FEASIBILITY OF USE OF COMPOSTED DETROIT SEWAGE SLUDGE

IN SOD PRODUCTION ON MINERAL SOILS

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At previous conferences our research on utilizing Detroit sewage sludge which has been composted with wood chips as the bulking agent by the Beltsville aerated pile method has been discussed. This work was completed by Mark Carroll and is published in his M.S. Thesis[1]. Most of the analytical determinations on soil and plant samples was done in early 1982. This report will give additional data that was not reported at conferences in 1980 and 1981.

The plots were established at two sod farms on mineral soils in Wayne County: the Huron Sod Farm on an Oakville fine sand and the Waltz Green Acres Sod Farm on a Pewamo sandy clay loam. Soil descriptions are given in Table 1. Appreciation is expressed to Bill Reinhold and Len Zilka at Huron Sod Farms and John, Steve and Bob Chont at Waltz Green Acres for their fine cooperation in allowing us to conduct these studies on their farms.

Table 1. Soil descriptions for fields used in composted sludge research

Sod farm Soil type	Waltz Pewamo sandy clay loam	Huron Oakville fine sand
pH	6.6	4.9
% sand	53.1	93.2
% silt	20.4	4.0
% clay	26.5	2.8
% organic matter	4.0	2.0

Results of compost treatments on turfgrass color and sod development were reported in 1982.[2] A summary of the effect of compost treatments on soil tests at the conclusion of the study is given in Tables 2 and 3. Compost increased pH on both sites, phosphorus tests on the Pewamo soil, potassium tests on both soils, calcium tests on both soils (pH related), and magnesium on the Oakville sand.

Concentration of macronutrients in the clippings of Kentucky bluegrass is presented in Tables 4 and 5. Compost treatments increased nitrogen concentrations in the clippings on the Pewamo soil site (Table 4) which received very little nitrogen fertilizer during the study. In contrast, the Oakville soil site was well fertilized as reflected in the high N content in clippings of all plots (Table 5). Phosphorus content in clippings increased with compost treatment on both sites even though soil P tests did not increase on the Oakville soil (Table 2). The P soil tests were very high at both sites.

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[1] Carroll, Mark J. 1982. Use of Detroit Sewage Sludge Compost for Sod Production on Two Mineral Soils. M.S. Thesis. Michigan State University. 101 pages.

[2] Carroll, M. J., and P. E. Rieke. 1982. Use of sewage sludge compost for for sod production. Proc. 52nd Ann. Mich. Turfgrass Conf. 11:90-97.

Potassium content of the clippings increased with compost addition on the Pewamo soil but not on the Oakville soil, reflecting the fertilization program at each site.

Soil tests for micronutrients and heavy metals for the two sites are given in Tables 6 and 7. Moderate to dramatic increases in zinc (Zn), copper (Cu), manganese (Mn), cadmium (Cd), nickel (Ni), chromium (Cr) and lead (Pb) occurred in both soils. While there was concern for the high levels of some of these elements in the soil, there was no apparent toxicity to the turf in these field plots and the levels of these elements in the clippings was not apparently a problem (See Tables 8 and 9). The most consistant increases occurred for zinc, cadmium, and nickel.

Several physical soil evaluations were also conducted. Table 10 gives the data for effects of compost additions on the water retention curves for the two soils. Increasing compost rates essentially doubled the available water holding capacity (Table 11) of both soils at the rates of composted sludge used. The organic matter content increased from 1.8% on the check plot to 4.5% on the Oakville soil at the highest rate of application (113 tons/acre) while in the Pewamo soil the organic matter content increased from 5.7% in the control plot to 11.3% at the highest rate. This contributes significantly to the water holding capacities of these soils.

Cores of soils from the field plots were brought into the laboratory for other determinations (Table 11). Increasing compost rate decreased bulk density of these soils dramatically, especially in the finer textured Pewamo soil. Saturated hydraulic conductivity (a measure of drainage rate) was increased on both soils.

Conclusions.

Based on our studies and reports from others, we can recommend the use of composted sewage sludge in sod production as an excellent means of adding organic matter to soils which are being depleted of topsoil with continued sod removal. The greatest concern is with the content of heavy metals and other toxic chemicals. Always have the sludge tested before use. Very high levels of metals could impair sod development, of course, but may cause more serious problems in limiting the other crops which could be grown on the site in future years. High levels of heavy metals should not be allowed to enter the food chain. If high levels develop as a result of sludge application, one could be restricted to growing only non-food or feed food or feed crops. Additionally, one should soil test regularly to prevent development of a nutrient imbalance in the soil. Consider these options carefully along with the sludge tests before utilizing sludge materials on a wide scale basis. Some sludges would present few limitations while others would be unacceptable.

Clearly, the use of this composted sewage sludge improved the physical properties of each soil in this study. These were also increases in the levels of many of essential elements. This is one means of recycling nutrients which otherwise are wasted.

We encourage the use of composted sludge if one carefully evaluates the potential for building undesired levels of heavy metals or nutrient imbalances.

Table 2. Soil tests for the Oakville fine sand soil amended with various compost treatments on August 21, 1979 and sampled September 19, 1981.

Treatment						
compost rate	incorporation depth	pH	P	K	Ca	Mg
					T/A	inches
			ppm			
0	4	5.9 b+	470 a	60 c	600 d	93 b
0	8	5.9 b+	470 a	80 bc	650 d	100 b
38	4	6.9 a	420 a	110 aa	1450 bc	187 a
76	4	7.0 a	500 a	120 a	1820 a	200 a
38	8	6.9 a	480 a	100 ab	1300 c	179 a
76	8	7.0 a	470 a	110 a	1620 ab	184 a
113	8	7.2 a	500 a	120 a	1650 ab	181 a

+ Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 3. Soil tests for the Pewamo sandy clay loam soil amended with various compost treatments on August 22, 1979 and sampled August 21, 1981.

Treatment						
compost rate	incorporation depth	pH	P	K	Ca	Mg
T/A	inches		ppm			
0	4	6.3 c+	150 d	280 b	4430 d	790 a
0	8	6.6 b	150 d	250 b	4610 d	810 a
38	4	6.7 ab	250 bc	300 b	5260 bc	790 a
76	4	6.8 a	310 ab	370 ab	5690 ab	810 a
38	8	6.8 a	220 cd	270 b	4810 cd	740 a
76	8	6.9 a	260 bc	310 b	5170 bc	770 a
151	8	6.9 a	350 a	440 a	6110 a	760 a

+ Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 4. Macroelement concentrations of Kentucky bluegrass clippings harvested July 19, 1981 from the Pewamo soil.

Treatment: compost rate	Treatment: incorporation depth	N	P	K	Ca	Mg
T/A	inches			% dry wt.		
0	4	2.24 d+	.27 cd	1.21 e	.58 a	.20 a
0	8	2.31 d	.25 d	1.22 e	.57 a	.18 a
38	4	2.37 cd	.30 bcd	1.52 d	.49 ac	.18 a
76	4	2.71 a	.35 ab	1.91 ab	.43 c	.17 a
38	8	2.49 bc	.34 ab	1.65 cd	.47 bc	.17 a
76	8	2.56 b	.31 bc	1.76 bc	.46 bc	.17 a
151	8	2.81 a	.37 a	2.01 a	.43 c	.17 a

+ Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 5. Macroelement concentrations of Kentucky bluegrass clippings harvested July 31, 1980 from the Oakville soil.

Treatment						
compost rate	incorporation depth	N	P	K	Ca	Mg
T/A	inches	% dry wt.				
0	4	4.43 a+	.35 bc	2.64 a	.32 cd	.17 b
0	8	4.34 a	.34 c	2.66 a	.31 d	.17 b
38	4	4.46 a	.38 abc	2.77 a	.39 abc	.19 a
76	4	4.30 a	.40 a	2.76 a	.45 a	.19 a
38	8	4.45 a	.39 ab	2.82 a	.39 abc	.20 a
76	8	4.24 a	.38 abc	2.67 a	.41 ab	.19 a
113	8	4. 16	.40 a	2.90 a	.38 abcd	.17 b

+ Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 6. Microelement levels of an Oakville fine sand soil amended with various compost treatments on August 22, 1979 and sampled September 19, 1981.

Treatment									
compost rate	incorporation depth	Fe	Zn	Cu	Mn	Cd	Ni	Cr	Pb
T/A	inches	ppm							
0	4	51 d+	6 d	2 d	10 d	.3 d	1 d	1 e	3 e
0	8	77 b	12 d	3 d	13 d	.7 d	2 d	1 e	5 e
38	4	237 b	68 c	18 c	35 bc	3.9 c	10 c	8 c	17 c
76	4	293 a	144 a	36 a	60 a	7.9 a	20 a	13 a	26 a
38	8	177 c	43 c	12 c	29 c	2.5 c	7 c	6 d	13 d
76	8	264 ab	96 b	25 b	42 b	5.4 b	14 b	10 b	22 b
113	8	286 a	134 a	35 a	63 a	7.3 a	19 a	13 a	27 a

+ Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 7. Microelement levels of a Pewamo sandy clay loam soil amended with various compost treatments on August 22, 1979 and sampled on August 21, 1981.

Treatment									
compost rate	incorporation depth	Fe	Zn	Cu	Mn	Cd	Ni	Cr	Pb
T/A	inches	ppm							
0	4	102 a	10 e[+]	4 c	77 b	.7 d	5 d	2 b	6 c
0	8	117 a	9 e	7 bc	76 b	1.7 cd	6 cd	2 b	7 bc
38	4	132 a	83 c	20 a	99 a	5.2 b	18 b	7 a	16 a
76	4	117 a	167 b	22 a	117 a	10.0 a	29 a	8 a	14 ab
38	8	114 a	58 d	16 ab	101 a	3.4 bc	12 bc	5 a	14 ab
76	8	122 a	87 c	17 a	106 a	4.2 bc	14 b	6 a	14 ab
151	8	113 a	203 a	12 ac	116 a	12.2 a	29 a	6 a	10 ab

[+] Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 8. Microelement concentrations of Kentucky bluegrass clippings harvested September 6, 1981 from the Oakville soil.

Treatment									
compost rate T/A	incorporation depth inches	Fe	Zn	Cu	Mn	Cd	Ni	Cr	Pb
		ppm							
0	4	57 a	50 b+	12 b	63 a	.3 c	2.2 d	.7 a	7 a
0	8	53 a	50 b	12 b	67 a	.2 c	2.3 d	.6 a	7 a
38	4	47 a	55 ab	14 ab	52 b	.5 b	4.6 c	.6 a	7 a
76	4	46 a	59 a	15 ab	54 b	.6 ab	7.2 a	.6 a	7 a
38	8	46 a	56 ab	15 ab	50 b	.5 b	4.2 c	.5 a	7 a
76	8	47 a	56 ab	15 ab	56 b	.5 ab	5.9 b	.6 a	7 a
113	8	49 a	61 a	16 a	51 b	.6 a	7.3 a	.6 a	7 a

+ Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 9. Micronutrient concentrations of Kentucky bluegrass clippings harvested July 29, 1981 from the Pewamo soil.

Treatment									
compost rate	incorporation depth	Fe	Zn	Cu	Mn	Cd	Ni	Cr	Pb
T/A	inches	ppm							
0	4	60 a[+]	21 c	2.7 a	36 a	.2 c	1.5 c	.9 a	7.5 a
0	8	63 a	24 bc	2.6 a	36 a	.2 c	1.6 c	.9 a	7.5 a
38	4	41 b	25 bc	2.8 a	24 b	.3 ab	2.2 bc	.7 b	6.4 b
76	4	38 b	34 a	3.4 a	26 b	.3 ab	4.2 a	.5 c	6.2 b
38	8	44 b	26 bc	2.8 a	21 b	.2 c	2.4 bc	.6 bc	6.5 b
76	8	37 b	27 b	3.0 a	20 b	.2 bc	2.7 b	.6 bc	6.3 b
151	8	37 b	34 a	3.3 a	24 b	.4 a	4.7 a	.5 bc	6.1 b

[+] Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test.

Table 10. The effect of compost on the water retention characteristics of 2 soil types.[z]

Compost rate	mass water/mass soil Matric potential (bars) 0.00	-0.03	-0.10	-0.33	-1.00	-15.00
			Pewamo sandy clay loam			
T/A			%			
	28.5	24.2	22.4	20.8	19.9	11.8
38	33.6	26.9	24.4	22.7	21.9	12.8
76	38.2	30.5	27.7	25.8	24.8	13.5
151	51.6	41.1	36.8	34.2	32.9	16.0
			Oakville fine sand			
0	26.6	23.3	11.2	7.2	6.6	3.4
38	30.5	26.6	12.8	9.7	9.0	4.6
76	35.9	30.9	16.1	13.2	12.4	6.4
113	41.1	34.1	19.5	16.5	15.5	9.3

[z] Cores collected August 22, 1981 from the Pewamo soil and September 25, 1981 from the Oakville soil. Water content from 0.00 to -1.00 bar determined on undisturbed soil cores collected from the field.

Table 11. Soil physical determinations made on cores collected from the field in late summer of 1981.

Treatment					
compost rate	incorporation depth	bulk density	saturated hydraulic conductivity	available[x] water	volume[y] wood chips
T/A	inches	g/cc	cm/hr	%	%
		Pewamo sandy clay loam			
0	8	1.49 a[+]	2.8 a	9.0 b	0.2 c
38	8	1.38 ab	3.7 a	9.9 b	3.5 bc
76	8	1.29 b	6.9 a	12.3 ab	6.6 b
151	8	1.08 c	12.5 b	18.2 a	14.8 a
		Oakville fine sand			
0	8	1.51 a	9.9 b	3.7 b	0.1 d
38	8	1.41 b	11.1 b	5.2 ab	1.7 c
76	8	1.30 c	12.7 a	6.8 a	3.3 b
113	8	1.21 d	13.1 a	7.3 a	5.5 a

[+] Treatment means having the same letter within a column are not significantly different at the 5% level by Duncan's New Multiple Range Test. Comparisons between the two sites were not made.

[x] Amount of water held between -0.33 and -15 bars on mass basis.

[y] Volumetric percentage of wood chips greater than 2.00 mm found in soil core.

[z] Cores collected August 22 from the Pewamo soil and September 25 from the Oakville soil.