

A photograph of a field of sunflowers in a hilly landscape. The sunflowers are in various stages of bloom, with some fully open and others just starting. The background shows rolling hills under a clear sky.

COVER CROP RESEARCH RESULTS

**MODIFIED FROM: NEW TRENDS WINTER SEMINAR,
SHELBY, DECEMBER 6, 2011**

I have some good news and bad news on MSU cover crop research

- Good news: In 2011, MSU received a 3 year grant from USDA to study the effects of mixed cover crops on soil quality and grain yield
- Bad news: The first field season will be 2012
- Good news: Perry Miller and others have been studying single species cover crops (green manures) for over a decade
- I'll show research results from single species cover crops first and finish with preliminary results from cover crop cocktails

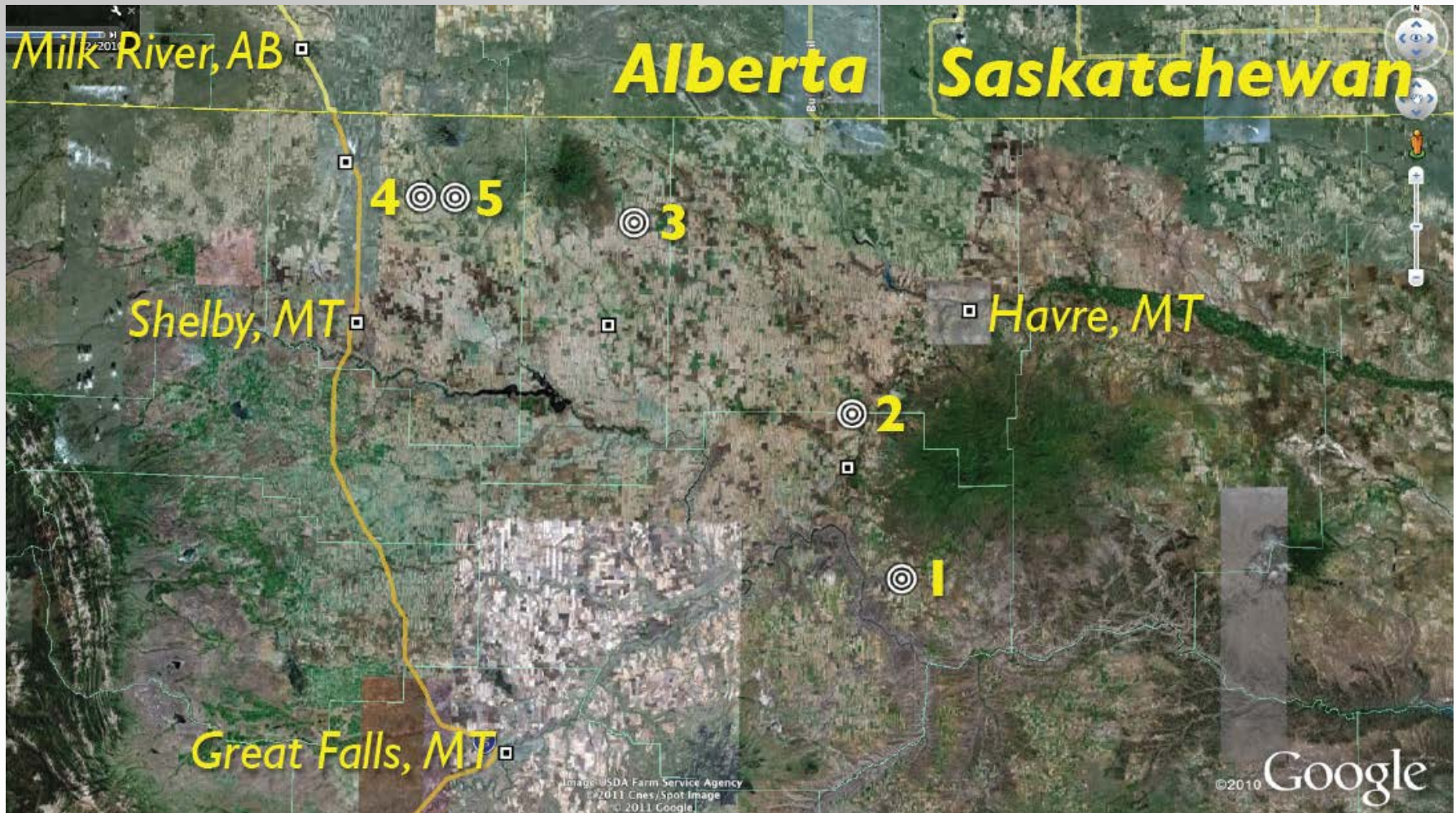
What we think we know about cover crops in Montana

- Replacing fallow with cover crops should reduce nitrate leaching, saline seeps, organic matter loss, and soil erosion.
- Legumes as forage or green manure crops are promising fallow replacements because of their N fixing capability.
- Water and nitrogen use by cover crop may reduce yield of following crop in some years



Field Study: Legume green manure (LGM) vs fallow

5 no-till producer-collaborators

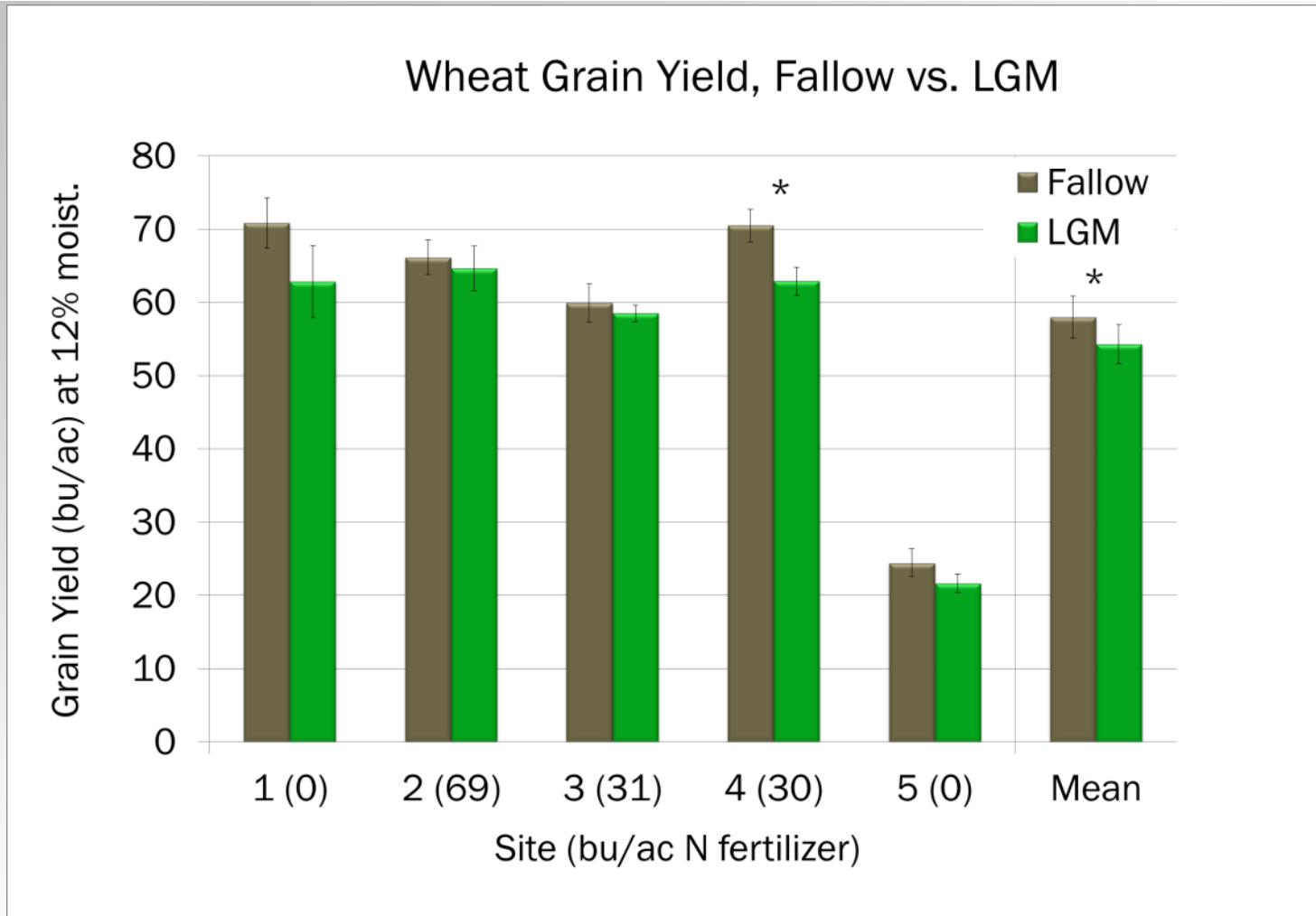


Experimental Design

- LGM (legume green manure - mainly pea) vs. summer fallow
- LGM grown in 2009 and sprayed out at first flower
- 6-12 paired samples/site
- 500-1200 yard transect lengths
- Wheat grown in 2010



How did LGM affect the following wheat grain yield?



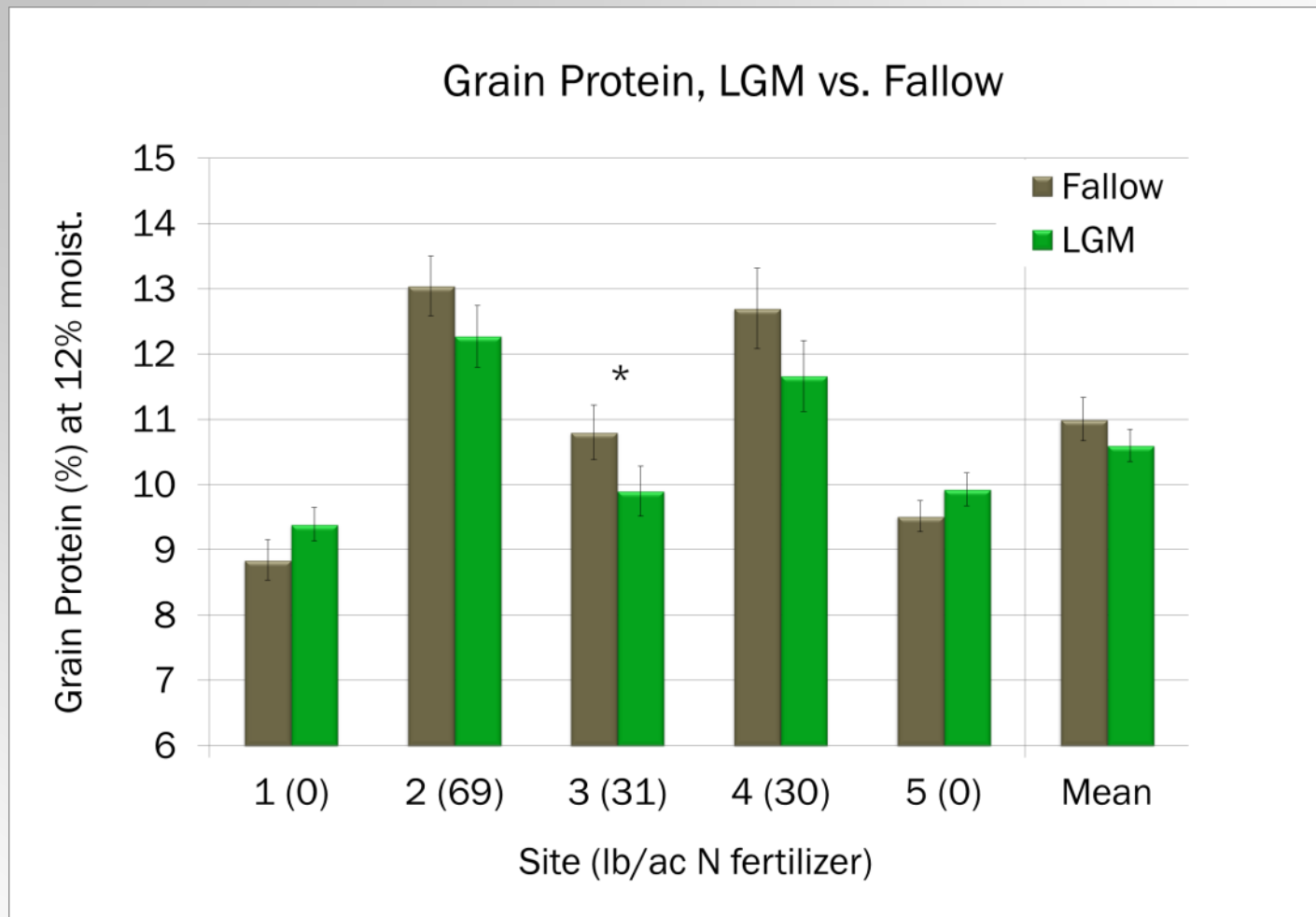
Wheat grain yield was about 4 bu/ac higher after fallow than after LGM

Questions...



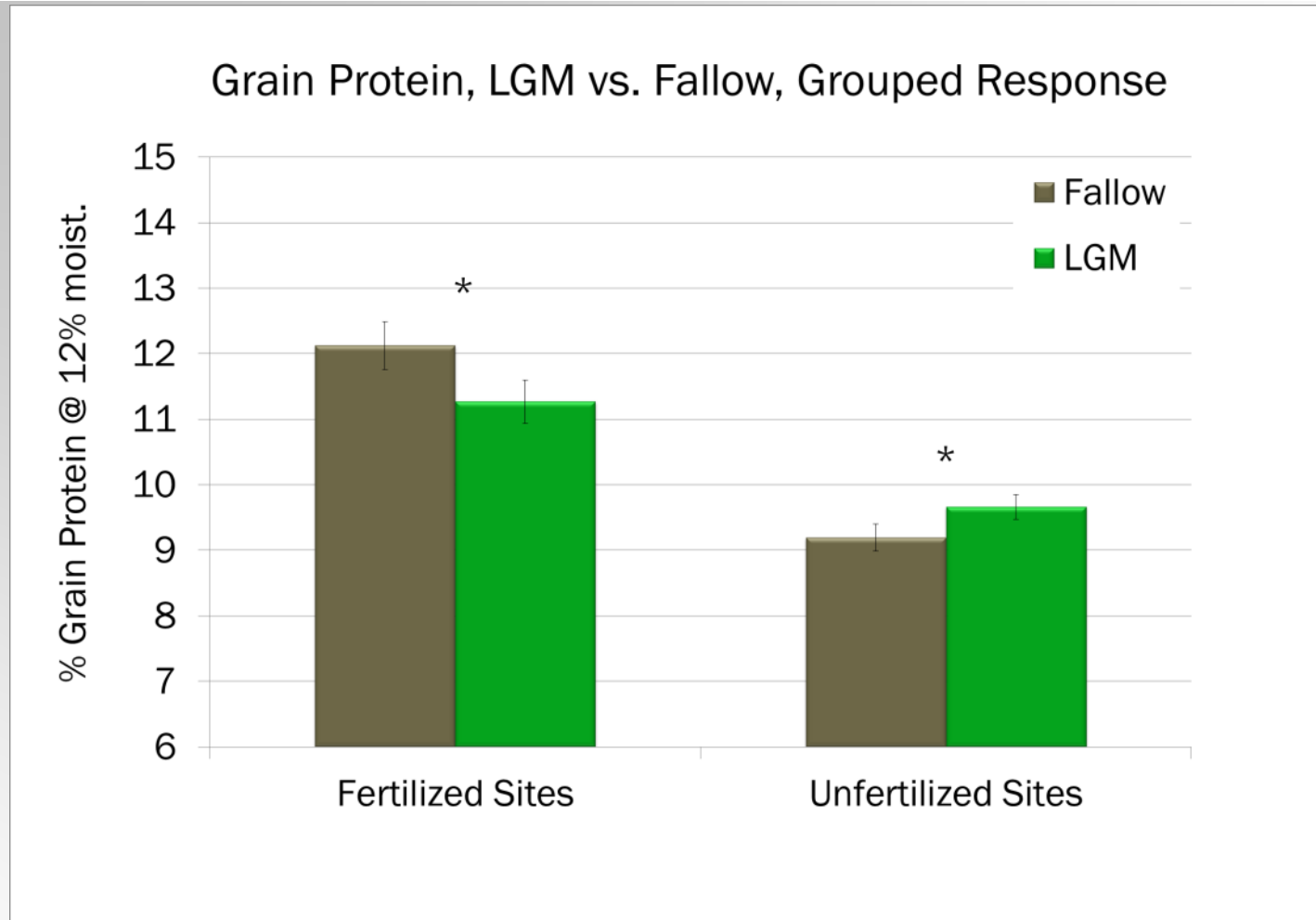
- Was water use by LGM responsible?
 - Likely not – 2010 had near record high precipitation
- Was lower nitrogen availability after LGM responsible?
 - Likely – LGM soil had ~18 lb N/ac less nitrate than after fallow at wheat seeding
- How possible?
 - Legumes will use some nitrate even if fixing N.
 - Lower soil water after LGM than fallow (2009 was dry) - lowers release of N from soil organic matter and residue.

How did LGM affect the following wheat grain protein?



Grain protein was not different between LGM and fallow when averaged across sites

How did LGM affect grain protein at fertilized vs unfertilized sites?



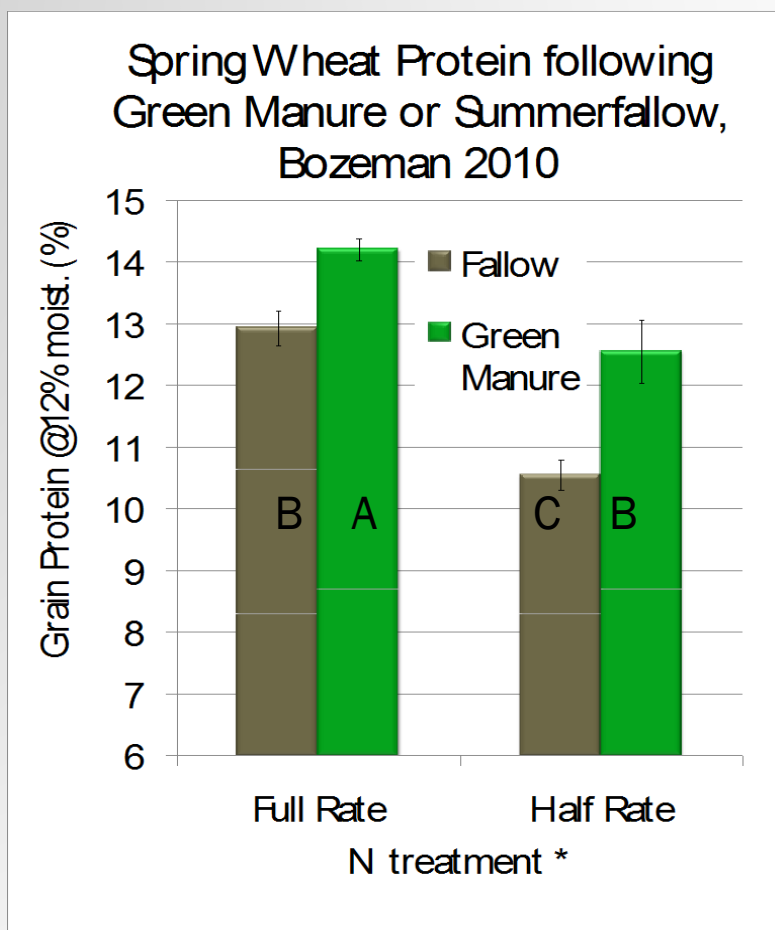
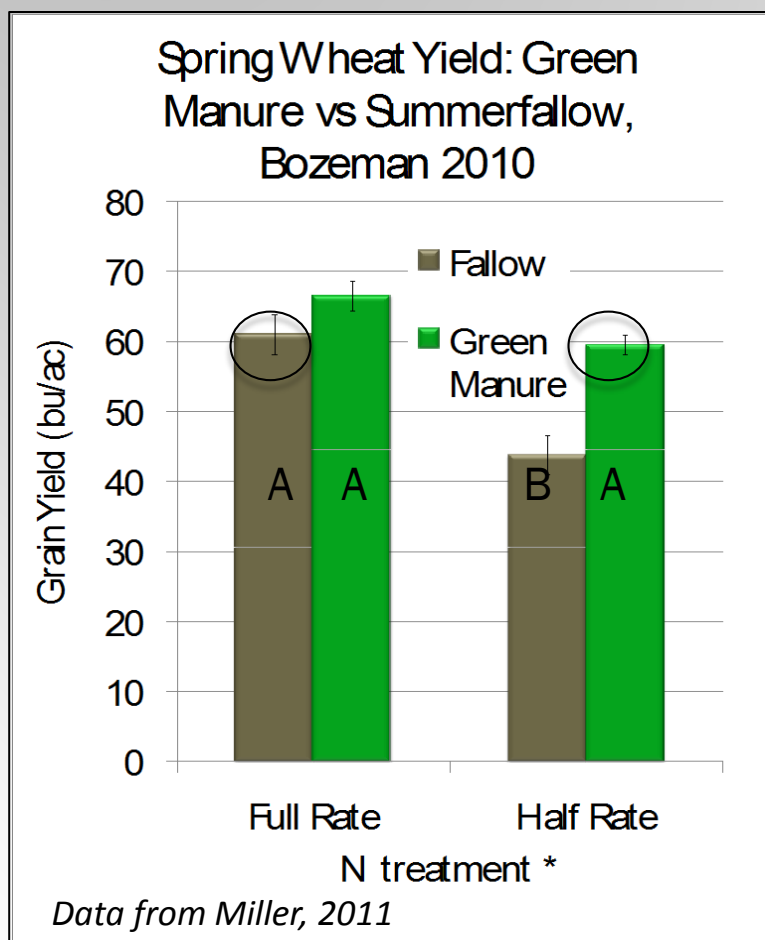
LGM decreased grain protein at fertilized sites and increased protein at unfertilized sites

Questions...

- Do legume green manures increase yield and protein in LONG TERM?
- Is soil quality enhanced by legume green manures?
 - Compared to fertilized wheat
- Effects of legume N vs. fertilizer N?



8 year study near Bozeman: LGM-wheat vs. Fallow-wheat systems



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

Pea green manure after 4 LGM-wheat rotations saved 124 lb N/ac COMPARED TO FALLOW!

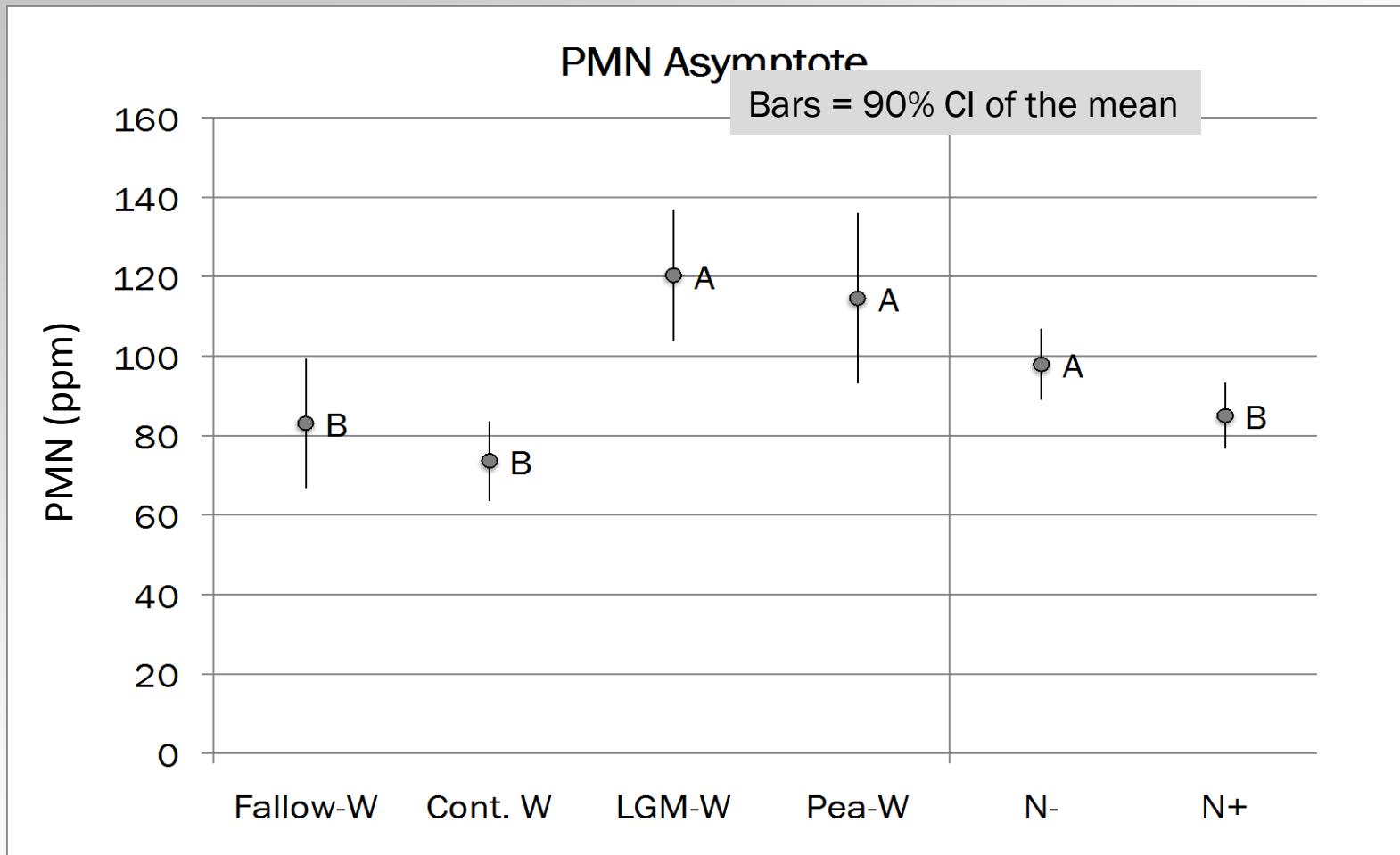
Did LGMs affect soil quality in this long term study?

- *Bozeman, MT: 8 year old Rotation Study*
- 4 systems compared
 - NT Fallow – Wheat (F)
 - NT Continuous Wheat (CW)
 - NT Legume (pea) Green Manure – Wheat (LGM)
 - NT Pea – Wheat (P)
- Sensitive indicators of soil quality change (0-15 cm)
 - Potentially mineralizable N (PMN)
 - Microbial biomass C (MB-C)
 - Wet aggregate stability (WAS)

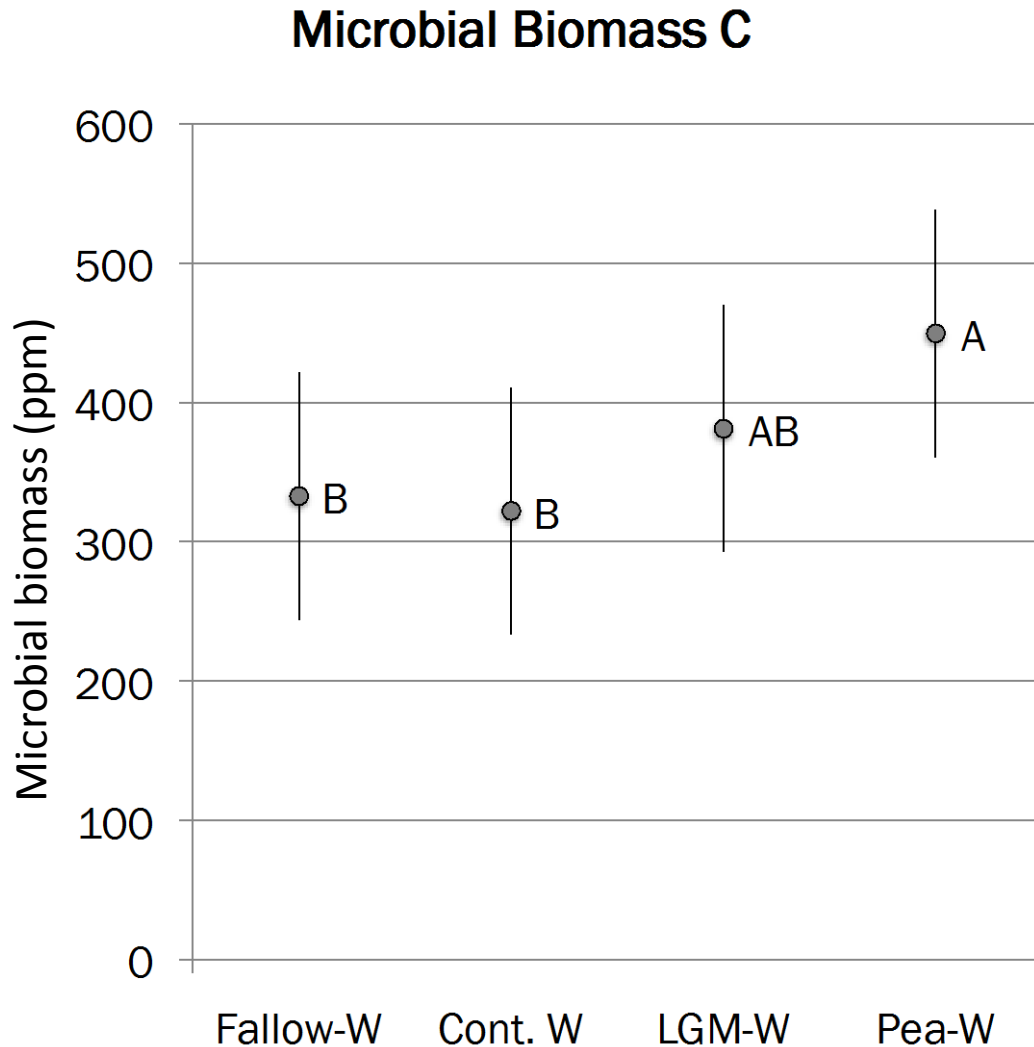


Potentially Mineralizable N

model results

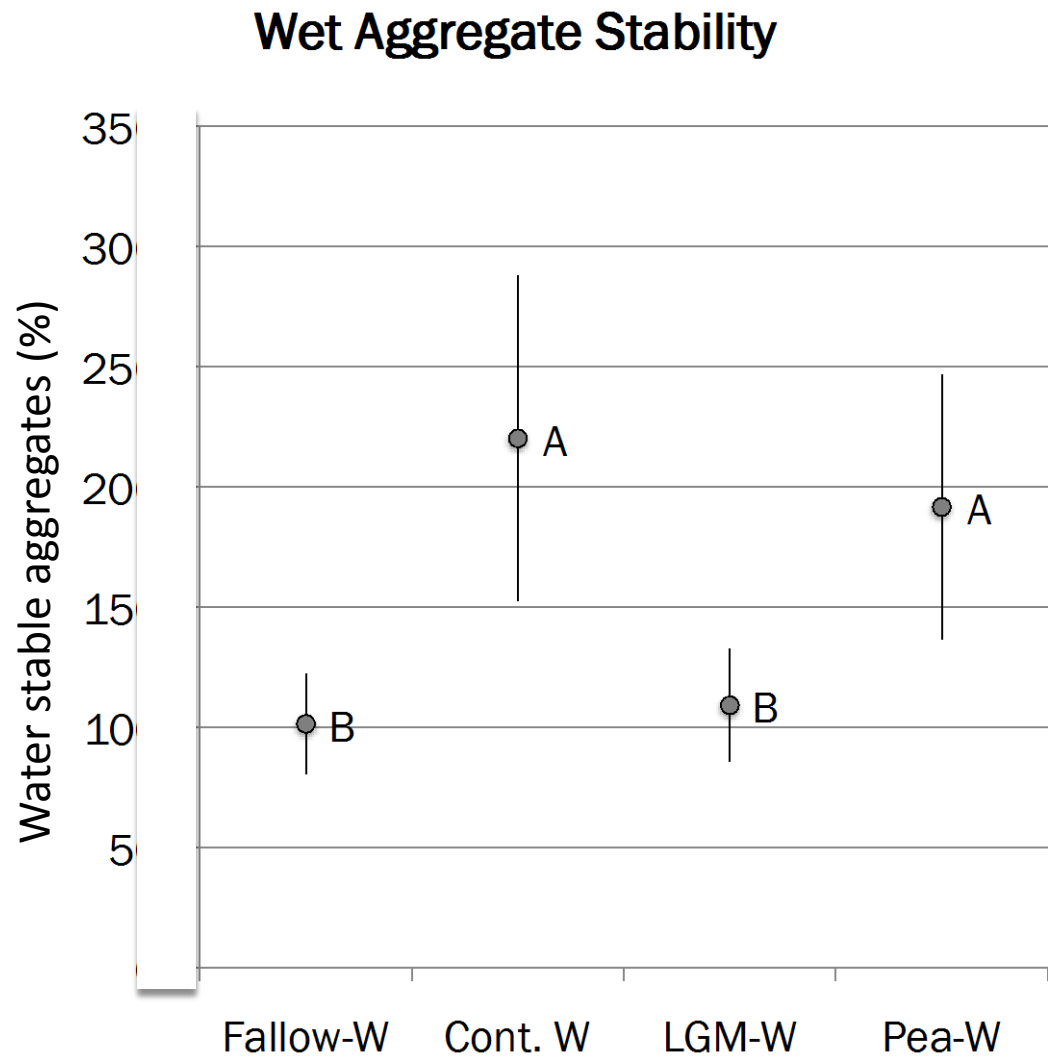


Microbial Biomass



MB: Legume >
Wheat systems
($P = 0.03$)

Wet Aggregate Stability



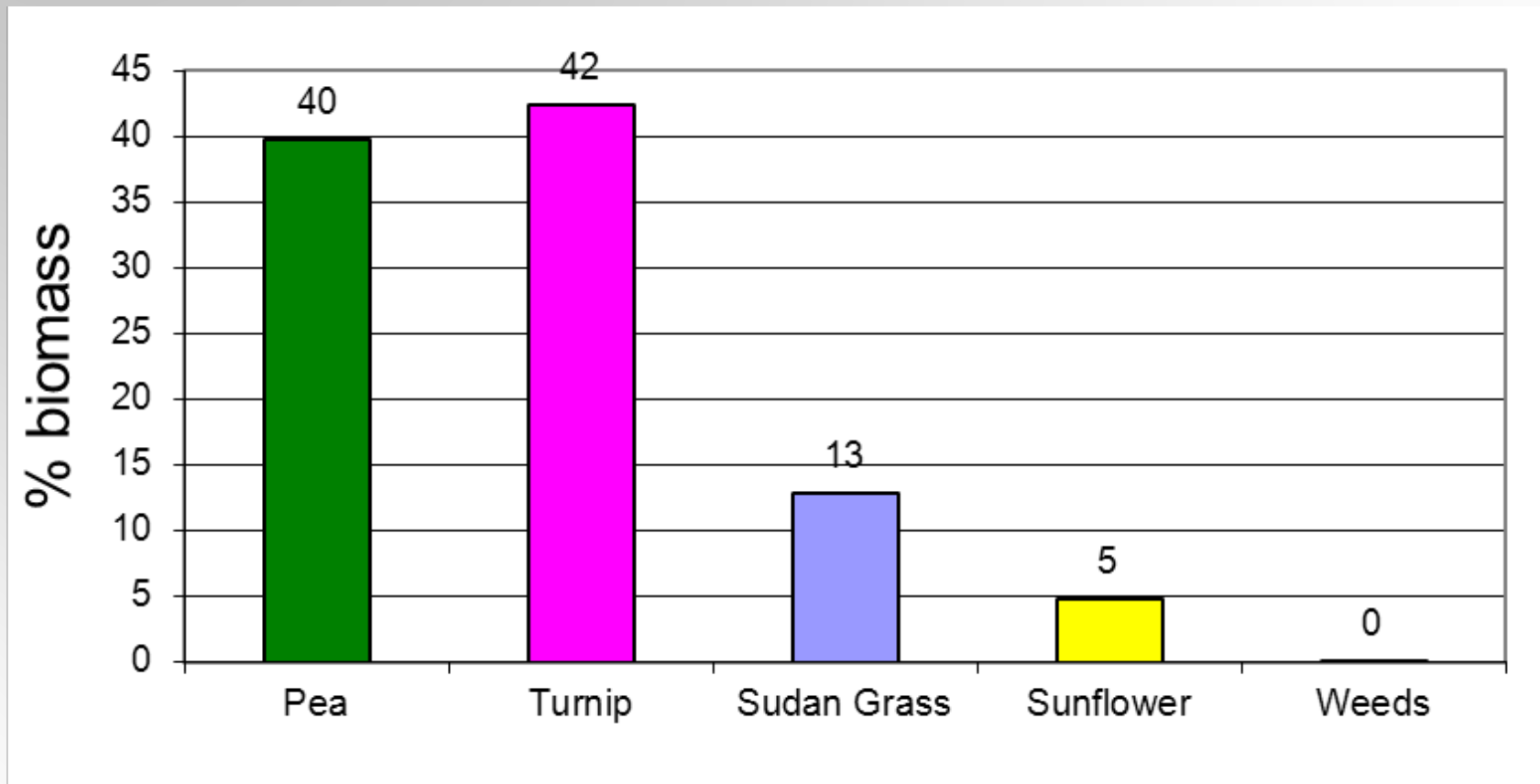
Cover Crop Cocktails – Preliminary Research Results

- Farmer's field near Willow Creek (as dry as Shelby!)
- Four species: pea, turnip, sudangrass, and sunflower
- Summer planted



Biomass production - 2010

~1.5 ton/acre total



Miller, unpub data

Cover Crop Cocktails – Preliminary Research Results

Soil water was only 3/4 inch less after cover crops than after fallow at wheat seeding.

Crop looked worse on cover crop side, but farmer tells us yields were similar.

Cover Crop Cocktails – Preliminary Research Results



Seeded

Site: Post Farm, 6 miles west of Bozeman

Goal: Determine effects of species and seeding date on root to shoot ratios (important for soil quality?)

Species: radish, beets, turnips

Seedings: April, May, June

April seeded radish bolted and reduced root growth compared to May seeded.

Summary

- One time cover crops have potential to lower yields and/or protein of following crops
- After 4 cover crop cycles, available N, yield and protein of following crop can be much higher than following fallow.
- Less is known in Montana on cover crop cocktails, but likely also provide a long term, not short term benefit
- Stay tuned for more research in next couple years

Acknowledgements

- **Funding:**

*NRCS-Conservation Innovation Grant Program,
Montana Wheat and Barley Committee, and USDA
– Western Sustainable Agriculture Research and
Education program*

Questions?

For More Information

Soil Fertility Website:

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

Contains links to my presentations including this one, economic N rate calculator, fertilizer facts, press releases, Extension publications, etc.