

# Manure Injection in No-till and Forages

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# Why Inject or Incorporate Manure?

1. Reduce odors, becoming more important with urban sprawl
2. **Agronomic** - Improve N use efficiency by decreasing ammonia volatilization, but economic importance depends on N prices
3. **Environmental** - Possibly decrease N and P losses in runoff

A BMP that is cost effective?

# Why not just till after manure application?

## Benefits of No-Till

1. Reduced time and energy inputs
2. Buildup soil organic matter
3. Improved soil tilth (structure, drainage)
4. Reduced soil erosion

# Benefits of No-Till

(Better Soils with the No-Till System, Penn State Univ)





# Types of Tools Available

1. **Shallow incorporation** after surface application, large range in soil disturbance
2. **Injection** of liquid and dry manures using chisels, knives, coulters
3. **Aeration** – helps increase infiltration, sometimes includes aspects of incorporation (e.g. AerWay set at an angle)



# We know how nutrients move: Runoff versus Leaching

## N Movement



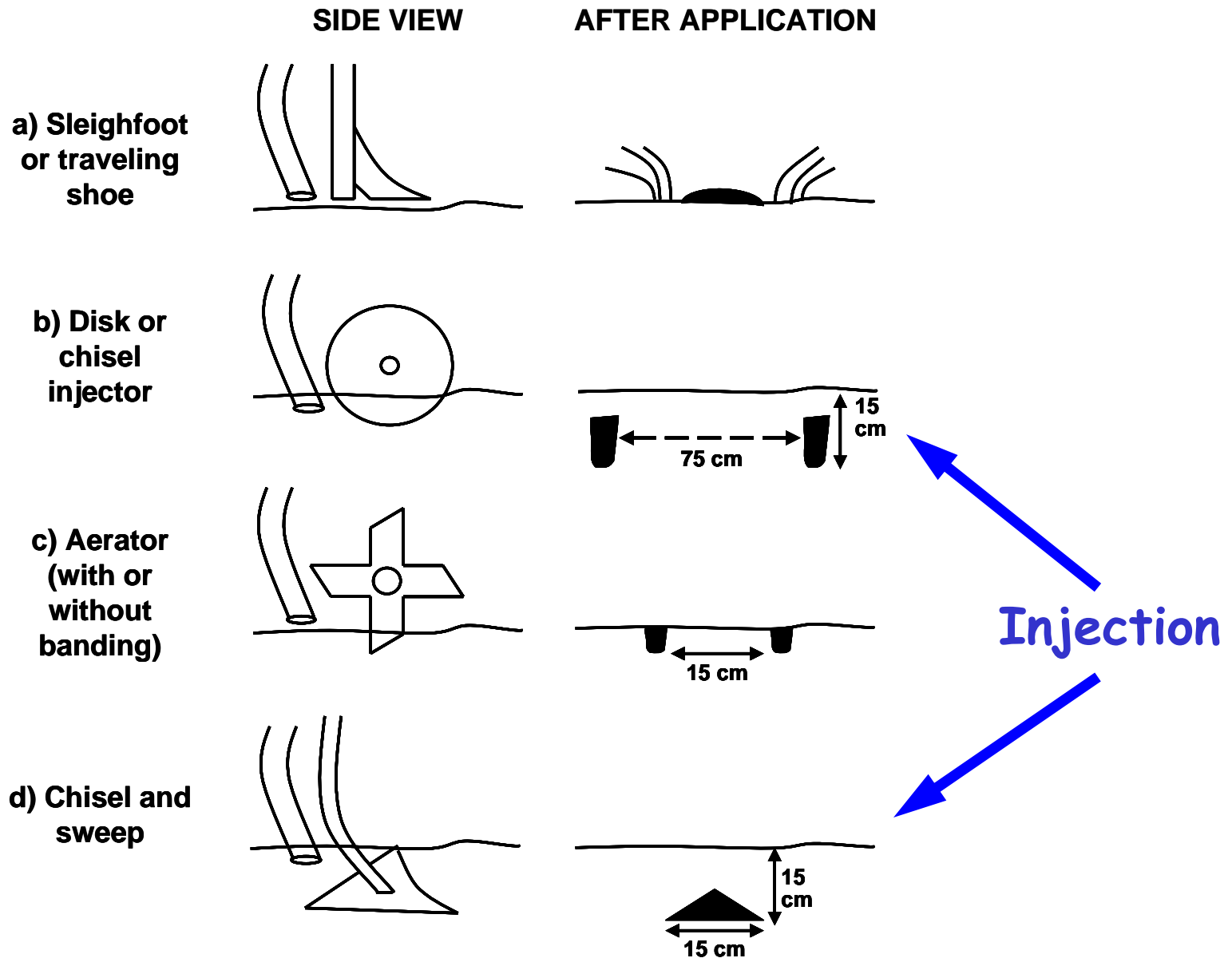
**Nitrate Leaches!!**

## P Movement



**P Leaches Slowly**

# Types of tool available













# Dairy Manure Plant Available Nitrogen (lbs/1000 gal)

Total N 19.22 - 8.88NH<sub>4</sub> = 10.34 Org N

	Surface	Injected
Organic	(35%) 3.62	(35%) 3.62
Ammonia	(25%) 2.22	(95%) 8.44
Total PAN	~6	12

# Value of Plant Available Nitrogen

Increased Value due to Injection = ~ 6 lb  
PAN/1000 gal

@ 70 ¢/lb, added value = \$4.20 / 1000 gal

Increased Nitrogen Value 500,000 gal =  
\$2,100



# Drawbacks to manure Injection

1. Slower, therefore takes more time
2. Equipment costs more to buy and maintain, can the increased nitrogen use efficiency cover the cost?
  - Retro fit an existing tanker with toolbar, hydraulic shredder, distributor with hoses , 6 x Yetter Avenger Injection units = **\$17,134**
  - Use nurse trucks





# Manure injection costs (6000 gal/acre on 80 acres)

Type	Ac./hr.	Equipment cost/hr.	\$/ac.	*N recovery w/ injection	Cost/a c. less N	Net injection cost/ac.
Broadcast	3.3	\$105	\$32	\$0	\$32	
Injection w/o nursing	2.6	\$150	\$58	\$35	\$23	(\$9)
Injection w/ nursing	3.3	\$255	\$77	\$35	\$42	\$10

\*N recovered amount 50 lb/acre and valued at \$.70/lb.

# Farmer Manure Injection Experience

1. More uniform/ consistent looking corn
2. Minimal problems with rocks
3. Pivoting tool bar and chopper helped
4. Nursing only effective over larger distances
5. Odor dramatically reduced
6. Little striping seen - still need starter nitrogen



# Farmer Manure Injection Experience

1. Roots proliferated in injection slits
2. NRCS cost share available
3. Due to flow meter, realized 5000 gal tank had significant foam
4. Need more yield data. Can the extra N from injection remove the need to side-dress?
5. Lower nutrient runoff



# Increased Carbon Capture?





# Conclusions

- Feasible - it can be done in local soils
- Close to break even before NRCS cost share, if you count value from nitrogen
- Odor reduction may open more areas
- Farmer research continuing
- Can the extra N from injecting replace the need for side-dress N?

Nurse truck



In-field  
Manure  
storage  
container



# Dragline system (Mid-Atlantic Ag, PA)





# Dragline system (Mid-Atlantic Ag, PA)





# Dragline system (Idaho)



**No-till**



# Aerway Aerator





# Angle on entry determines the level of disturbance (Basden, 2008)

*0° roller angle*



*5° roller angle*



*10° roller angle*



# Virginia Research Results

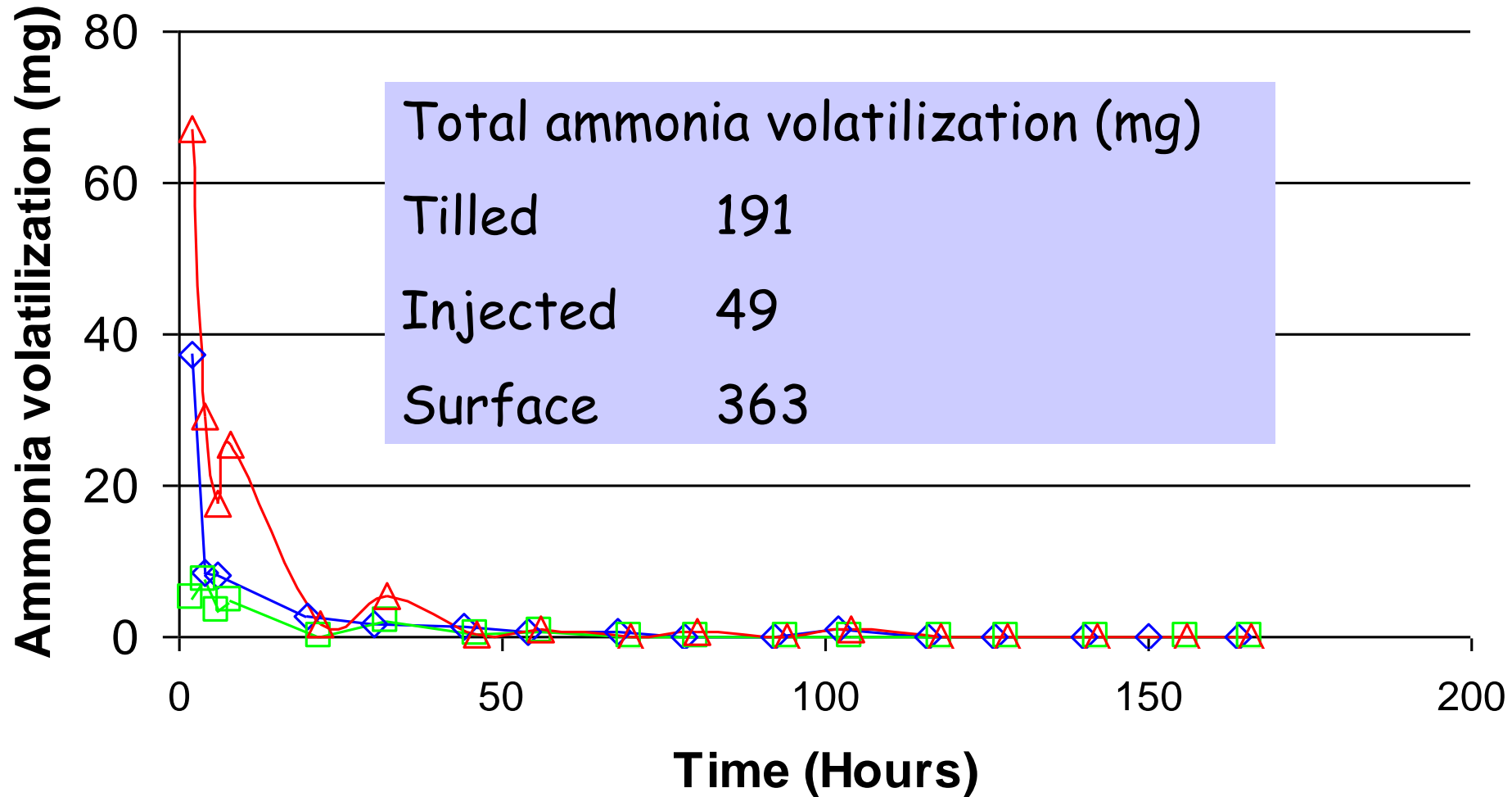
## Ammonia Volatilization







# Ammonia volatilization





# From Literature Review

1. **Ammonia volatilization** - no doubts about benefits with incorporation and injection. Aeration questionable
2. **Infiltration** - Few studies, but even aeration not consistent
3. **Sediment** - injection maybe neutral, aeration depends on soil disturbance, not enough data on incorporation but probably increases sediment losses.

# From Literature Review

4. **Phosphorus:** Injection and incorporation decreased Total P and soluble P losses, aeration questionable
5. **Nitrogen runoff:** Injection and incorporation decreased N loss, aeration questionable
6. **Nitrogen leaching:** One study
7. **Yields:** If you prevent  $\text{NH}_3$  loss, you can increase yield if N is limiting



# Knowledge Gaps

- ✓ What type of injection works 'best' and how site characteristics affect this?
- ✓ How do you calculate PAN for each method - ammonia vs organic N?
- ✓ Can we predict when aeration works?
- ✓ How can we encourage adoption by farmers?
- ✓ What are the trade-offs between nutrient management and no-till with these systems

# Other Issues

- ✓ Are technologies compatible with no-till cost share? Depends
- ✓ Pathogens ?!
- ✓ Hormones and antibiotics?



# **Results of Poultry Litter Injection in the Shenandoah Valley**

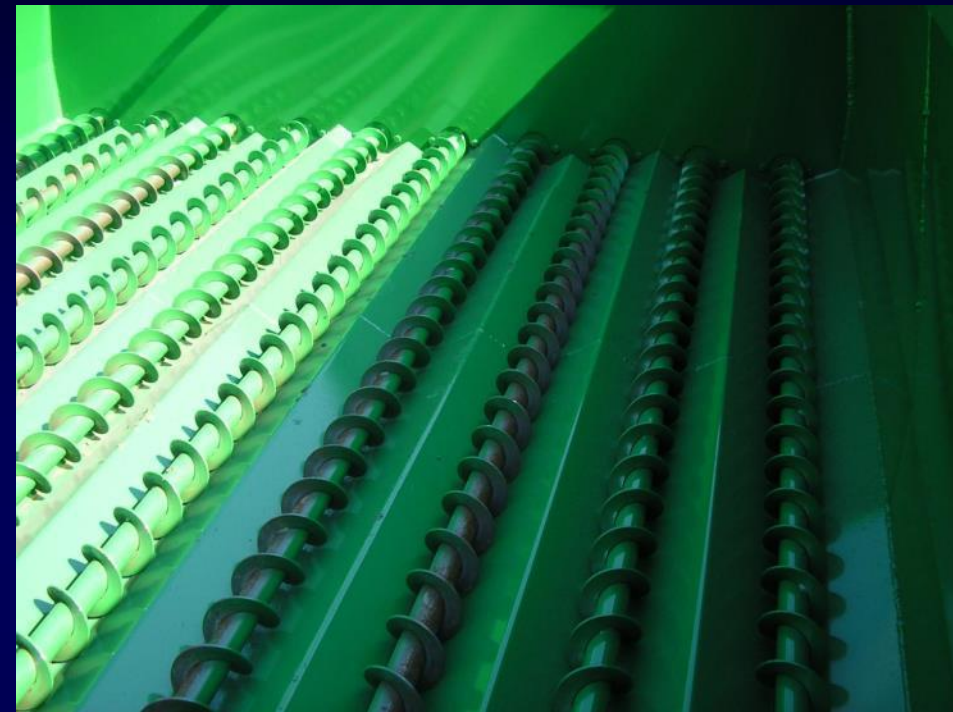
**Stephanie Kulesza, Rory Maguire**

# Poultry Litter Injector





# Poultry Litter Injector





# Poultry Litter Injector



# Litter Injector Issues

- **Works in small doses, but:**
  - **Hydraulics overheat for large acreages**
  - **Can't cope with wet litter**
  - **Only half a load at a time**
- **Currently under engineered, but being reworked. So following results are proof of concept**

# Objectives

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- **Determine the effects of injection and surface application of poultry litter on:**
  - **Ammonia volatilization**
  - **Soil inorganic nitrogen**
  - **Hay yield and quality**



# Litter Injection Conclusions

- Injection increased total inorganic N in the soil incubation and field studies
- Injection decreased ammonia volatilization to levels of the control
- Injection did not significantly increase yields in orchardgrass hay
- Injection increased protein in orchardgrass hay
- With increased N availability, injection could be a valuable alternative to traditional surface application of poultry litter (if equipment worked)

Questions?

