Conservation Tillage Phase 6 Panel Update

Panel Membership

Name	Affiliation	Role
Wade Thomason	VT	Panel Chair
Bill McCollum	DuPont Pioneer	Panel Member
Kevin Ganoe	Cornell	Panel Member
Dale Gates	NRCS	Panel Member
Mark Reiter	VT	Panel Member
Sjoerd Duiker	PSU	Panel Member
Bill Keeling	VADEQ	Watershed Technical Workgroup representative
Jeff Sweeney	CBPO	Modeling Team representative
Mark Dubin	UMD	AgWG Coordinator
Emma Giese	CRC	Staff

Proposal for Phase 6 strategy

Category	Description
Conventional/Hi Till	<15% cover
	15-29% cover, full width tillage
Low residue, strip till/notill	15-29% cover, strip till or NT, <40% soil disturbance, NRCS 329
new category	
Conservation tillage	30-59% cover, NRCS 345
High residue no tillage (HRTill)	≥60% cover, min disturbance

Lo Residue NT/ST

- Objective is to capture the positive effect of long-term NT on soil structure and infiltration, in systems with less than 30% cover (year round)
- Allow **no more than** ~40% soil disturbance (NRCS 329)

Sediment

- Began with strong (relatively) literature support for values in Conservation Till and HR Till
- Three additional data sources for sediment losses from long-term NT fields with low crop residue

Sediment

- The panel recommends a single efficiency value of 64% sediment reduction moving from conservation tillage to HR Till.

Brief Citation	% sediment reduction, Conservation Till to High-Res, Min Disturbance (NT)
Sm. Watershed-scale studies	
Shipitalo and Edwards, 1998	-61.5%
Staver, 2004	-67.5%
AVG	**-64.5%**
Small plot studies	
Verbree et al, 2010	-85.2%
Truman e al., 2005	-91.5%
Benham et al., 2007	-77.2%
Eghball and Gilley, 2001	-79.6%
Kleinman et al., 2009	-38.0%
AVG	**-74.3%**
15% small plot adjustment	**-63.1%**
RUSLE2 model runs	
Coastal Plain, 1% slope	-49%
Coastal Plain, 2% slope	-80%
Coastal Plain, 4% slope	-78%
Piedmont, 3-4% slope	-65%
Piedmont, 5-6% slope	-68%
Piedmont, 9-10% slope	-58%
Ridge & Valley, 3-4% slope	-66%
Ridge & Valley, 5-6% slope	-71%
Ridge & Valley, 9-10% slope	-70%
Plateau, 4% slope	-75%
Plateau, 6% slope	-77%
Plateau, 10% slope	-76%
AVG	**-69.4%**

Sediment

- McDowell, L. L., and K. C. McGregor. "Plant nutrient losses in runoff from conservation tillage corn." *Soil and Tillage Research* 4.1 (1984): 79-91.
- Wendt, R. C., and R. E. Burwell. "Runoff and soil losses for conventional, reduced, and no-till corn." *Journal of Soil and Water Conservation* 40.5 (1985): 450-454.
- Myers, J. L., and M. G. Wagger. "Runoff and sediment loss from three tillage systems under simulated rainfall." *Soil and Tillage Research* 39.1 (1996): 115-129.
- ~18% reduction in sediment loss for Lo Res NT compared to conventional till

n=3	Residue Cover	Sediment Loss	Rel. Change
	%	kg/ha	%
CT Grain	7	7358	
NT silage	23	6015	-18%
NT grain	82	503	-93%

Conventional Tillage	Lo Res No-Till	Conservation Tillage	High Residue, Min Soil Disturbance
0-15% residue; 16-30% residue, full width tillage	16-30% residue	31-60% residue	>60% residue
TSS High-Till	TSS Lo Res No-Till Load Reduction Rel to High-Till -18%	TSS Low-Till/Mulch-Till Load Reduction Rel to High-Till -41%	TSS HR Till Load Reduction Rel to High-Till -79%

New addition

Carryover from Phase 5 but reflects addition of HR Till category

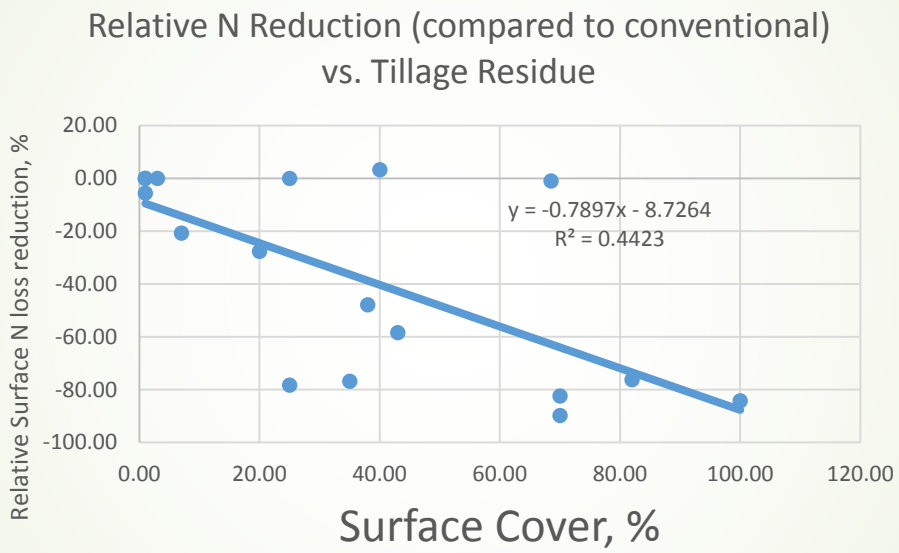
From Phase 5.3.2 report, just relative to Hi-Till

Nitrogen

- From the papers below, developed a relationship between surface residue cover and surface N losses for that component multiplied by the surface water loss partitioning coefficient for Uplands vs Coastal Plain
- Additional references on N leaching reported mixed results

  - McDowell, L. L., and K. C. McGregor. "Plant nutrient losses in runoff from conservation tillage corn." Soil and Tillage Research 4.1 (1984): 79-91.
  - Shipitalo, Martin J., et al. "Effect of no-till and extended rotation on nutrient losses in surface runoff." Soil Science Society of America Journal 77.4 (2013): 1329-1337.
  - Romkens, M.J.M, D.W. Nelson, and J.V. Mannering. "Nitrogen and Phosphorus composition of surface runoff as affected by tillage method." JEQ (1973). 2(2):292-295.
  - Owens, L.B. and W.M. Edwards. Tillage studies with a corn-soybean rotation: Surface runoff chemistry. 1993. SSSAJ. 57:1055-1060.
  - Chichester, F.W. 1977. Effectsof increased fertilizer rates on nitrogen content of runoff and percolate from monolith lysimeters. JEQ. 6(2):211-217.

Nitrogen


Relative N Reduction (compared to conventional)
vs. Tillage Residue
Relative Surface N loss reduction, %
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
y = -0.7897x - 8.7264
R² = 0.4423
0.00
20.00
40.00
60.00
80.00
100.00
120.00
Surface Cover, %

Nitrogen

Conventional Tillage	Lo Res No-Till	Conservation Tillage	High Residue, Min Soil Disturbance
0-15% residue; 16-30% residue, full width tillage	16-30% residue	31-60% residue	>60% residue
Surface N High-Till	Surface N Lo Res No-Till Load Reduction Rel to High-Till Uplands -5% Coastal Plain -2%	Surface N Low-Till/Mulch-Till Load Reduction Rel to High-Till Uplands -10% Coastal Plain -4%	Surface N HR Till Load Reduction Rel to High-Till Uplands -14% Coastal Plain -12%

Reflects only surface N losses

Differences among tillage categories are based on estimated residue levels

Differences due to landscape are due to water partitioning coefficient (USGS, from earlier cover crop work)

Phosphorus

- **Wide range in surface P losses range in the literature, even within the Bay watershed**
- **WELL DRAINED SOILS**
  - Erosion/sediment P drives losses
  - Reduced tillage decreases surface P losses
- **POORLY DRAINED SOILS**
  - Dissolved P drives losses (runoff is higher and NT doesn't improve infiltration - "saturation excess flow" and greater washoff.
  - No effect of tillage on P losses

Phosphorus Literature Search Example

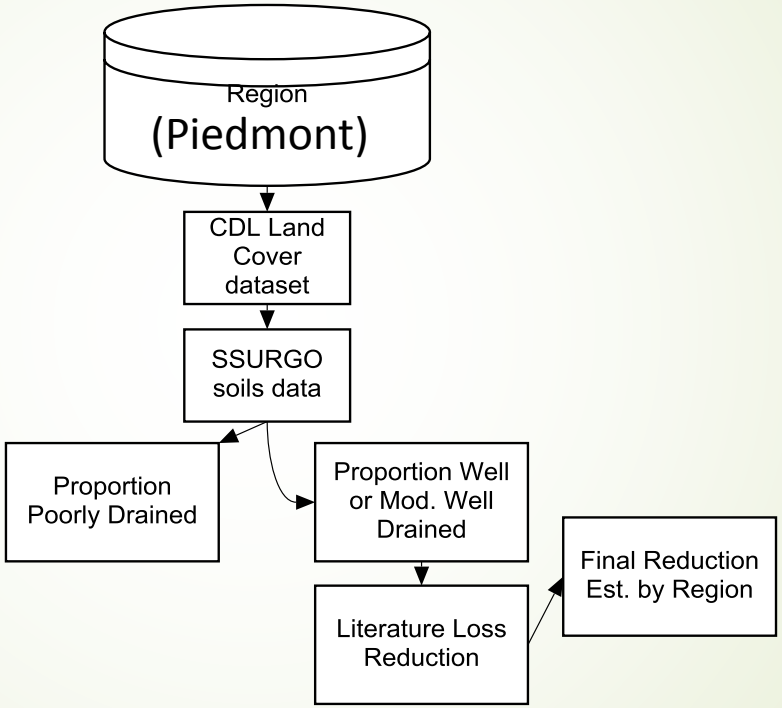
Citation	Region	Drainage	
Benham, 2007	Ridge & Valley	Well	-29%
Ross, 2001	Coastal Plain	Well	-4%
Kleinman, 2009	Plateau	Well	-49%
Sharpley, 2003	Ridge & Valley	Watson - mod well; Berks - well	-39%
Johnson, 2011	Plateau	Well	83%
		Mean	-8%
		Median	-29%

Verbree, 2010	Plateau	Hagerstown - Well: ; Buchanan - Poor to Mod	-5%
Staver, 2004	Coastal Plain	Elkton - Poor; Matapeake - Well; Mattapex - Mod Well	238%
Kibet, 2011	Coastal plain	Othello - Poor; Matapeake - Well	184%
Kleinman, 2009	Plateau	Poor	26%

Phosphorus

- Expanded literature review and regrouping of literature citations by soil drainage category
- Summary of relevant (Bay watershed) studies, by soil drainage category
  - High till to Low-Res NT (15-29% cover, no full width tillage)
  - Hight till to Conservation Till (30-59% cover)
  - High till to HR Till (≥60% cover)

Plan for Phosphorus Efficiency Estimate



Where we are:

Conventional Tillage	Lo Res No-Till	Conservation Tillage	High Residue, Min Soil Disturbance
0-15% residue; 16-29% residue, full width tillage	16-29% residue	30-59% residue	≥60% residue
Surface N High-Till	Surface N Lo Res No-Till Load Reduction Rel to High-Till Uplands -5% Coastal Plain -2%	Surface N Low-Till/Mulch-Till Load Reduction Rel to High-Till Uplands -10% Coastal Plain -4%	Surface N HR Till Load Reduction Rel to High-Till Uplands -14% Coastal Plain -12%
TOTP High-Till	TOTP Lo Res No-Till Load Reduction Rel to High-Till Coastal Plain Piedmont Ridge and Valley Plateau TBD	TOTP Low-Till/Mulch-Till Load Reduction Rel to High-Till Coastal Plain Piedmont Ridge and Valley Plateau TBD	TOTP HR Till Load Reduction Rel to High-Till Coastal Plain Piedmont Ridge and Valley Plateau TBD
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