Nitrogen Availability from Various Manure Components

Presented by Paul Cusick

Department of Soil Science

University of Wisconsin-Madison

Objectives

- Increased understanding of nitrogen availability of individual dairy manure components.
  - Feces
  - Urine
  - Bedding
- How does soil type and temperature affect N mineralization of these components?

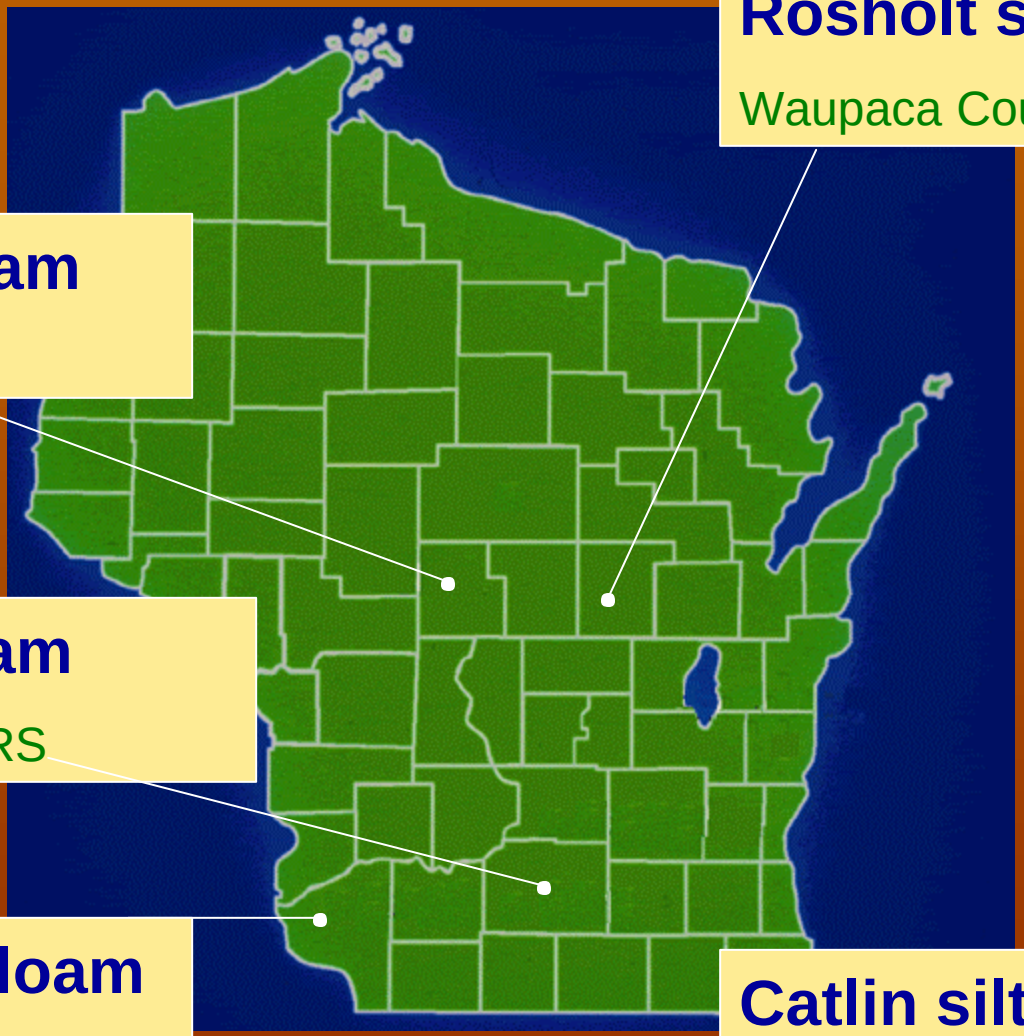
Study design

- Incubation trial
- 6 soils
- 5 treatments utilizing ^{15}N labeling
- 3 temperatures (52, 64 and 77°F)
- Incubated for 168 days
- Incubation vessels
  - 2qt canning jars
  - 250 g soil dry wt.
  - 60% Water Filled Pore Space
  - Aerated jars 1 hour each day

Symco sandy loam

Rosholt sandy loam

Waupaca County



Loyal silt loam

Marshfield ARS

Plano silt loam

West Madison ARS

Rozetta silt loam

Lancaster ARS

Catlin silt loam

Central Illinois (control soil)

Initial Soil Characteristics

Soil Series	Texture	Tot-C	Org-C	Bray P-1	Tot-N	Sand	pH
		%	%	ppm	%	%	
Loyal	Silt loam	2.61	2.35	42	0.21	13	7.0
Plano	Silt loam	3.55	2.56	72	0.22	26	7.4
Rozetta	Silt loam	1.82	1.23	32	0.16	4	6.8
Catlin	Silt loam	2.86	NR	NR	0.17	14	NR
Symco	Sandy loam	0.81	0.80	35	0.09	73	6.3
Rosholt	Sandy loam	0.87	0.83	42	0.09	53	5.7

NR= Not recorded

Treatments

- ^{15}N labeled and unlabeled
- Rate= 313 lbs Total N $acre^{-1}$
  - Proportionally added
  - 36% of N derived from FECES
  - 42% of N derived from URINE
  - 22% of N derived from BEDDING (oat straw)

Treatment	Feces	Urine	Bedding
1	^{15}N	^{14}N	^{14}N
2	^{14}N	^{15}N	^{14}N
3	^{14}N	^{14}N	^{15}N
4	^{15}N	^{15}N	^{15}N
5	Control (no manure applied)		

Analysis

- Analyzed for unlabeled NH_4^+ and NO_3-
- Analyzed for Total and Mineralized ^{15}N

Mineralized ^{15}N from FECES at 168 days.

Soil Type	Temperature			
	52 °F	64 °F	77 °F	Avg.
	----------% ^{15}N Recovered----------			
Loyal	8	8	12	**10**
Symco	20	16	27	**21**
Plano	13	18	26	**19**
Rozetta	12	5	15	**11**
Rosholt	15	7	16	**13**
Catlin	**----**	**----**	**----**	**----**
Avg.	**14**	**11**	**19**	

Statistical		Pr>D	LSD
Significance	Soil	0.0001	3.81
	Temp	0.0001	2.95
	S*T	0.0989	

Mineralized ^{15}N from URINE at 168 days.

Soil Type	Temperature			
	52 °F	64 °F	77 °F	Avg.
	----------% ^{15}N Recovered----------			
Loyal	52	45	69	**55**
Symco	49	54	56	**53**
Plano	44	60	63	**55**
Rozetta	61	61	59	**60**
Rosholt	52	46	51	**50**
Catlin	**----**	**----**	**----**	
Avg.	**51**	**53**	**60**	

Statistical		Pr>D	LSD
Significance	Soil	0.2467	NS
	Temp	0.5932	NS
	S*T	0.6240	

Mineralized ^{15}N from STRAW at 168 days.

Soil Type	Temperature			
	52 °F	64 °F	77 °F	Avg.
	----------% ^{15}N Recovered----------			
Loyal	12	20	19	**17**
Symco	14	16	22	**18**
Plano	15	24	25	**22**
Rozetta	15	12	16	**14**
Rosholt	20	14	15	**16**
Catlin	----	----	----	
Avg.	**15**	**17**	**19**	

Statistical		Pr>D	LSD
Significance	Soil	0.0093	*
	Temp	0.0015	*
	S*T	0.0036	

* Interaction significant at p=0.05

Mineralized ^{15}N from ALL COMPONENTS at 168 days.

Soil Type	Temperature			
	52 °F	64 °F	77 °F	Avg.
	----------% ^{15}N Recovered----------			
Loyal	20	23	25	**22**
Symco	26	19	23	**23**
Plano	24	30	36	**30**
Rozetta	40	18	30	**29**
Rosholt	25	16	22	**21**
Catlin	16	13	10	**13**
Avg.	**25**	**20**	**24**	

Statistical		Pr>D	LSD
Significance	Soil	0.0924	NS
	Temp	0.0003	5.01
	S*T	0.1003	

Conclusion

- Straw and fecal N mineralization were similar at 17 and 15%, respectively.
- Soil and temperature interacted to affect N mineralization of bedding.
- Soil type was significant for fecal N.
- Urine fraction was 55% available, but was not significant for soil or temp.
- All components were not affected by soil type.
- Although urine N readily mineralized, preliminary field data suggests that a greater proportion of the fecal N was taken up by the crop.
- Rapid release of urine N may be satisfying microbial requirements early in the season.