

# Northern NY Agricultural Development Program 2007-2008 Project Report

## Reducing Phosphorus and Nitrogen Loss with Aerway Incorporation of Manure

### Project Leader:

Quirine M. Ketterings, Nutrient Management Spear Program (NMSP), Cornell University

### Collaborator(s):

- Cornell University: Anne Place (NMSP graduate student;) Greg Godwin, Kevin Dietzel, and Chie Miyomoto (NMSP staff;) Karl Czymmek (PRODAIRY.)
- Cornell Cooperative Extension: Joe Lawrence (CCE of Lewis County)
- Consultants: Peter Barney (Barney Agronomic Services;) Peg Cook, (Cooks Consulting)

### Cooperating Producers:

- Jake Ashline, Miner Institute (Clinton County) Darren McIntyre (Lewis County)  
Dave Fisher (St Lawrence County) Dan Chambers (St Lawrence County)

### Background:

Phosphorus (P) and nitrogen (N) runoff, leaching and/or volatilization are of great concern to our farming community and their neighbors. In addition, soil erosion loss can greatly impact soil productivity and more producers are exploring reduced tillage option. A better quantification of such P and N losses and best management practices that can reduce losses without negatively impacting crop production is needed.

In discussions with NNY stakeholders, questions were raised about manure management options that are compatible with reduced-till corn systems and reduce runoff, leaching (tile drain) and volatilization risks.

The manure application method of most interest is surface application followed by partial incorporation with an Aerway. A 3-yr trial in central NY (Lawrence et al., 2008) showed Aerway incorporation following spring manure application for corn resulted in N conservation and subsequent yields similar to those obtained with chisel plowing. Additional research was needed to see if the results at the central NY farm could be duplicated on farms throughout the state.

### Methods:

Four farm fields were selected, two in St Lawrence County, one in Lewis County and one at the Miner Institute. We compared surface application (no incorporation until 5+ days after application) with (1) Aerway incorporation or (2) chisel incorporation directly following manure application. Each trial was conducted in 4 replications resulting in 12 strips per field. Strips ranged in length (spreader pattern and planter/harvester determined) and, depending on the field, 300+ feet long. Each strip was monitored for N dynamics (sampling prior to manure application, at planting, at PSNT time, and after harvest), soil fertility, residue coverage, compaction (penetrometer readings), soil

moisture content. With joint NYFVI and NNYADP funding, we were able to establish 10 on-farm locations, of which four were in NNY.

### **Results:**

Results for the four NNY locations are shown in the tables at the end of this report. At all sites, there was no significant difference in yield or quality between chisel and Aerway incorporation. At two sites, the surface application did result in a yield reduction although for one of the two sites, late harvest had resulted in lodged corn and yield loss. Given high PSNT and soil nitrate levels for this site, a yield response might not have occurred under more regular harvest conditions (to be evaluated in 2009). At a third site, that suffered from a late summer storm following water logged conditions early in the season, trends were the same but the differences between the surface application and the two incorporation treatments was not statistically significant. At the fourth location, nitrate levels were so high that nitrogen was not a production limitation as confirmed by the soil N levels, PSNT results and stalk nitrate results.

### **Conclusions/Outcomes/Impacts:**

An additional year of data is needed before we can draw final conclusions but these preliminary results suggest that Aerway incorporation is as effective as chisel plowing in conserving N and incorporation will result in higher yields under N limiting conditions. In situations where N is not limiting, incorporation will not benefit the crop. Stalk nitrate sampling seems an effective tool to evaluate the N status of the crop during the growing year.

### **Outreach:**

Preliminary results of the trial at Aurora were presented at the series of winter meetings in NNY in 2008 (co-presented with CCE field crops extension educators): “**Tillage options for conserving manure N**”. Presented by Joe Lawrence at: Making the most of your fertilizer dollars” (2008). Series of 5 meetings in Northern NY, March 17-21, 2008. ~90 people.

### **Next steps**

This was the first year of the project. All plots are marked to enable data collection for a second year so we have two years of data for all sites and so we can monitor changes in soil fertility levels over the two years. Farmer interviews will be done this winter, once the final results are reported to all farms (currently ongoing).

**Acknowledgments:** The project was funded through NNYADP and the NYFVI.

**Reports and/or articles in which the results of this project have already been published.** A Northeast DairyBusiness article written by Anne Place, graduate student on the project, will appear in the January 2009 issue. This issue has quotes from Dan Chambers, one of the participating farms.

### **For more information:**

Quirine Ketterings, Nutrient Management Spear Program, 323 Morrison Hall, Cornell University ([qmk2@cornell.edu](mailto:qmk2@cornell.edu) or 607 255 3061).

**Table 1: Stand density, corn silage yield and moisture content at harvest as impacted by manure application method.**

Treatment	Stand density at sidedress time	Corn silage yield (35% DM)	Moisture content at harvest
	plant/acre	tons/acre	%
Farm A			
Surface	30,786 a	17.4 b	64.0 a
Chisel incorporation	31,308 a	19.4 a	62.4 a
Aerway incorporation	32,088 a	19.4 a	61.7 a
Farm B			
Surface	30,856 a	20.7 a	59.4 a
Chisel incorporation	29,737 a	20.1 a	58.5 a
Aerway incorporation	29,916 a	21.1 a	55.7 a
Farm C			
Surface	30,504 a	11.8 a	65.0 a
Chisel incorporation	30,735 a	12.9 a	64.3 a
Aerway incorporation	32,197 a	13.5 a	63.9 a
Farm D (grain in bu/acre; damage due to late harvest)			
Surface	34,107 a	129.9 b	24.3 a
Chisel incorporation	34,843 a	164.9 a	25.0 a
Aerway incorporation	33,606 a	175.1 a	24.7 a

**Table 2: Forage quality at harvest as impacted by manure application method.**

Treatment	Crude Protein	Soluble Protein	NDF	dNDF	Lignin	Starch
	-----% of DM -----					
Farm A						
Surface	5.9 a	1.6 a	46.3 a	68.0 a	3.3 a	30.7 a
Chisel Incorporation	6.4 a	1.7 a	45.4 a	66.6 a	3.4 a	30.5 a
Aerway incorporation	6.4 a	1.6 a	45.1 a	67.0 a	3.4 a	31.1 a
Farm B						
Surface	7.1 a	2.0 a	44.5 a	62.4 a	3.2 a	31.8 a
Chisel Incorporation	7.3 a	2.0 a	41.3 a	62.4 a	3.1 a	35.1 a
Aerway incorporation	7.3 a	1.9 a	42.7 a	62.2 a	3.2 a	33.6 a
Farm C						
Surface	6.0 a	1.7 a	40.4 a	68.9 a	2.7 a	36.7 a
Chisel Incorporation	6.1 a	1.7 a	40.5 a	68.6 a	2.7 a	36.8 a
Aerway incorporation	5.9 a	1.6 a	38.9 a	67.5 a	2.6 a	39.1 a
Farm D						
Surface	.	.	.	.	.	.
Chisel Incorporation	.	.	.	.	.	.
Aerway incorporation	.	.	.	.	.	.

† Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )

**Table 3: Estimated milk production as impacted by manure application method.**

Treatment	Milk per acre	Milk per ton
	lbs per acre	lbs per ton of silage
Farm A		
Surface	20937 b	3441 a
Chisel Incorporation	23247 a	3426 a
Aerway incorporation	23402 a	3439 a
Farm B		
Surface	23928 a	3309 a
Chisel Incorporation	23917 a	3396 a
Aerway incorporation	24806 a	3346 a
Farm C		
Surface	14914 a	3624 a
Chisel Incorporation	16284 a	3615 a
Aerway incorporation	17250 a	3643 a
Farm D		
Surface	.	.
Chisel Incorporation	.	.
Aerway incorporation	.	.

† Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )

**Table 4: Soil nitrate level (0-8 inch depth) at four sampling times as impacted by manure application method.**

Treatment	Baseline	Planting	Sidedress	Harvest
	----- lbs/acre -----			
Farm A				
Surface	17.5 a	61.0 a	53.0 a	8.0 b
Chisel incorporation	14.8 a	72.8 a	60.8 a	18.5 a
Aerway incorporation	16.8 a	73.0 a	69.0 a	15.8 a
Farm B				
Surface	33.8 a	68.8 b	92.0 a	37.3 a
Chisel incorporation	36.5 a	97.3 a	107.8 a	53.0 a
Aerway incorporation	33.3 a	85.8 ab	91.3 a	45.5 a
Farm C				
Surface	29.5 a	42.5 a	35.8 a	20.3 a
Chisel incorporation	29.8 a	21.0 a	32.0 a	17.8 a
Aerway incorporation	28.5 a	39.0 a	28.0 a	22.0 a
Farm D				
Surface	31.8 a	86.0 a	114.8 b	.
Chisel incorporation	32.3 a	103.0 a	145.3 a	.
Aerway incorporation	32.0 a	85.5 a	124.5 ab	.

† Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )

**Table 5: Illinois Soil Nitrogen Test (ISNT) (0-8 inch depth), Pre-Sidedress Nitrogen Test (PSNT) (0-12 inch depth), and Late Season Stalk Nitrate as impacted by manure application method.**

Treatment	Sidedress		Harvest	
	ISNT	PSNT	Stalk N	
	----- ppm -----			
	Farm A			
Surface	346 a	22.6 b	191 a	L
Chisel incorporation	354 a	28.0 ab	1,095 a	O
Aerway incorporation	383 a	32.8 a	840 a	O
	Farm B			
Surface	357a	49.5 a	8,171 a	E
Chisel incorporation	378a	48.0 a	9,845 a	E
Aerway incorporation	373a	42.5 a	8,134 a	E
	Farm C			
Surface	355 a	12.5 a	30 a	L
Chisel incorporation	351 a	12.8 a	9 a	L
Aerway incorporation	363 a	13.0 a	21 a	L
	Farm D			
Surface	466 a	57.9 a	2,535 a	E
Chisel incorporation	472 a	57.8 a	2,751 a	E
Aerway incorporation	471 a	57.9 a	1,795 a	O

† Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )

**Table 6: Soil compaction readings taken at three sampling times as impacted by manure application method with rating from (0-5).**

Depth	Treatment	Baseline	Side-dress time	Harvest
		-----rating-----		
		Farm A		
3"	Surface	0 a	0 a	0.0 a
	Chisel incorporation	0 a	0 a	0.3 a
	Aerway incorporation	0 a	0 a	0.0 a
6"	Surface	0 a	0 a	1.5 a
	Chisel incorporation	0 a	0 a	1.3 a
	Aerway incorporation	0 a	0 a	1.0 a
9"	Surface	0 a	0 a	2.8 a
	Chisel incorporation	0 a	0 a	2.8 a
	Aerway incorporation	0 a	0 a	2.8 a
12"	Surface	0 a	0 a	3.0 a
	Chisel incorporation	0 a	0 a	4.3 a
	Aerway incorporation	0 a	0 a	3.8 a
		Farm B		
3"	Surface	0 a	0 a	0 a
	Chisel incorporation	0 a	0 a	0 a
	Aerway incorporation	0 a	0 a	0 a

Depth	Treatment	Baseline	Side-dress time	Harvest
		-----rating-----		
6"	Surface	0 a	0 a	0 b
	Chisel incorporation	0 a	0 a	0 b
	Aerway incorporation	0 a	0 a	0.8 a
9"	Surface	0 a	0 a	2.3 a
	Chisel incorporation	0 a	0 a	2.3 a
	Aerway incorporation	0 a	0 a	2.8 a
12"	Surface	0 a	1.3 a	4.3 a
	Chisel incorporation	0 a	0 a	3.8 a
	Aerway incorporation	0 a	0.3 a	4.5 a
		Farm C		
3"	Surface	0 a	0 a	0 a
	Chisel incorporation	0 a	0 a	0 a
	Aerway incorporation	0 a	0 a	0 a
6"	Surface	0 a	0 a	0.3 a
	Chisel incorporation	0 a	0 a	0 a
	Aerway incorporation	0 a	0 a	0.3 a
9"	Surface	0 a	0 a	2.3 a
	Chisel incorporation	0 a	0 a	1.0 a
	Aerway incorporation	0 a	0 a	2.3 a
12"	Surface	0 a	0.8 a	3.3 a
	Chisel incorporation	0 a	1.3 a	2.5 a
	Aerway incorporation	0 a	2.0 a	3.3 a
		Farm D		
3"	Surface	0 a	0 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0 a	.
6"	Surface	0 a	0 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0 a	.
9"	Surface	0 a	0 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0 a	.
12"	Surface	0 a	0.3 a	.
	Chisel incorporation	0 a	0 a	.
	Aerway incorporation	0 a	0.3 a	.

† Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )

**Table 7: Soil moisture (%) at three sampling times as impacted by manure application.**

Treatment	At planting	Side-dress time	Harvest
	----- % -----		
	Farm A		
Surface	20.3 a	21.4 a	19.8 a
Chisel incorporation	20.9 a	21.5 a	19.9 a
Aerway incorporation	21.5 a	21.8 a	20.0 a
	Farm B		
Surface	23.2 a	23.3 a	22.7 a
Chisel incorporation	22.4 a	23.0 a	22.1 a
Aerway incorporation	22.2 a	23.2 a	22.4 a
	Farm C		
Surface	22.2 a	24.1 a	22.4 a
Chisel incorporation	21.0 a	24.7 a	22.9 a
Aerway incorporation	21.7 a	23.7 a	22.6 a
	Farm D		
Surface	26.3 a	24.2 a	.
Chisel incorporation	26.3 a	23.9 a	.
Aerway incorporation	26.2 a	24.1 a	.

†Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )

**Table 8: Percent surface residue coverage before and after manure application method.**

Treatment	Baseline	After Manure Treatment
	----- % -----	
	Farm A	
Surface	18.0 a	7.5 a
Chisel incorporation	16.1 a	5.3 a
Aerway incorporation	15.7 a	6.8 a
	Farm B	
Surface	22.3 a	14.1 a
Chisel incorporation	19.2 a	6.2 b
Aerway incorporation	23.0 a	8.3 b
	Farm C	
Surface	49.1 a	52.9 a
Chisel incorporation	46.2 a	7.6 c
Aerway incorporation	50.8 a	19.8 b
	Farm D	
Surface	70.0 a	34.4 a
Chisel incorporation	67.8 a	27.6 a
Aerway incorporation	68.3 a	32.6 a

†Average values with different letters (a,b,c) are statistically different ( $\alpha = 0.05$ )