Cover Crops with Direct Seed Rotation in North Central Idaho

University of Idaho Extension Research and Demonstration Project
Personnel

- Ken Hart, University of Idaho Extension Educator, Lewis County
- Jim Church, University of Idaho Extension Educator, Idaho County
- Doug Finkelnburg, University of Idaho Extension Educator, Nez Perce County
- Kevin Seitz, NRCS Soil Conservationist, Lewis County
- Drew Leitch, cooperator
- Vern McMaster, Lewis Soil Conservation District
Goals

- Demonstrate cover crop benefits including enhanced soil biology, improved crop rotation diversity, improved soil structure, nutrient cycling, forage production, and reduced erosion.
- Demonstrate cover crops seeded in the fall and sprayed out for spring seeded cereal crop production.
- Demonstrate cover crops seeded in the late spring, grazed in late summer, and sprayed out in fall for fall seeded cereal crop production.
- Increased knowledge by livestock producers on the potential to extend their grazing season using unconventional forages seeded as cover crops.
- Study the effect of cover crops on the following cereal crop productivity.
- Producers will be more willing to try cover crops due to the availability of current, local research information.
On Farm Test Design
Cover Crop Individual Species Plots

Location: 700 block of Willow Street, West side of the street, Nezperce Idaho

Planting date: May 20 and 21, 2013

<table>
<thead>
<tr>
<th>Species</th>
<th>Drill setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Groundhog radish (North end)</td>
<td>16</td>
</tr>
<tr>
<td>2. Purple top turnip</td>
<td>12</td>
</tr>
<tr>
<td>3. Flax</td>
<td>13</td>
</tr>
<tr>
<td>4. Croza forage brassica</td>
<td>15</td>
</tr>
<tr>
<td>5. Corinne Ethiopian cabbage</td>
<td>10</td>
</tr>
<tr>
<td>6. Hunter forage brassica</td>
<td>13</td>
</tr>
<tr>
<td>7. Winfred forage brassica</td>
<td>13</td>
</tr>
<tr>
<td>8. Sunflower</td>
<td>35</td>
</tr>
<tr>
<td>9. Buckwheat</td>
<td>20</td>
</tr>
<tr>
<td>10. Safflower</td>
<td>20</td>
</tr>
<tr>
<td>11. Sorghum Sudan grass</td>
<td>18</td>
</tr>
<tr>
<td>12. Pearl millet</td>
<td>10</td>
</tr>
<tr>
<td>13. Red clover</td>
<td>8</td>
</tr>
<tr>
<td>14. Crimson clover</td>
<td>13</td>
</tr>
<tr>
<td>15. Hairy vetch</td>
<td>18</td>
</tr>
<tr>
<td>16. Lantil</td>
<td>18</td>
</tr>
<tr>
<td>17. Soybean</td>
<td>35</td>
</tr>
<tr>
<td>18. Austrian winter pea</td>
<td>31</td>
</tr>
<tr>
<td>19. Nutrogreen forage pea</td>
<td>33</td>
</tr>
<tr>
<td>20. Flex spring forage pea</td>
<td>33</td>
</tr>
<tr>
<td>21. Winter triticale (102, T1261)</td>
<td>23</td>
</tr>
<tr>
<td>22. Everleaf oat</td>
<td>23</td>
</tr>
<tr>
<td>23. Spring forage barley (South end)</td>
<td>23</td>
</tr>
</tbody>
</table>

Single species plots run east and west. Plots are 10 feet wide, 200 feet long.

Seeded with University of Idaho plot drill, 5 feet wide, double disk drill 8-inch spacing.

Plots seeded by Ken Hart, Lewis County Extension, Kevin Seitz, Natural Resources Conservation Service, and Vern McMaster, Lewis Soil Conservation District.
Deciding What to Seed

[Table and calculator interface for SmartMix Calculator]

- Nitrogen Fixation
- Grazing
- Drought
- Frost
- Winter
- Diversity
- Salinity

- C:N Ratio
- Total Cost per Acre: $0.00
- Total Seed Cost of Green Cover SmartMix: $0.00
- Seed Cost per Acre: $0.00

- Name: Ken
- Phone: 
- E-mail: 

- Address: 
- City: Spokane, WA

- Date: 8/3/14
- Pounds of Green Cover SmartMix Needed: 0
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Fall Seeded Cover Crops

- **Cover Crop Planting – Fall Seeded**
  - Cover crops were direct seeded on 10-12-12. Plots were planted in 45’ x 800’ strips. Treatments included:
    1) No cover crop (control)
    2) Nitrogen mix (*winter peas, winter oats, common vetch, red clover, and winter lentil*)
    3) Soil enhancement mix (*Crimson clover, red clover, winter pea, hairy vetch, winter lentil, winter triticale, spring barley, winter oats, purple top turnip, nitro radish, winter canola*).
  - Cover crops were sprayed out in March and spring canola was direct seeded. Strips were harvested in the fall of 2013. Winter wheat was seeded fall 2013. Winter wheat yields will be evaluated fall 2014.

  **Canola Yields**—Treatment 1 = 1473.3 lbs. (SD = 63.5), 1782.7 lb/ac
  Treatment 2 = 1483.3 lbs. (SD = 120.1), 1794.8 lb/ac
  Treatment 3 = 1373.3 lbs. (SD = 100.2), 1661.7 lb/ac
  (No significant difference at the 5% significance level.)
Fall Seeded Cover Crops
Spring Seeded Cover Crops

- Cover crops were direct seeded in 45’ x 1200’ strips in winter wheat stubble on May 20, 2013. Crop development was monitored throughout the growing season. Treatments included:
  1) No cover crop (chemical fallow, control)
  2) Nitrogen mix (Lentils, common vetch, spring forage peas, rapeseed, flax)
  3) Grazing mix (Common vetch, spring forage peas, crimson clover, spring oats, spring barley, rapeseed, forage turnips, forage radish, pearl millet)
  4) Soil enhancement mix (Crimson clover, soybean, winter pea, hairy vetch, spring forage peas, spring triticale, spring barley, pearl millet, oats, purple top turnip, rapeseed, nitro radish, forage brassicas, sunflower, buckwheat)

- Plots were grazed three times with target dates of August 1, August 15 and September 1. Each time a 200’ plot length was exposed to grazing. The final 600’ of plot length was not grazed. All plots were be sprayed out on about September 15 prior to direct seeding winter wheat after September 25. Winter wheat yields will be evaluated in fall 2014.
Spring Seeded Cover Crops
Grazing

- 24 head stocked at a rate of 1.4 AUM's per acre.
- Turned the cattle in on the cover crop trial on August 13th.
- They were removed the third week of September.
- The cattle were moved to a new paddock every other day. They had access to the paddocks previously grazed.
- The rate of gain was 1.5 pounds per day per head.
## Forage Tests

### Forage Analysis

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Moisture %</th>
<th>Protein %</th>
<th>Fiber %</th>
<th>aNDF %</th>
<th>Ash %</th>
<th>Nitrate (ppm)</th>
<th>NE/LACT</th>
<th>MCAL/LB</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 2</td>
<td>6.6</td>
<td>13.6</td>
<td>30.5</td>
<td>35.7</td>
<td>9.5</td>
<td>550</td>
<td>0.67</td>
<td>55.5</td>
<td></td>
</tr>
<tr>
<td>Average 3</td>
<td>6.5</td>
<td>9.0</td>
<td>32.5</td>
<td>45.4</td>
<td>8.7</td>
<td>544</td>
<td>0.64</td>
<td>51.5</td>
<td></td>
</tr>
<tr>
<td>Average 4</td>
<td>5.0</td>
<td>8.2</td>
<td>30.6</td>
<td>45.3</td>
<td>8.2</td>
<td>538</td>
<td>0.67</td>
<td>51.5</td>
<td></td>
</tr>
</tbody>
</table>

### Forage by Treatment (lbs/ac)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Production</th>
<th>Post Graze</th>
<th>Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - Nitrogen</td>
<td>5569.93</td>
<td>896.31</td>
<td>4673.62</td>
</tr>
<tr>
<td>3 - Grazing</td>
<td>6668.98</td>
<td>1920.67</td>
<td>4748.32</td>
</tr>
<tr>
<td>4 - Soil</td>
<td>5175.13</td>
<td>1931.34</td>
<td>3243.79</td>
</tr>
</tbody>
</table>

### Sample Date - 7/30/2013

Cover Crop Tour
# Soil Testing

**Baseline Cover Crop Soil Test**

<table>
<thead>
<tr>
<th>Potassium (ppm)</th>
<th>Phosphorus (ppm)</th>
<th>Boron</th>
<th>Nitrate-N (ppm)</th>
<th>N-Ammonium (ppm)</th>
<th>Sulfate (ppm)</th>
<th>Organic Matter (%)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6&quot;</td>
<td>230</td>
<td>4.2</td>
<td>0.47</td>
<td>2</td>
<td>4.2</td>
<td>7.5</td>
<td>5.80%</td>
</tr>
<tr>
<td>6&quot;-12&quot;</td>
<td>100</td>
<td>1.1</td>
<td>0.32</td>
<td>0.72</td>
<td>2.8</td>
<td>7.6</td>
<td>3</td>
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</table>

**11-10-2013 Nitrogen Sampling (ppm)**

<table>
<thead>
<tr>
<th></th>
<th>Spring Seeded</th>
<th>Fall Seeded</th>
</tr>
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<tbody>
<tr>
<td>NG1</td>
<td>40</td>
<td>F1</td>
</tr>
<tr>
<td>NG2</td>
<td>34</td>
<td>F2</td>
</tr>
<tr>
<td>NG3</td>
<td>33</td>
<td>F3</td>
</tr>
<tr>
<td>NG4</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>
Earthfort
Soil Foodweb Tests

Biological Analysis
Soil

<table>
<thead>
<tr>
<th>Organism Biomass Data</th>
<th>Dry Weight (µg/g)</th>
<th>Active Bacteria (µg/g)</th>
<th>Total Bacteria (µg/g)</th>
<th>Active Fungi (µg/g)</th>
<th>Total Fungi (µg/g)</th>
<th>Hyphal Diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results Comments</td>
<td>In Good Range</td>
<td>In range</td>
<td>Above range</td>
<td>Below range</td>
<td>In range</td>
<td>2.85</td>
</tr>
<tr>
<td>Expected Range Low</td>
<td>0.85</td>
<td>45</td>
<td>45</td>
<td>40</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>0.85</td>
<td>800</td>
<td>600</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prototaxa (Numbers)</th>
<th>Total Nematodes #/g</th>
<th>Mycorrhizal colonization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results Comments</td>
<td>Flagellates High</td>
<td>ENDO</td>
</tr>
<tr>
<td>Expected Range High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>3487</td>
<td>57021</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>9.12</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organism Biomass Ratios</th>
<th>Total Fungi to Tot.Bacteria</th>
<th>Active to Total Fungi</th>
<th>Active to Total Fungi</th>
<th>Active Fungi to Act.Bacteria</th>
<th>Nitrogen Cycling Potential (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results Comments</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>100-150</td>
</tr>
<tr>
<td>Expected Range Low</td>
<td>1</td>
<td>0.10</td>
<td>0.04</td>
<td>0.85</td>
<td>1</td>
</tr>
<tr>
<td>High</td>
<td>2</td>
<td>0.2</td>
<td>0.2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

For interpretation of this report please contact Earthfort Labs
info@earthfort.com
(541) 257-2012

635 SW Western Blvd. Corvallis, OR 97333 USA
(541) 257-2612 info@earthfort.com
www.earthfort.com
### Combined Foodweb Results

| Customer Reference | Dry Weight | Active Bacteria | Total Bacteria | Active Fungi | Total Fungi | Hyphal Diameter | Protot axial flagellates | Protozoa amoebae | Chit百花 | Natured | VAM | TF/TF | AF/TF | AB/TR | AF/AB | Nitrogen | Active Bacteria |
|--------------------|------------|----------------|---------------|-------------|-------------|----------------|-----------------------|----------------|---------|---------|-------|------|-------|-------|-------|--------|----------|------------------|
| G1-2013            | 0.770      | 25.1           | 1317          | 36.6        | 830         | 2.80          | 7304                  | 10000          | 320     | 7.96    | Pending | 0.73 | 0.04 | 0.05 | 0.63 | 100-150 | 3.74     |
| G2-2013            | 0.780      | 71.9           | 1301          | 23.6        | 859         | 2.00          | 2914                  | 17002          | 29      | 6.68    | Pending | 0.53 | 0.83 | 0.06 | 0.33 | 100-150 | 0.00     |
| G3-2013            | 0.790      | 43.1           | 1730          | 23.3        | 282         | 2.00          | 10940                 | 30400          | 26      | 3.59    | Pending | 0.15 | 0.02 | 0.02 | 0.33 | 100-150 | 3.02     |
| G4-2013            | 0.790      | 42.8           | 1340          | 38.9        | 490         | 2.00          | 50950                 | 54000          | 74      | 6.21    | Pending | 0.37 | 0.08 | 0.03 | 0.20 | 200+    | 2.45     |
| NG1-2013           | 0.800      | 47.1           | 1030          | 17.8        | 217         | 2.00          | 5701                  | 11421          | 7       | 3.48    | Pending | 0.21 | 0.04 | 0.03 | 0.23 | 100-150 | 2.05     |
| NG2-2013           | 0.800      | 20.7           | 1100          | 32.3        | 322         | 2.00          | 3487                  | 5790           | 17      | 3.12    | Pending | 0.28 | 0.10 | 0.04 | 0.63 | 100-150 | 1.44     |
| NG3-2013           | 0.790      | 53.3           | 1040          | 41.4        | 473         | 2.00          | 3489                  | 5790           | 17      | 0.62    | Pending | 0.43 | 0.03 | 0.03 | 0.78 | 100-150 | 4.01     |
| NG4-2013           | 0.790      | 57.9           | 576           | 24.5        | 304         | 2.00          | 3507                  | 10521          | 106     | 5.78    | Pending | 0.81 | 0.07 | 0.10 | 0.42 | 75-100  | 4.30     |
| F1-2013            | 0.750      | 54.6           | 719           | 25.4        | 600         | 2.00          | 7423                  | 30770          | 179     | 5.60    | Pending | 1.19 | 0.06 | 0.08 | 1.00 | 100-150 | 14.8     |
| F2-2013            | 0.750      | 50.1           | 557           | 28.7        | 512         | 2.00          | 7414                  | 30725          | 304     | 5.88    | Pending | 0.32 | 0.06 | 0.03 | 0.57 | 100-150 | 2.45     |
| F3-2013            | 0.700      | 47.2           | 573           | 19.0        | 404         | 2.00          | 17747                 | 17747          | 57      | 0.67    | Pending | 0.81 | 0.04 | 0.08 | 0.42 | 100-150 | 2.45     |
Fall Harvest 2014 – Winter Wheat

- Harvest fall seeded plot site
- Harvest spring seeded plot site
Lessons Learned

- Spring barley not a good choice
- Seed as late as possible
- Start grazing at least by August 1
- Small seed shallow placement
Future Plans and Prospects

- On-going small plot studies
- Demonstrations of various cover crop species
- Possible on-farm test of grazing
- Be open and flexible to try new ideas
- There’s more here than meets the eye
Questions and Discussion
Contact:

Ken Hart, UI Extension Educator
Lewis County Extension Office

khart@uidaho.edu
208-937-2311