COVER CROPS: PAST AND PRESENT RESEARCH AT MSU

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Why grow cover crops?

- Decrease erosion
- Decrease leaching
- Increase soil organic matter
- Increase soil quality?
- Improve subsequent yield and protein?
What are the important issues surrounding cover crops?

1. Species selection
2. Seeding timing, method, and rate (see Fertilizer Fact sheet 61).
3. Weed management
4. Termination timing and method
5. Effect on subsequent crop/economics
6. Soil quality effects
7. Cover crop cocktails vs single species cover crops
MSU research on single species cover crops:

- Most conducted by Perry Miller, largely on annual legumes, in both organic and non-organic systems.
- Subsequent grain yields higher when:
  - Winter pea grown, vs. spring pea or lentil
  - Spring seeded vs. summer seeded
  - Terminated early (bloom), vs. at pod
  - Tilled (see Fertilizer Fact 58), vs. chem fallow

- Cover crop-wheat is generally less economical than fallow-wheat. Why?
Conclusions on mono cover crops in short- and long-term

- Conserving water is likely most important strategy.
- Benefits to soil and next crop often not observed in two year studies.
- Soil nitrogen (N) availability and some soil quality parameters (potentially mineralizable N and carbon) increase in long-term (8+ years)
- Net revenue likely increases in long-term (though not above pea grown for grain-ww at Bozeman from 2009 to 2012)
North Dakota and Montana farmers have been trying these cocktails
Can cover crop cocktails work in Montana?

NOAA, 30 year average

Quote Army and Hide: “Can’t simply transfer an agriculture system from a wet area to a dry area.”

MT NRCS

Monthly precip (inches)

Bismarck
Great Falls
Havre

NOAA, 30 year average
Questions we’re attempting to answer in USDA-WSARE study

1. Are cover crop mixtures more valuable than single species?
2. What mixtures or ‘functional groups’ have a more positive effect on soil quality?
3. What mixtures have a more positive effect on subsequent yield & quality?
Functional Groups & Plant 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: CCM Phase
4 farms including 2 in Golden Triangle

Companion full field study on four farms focused on subsequent yield and quality

Measurements
- Cover Crop Biomass
  - Microbial biomass
  - Enzyme activity
  - PMN
  - Mycorrhizal colonization and infectivity
- Physical Indicators
  - Wet aggregate stability
  - Compaction
  - Soil temperature
  - Soil water
- Chemical Indicators
  - Available N
  - Available P
Locations, seeding, and termination timing

- **Cover crop mixtures:**
  - 2012 and 2014: Conrad and Amsterdam
  - 2013: Dutton and Bozeman (Kelly Canyon)

- **Cover crop mixture growing season**
  - 2012: Seeded early April, sprayed out mid June
  - 2013: Seeded early/mid-May, sprayed out early mid-July

- **Following test crop:**
  - Conrad and Amsterdam: Spring wheat
  - Dutton and Bozeman: Winter wheat
Unpleasant surprise #1: At Conrad in 2012, weed biomass > crop biomass in treatments with cereals
Unpleasant surprise # 2: Glyphosate alone didn’t kill common vetch
Other practical findings to date

- Seeding shallow (1/2 inch, all through box) produced more consistent stands than with small seeds shallow and large seeds deep (2012)
- Radish, oat, pea, turnip, safflower all did well. Millet, ryegrass, camelina, and lentil not so well.
- Mid May seeding (2013) worked better than early April (2012) for weed control
- Need a herbicide mix to kill pea and vetch
Pleasant surprises (it rained in 2013)
Pleasant surprises: there was good to excellent biomass at both sites

Dutton Biomass by Species without Weeds 2013

No biomass differences among crop treatments

Biomass (tons/acre)

Treatment

PEA FULL FIBROUS BRASSICA TAP ROOTS N FIXERS

Paw Pea
Lentil
Oat
Millet
Radish
Winter Canola
Turnip
Safflower
Large soil temperature differences among treatments

Most soils were cooler under cover crop than under fallow (and fibrous cc) for over a month. Benefit?

Dutton Soil Temperature (2" Deep) 2013

Crops terminated on 7/11
Other research findings to date

- Potentially mineralizable nitrogen:
  
  Amsterdam: Pea=full mix>fallow
  Conrad: Pea>fallow=full

- Microbial enzymes, microbial biomass, and penetration resistance not different among treatments at 2012 sites

- Subsequent wheat yield – data being compiled but yield on fallow appears highest at Conrad

- Wet aggregate stability, mycorrhizal fungi, nitrate? Stay tuned.

- Northern Ag Research Center is conducting a separate cover crop cocktail study on larger plots with forage harvest treatment, more combinations, different timings. Talk to Darrin Boss if interested.
Conclusions

- Single species cover crops generally do not benefit soil quality, yield, or economics in short term.
- In long term, single species cover crops have been found to increase grain yield and protein, especially under low N conditions.
- Cover crop cocktails may have benefits over single-species, but benefits to soil quality have yet to be documented in Montana.

For more information on project, go to: http://landresources.montana.edu/soilfertility and click on cover crops. Can also find numerous documents and tools on nutrient management, including bulletin and fact sheets mentioned.
Questions?

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