheat
2015	wheat	cover crop

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

2014
Canaryseed

Tap Root

Safflower
Carthamus tinctorius

Purple Top Turnip
Brassica rapa

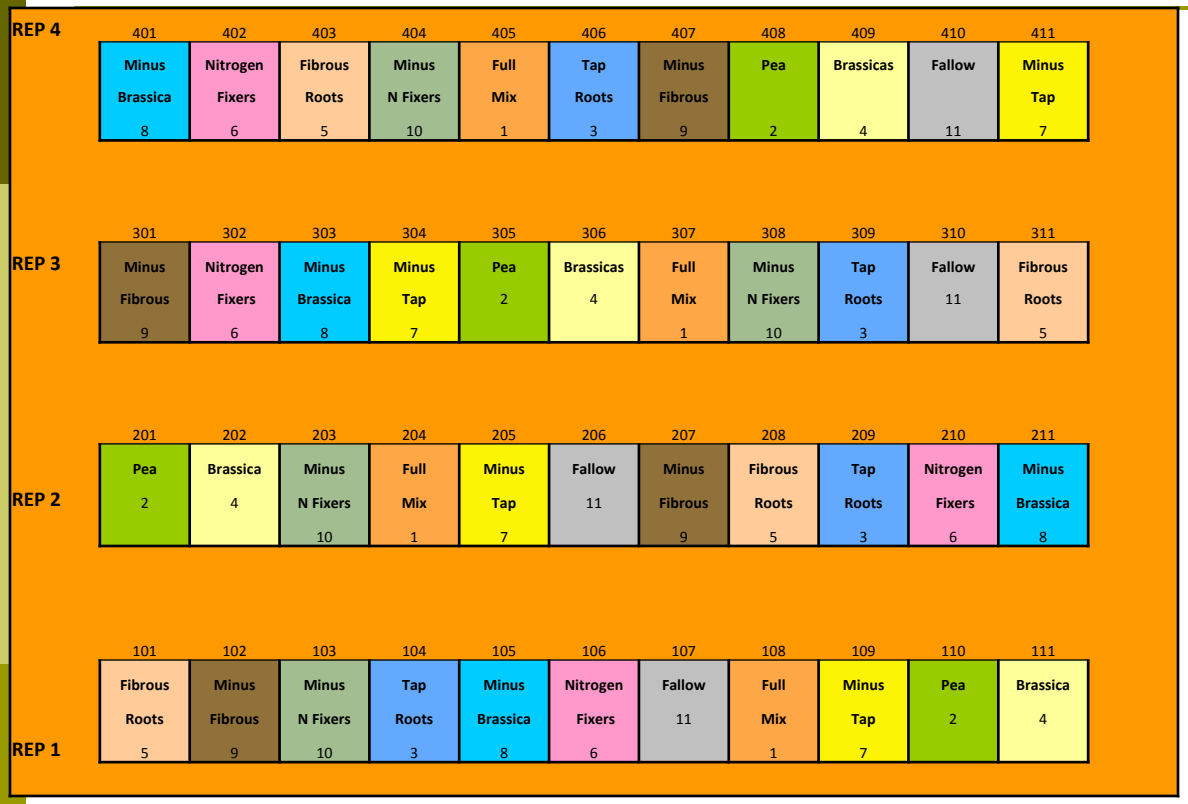
Brassica

Daikon radish
Raphanus sativus

Camelina
Camelina sativa

Winter Canola
Brassica napus

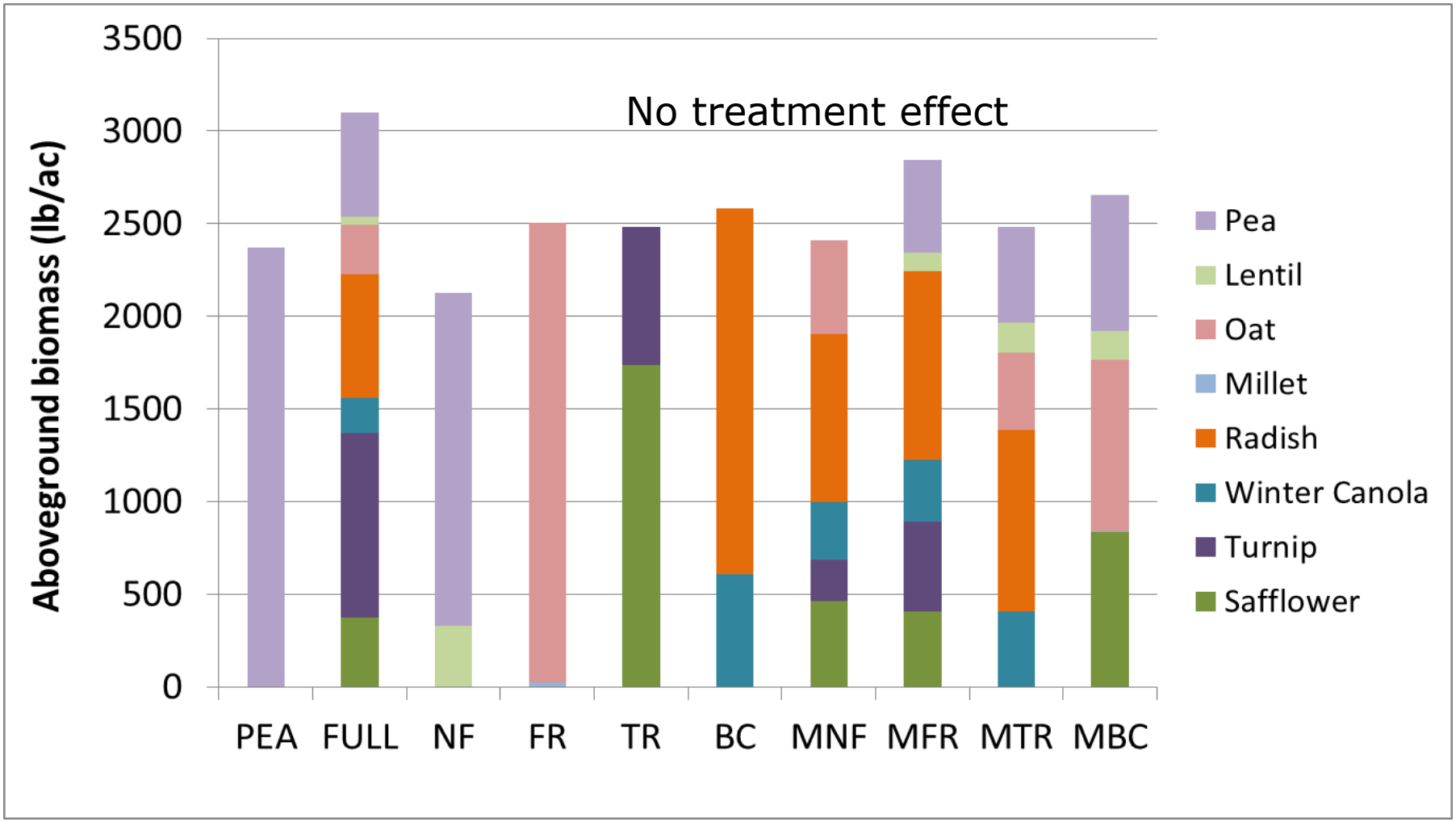
Plot Study: CCM Phase
4 farms including 2 in Golden Triangle



Treatments

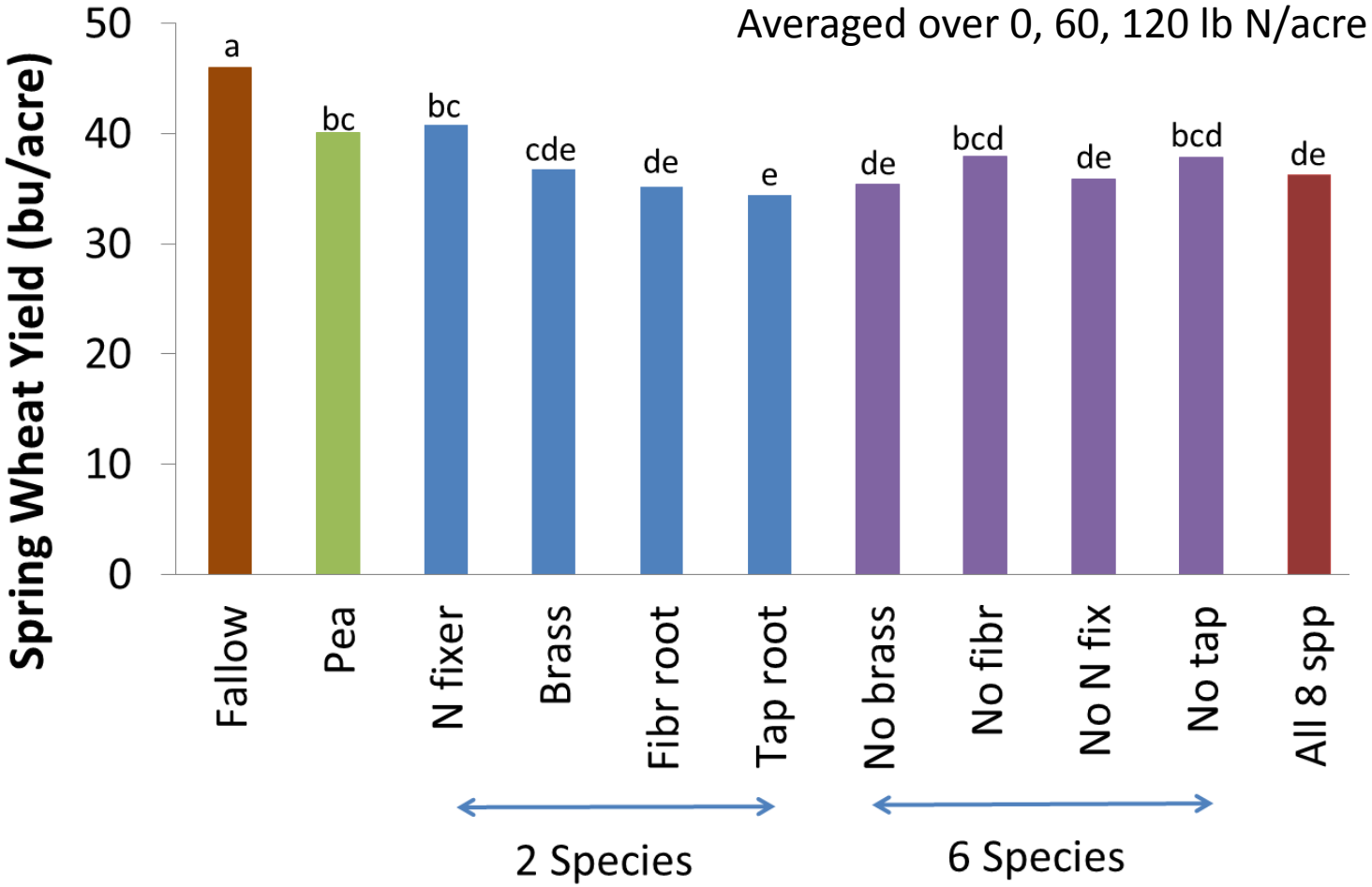
- **Summer fallow**
- **Pea**
- **N fixers (NF)**
- **Taprooted (TR)**
- **Fibrous rooted (FR)**
- **Brassica (BR)**
- **Full (all 8 spp)**
- **Minus NF**
- **Minus TR**
- **Minus FR**
- **Minus BR**

2013 Cover Crop Biomass at Dutton



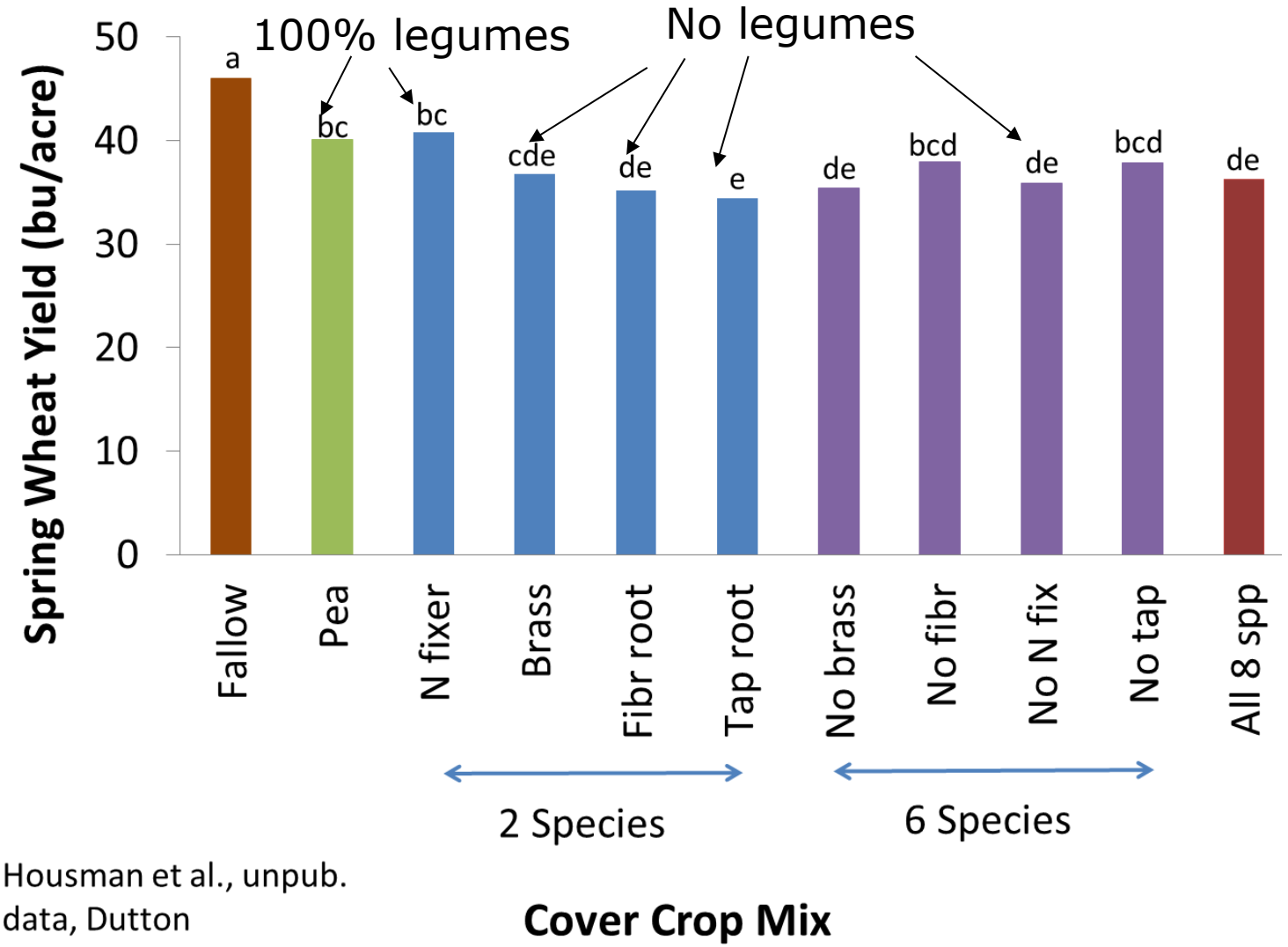
Increasing diversity did not appear to importantly increase biomass when combined with Bozeman data

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



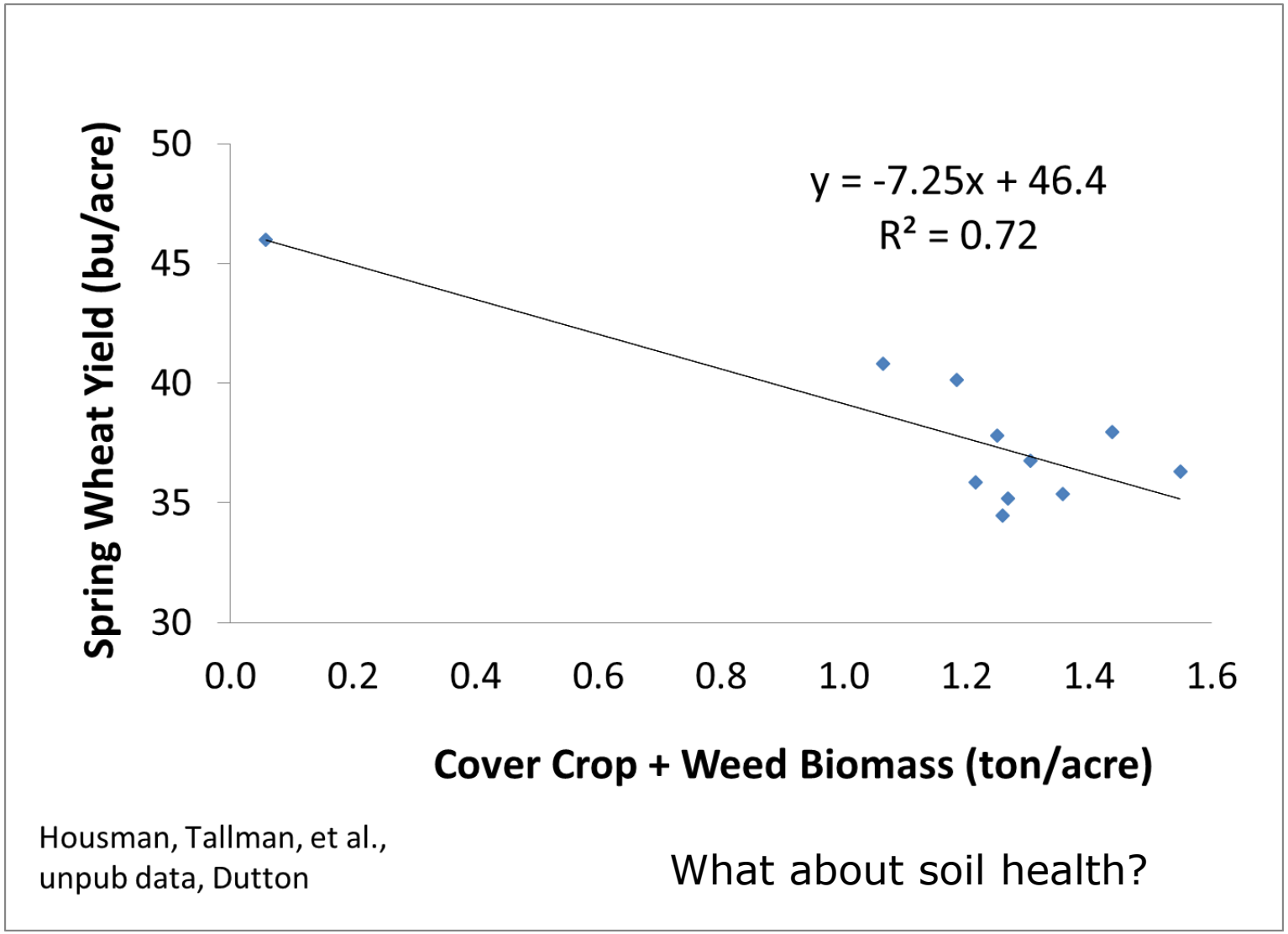
Housman et al., unpub. data, Dutton

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



Housman et al., unpub. data, Dutton

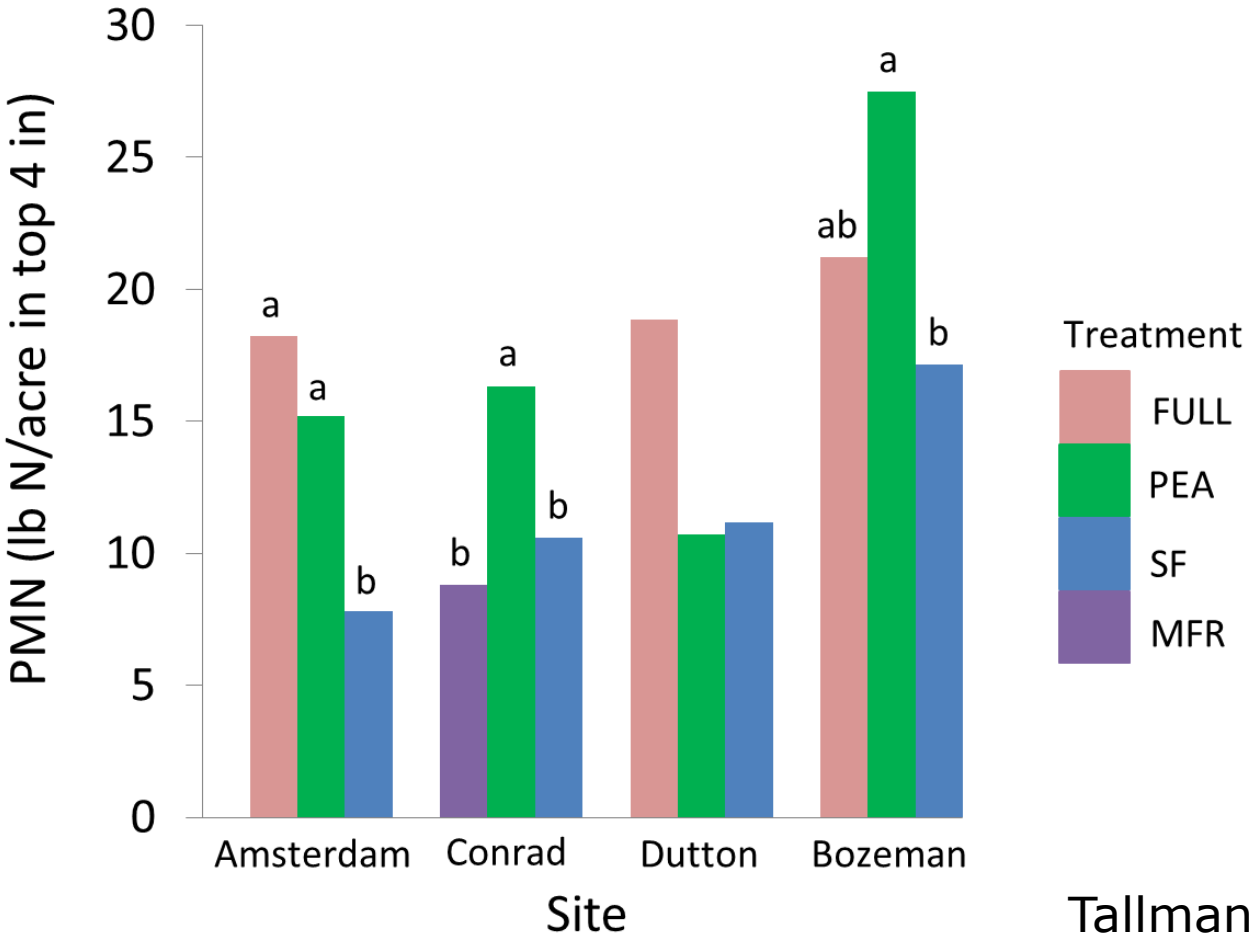
Spring wheat yield at Dutton vs previous year total biomass (cc + weed)



Housman, Tallman, et al., unpub data, Dutton

What about soil health?

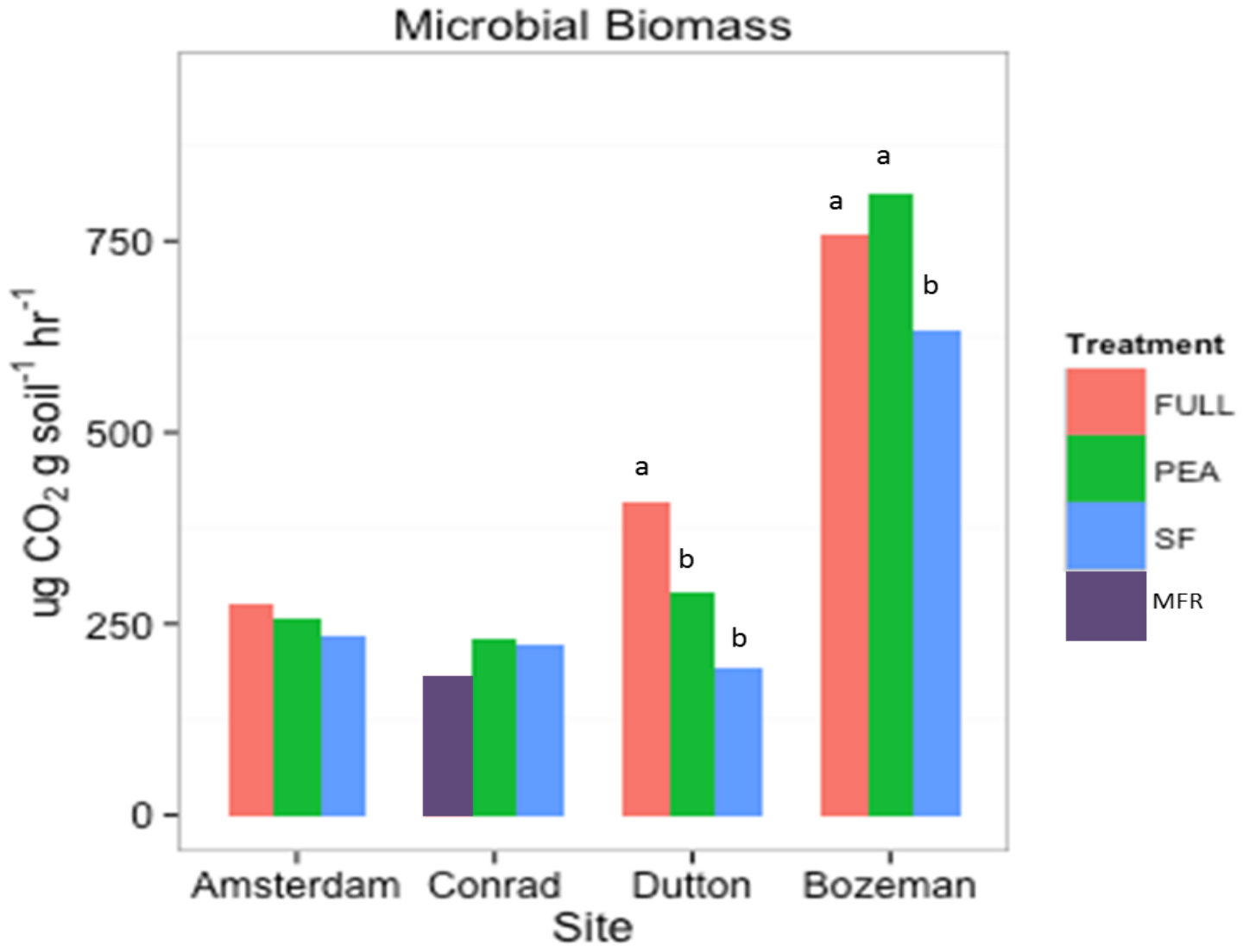
Potentially Mineralizable Nitrogen



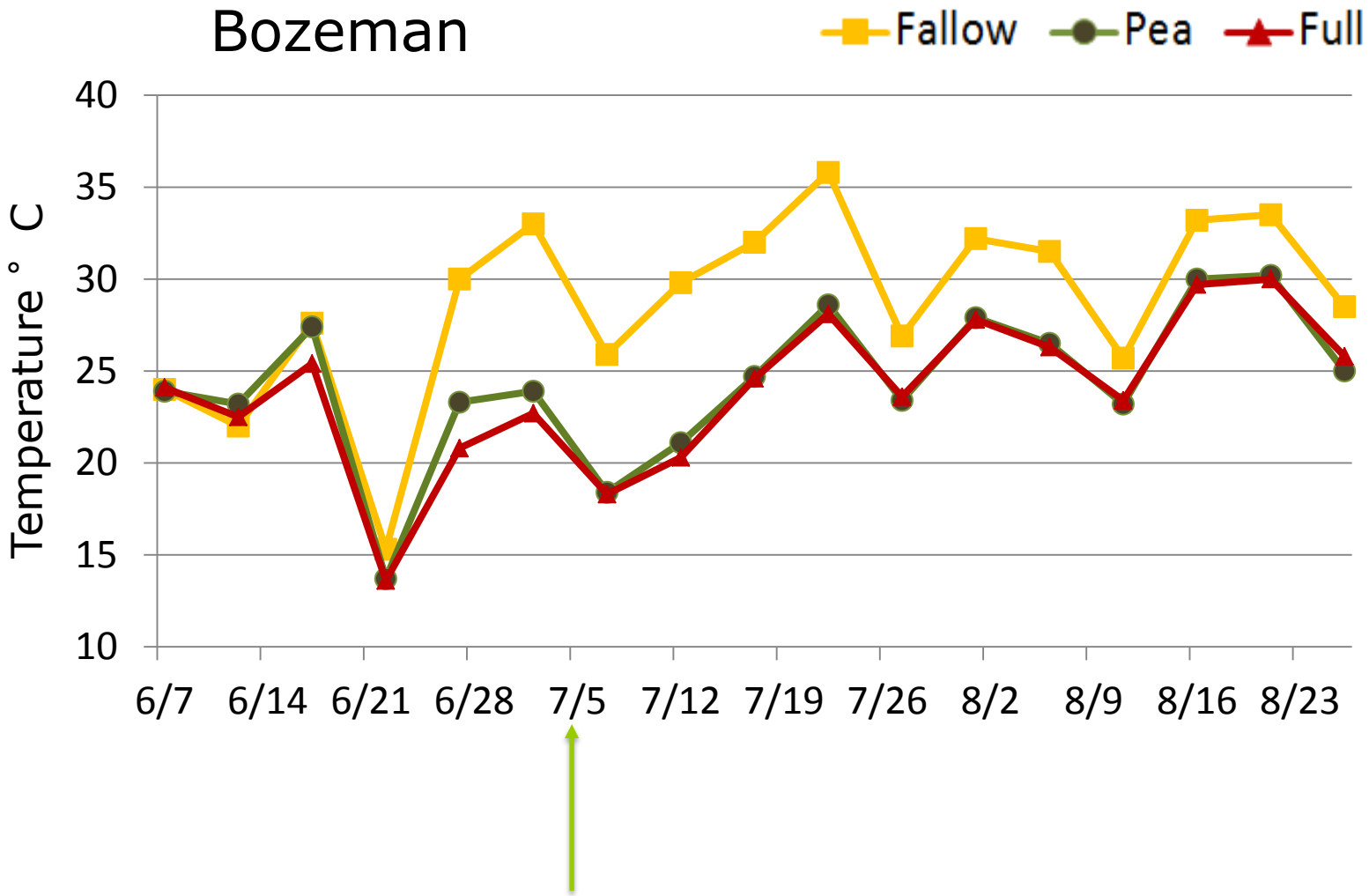
Tallman, Housman, et al., unpub data

Preliminary Results

Microbial Biomass



2013 Soil Temperature study (2”)



Cover crops terminated on 5 July

Jones, Miller, et al. unpublished

Summary after first full rotation

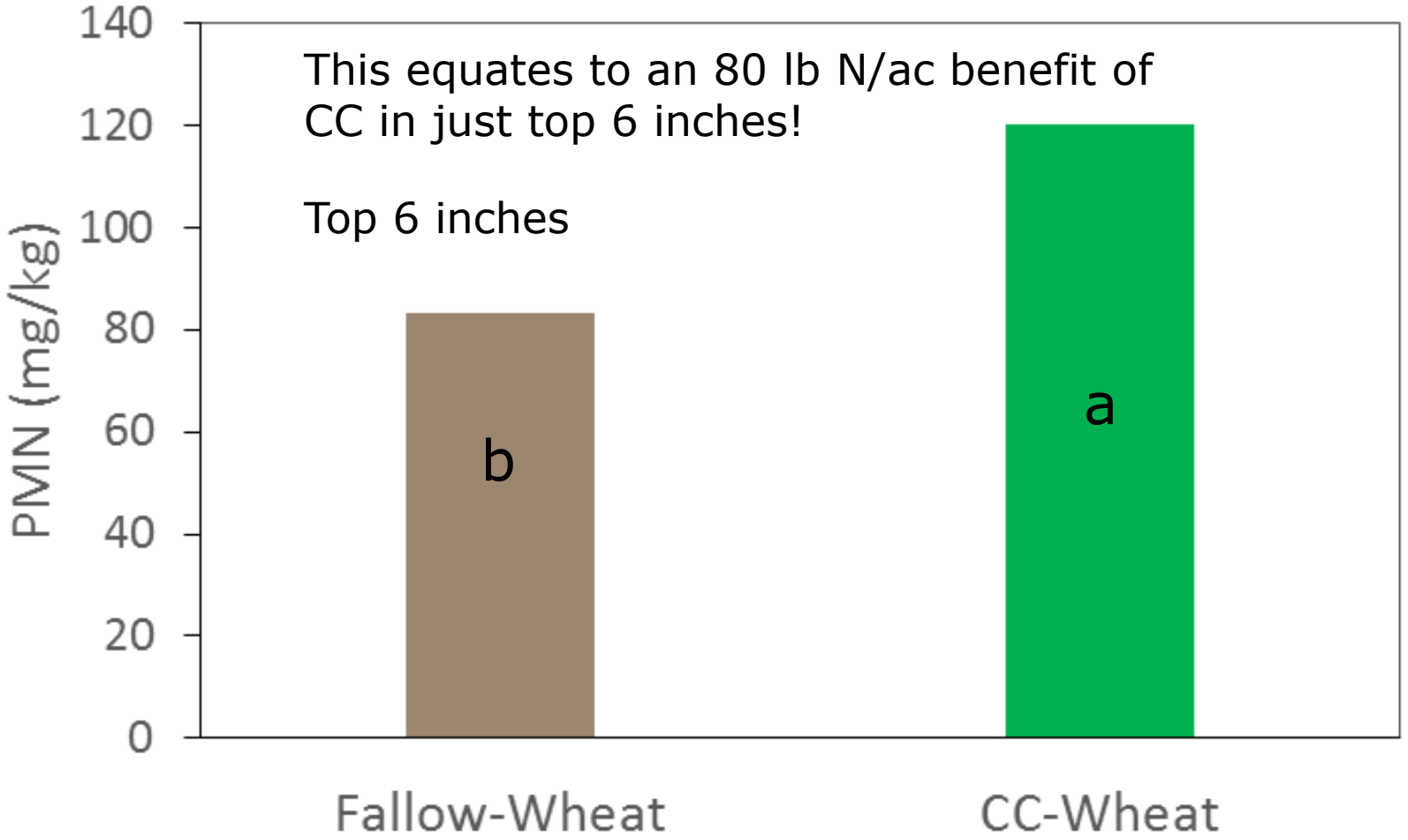
	Amsterdam	Conrad	Dutton	Bozeman
CC Biomass	**ns**	**ns**	**ns**	**ns**
Micro Biomass	**ns**	**ns**	**CCrop>fallow**	**CCrop>fallow**
Enzymes (5 total)	**ns**	**ns**	**8 spp>Pea (1 enzyme)**	**Ccrop>fallow (1 enzyme)**
PMN	**CCrop>fallow**	**Pea>6 spp**	**CCrop>fallow**	**ns**
Mychorrhizal infectivity pot.	**ns**	**ns**	**ns**	**ns**
Olsen P	**ns**	**ns**	**Not analyzed**	**Not analyzed**
Max daily temp	**--**	**--**	**fallow>CCrop**	**fallow>CCrop**
Penetration resistance*	**ns**	**Pea>6 spp**	**ns**	**ns**

ns – no significant difference between 8 species (full mix) and pea
* - penetration resistance less for fallow than CCs at Dutton and Conrad, likely due to higher water content, not less compaction so only CCs compared.

Study 2: Eight-year, plot study

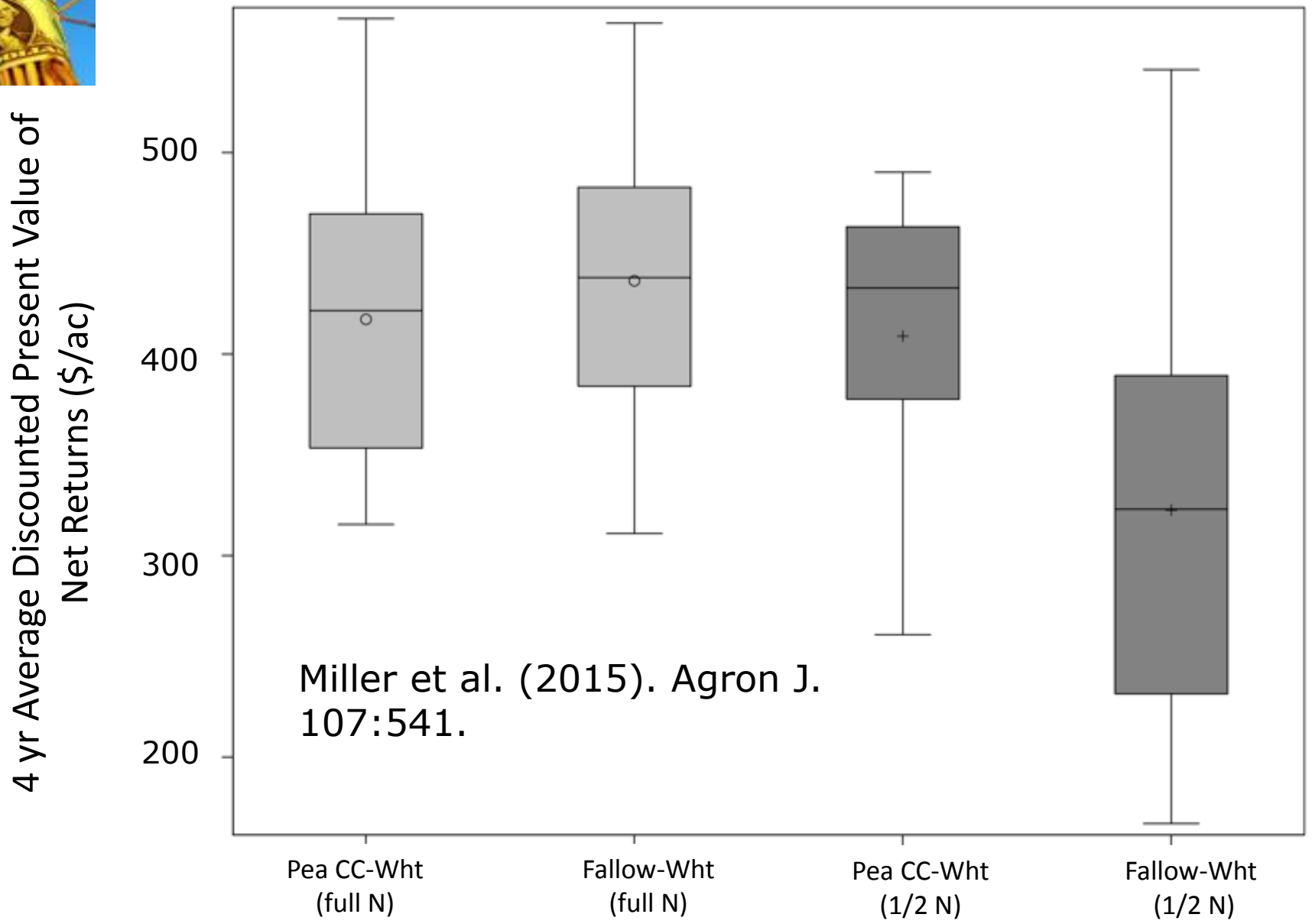
- Objective: Determine long-term effects of legume-containing rotations vs. fallow on subsequent wheat mainly in no-till.
- ~16 inch annual precip. (4 miles west of Bozeman)
- Pea forage grown in 2003, 05, 07 and pea CC ("legume green manure", LGM) grown in 2009, terminated at full pod
- Spring or winter wheat planted in even years. 2010 was wettest of wheat years, 2012 record drought.
- 2 N rates: Full (3 lb available N/bu) and ½ N
- *NO differences in wheat yield following CC and following fallow in 2004, 2006, 2008, and 2012, and large benefit of CC in 2010.*

Potentially mineralizable N (PMN)
Cover crop-wheat vs fallow-wheat (April of 8th yr)



O'Dea et al. (2015)

Study 2 Economics (2009 – 2012)



Conclusions

- In short term (1 CC-cycle studies), grain yield and protein were generally equal or less than after fallow.
- Early termination (by ~ first pea bloom) is key to preventing yield and protein losses.
- In short term studies, there does not appear to be yield or soil quality advantages of multiple species mixes over pea.
- In long term (4+ cycles), yield, protein, and net revenue can be greater after cover crops than fallow, especially at low N rates, likely from greater PMN.
- Cover crop value to soil health, subsequent crops, and possibly land value is expected to increase over time in Montana.

Acknowledgments

- USDA – AFRI
- USDA – WSARE
- NRCS – CIG
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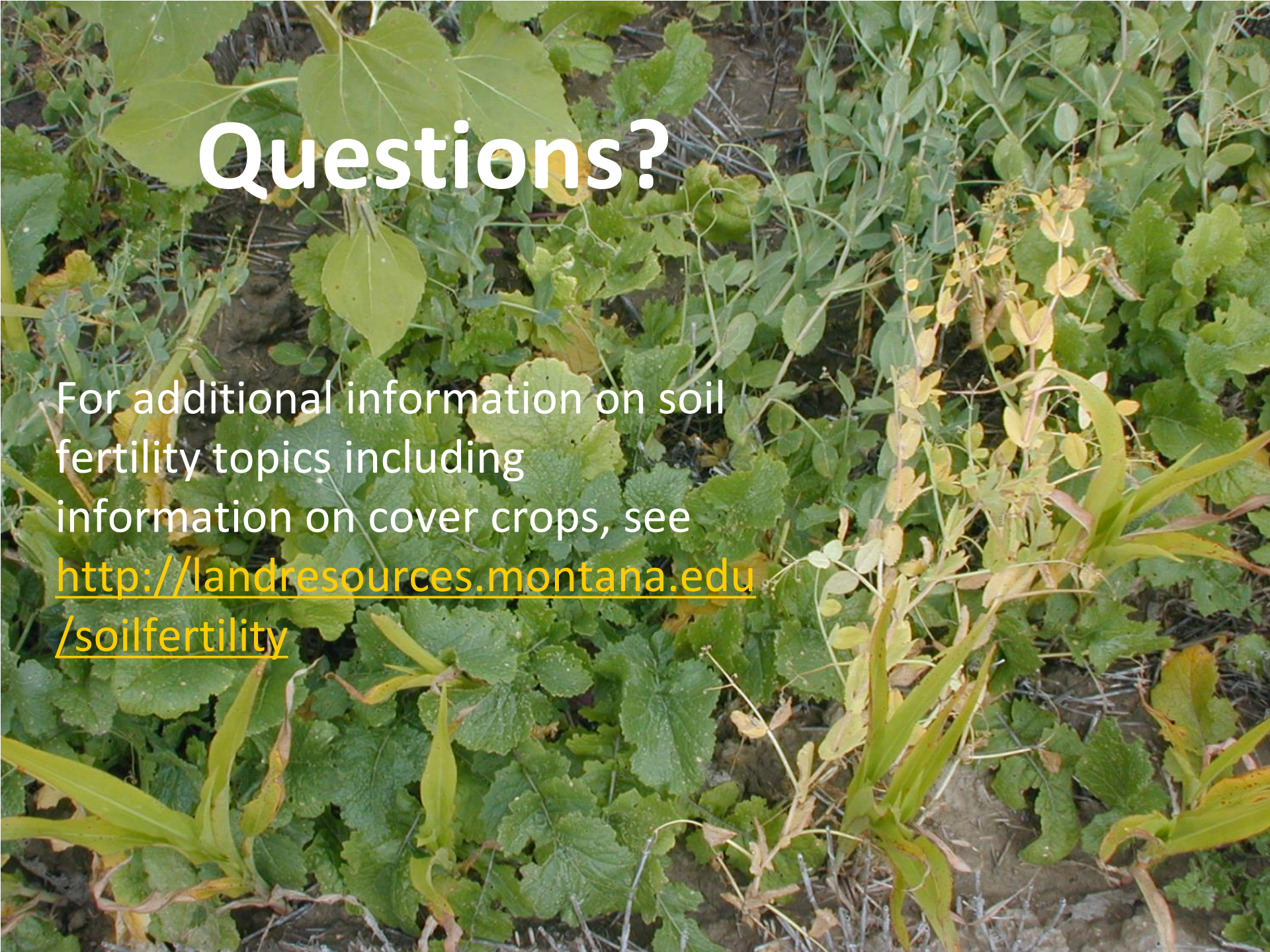
- Montana Wheat and Barley Committee
- Numerous landowners
- Ann McCauley
- Jeff Holmes



Questions?

For additional information on soil fertility topics including information on cover crops, see http://landresources.montana.edu/soilfertility