# Composted greenwaste used as a bermudagrass soil amendment

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## Abstract

The California Integrated Waste Management Act mandated a 50% diversion of landfill wastes by the year 2000, based on 1990 levels. Grass clippings comprise approximately 50% of yard trimmings deposited in California landfills, and yard trimmings are the largest single component of California's municipal waste. Recycling greenwaste into composted soil amendments for use in turfgrass plantings could improve turfgrass quality and significantly reduce landfill deposits. In this study, three rates of composted greenwaste (0.24, 0.39 and 0.49 $m^3$ $m^{-3}$) were incorporated into the top 10 cm of a sandy loam soil. Arizona common bermudagrass (*Cyonodon dactylon* L) was seeded 2 wk subsequent. Sports traffic was mimicked using a modified Brinkman simulator over three seasons. Soil amended with composted greenwaste resulted in higher turfgrass visual quality ratings and greater infiltration rates and total plant biomass than unamended soil. The highest overall visual quality ratings occurred in plots receiving no traffic and the greatest volumes of compost. Infiltration rates were highest in the 0.49 $m^3$ $m^{-3}$ treatment receiving no traffic and lowest in plots receiving traffic. Total plant biomass levels resulting from the 0.49 $m^3$ $m^{-3}$ treatment receiving traffic were not significantly lower than the.25 $m^3$ $m^{-3}$ no traffic treatment. Plots receiving no amendment and traffic produced the lowest biomass of all treatments. The highest volume of amendment applied did not reduce visual quality, biomass production or infiltration rates, potentially increasing the market for greenwaste compost as a turfgrass soil amendment and leading to greater landfill diversion.

## Media Summary

Findings of this study suggest that composted greenwaste used as a soil amendment can improve turfgrass quality while diverting organic matter from landfills.

## Keywords

turfgrass, compost, California, biomass, landfill diversion

## Introduction

The California Integrated Waste Management Act enacted in 1989 mandated a 50 percent diversion of landfill wastes that each county and city generate by the year 2000, based on 1990 levels. An average California lawn produces as much as 20 metric tons of organic matter per hectare annually. Grass clippings have historically comprised 50% of yard trimmings deposited in California landfills, and yard trimmings account for the largest single component of California's municipal waste. Recycling greenwaste by adding these materials as soil amendments to turfgrass plantings to improve turfgrass quality and augment landfill diversion efforts is becoming increasingly important in California. However, there are few published data indicating the optimum volume and specific benefits of composted organic materials for this purpose. Previous research indicates that, in general, organic soil amendments increase water and nutrient retention of sandy soils (Hartz et al.,1996; Laganiere et al.,1995) and may enhance drought resistance (Miller, 2000). Organic soil amendments added to coarse-textured soils may also increase the diversity of pore sizes leading to a more gradual water release (McCoy, 1992). Inorganic materials used as soil amendments have been used with some success (Wehtje, 2003) although often held water is largely unavailable to the plant (Waddington et al., 1974). Objectives of this three year research project were to measure the effect of three volumes of composted greenwaste applied as a soil amendment on bermudagrass visual quality, overall plant biomass, and soil infiltration.

## Materials and Methods

Three rates of composted greenwaste (0.24, 0.39 and 0.49 $m^3 m^{-3}$ final volume) supplied by California Biomass, Inc. (Bloomington, California) were incorporated into the top 10 cm of a sandy loam soil in early August 2000 at the UC Riverside turfgrass research site (33.97? N, 117.33? W). Percentages of N, C and OM contained in the compost were 1.39, 14.21, and 11.78, respectively. The C:N ratio was 10:26; CEC 38.8 meq/100 g; pH 7.6; EC 30.2 mmhos/cm and SAR 18.8. Ionic concentrations (meq/L) were: Ca 35.8; Mg 35.8; Na, 112.8; Cl 272.0; and, $HCO_3$,14.3. A randomized complete block experimental design with six replicates in two plots was used An unamended control was included. Arizona common bermudagrass (*Cyonodon dactylon* L) was seeded 2 wk later at a rate of 9.8 g $m^{-2}$. Simulated traffic began in May 2001 by subjecting assigned treatments to 3 passes every 2 wk with a modified Brinkman traffic simulator. Plots were irrigated at 80% of historic reference evapotranspiration (ETo), adjusted on a monthly basis. Fertilizer was applied during the growing season to all treatments at a total rate of 24.4g N $m^{-2}yr^{-1}$. Data were analyzed by ANOVA SAS statistical software (SAS Institute,1988) and means were separated according to Fisher's protected LSD.

Turfgrass visual quality was measured every 2 to 4wk throughout the year, except January, on a 1-9 scale (9 = highest quality). Plant mass, water infiltration rate and surface elevations were measured 2 to 3 times annually. Infiltration was quantified using a static head, double ring infiltrometer in two locations per plot. Oven-dried plant mass was measured after removing soil from one 5 cm-wide x 10 cm-deep soil core per treatment plot and separating shoots and roots.

## Results

During the initial 12 months of the study (Table 1) there were no differences in visual quality ratings between traffic vs. no traffic treatments receiving the same volume of compost amendment and overall quality of all treatments was lower than in successive years. The second and third years resulted in higher visual quality ratings in all treatments than the first year and plots receiving the same volume of compost without traffic rated higher than those receiving traffic (Table 1). The highest overall visual quality ratings occurred in plots receiving no traffic and the greatest amounts of compost (0.49 and 0.39 $m^3 m^{-3}$) (Table 2). By the end of the study, all compost treatments resulted in higher quality ratings than plots receiving no amendment and traffic (Table 2).

**Table 1. Visual turfgrass quality . 1-9 scale: 9 = highest.**

| Treatment | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| 0.49 ($m^3 m^{-3}$), no traffic | 5.6 | 6.3 | 6.2 |
| 0.39, no traffic | 5.5 | 6.3 | 6.1 |
| 0.25, no traffic | 5.5 | 6.2 | 6.1 |
| No amendment, no traffic | 5.5 | 6.0 | 6.0 |
| 0.49 with traffic | 5.5 | 6.1 | 6.0 |
| 0.39 with traffic | 5.4 | 6.0 | 5.9 |

| | | | |
|---|---|---|---|
| 0.25 with traffic | 5.5 | 5.7 | 5.9 |
| No amendment, with traffic | 5.4 | 5.2 | 5.7 |
| **LSD** | **0.2** | **0.2** | **0.2** |

**Table 2. Overall visual turfgrass quality. 1-9 scale: 9 = highest.**

| Treatment | Year 1-3 |
|---|---|
| 0.49 ($m^3$ $m^{-3}$), no traffic | 5.7 |
| 0.39, no traffic | 5.7 |
| 0.25, no traffic | 5.6 |
| No amendment, no traffic | 5.6 |
| 0.49 with traffic | 5.6 |
| 0.39 with traffic | 5.5 |
| 0.25 with traffic | 5.4 |
| No amendment, with traffic | 5.2 |
| LSD | 0.1 |

Infiltration rates were highest in the 0.49 ($m^3$ $m^{-3}$) treatment receiving no traffic and lowest in all plots receiving traffic (Table 3). Treatments receiving no traffic had greater infiltration rates than those receiving traffic. The lowest infiltration rate resulted from traffic and no amendment.

**Table 3. Infiltration Rate (cm $hr^{-1}$)**
**(Dec. '01, Aug. '02, Dec. '02, Aug, '03, Nov.'03)**

| Treatment | cm $h^{-1}$ |
|---|---|
| 0.49 ($m^3$ $m^{-3}$), no traffic | 8.6 |
| 0.39, no traffic | 4.8 |

| | |
|---|---|
| 0.25, no traffic | 4.0 |
| No amendment, no traffic | 3.6 |
| 0.49 with traffic | 2.5 |
| 0.39 with traffic | 1.8 |
| 0.25 with traffic | 0.8. |
| No amendment, with traffic | 0.7 |
| **LSD** | **2.5** |

Total plant biomass was greater for treatments receiving equal amounts of composted greenwaste in the no traffic plots than the traffic plots (Table 4). However, biomass levels resulting from the 0.49 $m^3$ $m^{-3}$ treatment receiving traffic were not significantly lower than the.25 $m^3$ $m^{-3}$ no traffic treatment. The treatment in which plots received no amendment and traffic produced the lowest biomass of all treatments.

**Table 4. Total plant biomass (g $m^{-2}$ to 10 cm depth)**
**(June '01, Sept. '01, June '02, Oct.'02, June '03, Sept. '03)**

| **Treatment** | **g $m^{-2}$** |
|---|---|
| 0.49 ($m^3$ $m^{-3}$), no traffic | 1297 |
| 0.39, no traffic | 1278 |
| 0.25, no traffic | 1208 |
| No amendment, no traffic | 1159 |
| 0.49 with traffic | 1147 |
| 0.39 with traffic | 1134 |
| 0.25 with traffic | 1068 |
| No amendment, with traffic | 922 |

| LSD | 110 |
|---|---|

## Conclusions

In this study, soil amended with composted greenwaste resulted in higher bermudagrass turfgrass visual quality and greater infiltration rates and plant mass than unamended control soil. The highest volume of amendment applied (0.49 $m^3$ $m^{-3}$ ) did not result in reduced visual quality, biomass production or decreased infiltration rates, potentially increasing the market for greenwaste compost as a turfgrass soil amendment and leading to greater landfill diversion of these organic materials. Additional research comparing the combined effects of different depths and volumes of organic matter incorporation on visual quality, biomass and infiltration rates of bermudagrass plantings subjected to varying levels of traffic simulation would further define recommended standards.

## References

Hartz. T.K., F.J. Costa, and W.L. Schrader. 1996. Suitability of composted greenwaste for horticultural uses. HortScience 31(6):961-964.

Laganiere, M., P.Lecomte, and Y. Desjardsins.1995.The effect of composted paper sludge and municipal waste compost amendments on the growth of Kentucky bluegrass. HortScience 30(4):896.

McCoy. E.L. 1992. Quantitative physical assessment of organic materials used in sports turf rootzone mixes. Agron. J. 84:375-381.

Miller, G.L. 2000. Physiological responses of bermudagrasss grown in soil amendments during drought stress. HortScience 35:213-216.

SAS Institute. 1988. STAT user's guide. 6th ed. SAS Inst., Cary, NC.

Waddington, D.V., T.L. Zimmerman, G.J. Shoop. L.T. Kardos, and J.M. Duich. 1974. Soil modification for turfgrass areas. I. Physical properties of physically amended soils. Prog. Rep. 337. Pennsylvania State Univ. College of Agriculture, Agric. Exp. Stn., University Park, PA.

Wehtje, G.R., J.N. Shaw, R.H. Walker, and W. Williams. 2003. Bermudagrass growth in soil supplemented with inorganic amendments. HortScience 38:613-617.