A PROGRAM TO STIMULATE COVER CROP ADOPTION AFTER CORN SILAGE WITHOUT CARROTS OR STICKS

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Cover Crops After Corn Silage

The ‘Low Hanging Fruit’

- 30-40% of corn acreage in Pennsylvania
- Early establishment of cover crops possible
- Nutrient uptake helps nitrate losses in fall and spring
- Otherwise bare soil now protected from erosion
- Since most P moves with soil – P losses reduced
- Dairy farmers need to spread manure – compaction reduction with cover crops
- Dairy farmers need forage – options to use cover crops for silage
Outreach / Research Program

- Approx 10 demo farmers/yr
- Farmers work with Extension Educators
- Test cover crop mixes in small plot, replicated trials at all locations
- Take biomass data in fall and spring and analyze for nutrient content
- Have farmer plant 10 acres of new cover crop mix of his/her choice for evaluation
- Hold field days in fall and spring
- Farmer involvement important
- Make 5 videos
- Fact sheet
- Articles
- Coverage in press
Testing cover crop mixtures

• Search for species that complement each other:
  • Soil erosion control in fall and winter
  • Soil erosion control in spring
  • Nutrient uptake in fall and winter
  • Nutrient uptake in spring
  • Nitrogen fixation potential
  • Root system – taproot vs fine roots
  • Feed production potential in fall
  • Feed production potential in spring
Example of Geographic Spread (2010/11)
Spring Cover crop Biomass (lbs/A)

Summary of 9-10 annual on-farm cover crop trials in PA

Dry matter (lbs/A), average, minimum and maximum

Calculations based on 4 reps (2011) or 3 reps (2012+2013)
### Summary of 9-10 annual on-farm cover crop trials in PA

**Spring 2011**

<table>
<thead>
<tr>
<th>Cover Crop Combination</th>
<th>Average (lbs/A)</th>
<th>Minimum (lbs/A)</th>
<th>Maximum (lbs/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crimson + Ryegrass</td>
<td>70</td>
<td>21</td>
<td>104</td>
</tr>
<tr>
<td>Ryegrass + Triticale</td>
<td>73</td>
<td>41</td>
<td>126</td>
</tr>
<tr>
<td>Rye + F.Oat</td>
<td>76</td>
<td>44</td>
<td>139</td>
</tr>
<tr>
<td>Radish + Rye</td>
<td>82</td>
<td>49</td>
<td>161</td>
</tr>
<tr>
<td>Rape + Vetch + Rye</td>
<td>87</td>
<td>50</td>
<td>169</td>
</tr>
<tr>
<td>Radish + Vetch + rye</td>
<td>89</td>
<td>52</td>
<td>164</td>
</tr>
<tr>
<td>Rye</td>
<td>93</td>
<td>47</td>
<td>182</td>
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</tbody>
</table>

**Spring 2012**

<table>
<thead>
<tr>
<th>Cover Crop Combination</th>
<th>Average (lbs/A)</th>
<th>Minimum (lbs/A)</th>
<th>Maximum (lbs/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryegrass + F.Oat</td>
<td>52</td>
<td>21</td>
<td>74</td>
</tr>
<tr>
<td>F.Oat + Rye</td>
<td>69</td>
<td>26</td>
<td>107</td>
</tr>
<tr>
<td>G.Oats + Rye</td>
<td>73</td>
<td>34</td>
<td>97</td>
</tr>
<tr>
<td>Radish + Vetch + Rye</td>
<td>82</td>
<td>39</td>
<td>120</td>
</tr>
<tr>
<td>Rye</td>
<td>84</td>
<td>35</td>
<td>120</td>
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<tr>
<td>Crimson + F. Oat</td>
<td>103</td>
<td>57</td>
<td>144</td>
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<tr>
<td>Crimson + Ryegrass</td>
<td>106</td>
<td>63</td>
<td>140</td>
</tr>
<tr>
<td>Crimson + Triticale</td>
<td>112</td>
<td>65</td>
<td>147</td>
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</table>

**Spring 2013**

<table>
<thead>
<tr>
<th>Cover Crop Combination</th>
<th>Average (lbs/A)</th>
<th>Minimum (lbs/A)</th>
<th>Maximum (lbs/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryegrass + G.Oat</td>
<td>31</td>
<td>5</td>
<td>72</td>
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<tr>
<td>Crimson + G.Oat</td>
<td>54</td>
<td>7</td>
<td>135</td>
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<tr>
<td>Huron rye + G.Oat</td>
<td>66</td>
<td>16</td>
<td>125</td>
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<tr>
<td>Rye + G.Oat</td>
<td>66</td>
<td>17</td>
<td>122</td>
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<tr>
<td>Crimson + Ryegrass</td>
<td>70</td>
<td>18</td>
<td>125</td>
</tr>
<tr>
<td>Radish + Vetch + Rye</td>
<td>79</td>
<td>16</td>
<td>158</td>
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<tr>
<td>Rye</td>
<td>82</td>
<td>16</td>
<td>176</td>
</tr>
<tr>
<td>Crimson + Triticale</td>
<td>83</td>
<td>23</td>
<td>130</td>
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</tbody>
</table>

Calculations based on 4 reps (2011) or 3 reps (2012+2013)
Growing degree calculations from http://www.weather.com/outdoors/agriculture/growing-degree-days/
Comparison of GDD-40 accumulation between cover crop establishment and termination times.
Spring Biomass vs GDD accumulation

Crimson Clover and Oat Mixture

\[ y = 3.9559x - 2213.5 \]

\[ R^2 = 0.4213 \]
Mid-May picture of crimson clover established with oats in late August in Central Pennsylvania
Spring picture of crimson clover/oat in spring where oat was very competitive
Spring Biomass vs GDD accumulation

Crimson and Annual Ryegrass Mix

$y = 4.2404x - 1990.8$

$R^2 = 0.3948$
Spring Biomass vs GDD accumulation

Crimson Clover and Triticale Mix

\[ y = 4.7413x - 1817.4 \]

\[ R^2 = 0.4666 \]
Crimson clover/annual ryegrass

Crimson clover/triticale
Ryegrass interseeded into corn

Ryegrass/red clover interseeded into corn
Spring Biomass vs GDD accumulation

\[ y = 2.802x + 701.9 \]
\[ R^2 = 0.214 \]
Spring Biomass vs GDD accumulation

Rye Oat Mix

\[ y = 2.958x + 351.22 \]

\[ R^2 = 0.2474 \]
Spring Biomass vs GDD accumulation

Cereal Rye

\[ y = 3.6139x + 96.65 \]
\[ R^2 = 0.2718 \]
Average Protein concentration

- Crimson oat: 20%
- Crimson ryegrass: 17%
- Crimson triticale: 16%
- Huron grain oat: 14%
- Radish rye: 12%
- Radish vetch rye: 12%
- Rye: 11%
- Rye oat: 11%
- Ryegrass oat: 15%
- Ryegrass triticale: 15%

Penn State Extension
Select forage quality from spring 2011 biomass sampling

<table>
<thead>
<tr>
<th>Location</th>
<th>Species</th>
<th>CP</th>
<th>NDF</th>
<th>RFV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lancaster</td>
<td>Annual rye + crimson clover</td>
<td>12.5</td>
<td>50.2</td>
<td>111</td>
</tr>
<tr>
<td>(Landisville)</td>
<td>Annual rye + triticale</td>
<td>9.2</td>
<td>57.5</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>Cereal rye (full boot)</td>
<td>8.6</td>
<td>70.2</td>
<td>70</td>
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<tr>
<td>Bradford</td>
<td>Annual rye + crimson clover</td>
<td>12.6</td>
<td>37.8</td>
<td>179</td>
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<tr>
<td></td>
<td>Annual rye + triticale</td>
<td>15.0</td>
<td>43.4</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td>Cereal rye (veg-to-early boot)</td>
<td>12.3</td>
<td>55.6</td>
<td>104</td>
</tr>
<tr>
<td>Dauphin</td>
<td>Annual rye + crimson clover</td>
<td>24.5</td>
<td>47.7</td>
<td>135</td>
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<tr>
<td></td>
<td>Annual rye + triticale</td>
<td>22.3</td>
<td>49.1</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Cereal rye (very early boot)</td>
<td>21.5</td>
<td>52.0</td>
<td>120</td>
</tr>
<tr>
<td>Montgomery</td>
<td>Annual rye + crimson clover</td>
<td>20.0</td>
<td>43.8</td>
<td>153</td>
</tr>
<tr>
<td></td>
<td>Annual rye + triticale</td>
<td>16.2</td>
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‘Without Carrot or Stick’: activities

- Ca 10 on-farm demos established every fall
- 52 field crop walks
- 27 in-door presentations
- 1886 attendees
- 5 videos – viewed 5000+ times
- 21 Field Crop News articles – 1800 subscribers
- Fact sheet
- 2 articles in Lancaster Farming (56,000 subscribers)
Conclusions

• Outreach program of on-farm demonstrations, farmer and extension educator involvement, using multiple outlet methods proved highly effective in stimulating cover crop adoption without carrots or sticks.

• Cover crops after corn increased approximately 25-30% of corn acres in 4 years.

• Project resulted in valuable research data.