



Using the Cycles Model to Analyze the Effects of Dairy Manure and Anaerobic **Digestate Fertilizers on the Nitrogen Cycle**

Introduction:

The type and amount of fertilizer are known to have impacts on soil chemistry and crop yields. There is some question as to how variation in manure composition from year to year ar whether the manure is digested or raw will affect the nitroge cycle and crop yields.

Overarching Question:

Can we test a field management plan that optimizes crop yi while maintaining a Nitrogen Cycle balance with dairy manu (constant and varied yearly) and digested fertilizer?

Methods: Using Cycles (Kemanian)

The Cycles Model allows one to vary many inputs (fertilizer, crop selection, weather, etc.) and runs multiple years of modeling that produces outputs pertaining to nutrient cycling and crop yields.



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	Mean Difference (Manure - Digestate)							Mean Difference (Constant manure - varied manure)							
															GRAIN Y
GR/	AIN YIELD			-0.03						0.3					
	I HARVEST				0.4									5.4	N IN HA
				-0.6	_				-0.4					- 1	N2O EM
■ N20	D EMISSION	- 4		0.0											
	ATILIZATION	2.1		1				_	-0.7					– `	VOLATI
				-0.5				-2.2						- 1	DENITR
	IIIRIFICATION			0.0	01					0.002					
NH4	1 Leach/Bypass						1.9			0.9					NH4 Lea
														- I	NO3 Lea
=3 0	3 Leach/Bypass	0	-1 0	0.0		1 0	2.0	-2.2 -	12 -02	0.8	18	2.8	3.8 4	8	58
	Dairy Manure	Dairy Manure	Dairy Manure	Dairy Manure	Dairy Manure	Dairy Manure	Dairy Manure		Manure Constant	Manure Constant	Manure Constant	Manure Constant	Manure Constan	t Manure Co	onstant
	Dairy Manure NO3 Leach/Bypass kg N/ha	Dairy Manure NH4 Leach/Bypass kg N/ha	Dairy Manure DENITRIFICATION kg N/ha	Dairy Manure VOLATILIZATION kg N/ha	Dairy Manure N2O EMISSION kg N/ha	Dairy Manure N IN HARVEST kg N/ha	Dairy Manure GRAIN YIELD Mg/ha		Manure Constant NO3 Leach/Bypass kg N/ha	Manure Constant NH4 Leach/Bypass kg N/ha	Manure Constant DENITRIFICATION kg N/ha	Manure Constant VOLATILIZATION kg N/ha	Manure Constan N2O EMISSION kg N/ha	t Manure Co N IN HAR kg N/h	onstant VEST
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Discussion 1:

There were two areas with noticeable differences in the nitrogen cycle. The first was in nitrate leaching/bypass, where dairy manure showed higher amounts. The digestate showed a higher value in volatilization. The nitrate leaching/bypass is of more note seeing that it is a higher percentage difference. This is of note that the two fertilizers are essentially trading off nitrogen losses.

Conclusions 1:

The model shows that producing an equivalent grain yield while using digestate in place of undigested dairy manure is attainable. There may be benefits in the amount of nitrate leaching and bypass when using digestate as well.



Discussion 2:

The constant manure showed a higher nitrogen in harvest while the varied manure showed a higher denitrification. The denitrification number would have a higher percent difference but seeing that the grain yield is essentially the same, the higher nitrogen in harvest for the constant manure may be more of interest.

Conclusions 2:

The model shows an equivalent grain yield, but a disparity in the nitrogen in the harvest. This indicates that the constant composition manure may provide an excess of nitrogen, but that may not be increasing grain yields.

Further Questions:

1) Digestate Variability 2) Broadcast / till vs Injection / no till 3) Carbon / Phosphorous impacts

