

Dairy Manure Treatment Effects on Soil Test Phosphorus

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Objective

- To evaluate the effect of manure treatment on the increase in soil test P after manure application

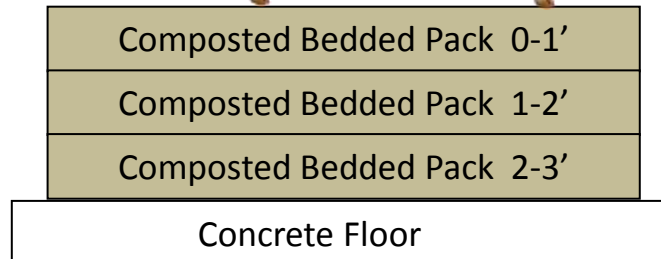
Soils

Soil Properties	Antigo	Dodgeville	Hortonville	Mahtomedi	Waymor
A2809 Soil Group	D	B	C	E	A
pH	5.6	5.7	6.9	6.7	6.6
OM, %	3.4	3.4	2.9	1.5	2.9
Sand, %	55.9	18.2	17.9	87.9	48.9
Clay, %	3.1	15.8	12.1	3.1	11.1
Bray P-1, %	24	18	43	16	30
CEC, $\text{cmol}_c \text{ kg}^{-1}$	4	12	11	6	13

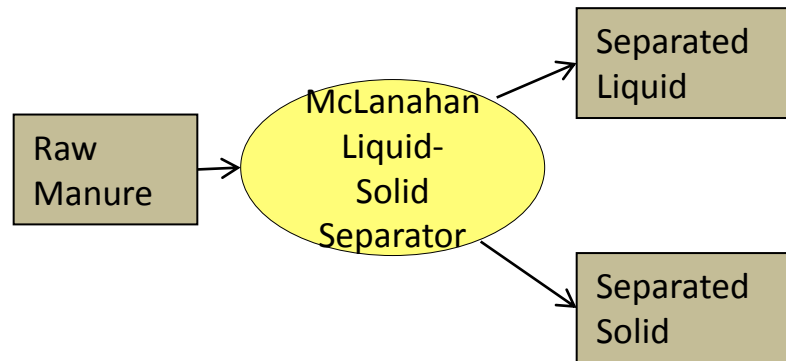
Manure Treatment Systems/Locations



Dairy 1

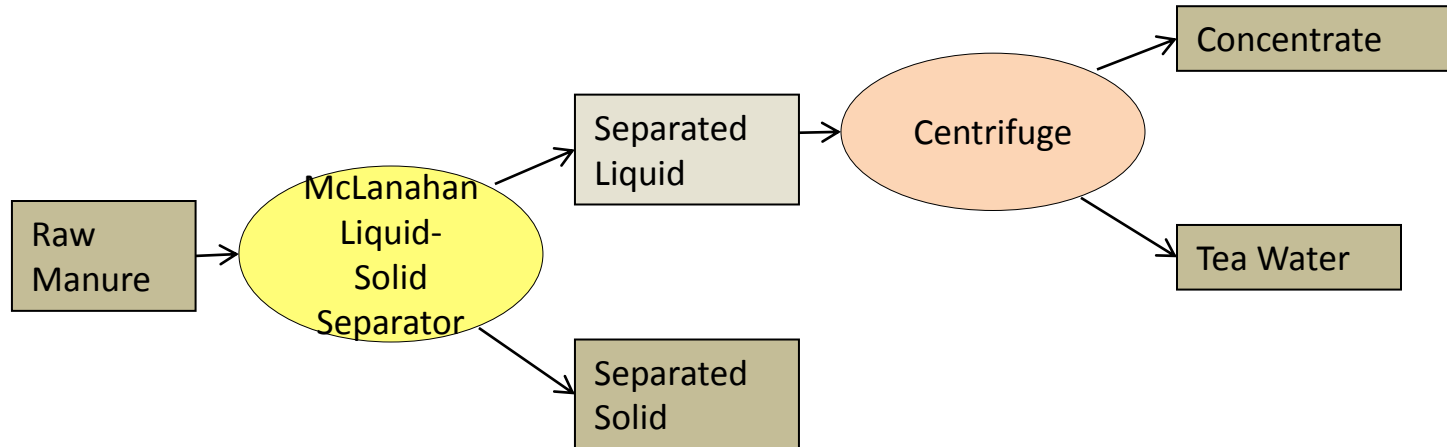


Dairy 2

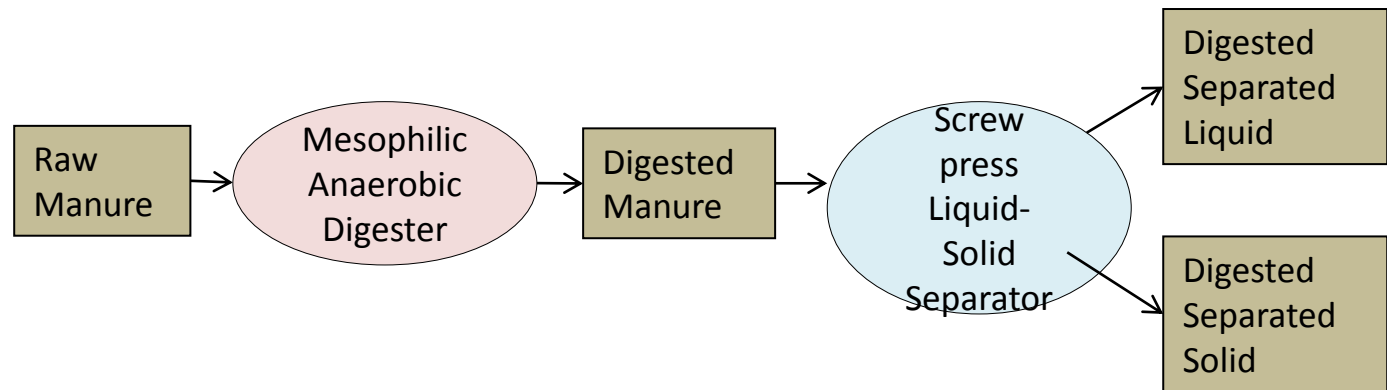


Manure Treatment Systems

Dairy 3



Dairy 4 & 5



Dairy	Manure	DM	C:N	Total N	NH ₄ -N	Total K ₂ O	Total P ₂ O ₅	WSP ₂ O ₅ †	WSP ₂ O ₅ / Total P ₂ O ₅
		%		lb/T ‡					%

Composted Bedded Pack

1	Top	33.7	38	8.1	1.3	14.6	2.8	1.32	48
	Middle	33.4	33	9.4	3.3	13.6	5.7	1.87	33
	Bottom	31.4	29	10.0	2.5	13.6	5.3	1.62	30

Liquid-Solid Separation

2	Raw	10.6	12	7.0	3.8	5.1	2.6	0.64	25
	Sep Liquid	3.6	5	4.3	1.7	3.0	1.6	0.95	60
	Sep Solid	28.6	15	17.2	0.6	4.8	2.0	0.03	1
3	Raw	7.0	14	3.8	1.8	4.2	1.6	0.31	20
	Concentrate	6.1	6	8.9	3.1	4.1	3.6	0.64	18
	Tea water	1.0	3	2.0	1.7	5.4	0.1	0.05	71
	Sep Solid	23.2	13	14.4	0.9	3.9	3.1	1.68	55

† WSP₂O₅, water soluble phosphate

‡ Units are pounds per ton of “as is” manure. For liquid manures, multiple by 4.165 to convert to pounds per 1,000 gallons.

Dairy	Manure	DM	C:N	Total N	NH ₄ -N	Total K ₂ O	Total P ₂ O ₅	WSP ₂ O ₅ †	WSP ₂ O ₅ / Total P ₂ O ₅
		%		lb/T ‡					%

Anaerobic Digestion / Separation

4	Raw	4	7	4.8	2.8	3	2.2	0.19	9
	Digested	5.4	6	6.9	4.2	4.4	2.7	0.21	8
	Dig Sep Liq	3.9	5	6.4	3.3	4.5	2.7	0.15	6
	Dig Sep Sol	24.8	18	12.4	3.5	6.5	8.1	1.54	19
5	Raw	6	7	7.1	4.3	5.6	3	0.19	7
	Digested	5.1	6	6.4	4.3	5.1	2.4	0.16	7
	Dig Sep Liq	3.1	3	6.5	4.5	5.5	1.9	0.08	4
	Dig Sep Sol	32.8	18	15.7	3.9	7.9	14.3	2.2	15

† WSP₂O₅, water soluble phosphate

‡ Units are pounds per ton of “as is” manure. For liquid manures, multiple by 4.165 to convert to pounds per 1,000 gallons.

Experimental Design

- 40 mg P kg⁻¹ soil: 183 lb P₂O₅/a
 - Tea water applied as 10" of irrigation water (73 lb P₂O₅/a)
- Incubation: 25°C for 10 weeks, water content 40 – 60%
- Bray P-1 extraction after incubation
- Increase in STP = STP of a treatment – mean STP in the control



P buffer capacity (PBC) with fertilizer

P Source	Waymor	Dodgeville	Hortonville	Antigo	Mahtomedi
	----- lb P ₂ O ₅ /a/ppm -----				
Fertilizer	13 A	10 B	10 B	9 B	8 B

† Treatments with the same letter are not significantly different (P<0.05).

- All PBC less than A2809
 - Groups A-D (silt loams): 18 lb P₂O₅/a/ppm
 - Group E (sands & Loamy sands): 12 lb P₂O₅/a/ppm
- Lab incubation PBC often lower than field derived PBC

P buffer capacity (PBC) with composted bedded pack

P Source	Waymor	Dodgeville	Hortonville	Antigo	Mahtomedi
	----- lb P ₂ O ₅ /a/ppm -----				
Fertilizer	13	10	10	9	8
Compost Top	29* a†	73*	28* a	19* a	18* a
Compost Middle	15 b	16	16* b	11 b	8 b
Compost Bottom	25* a	23	10 b	15* ab	14 ab

† Within a soil, treatments with the same letter are not significantly different (P<0.05). Means followed by * are significantly different than fertilizer.

P buffer capacity (PBC) with liquid-solid separation

P Source	Waymor	Dodgeville	Hortonville	Antigo	Mahtomedi
	----- lb P ₂ O ₅ /a/ppm -----				
Fertilizer	13	10	10	9	8
2-Row	20*	22 a	18	17	12 a
2-Sep Liquid	18	16 b	14	10	10 b
2-Sep Solid	na	na	na	na	na
3-Row	17 ab	38* a	9	13	12 b
3-Concentrate	15 ab	20* bc	12	14	8 b
3-Tea water	11 b	12 c	10	6	9 b
3-Sep Solid	25* a	31* ab	11	16	25* a

† Within a soil, treatments with the same letter are not significantly different (P<0.05). Means followed by * are significantly different than fertilizer.

P buffer capacity (PBC) with digestion/separation

P Source	Waymor	Dodgeville	Hortonville	Antigo	Mahtomedi
	----- lb P ₂ O ₅ /a/ppm -----				
Fertilizer	13	10	10	9	8
4-Raw	16	18*	21* ab	13*	9
4-Digested	14	13	18 ab	10	9
4-Dig Sep Liquid	13	17*	27* a	11	10
4- Dig Sep Solid	15	16	12 b	11	14
5-Raw	16	28* a	13	13* a	11
5-Digested	17	26* ab	17*	11 ab	12
5-Dig Sep Liquid	15	26 ab	15	10 b	12
5- Dig Sep Solid	15	20 b	17*	11 ab	13

† Within a soil, treatments with the same letter are not significantly different (P<0.05). Means followed by * are significantly different than fertilizer.

Summary

- Compost bedded pack
 - Middle layer sig. lower PBC compared to top
 - Top layer PBC always significantly greater than fertilizer
- Liquid-solid separation
 - Dairy 2: PBC raw greater than separated liquid
 - Dairy 3: In general, tea water had the lowest PBC & separated solids had the greatest PBC

Summary

- Digestion/separation
 - Dairy 4: No differences in PBC between manures except for:
 - Hortonville where digested separated solid had a significantly lower PBC compared to digested separated liquid
 - Dairy 5: No differences in PBC between manures except for:
 - Dodgeville where digested separated solids had a significantly lower PBC compared to raw slurry
 - Antigo digested separated liquid had a significantly lower PBC compared to raw slurry

Summary

- Manure PBCs generally greater than fertilizer
 - BUT only significant in <30% of the comparisons
 - THEREFORE, should assume that manure total P will increase soil test P as much as fertilizer, though it might take a little more manure total P to raise soil test levels
- Additional data analysis is needed on this and another data set before final conclusions can be made

Thanks for your support

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