COMPOST APPLICATION TO RYEGRASS

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ABSTRACT

Four different composts at 3 different amounts were incorporated into 4 replicated plots of Myakka fine sandy soil (Typic Haplaquod) prior to seeding annual ryegrass (Lolium multiflorum L.) The composts used were municipal solid waste (MSW), 2 yard waste composts (YW1, YW2), and a compost made of yard and food wastes (KYW). Composts were applied to supply 168, 336, or 672 total kg N ha^{-1}, by estimating ½ of the total N in the compost might be available in the first growing season. Phosphorus was supplied preplant as triplesuperphosphate (44.8 kg/ha P). Potassium was supplied as KCl (89.7 kg/ha K). In the early months after amending the soil, vigor and coverage of ryegrass were impeded by yard waste compost while MSW compost had the least adverse effects on early vigor and coverage. Supplemental N was needed with all composts. A second year of seeding ryegrass into the plots also required supplemental N to achieve an acceptable stand. Over the two year period, amendments of compost doubled the yields of ryegrass, compared to unamended plots grown with chemical fertilizer alone, however no differences in yields occurred due to the amounts of amendments used.

INTRODUCTION

Traditionally, municipal solid waste (MSW) as well as yard trimmings or kitchen scraps have been considered a disposal problem and have been landfilled, incinerated, or dumped into the ocean. These methods are increasingly being eliminated as legislation is written to alleviate adverse effects on air and water quality. Landfill space is becoming limited with many states reporting their landfill capacity will be reached by the end of the century (Repa and Sheets, 1992). Composting is an alternative method for processing MSW, yard trimming, and kitchen scraps, and removing these materials from the traditional waste stream.

Compost is increasingly being considered as a soil conditioner and fertilizer (Stratton et al., 1995). It is well documented that the addition of compost to sandy soil greatly improves tilth, soil structure and quality, as well as increasing water-holding capacity and cation exchange capacity (Cook et al., 1994; de Bertoldi et al., 1987; Elliott and Stevenson, 1977; Hernando et al., 1989; Hortenstein and Rothwell, 1972; Mays et al., 1973; Scanlon et al., 1973). Yield increases due to compost amendments have been reported for turfgrass (Bevacqua and Mellano, 1993) and corn (Mays and Giordano, 1989) as well as several vegetable crops. MSW compost can supply essential plant nutrients (Gallardo-Lara et al., 1990; Giusquiani et al., 1988; Juste and Mench, 1992; Koma-Alimu and Janssen, 1976; Tisdale et al., 1985). A detailed review of the effects of composts on crops and the environment may be found in a review chapter on the subject by Stratton et al. (1995).

At this time, over 4.86 million hectares of grassland are grown in Florida. Grasses grown on sandy soils of low fertility may benefit from additions of compost to the soil. Marginal soils with poor structure and low amounts of

organic matter and plant nutrients have shown the greatest benefits from additions of compost (Hortenstein and Rothwell. 1972; Scanlon et al.. 1973). The soils of Florida grasslands are typically sandy and of low fertility and may show much benefit from land application of composts. Short-term benefits may include increased coverage. vigor. and yields of forage grasses. Long-term expected benefits may include improved soil structure. increased water-holding capacity. increased cation exchange capacity. and possible increased retention of fertilizers. fungicides. or pesticides. More research is needed on the long-term benefits of amending soils with composts. Additional benefits of land-applying compost include the removal of MSW. and kitchen and yard wastes from the traditional waste stream and the effects that removal will have on the innumerable environmental systems involved. The research reported herein investigated the effects of amending soil with MSW compost. yard waste compost. or yard and kitchen waste compost on the vigor. coverage. and yield of annual ryegrass (Lolium multiflorum L.).

OBJECTIVES

1. To determine the effects of MSW compost. yard waste compost. or kitchen and yard waste compost on vigor. coverage. and yield of annual ryegrass forage (Lolium multiflorum L.)

2. To compare and contrast the effects of the MSW compost with those of a kitchen and yard waste compost. three different yard wastes. or ammonium nitrate on coverage. vigor and forage yield of ryegrass.

MATERIALS AND PROCEDURES

1996 SEASON PLANTING

In November 1995. 2 composts and 2 yard wastes were obtained from 4 different facilities. The MSW compost was produced by the Sumter County Municipal Composting Facility in Sumterville. FL. The kitchen and yard waste compost (KYW) was produced by the Disney composting facility in Orlando. FL. Yard waste 1 (YW1) was obtained from the St. Petersburg Municipal Greens Waste Collection program in St. Petersburg. FL. Yard waste two (YW2) came from yard wastes collected in Sarasota. FL and handled by a private company. Hereafter in general. and in tables. these materials will be referred to as N Sources. Analyzes of the five materials is shown in Table 1.

The composts and yard waste materials were applied to the soil prior to early December planting of the 1995-1996 winter annual ryegrass crop. Incorporation is described below. Three different amounts of each material were applied along with an ammonium nitrate comparison series. The amounts of amendments applied were calculated on preliminary analyzes of the amendments (provided by the supplier) with the estimate that 50% of the N in the composts and wastes might be readily available to the plants in the first growing season. For each amendment. at each calculated amount. the estimated available N from the amendment was expected to approximate the amounts of N applied as ammonium nitrate. Treatments applied are reported in Table 2.

Plots were 2.2 x 4.6 m at the Range Cattle and Education Center at Ona. FL. on Myakka fine sandy soil (Aeric Haplaquod). Four replications of each treatment were laid out in randomized complete block design. Prior to applications the soil was analyzed and results are reported in Table 3.

Concurrent with application of the ammonium nitrate. composts or wastes. P (44.8 kg/ha) and K (89.7 kg/ha) were applied. Composts. yard wastes. and the fertilizers were surface applied then disked in to 15 cm depth. Annual ryegrass seed was broadcast 33.6 kg/ha. Soil was tamped with a weighted barrel roller. Seed planted in November 1995 failed to germinate and the plots were reseeded in early December 1995. Supplemental N at 56 kg N/ha as NH_4NO_3 was applied in January. Forage was harvested March 22. and April 17. 1996. Soil was sampled in January and April 1996. The top 5 cm of soil was scraped from the surface and an auger 2.5 cm in diameter was used to take 3 samples per plot which were then mixed and frozen for later analysis. Soil moisture was calculated using field moist soils which were air dried for 3 days then reweighed.

Table 1. Analyzes of composts and wastes for soil application to annual ryegrass forage plots

N Source	pH	EC(dS/m)	C/N	%N	%P	%K	%Ca	%Mg
MSW	7.89	2.6	20.8	1.31	0.22	0.18	2.92	0.18
YW1	8.02	2.76	25.1	0.90	0.11	0.26	6.45	0.14
KYW	7.74	7.56	10.8	1.48	0.51	0.41	2.25	0.15
YW2	8.06	2.42	25.7	0.67	0.19	0.21	4.05	0.21

Table 1. (continued) Analyzes of composts and wastes for soil application to annual ryegrass forage plots

N Source	Zn	Cu	Mn	Fe	B	Cd	Pb	Ni
	mg/kg							
MSW	1210	413	630	25650	75	6	204	52
YW1	251	26	47	2000	17	0.5	41	14
KYW	84	59	150	3880	17	1.0	9.5	3
YW2	38	10	56	3165	17	0.5	9.5	2

Table 2. Materials and amounts of soil amendments or fertilizer applied

N Amount		N Source			
estimated kg/ha as N	NH_4NO_3 kg/ha as N	MSW Mg/ha.ww	YW1 Mg/ha.ww	KYW Mg/ha.ww	YW2 Mg/ha.ww
0	0	NA	NA	NA	NA
168	168	72	27	13	27
336	336	143	54	26	54
672	672	287	107.5	51.5	107.5

NA=not applied

Table 3. Analysis of unamended Myakka fine sandy soil

EC(ds/m)	0-0.1
pH	6.3-6.9
	------mg/kg------
NH_4-N	1.5-3.8
NO_3-N	0-0.5
P	6-7
K	13-19
Ca	600-700
Mg	175-200
Mn	0.5-0.8

Analysis of the forage harvest included yield, vigor, and coverage. Yield was measured by collecting completely all the clippings in a mowed strip, weighing the clippings wet and dried, and calculating yield for a hectare. Vigor was rated visually on a scale of 1 to 10, 1 representing discolored spindly seedlings with just a few leaves, 10 representing thick-bladed, large green seedlings with many blades. Coverage was rated visually using an estimate of percentage of soil surface covered by the seedlings. Vigor and coverage ratings were made on Feb 20, 1996 for the first harvest, the first season. Statistical analysis was by analysis of variance, and regression analysis (Snedecor and Cochran, 1980).

1997 SEASON PLANTING

Seed planted in early December 1996 failed to germinate due to severe drought, and ryegrass was reseeded January 3, 1997. Phosphorus (44.8 kg/ha) and K (89.7 kg/ha) were applied as in 1996. Supplemental irrigation as well as an application of supplemental N (56 kg/ha N as NH_4NO_3) was needed to obtain a single harvest of forage on February 24, 1997. The next scheduled harvest, a month later, was canceled due to severe drought and death of the grass.

RESULTS

VIGOR

Plots grown with ammonium nitrate had good vigor especially at the highest amount of N fertilization (Table 4). Plants in this treatment were robust, well-shaped plants with many blades of good color and extension of rhizomes was readily apparent. Plants grown with MSW compost had moderate to fair vigor which decreased somewhat at the highest amount of MSW application. Plants grown with the two yard wastes and the yard waste with kitchen waste (YW1, YW2, and KYW, respectively) appeared pale and stunted, with fewer leaves and fewer apparent rhizomes than those grown with ammonium nitrate (Table 4). In plants grown with KYW vigor increased as the amount of application increased (Table 4). Significant linear regressions occurred with ammonium nitrate and KYW.

COVERAGE

Coverage is reported as the percentage of soil that is covered (100 - the %that is bare). Coverage was greatest in plots with ammonium nitrate, and coverage increased as amount of N increased (Table 5). MSW amended plots showed the next greatest coverage between 44 and 77% and increasing with amount) while KYW amended plots had only about 50% of the soil covered with grass. The yard waste amended plots (YW1, YW2) had only about 1/3 of the soil covered with growth, and with higher amounts of application less coverage occurred (Table 5). Significant linear regressions occurred with ammonium nitrate and KYW.

Table 4. Vigor of grass planted in amended plots (1-10 rating*)

N Amount				N Source		
kg/ha	NH_4NO_3	MSW	YW1	KYW	YW2	Mean
0	1.68	1.68	1.68	1.68	1.68	1.68 d
168	3.12	3.25	2.25	2.50	2.88	2.39 c
336	5.38	3.37	2.38	3.00	2.75	3.12 b
672	8.25	3.00	2.38	3.37	2.75	3.56 a
Mean	6.61 a	2.82 a	2.17 a	2.34 bc	2.52 bc	

*Vigor (10 = premium color. large. evenly-shaped leaf blades. 1= yellow and/or purple color. stunted plant with curled or twisted leaf blades)
Means within columns or within rows followed by the same letter are not significantly different ($p \leq 0.05$).

Table 5. Coverage of grass planted in amended plots*

N Amount				N Source		
kg/ha	NH_4NO_3	MSW	YW1	KYW	YW2	Mean
0	44.4	44.4	44.4	44.4	44.4	44.4 b
168	70	70	37.5	43.8	36.2	47.1 b
336	89.5	77.5	35.0	55.0	35.0	53.5 a
672	99.5	76.2	35.0	56.2	32.5	54.7 a
Mean	75.8 a	67.0 b	47.8 c	49.8 c	37.0 d	

*Coverage (% of plot area covered by vegetation. visual estimate)
Means within columns or within rows followed by the same letter are not significantly different ($p \leq 0.05$).

YIELD

Yield differed greatly between harvests made on 3-15-96. 4-17-96. and February. 1997 and the different harvests are reported in Tables 6. 7 and 8. Yields were especially low where no amendment was made to the soil. but was also quite low where ammonium nitrate was the amendment. At the March 1996 harvest. MSW and KYW produced the highest yields and ammonium nitrate the lowest. With MSW or the two yard wastes. yields were lower at the highest amount of application than at the amount just below. At the March harvest. all of the amendments except ammonium nitrate or KYW resulted in lower yields at the highest amounts of application (Table 6). By the next monthly harvest there was no difference in yield between amounts of amendments other than with ammonium nitrate: any amount of organic amendments produced about the same yield (Table 7). At the April 1996 harvest. the MSW. and yard waste treatments produces the highest yields. ammonium nitrate the lowest. Plants grown only with ammonium nitrate had the lowest forage monthly yield in both March and April of 1996 (Tables 6 and 7). In 1997. kitchen and yard waste compost (KYW) produced the highest yields of ryegrass. and ammonium nitrate the lowest (Table 8). At the highest amounts of application. MSW compost produced lower yields than at the next lower amount (Table 8).

Table 6. Yield of monthly ryegrass harvest 3-15-96 (kg/ha dw)

N Amount				N Source		
kg/ha	NH_4NO_3	MSW	YW1	KYW	YW2	Mean
0	26.5	26.5	26.5	26.5	26.5	26.5 c
168	74	1795	1730	1337	1497	1261 a
336	159	1873	1370	1546	1200	1232 a
672	496	1283	1153	1795	1024	1050 b
Mean	189 e	1244 a	1070 bc	1176 ab	937 c	

Means within columns or within rows followed by the same letter are not significantly different ($p \leq 0.05$).

Table 7. Yield of monthly ryegrass harvest 4-17-96 (kg/ha DW)

N Amount				N Source		
kg/ha	NH_4NO_3	MSW	YW1	KYW	YW2	Mean
0	164	164	164	164	164	164 b
168	317	3313	2953	2507	3117	2557 a
336	473	3377	3118	2896	2676	2584 a
672	666	3308	3137	3402	3306	2753 a
Mean	405 c	2541 a	2343 ab	2242 b	2316 ab	

Means within columns or within rows followed by the same letter are not significantly different ($p \leq 0.05$).

Table 8. 1997 Ryegrass yields in response to N source and N Amount (kg/ha DW)

N Amount				N Source		
kg/ha	NH_4N0_3	MSW	YW1	KYW	YW2	Mean
0	346	346	346	346	346	346c
168	588	906	915	1105	996	894b
336	786	1124	1244	1147	1036	1072a
672	1311	880	1087	1420	1071	1129a
Mean	662b	823b	903ab	1017a	862ab	

Means within columns or within rows followed by the same letter are not significantly different ($p \leq 0.05$).

DISCUSSION

Within a month of establishing the first crop of ryegrass. some growth impediment was visibly evident with certain amendments. Some of the impediment appeared physical as in plots amended with yard waste two (YW2). Some of the decrease in vigor and coverage may also be attributable to nutrient deficiency. primarily N. Coverage and vigor of the plants was least in plots amended with the yard wastes. and these yard wastes had higher C/N ratios than did the MSW or KYW (Tables 1. 4 and 5). In both years supplemental N was applied after the amendments were applied. In 1996. prior to supplemental N fertilization the plants were visibly stunted and colored as to suggest severe N deficiency. especially on plots where yard wastes had been applied. This effect was most likely due to N immobilization by soil microbes as the yard waste decayed in situ. In plots where only chemical fertilization was used the N was out of the root zone within a month to six weeks. and plants receiving the N fertilizer without a waste amendment produced less forage yield than those grown with waste amendment and a small one-time application of N. Yields were best where the wastes with lower C/N ratios and supplemental N were accompanied by good growing conditions such as adequate soil moisture and cool temperatures. as was the case in the April 1996 monthly forage harvest.

CONCLUSIONS

1. Applications of yard wastes can result in impediment of vigor and coverage of ryegrass if seeding directly follows amendment incorporation.

2. Yield of ryegrass is greater with addition of organic matter to soil. provided enough N is made available to the crop.

LITERATURE CITED

Bevacqua. R.F.. and Mellano. V.J.. 1993. Sewage sludge compost's cumulative effects on crop growth and soil properties. Compost Sci. Util. 1(3):34.

Bradstreet. R.B. 1965. The Kjeldahl Method for Organic Nitrogen. Academic Press. NY.

Cook. B.D.. Halbach. T.R.. Rosen. C.J.. and Moncrief. J.R.. 1994. Effect of a waste stream component on the agronomic properties of municipal solid waste compost. Compost Sci. Util. 2(2):75.

De Bertoldi. M.. Ferranti. M.P.. L'Hermite. P.. and Zucconi. F.. 1987. Compost: Production. Quality and Use. Elsevier Applied Science. London.

Elliott. L.F. and Stevenson. F.J.. 1977. Soils for Management of Organic Wastes and Waste Waters. Soil Science Society of America. Madison. WI.

Gallardo-Lara. F.. Navarra. A.. and Nogales. R.. 1990. Extractable sulphate in two soils of contrasting pH affected by applied town refuse compost and agricultural wastes. Biol. Wastes 33(1):39.

Giusquiani. P.L.. Marucchini. C.. and Businelli. M.. 1988. Chemical properties of soils amended with compost of urban waste. Plant Soil 109:73.

Hernando. S.. Lobo. M.C.. and Polo. A.. 1989. Effect of application of a municipal refuse compost on the physical and chemical properties of a soil. Sci. Total. Env. 82:589.

Hortenstein. C.C. . and Rothwell. D.F.. 1972. Use of municipal compost in reclamation of phosphate-mining sand tailings. J. Env. Qual. 1:415.

Juste. C. and Mench. M., 1992. Long-term application of sewage sludge and its effects on metal uptake by crops. P. 159 In: Adriano. D.C. (editor) Biogeochemistry of Trace Metals. Lewis Publishers, Boca Raton. FL.

Keeney. D.R.. and Nelson. D.W., 1982. Nitrogen- Inorganic forms. P. 643. In: Methods of Soil Analysis. Part 2. ASA_SSSA. Madison. WI.

Koma-Alimu F.X.. and Janssen. B.H., 1976. Evaluation of municipal refuse from Dohomey (Benin) as and organic manure. Proc. Soil Organic Matter Studies Symposium 6. Braunschweig.

Mays. D.A.. and Giordano. P.M.. 1989. Landspreading municipal waste compost. BioCycle 30(3):37.

Mays. D.A.. Terman. G.L.. and Duggan. J.C.. 1973. Municipal composts: effects on crop yields and soil properties. J. Env. Qual. 2:89.

Repa. E.W.. and Sheets. S.K.. 1992. Landfill capacity in North America. Waste Age 23:18.

Scanlon. D.H.. Duggan. C.. and Bean. S.D.. 1973. Evaluation of municipal compost for strip mine reclamation. Compost Sci. Util. 14:4.

Snedecor. G.W.. and Cochran. W.G.. 1980. Statistical Methods. Seventh Edition. Iowa State University Press. Ames. IA.

Tisdale. S.L.. Nelson. W.L.. and Beaton. J.D.. 1985. Soil Fertility and Fertilizers. Macmillan Publishing Company. NY.

Stratton. M.L.. Barker. A.V.. and Rechcigl. J.E.. 1995. Compost. P. 249. In: Rechcigl. J.E. (editor) Soil Amendments and Environmental Quality. Lewis Publishers. Boca Raton. FL.