COVER CROP COCKTAILS

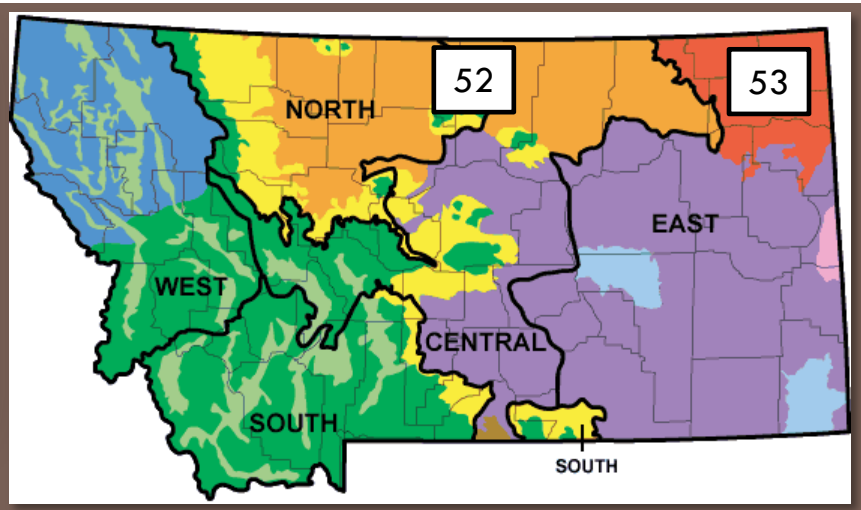
USING MULTI-SPECIES COVER CROP MIXTURES TO IMPROVE NO-TILL SOIL QUALITY IN LOW RAINFALL AREAS OF THE NORTHERN PLAINS

Susan Tallman, CCA
MSc Candidate

The Summerfallow Challenge

MT NRCS

+ Soil moisture recharge
- Saline seeps
- N leaching
- Erosion
- Organic matter
- Soil quality



MT NRCS

Decrease in Summerfallow Acres

1971: 42 million acres
2010: 10 million acres

Tanaka et al., 2010

MLRA 52: 84% of cropland
MLRA 53: < 40% of cropland

NASS, 2010

Cover Crops as a Solution

Photos courtesy of BCSCD, Bismarck, ND

Example 1

Decrease N leaching on sandy soils
July – Oct.

- Millet
- Soybean
- Radish
- Sweet Clover
- Cowpea
- Turnip
- Sunflower

Example 2

Increase OM on field previously used for corn silage
May - July

- Oat
- Pea
- Radish
- Turnip
- Red Clover
- Hairy Vetch

Benefits of Cover Crop Cocktails

- Decrease N leaching
- Increase OM
- Decrease herbicide use
- Cattle forage/Corn silage replacement
- Improve soil nutrient availability

Gabe Brown

- No-till since 1993
- Cover crop cocktails
- Intensive rotational grazing
- Intercropping
- Reduced herbicide: 75%
- Reduced fertilizer: 90%

www.attra.org

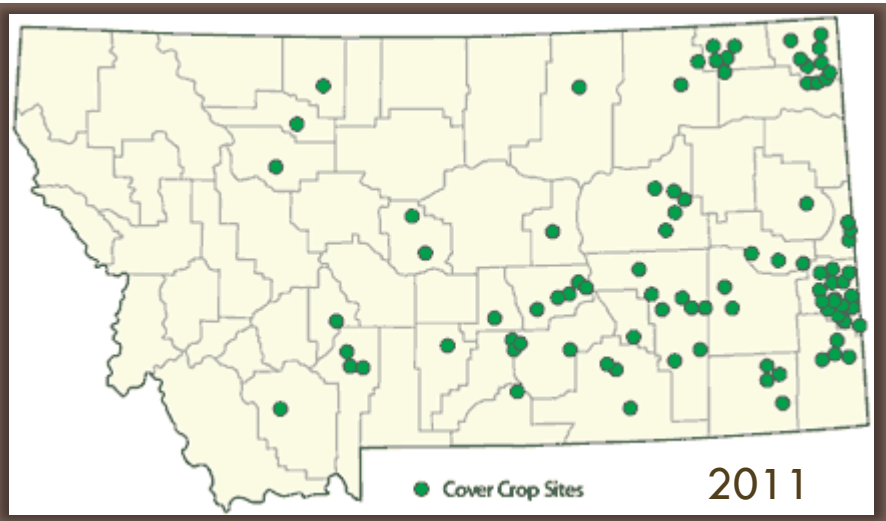
www.bcscd.com

Can cover crop cocktails work in Montana?

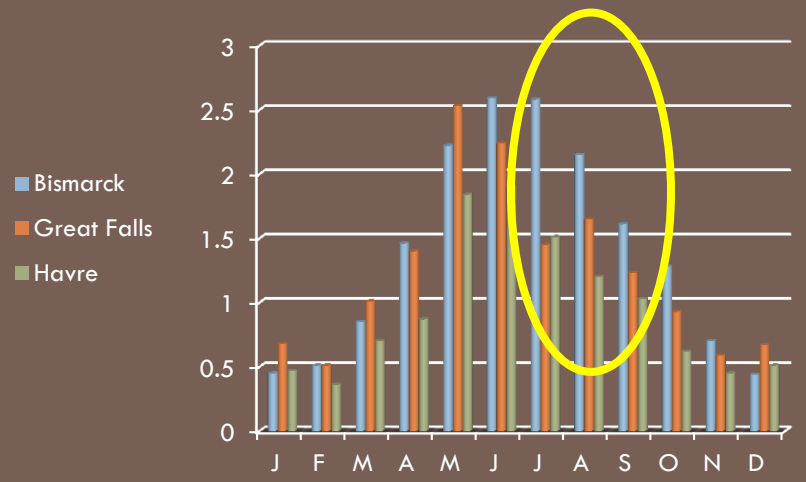
Annual Precipitation (in)

	BISMARCK	GREAT FALLS	HAVRE
J	0.45	0.68	.47
F	0.51	0.51	.36
M	0.85	1.01	.70
A	1.46	1.4	.87
M	2.22	2.53	1.84
J	2.59	2.24	1.90
J	2.58	1.45	1.51
A	2.15	1.65	1.20
S	1.61	1.23	1.03
O	1.28	0.93	.62
N	0.70	0.59	.45
D	0.44	0.67	.51
TOTAL	**16.84**	**14.89**	**11.46**

NOAA, 30 year average



MT NRCS



Research Questions

1. How might a cover crop mixture affect both soil water use and soil quality compared to both summerfallow and a single species legume cover crop?
2. How will a cover crop mixture affect the following year's grain yield, quality, and economic return compared to both summerfallow and a single species legume cover crop?
3. What does each plant functional group in the mixture contribute to overall soil quality?

Study Design: 2 Approaches

Plot Study

- 4 no-till sites
- April – June growth
- Herbicide termination
- 3 year rotation
  CCM – wheat – CCM

Farm Study

- 4 to 6 no-till farms
- 2 year rotation: CCM – wheat
- Farmers select species and timing

Plot Study Functional Groups & Species

Nitrogen Fixers

Spring Pea
Pisum sativum

Common Vetch
Vicia sativa

Fibrous Root

Oats
Avena sativa

Italian Ryegrass
Lolium multiflorum

Tap Root

Safflower
Carthamus tinctorius

Purple Top Turnip
Brassica campestris

Brassica

Daikon radish
Raphanus sativus

Camelina
Camelina sativa

Plot Study: Treatments

1. SF - Summerfallow
2. PEA - Spring Pea
3. CCM - Full Mixture: Pea, Vetch, Oat, Ryegrass, Turnip, Safflower, Radish, Camelina

4. NF - Nitrogen Fixers: Pea, Vetch
5. FR - Fibrous Root: Oat, Ryegrass
6. TR - Tap Root: Turnip, Safflower
7. BC - Brassica: Camelina, Radish

8. MNF - Minus NF: Oat, Ryegrass, Turnip, Safflower, Camelina, Radish
9. MFR - Minus FR: Pea, Vetch, Turnip, Safflower, Camelina, Radish
10. MTR - Minus TR: Pea, Vetch, Oat, Ryegrass, Camelina, Radish
11. MBC - Minus BC: Pea, Vetch, Oat, Ryegrass, Safflower (No turnip)

Plot Study: CCM Phase

Sampling

Year 1: SF, PEA, Full Mix

Biomass of all treatments by species

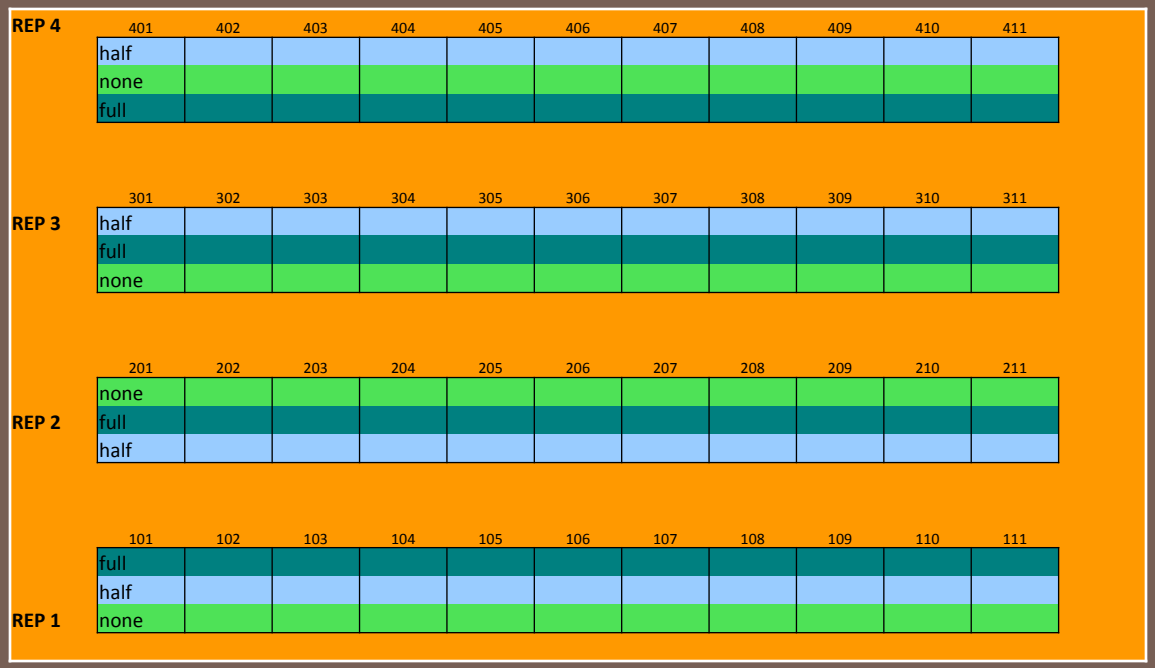
Year 3: Repeat treatments in place

Sample all treatments

Measurements

- **Cover Crop Biomass**
- **Biological Indicators**
  - Microbial Biomass
  - Enzyme activity
  - PMN
  - Mycorrhizal colonization and infectivity
  - Earthworm density
- **Physical Indicators**
  - Wet aggregate stability
  - Compaction
  - Soil Temperature
  - Soil water
- **Chemical Indicators**
  - Available N
  - Available P

Plot Study: Winter Wheat Phase



Measurements

- Grain yield
- Grain quality
- Economic return

Sampling

Year 2: All treatments

Plot Study Timeline

Year	Phase	Location	Site
2012	CCM	Gallatin valley (1)	Vandermolen farm
	CCM	MLRA 52 (1)	Oehlke farm
2013	CCM	Gallatin valley (2)	TBD
	CCM	MLRA 52 (2)	TBD
	Spring Wheat	Gallatin valley (1)	Vandermolen farm
	Spring Wheat	MLRA 52 (1)	Oehlke farm
2014	CCM	Gallatin valley (1)	Vandermolen farm
	CCM	MLRA 52 (1)	Oehlke farm
	Spring Wheat	Gallatin valley (2)	TBD
	Spring Wheat	MLRA 52 (2)	TBD

Farm Study

2012 and 2013
4 to 6 on farm studies
Field scale with adjacent fallow control
No-till with herbicide termination

Sampling

- Cover crop biomass
- Plant N content
- Soil water (4 ft): fallow, CCM
- Nitrate-N (3 ft): fallow, CCM
- Grain yield and quality in following year

Expected Results: 2012 - 2013

Plot Study	
Biomass	Full Mix > Pea
Microbial Biomass, PMN, Mycorrhizae	Full Mix ≥ Pea > SF
Soil Water	SF > Pea ≥ Full Mix
Available N (spring)	Full Mix ≈ Pea > SF
Soil Temp	SF > Functl. Groups ≈ Pea ≥ Full Mix
Grain Yield	SF ≈ Pea ≈ Full Mix
Grain Quality	Full Mix ≈ Pea > SF

Soil Type ?

Species Selection ?

Timing ?

Weather Pattern ?

Site History ?

Resource Goals ?

Farm Study	
Soil Water	SF > Full Mix
Available N (spring)	Full Mix > SF
Grain Yield	SF ≈ Full Mix
Grain Quality	Full Mix > SF

Burgess, unpublished

Do CCM's provide soil quality benefits?
If so, how can we make recommendations for their use?

Thanks and Further Resources

- USDA - WSARE
- Dr. Perry Miller, MSU
- Dr. Cathy Zabinski, MSU
- Dr. Clain Jones, MSU
- Jeff Holmes, MSU
- Herb Oehlke
- Carl Vandermolen
- Jane Holzer, MT Salinity Control Assoc
- Stacey Eneboe, MT NRCS
- Jay Fuhrer, ND NRCS
- Gabe Brown
- Burleigh County Soil Conservation District, www.bcscd.com
- Dr. Mark Liebig, USDA-ARS
- Dr. Yvonne Lawley, U Manitoba
- Dr. Lisa Rew, MSU
- Dr. Bruce Maxwell, MSU
- Pat McGunagle
- NCAT/ATTRA, www.attra.org

WESTERN SARE
Sustainable Agriculture Research & Education

First Field Day:
June 14th 10 am
Vandermolen Farm
Amsterdam, MT

MSU Cover Crop Cocktails website:
landresources.montana.edu/soilfertility/covercrops.html

MT NRCS
www.mt.nrcs.usda.gov/news/features/covercropsites.html