Conservation Tillage Panel Report

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Panel Membership

Member	Jurisdiction	Affiliation
Ben Coverdale	Delaware	DE-Agriculture
Phillip Sylvester	Delaware	University of Delaware
Jack Meisinger	Maryland	USDA-ARS
Josh McGrath	Maryland	University of Maryland
Ken Staver	Maryland	University of Maryland
Royden Powell	Maryland	MD-Agriculture
Dale Gates	New York	USDA-NRCS-NY
Kevin Ganoe	New York	Cornell
Bill Clouser	Pennsylvania	PA-Agriculture
Sjoerd Duiker	Pennsylvania	Penn State University
Mark Goodson	Pennsylvania	USDA-NRCS
Bill Keeling	Virginia	VA-Environmental
Mark Reiter	Virginia	Virginia Tech
Rory Maguire	Virginia	Virginia Tech
Tim Sexton	Virginia	VA-Environmental
Wade Thomason	Virginia	Virginia Tech
Patrick Bowen	West Virginia	USDA-NRCS-WV
Tom Basden	West Virginia	West Virginia University
Neely Law		Center for Watershed Protection
Don Meals		Tetra Tech
Jennifer Ferrando		Tetra Tech
Mark Dubin		AgWG
Emma Giese		CBP

Existing CT Practices

1. Conventional Tillage:
   Model base condition expressed as a land use. Range of residue values from 0 to 29% at planting.
2. Conservation Tillage:
   Annual BMP expressed as a land use. Range of residue values from 30%+ at planting.
3. Continuous No-Till:
   Annual BMP expressed only as an effectiveness value with the CT land use. Incorporates cover crop and NM BMPs. Minimum 5 year CNT crop rotation required.

Panel Focus

- In order to maximize the potential impact of the panels’ limited time and scope for potential revisions to the overall set of conservation tillage practices, the panel decided to focus emphasis directly on a “stackable” CNT practice.

Panel Focus

- After considerable time spent reviewing the literature and discussing the various effects of no-till practices, the panel agreed that the preponderance of evidence indicated that a high degree of soil cover, over 60%, had the greatest impact on water quality benefits.
- Research from soils and cropping systems within the Chesapeake Bay watershed and from similar conditions elsewhere suggests the effects on infiltration and sediment loss are predominantly determined by residue cover and not by soil disturbance per-se.

The **High-Residue, Minimum Soil Disturbance** practice

- The Continuous High-Residue Minimum Soil-Disturbance (HR) BMP is a crop planting and residue management practice in which soil disturbance by plows and implements intended to invert residue is eliminated. Any disturbance must leave a minimum of 60% crop residue cover on the soil surface as measured after planting. HR involves all crops in a multi-crop, multi-year rotation and the crop residue cover requirement (including living or dead material) is to be met immediately after planting of each crop.

- The purpose of implementing the HR BMP is to improve soil organic matter content and soil quality, and to reduce runoff and sediment and nutrient losses coupled with a continuous high-residue management system. Multi-crop, multi-year rotations on cropland are eligible. The system must be maintained for a minimum of one full crop rotation.

- The Chesapeake Bay Watershed Model has hi-till (0-29% crop residue or conventional tillage) crop land-uses and low till (30+% crop residue or conservation tillage) land-uses, but does not have an explicit land use that defines the properties of continuous HR with minimum soil disturbance. Since continuous HR will be considered a sub-set of the current conservation tillage land use, it is necessary to calculate the effects of HR as reduction efficiency relative to the efficiency already achieved by the conservation tillage land use. The continuous HR with minimum soil disturbance practice can be combined with other associated, applicable BMP's for additional reductions, including nutrient management and cover crops.

Tracking options

- This practice could be tracked through field transect surveys (CTIC methodology), through remote sensing and limited field transect surveys, or through state or federal programs that collect information on high-residue minimum disturbance practices.
- The panel discussed the importance of obtaining complete information about implementation of this practice. Therefore, information about implementation obtained through programs needs to be supplemented with other information to report acres where farmers practice HR voluntarily.

Panel Proposed HR BMP

TOTN Uplands Continuous High-Residue Minimum Soil-Disturbance lbs/acre Low-Till → Continuous HR (Stackable) Load Reduction TBD	TOTN Coastal Plain Continuous High-Residue Minimum Soil-Disturbance lbs/acre Low-Till → Continuous HR (Stackable) Load Reduction TBD
TOTP Uplands Continuous High-Residue Minimum Soil-Disturbance lbs/acre Low-Till → Continuous HR (Stackable) Load Reduction TBD	TOTP Coastal Plain Continuous High-Residue Minimum Soil-Disturbance lbs/acre Low-Till → Continuous HR (Stackable) Load Reduction TBD
TSS Uplands Continuous High-Residue Minimum Soil-Disturbance tons/acre Low-Till → Continuous HR (Stackable) Load Reduction -64.0%	TSS Coastal Plain Continuous High-Residue Minimum Soil-Disturbance tons/acre Low-Till → Continuous HR (Stackable) Load Reduction -64.0%

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%**

Phosphorus

Literature Citation	Particulate P	Dissolved P	Subsurface P	Total P	Location	Notes
	% change Conserv-Till to HRMSD (NT)					
Benham, B., D. Vaughan, M. Laird, B. Ross and D. Peek. 2007. Surface Water Quality Impacts of Conservation Tillage Practices on Burley Tobacco Production Systems in Southwest Virginia. Water Air Soil Pollut 179: 159-166. doi:10.1007/s11270-006-9221-z.				-23%	VA; Ridge and Valley	Rainfall simulation on 2.1x7m plots at 50 mm/hr. average soil loss kg/ha of 6 runs reported; Speedwell sandy loam, 1% slope; alluvial soil; No till was 82% cover, strip till was 59%, conventional till was 5%
Verbree, D. A., S. W. Duiker, P.J.A. Kleinman. 2010. Runoff losses of sediment and phosphorus from no-till and cultivated soils receiving dairy manure. J. Environ. Qual. 39:1762-1770	-73%	333%		-5%	PA	Central PA, limestone derived soil (WD) and colluvium-derived soil (SWPD). 3, 1-hr rainfall events (planting, mid-season,after silage harvest)
Kleinman, P.J.A., A.N. Sharpley, B.G. Moyer and G.F. Elwinger. 2002. Effect of Mineral and Manure Phosphorus Sources on Runoff Phosphorus. J. Environ. Qual. 31: 2026-2033. doi:10.2134/jeq2002.2026.				147%	PA	3 soils, 4 P sources, 100 kg/ha TP applied, rainfall sim

Phosphorus

Kleinman, P.A., A. Sharpley, L. Saporito, A. Buda and R. Bryant. 2009. Application of manure to no-till soils: phosphorus losses by sub-surface and surface pathways. Nutrient Cycling in Agroecosystems 84: 215-227. doi:10.1007/s10705-008-9238-3.	5%	80%	71%	10%	PA Plateau	Clymer and Wharton soil, manure application of 30 kg/ha TP, subwatershed, includes leachate
Quincke, J.A., C.S. Wortmann, M. Mamo, T. Franti, R.A. Drijber and J.P. García. 2007. One-Time Tillage of No-Till Systems. Agron. J. 99: 1104-1110. doi:10.2134/agronj2006.0321.	14%	0%		9%	Nebraska, 2 and 3% slope	NE, sharpsburg scl, Yutan scl, corn soy sorghum rotation, NT since 1992one time tillage after 15 yr NT, disc vs NT, rainfall sim, 2 yr after tillage
Sharpley, A.N., S.J. Smith, J.R. Williams, O.R. Jones and G.A. Coleman. 1991. Water Quality Impacts Associated with Sorghum Culture in the Southern Plains. J. Environ. Qual. 20: 239-244. doi:10.2134/jeq1991.00472425002000010038x.				-32%	OK, TX	grain sorghum in southern plains, rainfall sim
Staver, KW. 2004. EFFICIENT UTILIZATION OF POULTRY LITTER IN CASH GRAIN ROTATIONS. Final Report submitted to: Maryland Grain Producers Utilization Board Maryland Center for Agro-Ecology, MCAE Pub. 2004-03	-65%	421%		238%	Coastal Plain	Wye REC, MD: 4-yr study. small watershed scale study. The primary objective of this project was to evaluate the effect of nitrogen-based poultry litter applications on phosphorus and nitrogen transport rates in tilled and no-till settings during a three crop/two year rotation of corn/wheat/double-crop soybeans. Two complete cycles of the rotation were completed. Poultry litter was applied in the spring (3 tons/acre) prior to corn planting and also in the fall (2 tons/acre) prior to wheat planning in 1998 and 2000. During the second year of the rotation, no additional poultry litter was applied but nutrient transport patterns were tracked during wheat/double-crop soybean production. To meet the project objectives poultry litter was applied to two fully instrumented field-scale watersheds where detailed studies have been conducted since 1984 of nutrient transport rates from cropping systems utilizing inorganic fertilizers. Field edge
Ross, B. B., Davis, P. H., and Heath, V. L. June 11, 2001. Water Quality Improvement Resulting from Continuous No-Tillage Practices. Final Report. Colonial Soil and Water Conservation District.				-87%	Coastal Plain	A rainfall simulator was used to demonstrate and evaluate the effectiveness, in terms of NPS pollution control, of various nutrient inputs, as well as corn pre-planting and post-harvest tillage operations in preparation for small grain planting. An average 85.9 mm (3.38 in.) of artificial rainfall was applied to ten runoff plots during three separate runs conducted over a two-day period. During the simulated rainfall events, runoff from the plots was measured and sampled for sediment and various forms of nitrogen and phosphorus. Plot yields for each water quality parameter were determined and averaged for a total of five treatments and two replications. Differences between the one clean tilled treatment and the four continuous no-till treatments were statistically significant with average percentage loss reductions of 75, 99, 95, and 92 for runoff, sediment, nitrogen phosphorus, respectively. No statistically significant impacts were determined with regard to subsoiling (at the time of corn planting) vs. no subsoiling or, by the corn post-harvest stage evaluated, commercial fertilizer vs. poultry litter vs. no nutrient applications.

Options for N and P

1. Recommend the new HRMSD practices with only a sediment efficiency (delaying the decision on N and P). It would be "stackable" but no N or P credit would be given in this form. AND retain the current 'non-stackable' CNT practice in the model.

2. Adopt the current 'interim' N and P reductions for this practice (-5, and-10% for N and P, respectively).

3. Reduce the current 'non-stackable' CNT N and P numbers by some factor (i.e. a factor of 20% off the current values would be):

	Upland	Coastal Plain
Total P	-32.0%	-16.0%
Total N	-12.0%	-8.0%

4. Derive the N and P reductions relative to the reduction efficiencies from conservation tillage over High Till using a value similar to that from sediment and the fraction of nutrients applied as organic sources (w/i Lo-Till + manure category); for example:

(TOTP, lbs/ac, LO-Till) * (sediment reduction,%, from HRMSD after conversion to LO-Till) * (Fraction of P from organic) = est reduction in TOTP from HRMSD, lbs/ac

(1.64 lbs/ac) * (0.375) * (0.3) = 0.1845 lbs/ac TOTP reduction

0.1845/1.64 = **11.25 % est TOTP** reduction for HRMSD

N reduction est = **6.37%** (same approach)