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

NOT THE PACIFIC OCEAN
Montana
Average Annual Precipitation, 1971-2000

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*

5-yr drought 1999-2003
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

1999 Crop Treatments
Conserved soil water drove grain yield

Havre, MT - 2000

<table>
<thead>
<tr>
<th>Previous Crop</th>
<th>Grain (kg ha⁻¹)</th>
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<tbody>
<tr>
<td>Wheat</td>
<td>1000</td>
</tr>
<tr>
<td>Pea</td>
<td>1500</td>
</tr>
<tr>
<td>Fallow</td>
<td>2000</td>
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</table>

Wheat Grain kg ha⁻¹

- Wheat: 1000
- Pea: 1500
- Fallow: 2000

Green Grain + Residue
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.

16-inch precip zone
Change in soil N supply over time; pea hay (Sys 6) vs chem fallow (Sys 2)

Despite taking a 36-lb N credit
Economics? Summed net returns 2009 - 2012

Under different N fertilizer and wheat protein discount scenarios, pea ‘covers’ did as well or better than fallow-wheat systems.

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

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 fixers
9. Full mix minus fibrous roots
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)

1.5 to 4 inches of water use compared with fallow
Preliminary Results:

• Brassica story?
What are Montana farmers doing with covers?

Annual 'Cover crops' in Montana

<table>
<thead>
<tr>
<th>Year</th>
<th>Cover/GM</th>
<th>Forage</th>
<th>Grazing</th>
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<tbody>
<tr>
<td>2014</td>
<td>50</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>2015</td>
<td>50</td>
<td>200</td>
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<td>2016</td>
<td>50</td>
<td>250</td>
<td>50</td>
</tr>
<tr>
<td>2017</td>
<td>50</td>
<td>300</td>
<td>50</td>
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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!

Discussion?
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? WSAF funded for first four years (two 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