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Comparing Manure Incorporation Methods in Reduced Till Systems

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Introduction

Determining effective manure management options that are compatible with reduced-tillage corn systems is important for reducing nutrient runoff and N-volatilization. Shallow tillage reduces soil erosion compared to conventional tillage by reducing overall soil disturbance and maintaining a greater degree of surface residue cover. Various companies make aeration tools that allow for shallow mixing of manure and soil. These aerators operate through the use of eight inch tines that rotate as they cut into the ground and shift the soil. This is unlike most conventional tillage equipment where the soil is churned and then followed by secondary tillage to prepare a seed bed. In a 3-yr trial conducted at the Aurora Research Farm, we used an AerWay® Aerator to compare N conservation following shallow mixing with chisel incorporation and with surface application (What's Cropping up? 17(4), Lawrence et al., 2007). This trial showed that shallow mixing of spring-applied manure resulted in corn grain yields that were similar to those obtained with chisel plowing, suggesting a similar level of ammonia-N conservation. On-farm testing of the effectiveness of shallow tillage was needed and funding from the New York Farm Viability Institute and Northern New York Agricultural Development Program allowed us to implement similar trials at ten farm locations in 2008. Of the ten sites, one farm conducted a chisel versus injection comparison. All others compared chisel with shallow incorporation using aerator tools. In this article, we report on the results of the aeration and chisel incorporation treatments.

Methods

Farm fields were selected in seven counties, two each in St Lawrence and Cayuga, and one each in Lewis, Clinton, Wyoming, Chenango, and Columbia. In addition, trials were continued at the Aurora Research Farm. Most of the fields in this study were either second or third year corn silage or corn grain sites. Site F was first year corn silage while Site H was fourth year corn grain. Soil samples, residue measurements and compaction readings were taken before manure was applied. The manure application rate at each site was determined by the farmer, with actual rates ranging from 5,000 to 9,000 gallons/acre. Incorporation took place within one hour of manure application and a second residue reading was done to compare the surface residue remaining for each treatment method. All sites were sampled three more times for soil fertility and soil moisture (at planting, sidedress time, and harvest). Stand density was determined at sidedress time. At harvest time, soil compaction was measured one last time, and yield and forage quality samples were taken.

Results

Yield response and N requirements

For the first year of this trial there were no significant yield differences between the aerator and chisel incorporation treatments. The two sites with the lowest yields were impacted by saturated field conditions (Site A) and heavy hail damage (Site D). The Pre-sidedress Soil Nitrate Test (PSNT) (0-12 inch depth) results showed that at seven of the nine sites N was not yield limiting

and stalk nitrate results confirm optimal to excessive nitrate levels for these sites. Except for one site (Site D, the location with planter skips and severe hail damage), N conservation with the aerator was not significantly different from the chisel treatment.

Table 1: Surface residue before and after manure application/incorporation, corn yield, Pre-Sidedress Nitrogen Test (PSNT) (0-12 inches depth), and Late Season Stalk Nitrate (L=Low; O=Optimum; E=Excess), as impacted by manure application method.

	Residue coverage		Corn silage yield	PSNT	Late Season Stalk Nitrate Test	
	before	after	(35% DM)	(0-12 inches)		
Treatment	----------%----------		tons/acre	ppm	ppm	
Site A (saturated field for large portion of the season)						
Chisel	46.2 a	7.6 b	12.9 a	12.8 a	9 a	L
Aerway	50.8 a	19.8 a	13.5 a	13.0 a	21 a	L
Site B*						
Chisel	83.3 a	.	22.7 a	17.0 a	363 a	O
Aerway	84.7 a	.	22.1 a	13.0 a	108 b	L
Site C						
Chisel	16.1 a	5.3 a	19.4 a	28.0 a	1,095 a	O
Aerway	15.7 a	6.8 a	19.4 a	32.8 a	840 a	O
Site D (severe hail damage and planter skips)						
Chisel	84.5 a	4.8 b	15.2 a	46.3 a	6,395 a	E
Aerway	88.1 a	14.8 a	14.9 a	26.9 b	3,545 b	E
Site E						
Chisel	22.3 a	2.5 b	21.7 a	42.6 a	8,167 a	E
Aerway	20.3 a	14.9 a	21.6 a	40.5 a	4,516 a	E
Site F						
Chisel	73.2 a	12.8 b	27.1 a	50.0 a	6,903 a	E
Aerway	68.3 a	33.5 a	27.1 a	50.5 a	6,458 a	E
Site G						
Chisel	19.2 a	6.2 a	20.1 a	48.0 a	9,845 a	E
Aerway	23.0 a	8.3 a	21.1 a	42.5 a	8,134 a	E
Site H (grain site - bu/acre)						
Chisel	83.1 a	14.3 b	179.9 a	55.0 a	517 a	O
Aerway	83.6 a	37.8 a	177.9 a	46.0 a	327 a	O
Site I (grain site - bu/acre)*						
Chisel	67.8 a	.	164.9 a	57.8 a	2,751 a	E
Aerway	68.3 a	.	175.1 a	57.9 a	1,795 a	O

†Average values with different letters (a,b) are statistically different ($\alpha = 0.05$).
*Sites that had secondary tillage before "after treatment" residue measurement could be taken.

Surface Residue Coverage

Maintaining good surface residue coverage and minimizing soil disturbance are important for managing soil erosion and conserving soil moisture. The aerator incorporation treatments reduced soil disturbance and conserved significantly more surface residue than the chisel incorporation treatment at five of the seven sites in which we were able to measure residue

coverage after application. For two sites, both with initial surface residue coverage of less than 25% (Sites C and G), there was no significant difference in residue coverage between the two application methods.

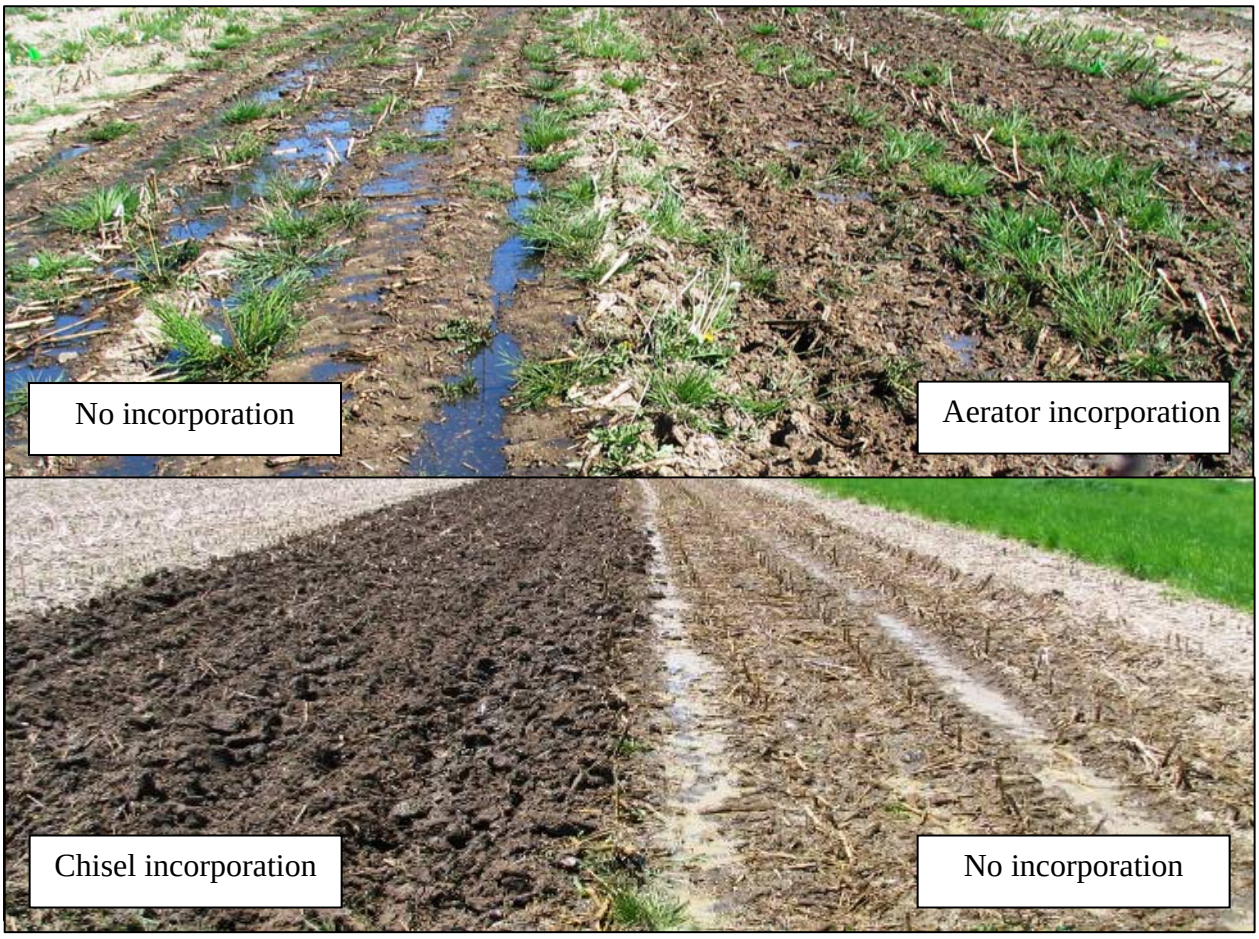

Figure 1: Surface application (top left,) and aerator incorporation (top right), chisel incorporation (bottom left) and surface application (bottom right).

Year One Preliminary Conclusions

The results of this first year show no yield differences and PSNT and stalk nitrate results that indicate similar levels of N conservation between the two application methods. Aerator incorporation did show promise in reduced tillage systems for its ability to conserve surface residue coverage while incorporating manure and conserving N. Aerator incorporation is expected to conserve moisture as compared to the more aggressive chisel plow incorporation, but because 2008 was extremely wet at many of the sites, no soil moisture differences were observed this season. Another year of data will be collected and final conclusions will be drawn at the end of the 2009 growing season.

For Further Information

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