

Nitrogen Availability of Treated and Raw Dairy Manure

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Reasons for Manure Treatment

- Reduced volume
 - Transportation
 - Storage
- Decreased odor
- Lower pathogen levels
- Biogas production

Wisconsin Availability Coefficients

Species	Surface [†] N	Inc. [†] N	P ₂ O ₅	K ₂ O
-----%				
First-year Availability				
Dairy	30	40	60	80
Beef	25	35	60	80
Swine	50	65	60	80
Second-year Availability				
All species	10	10	10	10
Third-year Availability				
All species	5	5	5	5

[†] Surface = surface applied; Inc. = incorporated within 3 days of application.

Treated manures mineralize N differently

- Composted manures mineralize N slower and less than raw manures (Kliese et al., 2005 and Shi et al., 1999)
- Relationships exist between manure properties and N mineralization (Nmin) rates (Griffin et al., 2005 and Kyvsgaard, 2000)
 - C:N
 - Neutral detergent fiber (NDF)
 - C:NH₄
 - NDF:N
 - Acid detergent fiber (ADF)
 - Lignin
 - Lignin:N
 - Hemicellulose

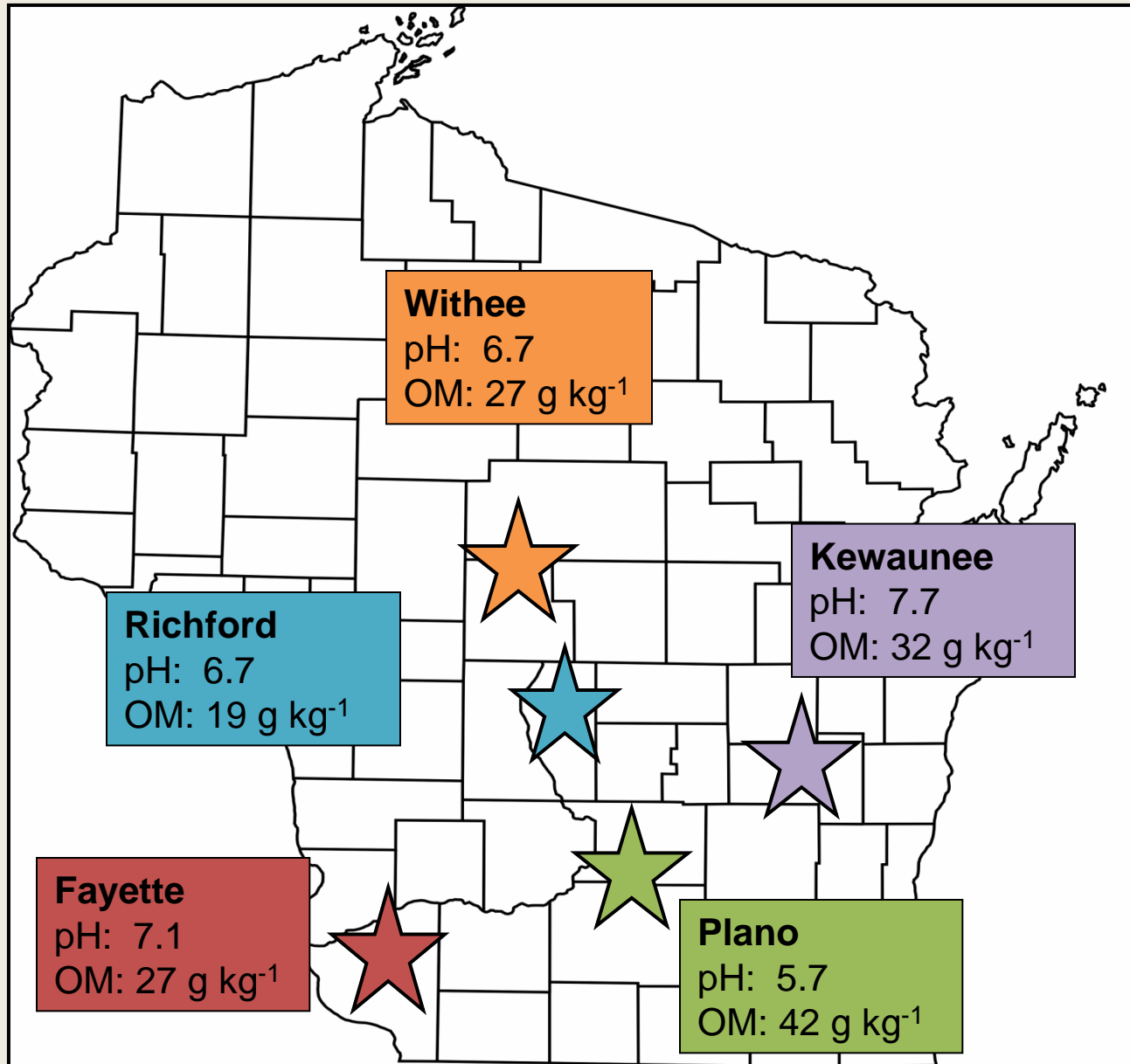
Should adjustments be made?

Incubation Setup

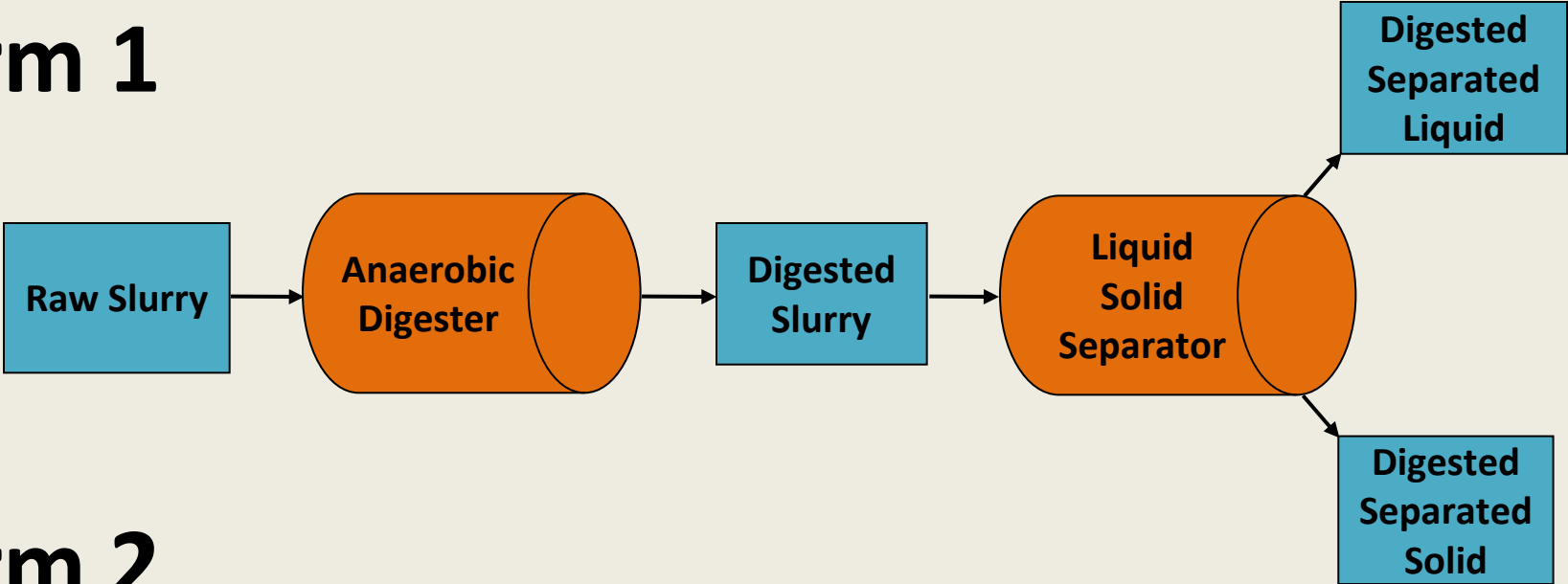
- Five soils throughout Wisconsin
 - Four silt loams
 - One sand
- Nine manures from two farms
- Incorporated at rate of 300 (or 200) lb total N a⁻¹ soil
- 112 day incubation
 - Day 0, 3, 7, 14, 28, 56, and 112 samplings
- Determined NH₄ and NO₃ concentrations at each sample date



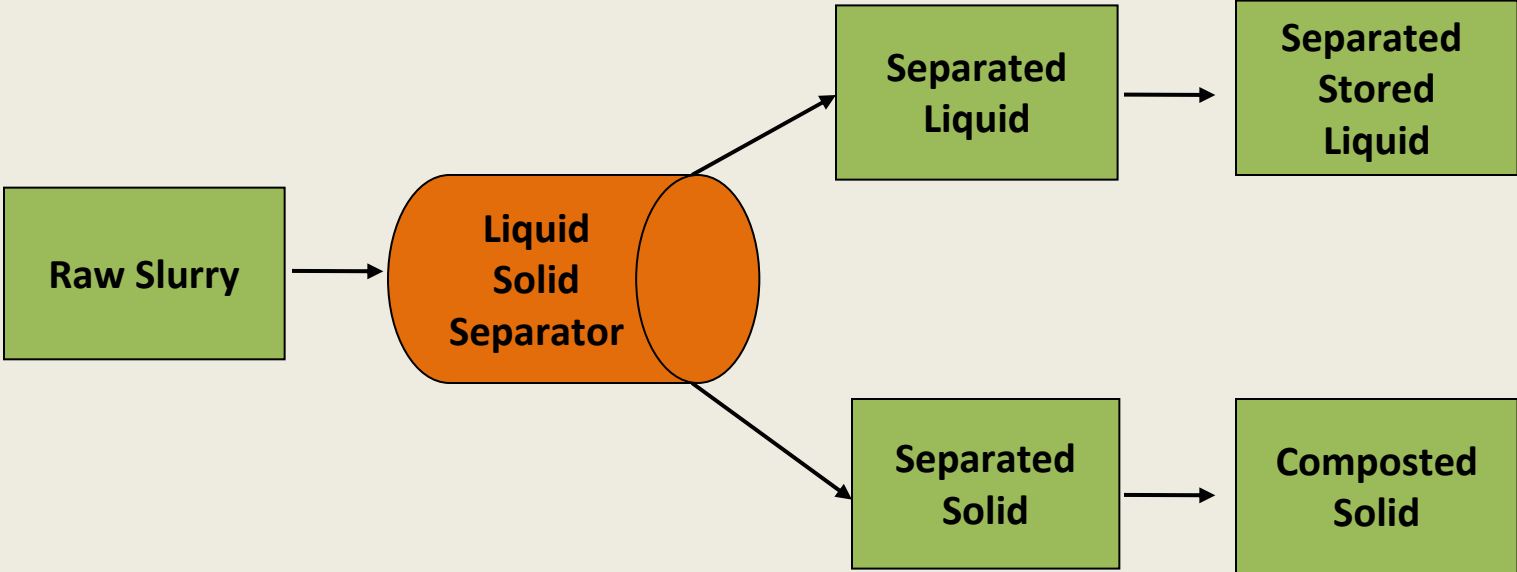
Soil Locations



Farm 1



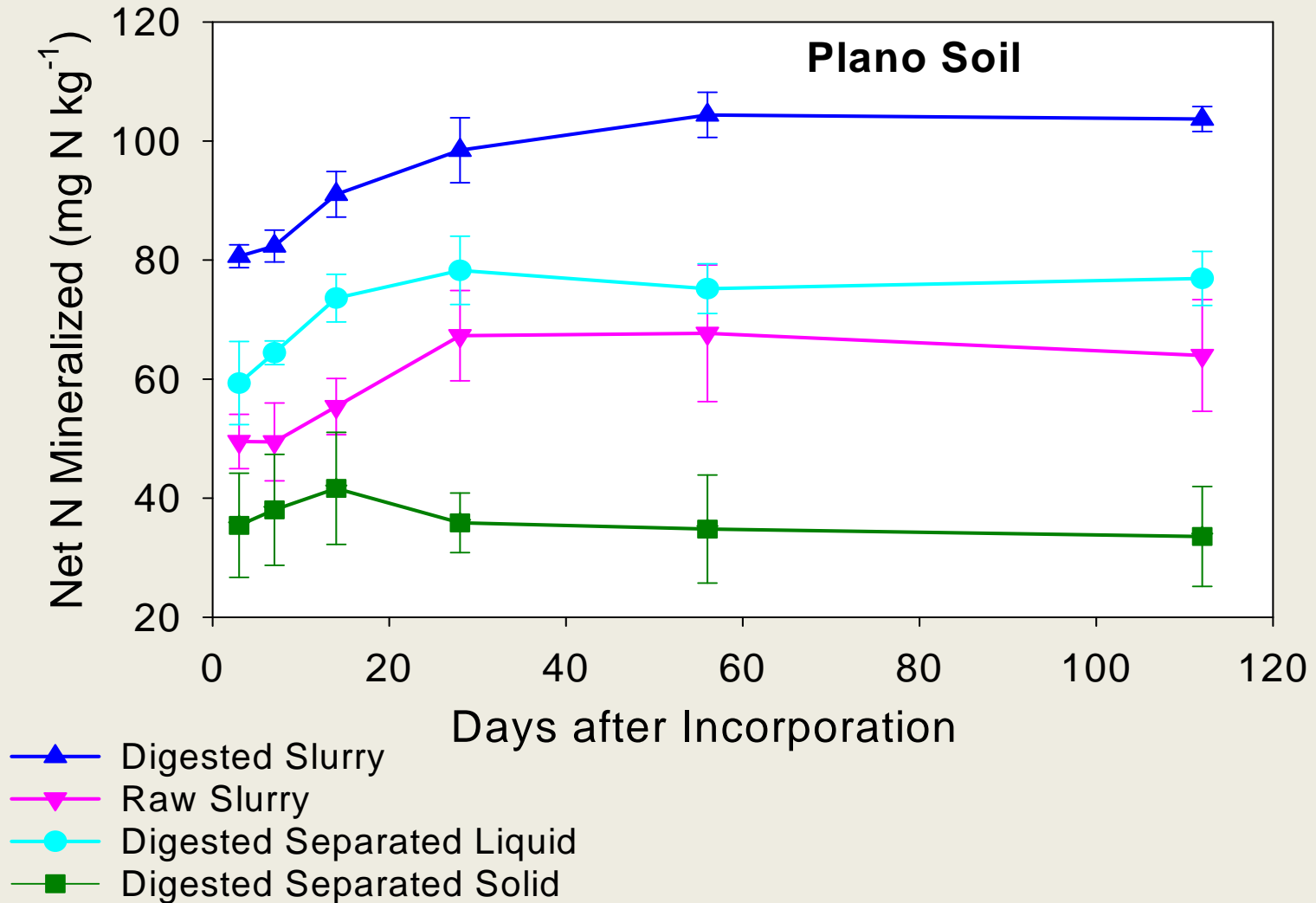
Farm 2



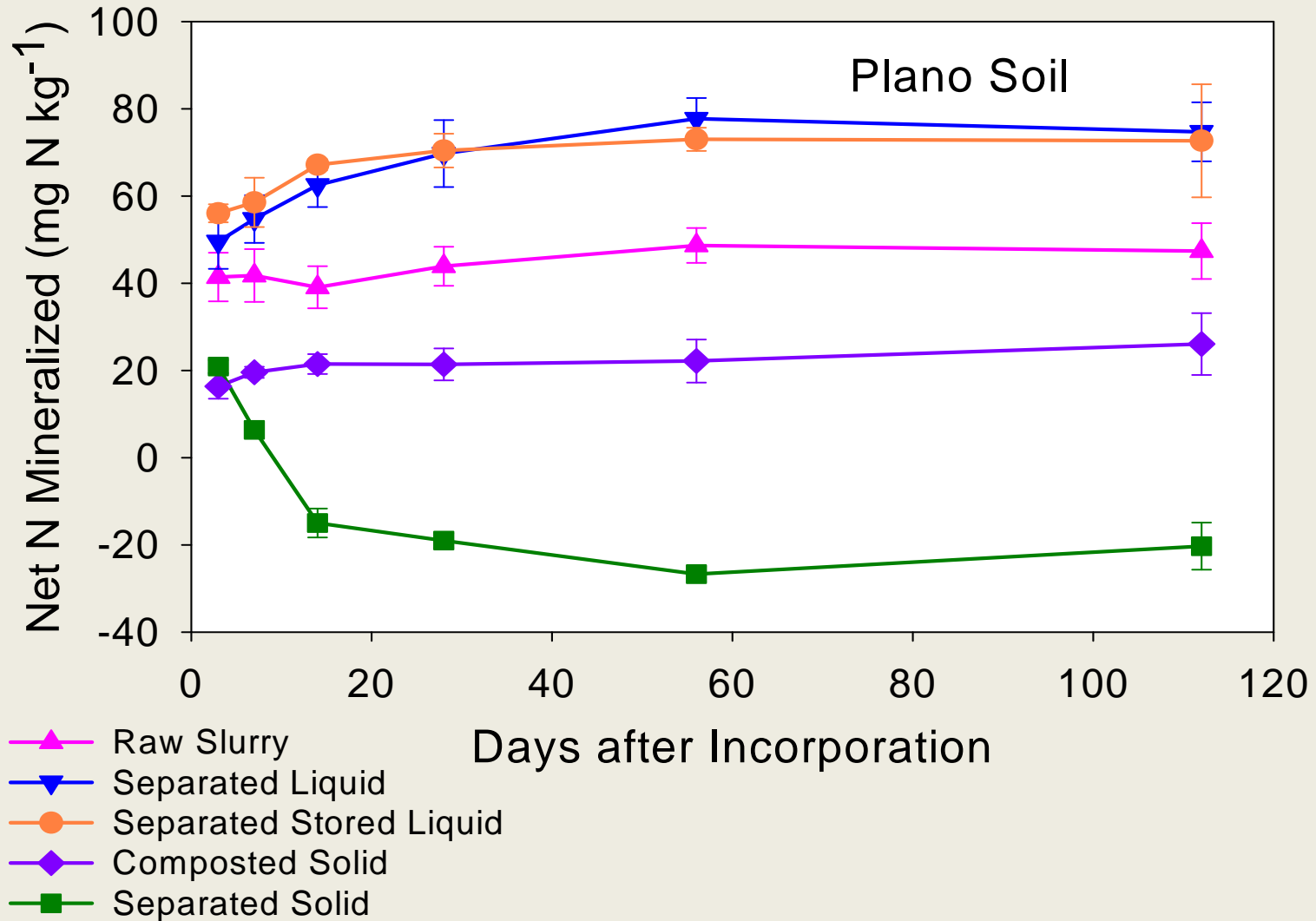
Manure Characteristics

	Dry Matter	TN	NH ₄ -N	TC	C:N
	%	—lb / 1000 gal or ton —			
Farm 1 (Digester and Separator)					
Raw Slurry 1	4.9	16.1	8.4	157.2	9.8
Digested Slurry	7.5	49.4	32.7	228.1	4.6
Digested Separated Liquid	2.6	8.3	4.4	68.6	8.3
Digested Separated Solid	24.7	11.3	2.9	887.5	18.9
Farm 2 (Separator only)					
Raw Slurry 2	2.7	10.4	6.7	104.8	7.4
Separated Liquid	1.0	9.5	7.8	27.9	3.2
Separated Stored Liquid	2.8	16.9	7.5	87.2	6.2
Separated Solid	15.3	4.8	1.1	596.0	32.6
Composted Solid	24.8	14.1	0.6	868.9	13.5

Farm 1. Digester and Separator



Farm 2. Separator only



Farm 1. Digester and Separator

Incubation day 112.

	----- Soil -----				
Manure	Fayette	Kewaunee	Plano	Withee	Richford
	----- % of total N mineralized -----				
Raw Slurry	31 C†	45 A	43 C	35 C	41 B
Digested Slurry	58 A	52 A	69 A	60 A	48 AB
Digested Separated Liquid	45 B	43 A	51 B	52 B	51 A
Digested Separated Solid	14 D	19 B	22 D	18 D	11 C

† Means within a row for a given manure followed by the same lowercase letter or means with a column for a given soil followed by the same uppercase letter are not significantly different ($p < 0.05$) from each other.

Farm 2. Separator only

Incubation day 112.

	----- Soil -----				
Manure	Fayette	Kewaunee	Plano	Withee	Richford
	----- % of total N applied -----				
Raw Slurry	22 B	23 C	32 BC	35 C	43 C
Separated Liquid	58 A	50 B	56 AB	53 B	63 B
Separated Stored Liquid	62 A	62 A	73 A	72 A	77 A
Separated Solid	-25 D	-17 E	-14 D	-18 E	-5 D
Composted Solid	6 C	6 D	17 C	8 D	7 D

† Means within a column for a given soil followed by the same uppercase letter are not significantly different ($p < 0.05$) from each other.

Average % of Total N Mineralized

Farm 1

Raw Slurry	39%
Digested Slurry	58%
Digested Separated Liquid	49%
Digested Separated Solid	17%

Farm 2

Raw Slurry	31%
Separated Liquid	56%
Separated Stored Liquid	69%
Separated Solid	-16%
Composted Solid	9%

Linking Manure Characteristics to Nmin

Manure Characteristic	Correlation Coefficient (r)
Total N	0.78
Total C	-0.77
C:N	-0.90
NDF	-0.83
NDF:N	-0.93
ADF	-0.79
ADF:N	-0.93

- Best Nmin predictors include:
 - NDF:N
 - ADF:N
 - C:N

Future Work

- Three remaining farms
 - Bedded pack system
 - Digester system
 - Digested stored liquid
 - Digested cured solid
 - Various raw
- First stages of data analysis

Summary

- N more available than raw slurry:
 - Digested slurry
 - Digested separated liquid
 - Separated liquid (not digested)
 - Separated stored liquid (not digested)
- N less available than raw slurry:
 - Digested separated solid
 - Separated solid (not digested)
 - Composted solid (not digested)
- Not digested separated solid immobilized N in the soil
- NDF:N, ADF:N, and C:N are good predictors of Nmin
- Preliminary data suggests N availability guidelines should be modified to consider manure treatment