Cover Crops and Soil Health
Harvesting the Potential:
Environmental Impacts of Cover Crops

February 18, 2014
Omaha, Nebraska

The Role of Winter Cover Crops in the Restoration of Chesapeake Bay

Ken Staver

University of Maryland
College of Agriculture and Natural Resources
Wye Research and Education Center
Queenstown, Maryland
The Main Problem in the Bay

Excessive nutrient inputs are driving algal growth, resulting in low oxygen levels (dead zones) and reduced light availability for rooted vascular plant communities.
The Restoration Strategy

In the late 1980’s agreements were signed by states in the watershed with the primary goal being to cut nutrient inputs to Chesapeake Bay by approximately 40%. Lots of updates!
The Problem on the Land

Groundwater under cropland is highly enriched in nitrate-N and results in high nitrate levels in stream flow and high loading rates of algal available N to tidal waters.
Some Rough Numbers

In the Coastal Plain, approximately 80% of the N delivered to Chesapeake Bay from crop land moves through groundwater flow paths.

~20-30 lb/acre
It All Starts in the Root Zone

Achieving significant reductions in N losses from cropland will require reductions in nitrate leaching rates which will lead to lower groundwater and stream nitrate concentrations. Winter cereal cover crops do this very well!

Groundwater nitrate-N (mg/L)

Conventional till
No-till

Continuous corn 140 lb N/acre

Started using rye
winter cover crops
Continuous corn
140 lb/acre N
Yield 160 bu/acre

Soil nitrate-N (ppm)
0
2
4
6
8
10

July August September October
1995

0-6 inches
6-12 inches
<table>
<thead>
<tr>
<th>Practice</th>
<th>Coverage (acres)</th>
<th>N Load Reduction</th>
<th>P Load Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Cons./Water Quality Plan</td>
<td>35,893</td>
<td>73,222</td>
<td>6,820</td>
</tr>
<tr>
<td>Conservation Tillage</td>
<td>27,134</td>
<td>103,923</td>
<td>8,412</td>
</tr>
<tr>
<td>Nutr. Mngmt. – Fertilizer</td>
<td>129,806</td>
<td>192,113</td>
<td>7,788</td>
</tr>
<tr>
<td>Nutr. Mngmt – Organic</td>
<td>20,443</td>
<td>90,768</td>
<td>3,680</td>
</tr>
<tr>
<td>Cover Crops</td>
<td>50,586</td>
<td>437,063</td>
<td>8,094</td>
</tr>
</tbody>
</table>
Implementation is the Challenge

Although cover crops were recognized as a potential solution to N losses from cropland decades ago, the problem has been getting them on the land.
Cost-shared cover crops in the Choptank watershed

1995 goal - 50,500 acres
new goal - 91,800 acres
Cover crop effects over a landscape
(Staver and Brinsfield, 2000, DNR Final Project Rpt.)

Horizontal distance from mean low water (m)
-160 -140 -120 -100 -80 -60 -40 -20 0 20

Elevation (m)
-2 0 2 4 6 8 10

Ground Water Divide
Land Surface, Sassafras loam
Total sub-surface water residence times, yrs

Wye River Discharge zone

Elevation (m)

Horizontal distance from mean low water (m)

12 y 8 y 6 y 5 y 12 y 8 y 6 y 5 y 4 y 3 y 2 y 1 y
Carrots or Sticks?

So far Maryland has had an all carrots approach focused totally on reducing N losses. Cover crops add an extra layer of management and farmers do not perceive a positive bottom line.
Cover Crops... Protecting the Bay
MD cost-share spending for winter cover crops

![Graph showing MD cost-share spending for winter cover crops from 1992 to 2012. The x-axis represents years, and the y-axis represents winter cover crops cost share (in million $). The spending increased significantly from 2008 onwards.]
MD cost-share spending for winter cover crops

Winter cover crops cost share ($/acre)

Cost-share is directed to high risk acres

- Corn
- Vegetables
- Manure
- Priority watersheds
Cost-share is directed to most effective cover crop practices

- Early planting
- No-till drilling
- Rye
To reach acre goals many options are in the program

• All crops
• Aerial seeding
• Radishes
• Vertical tillage
• Mixtures
• Keep tweaking
Lessons Learned

• Farmers like to be good stewards but the bottom line rules
• Implementation has to be high
• Be clear about objectives – water quality probably the simplest
• Match credits to incentives – the TMDL problem