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Characterization of fresh yard trimmings for agricultural use

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Abstract

Direct application of yard trimmings to agricultural land can benefit soils and crop production, while providing an outlet for handling high volumes of materials at compost facilities. Variability in the composition of yard trimmings can make it difficult to determine appropriate application rates. Our objective was to characterize the chemical composition and variability of yard trimmings generated throughout the spring and summer season at facilities in the Puget Sound region of Washington State. Yard trimmings were sampled from four composting facilities on five dates between April and August 1999. One material contained mostly grass clippings and had higher mean total N (3.2%) than mixed grass and woody materials (1.5–2%). Mean C:N was lower in the grass-rich material (12:1 vs. 15 to 21:1), while mean ammonium concentrations were similar (0.18–0.28%). Variation among facilities was greater than variation over time. The amount of variation observed with other nutrients, pH, EC, or trace elements would not affect use of the yard trimmings in agriculture. Our results suggest that it is possible to characterize yard trimmings adequately for agricultural use.

Keywords: Yard trimmings; Yard debris; Yard waste; Nitrogen; CN ratio; Fiber fractionation; Trace elements; Seasonal variation

1. Introduction

Yard trimmings comprise nearly 13% of the waste stream in the United States (USEPA, 2000). In the densely populated Puget Sound region of western Washington, most yard trimmings are recycled via composting at private, commercial facilities. In the Seattle-King County area, 185,000 tons of yard trimmings were composted at commercial facilities in 1999, which was nearly 75% of the total generated (Cascadia Consulting, 2000).

The main components of yard trimmings in the Puget Sound area are grass clippings, woody trimmings, and woody debris. The largest volumes are generated from April through July, which is also the period with the greatest proportion of grass clippings in the yard trimmings (Uhlar-Heffner et al., 1998). The large volumes of grass-rich materials can lead to serious odor problems at composting facilities, requiring composters and municipalities to look for alternative strategies to reduce yard trimmings volumes during peak periods.

Two strategies currently used are grass cycling (encouraging residents to leave clippings on the lawn) and direct application of yard trimmings to agricultural land (Uhlar-Heffner et al., 1998). Research in the Puget Sound area has shown that land-applied yard trimmings can meet the nutrient needs of a corn crop, and increase the organic matter content of the soil (Bary et al., 2004). Local farmers have tested yard trimmings on a variety of crops, including corn, flower bulbs, rhubarb, winter squash, and cabbage. A key to the successful use of yard trimmings is being able to predict agronomic application rates that will supply adequate N for crop growth without excessive leaching of nitrate into ground water.

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Variability in the composition of yard trimmings increases the uncertainty in determining agronomic application rates. In a national survey, Oshins and Block (2000) reported wide ranges in the types of materials received at yard trimmings composting facilities, even among facilities in the same geographic area. The different sources of materials (grass clippings, woody trimmings, leaves, debris) differ in chemical composition, resulting in highly variable composition of the yard trimmings materials.

We conducted this study to characterize the chemical composition and variability of yard trimmings from different facilities in the Puget Sound area through a spring and summer season. It is part of a larger project focused on determining appropriate application rates and practices for yard trimmings (Bary et al., 2004; Sullivan et al., 2004).

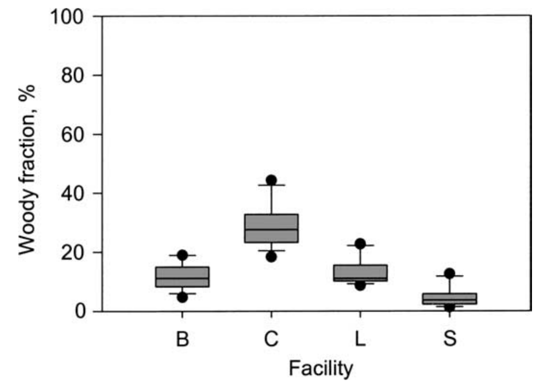

Fig. 1. Oversize woody trimmings (retained on 16 mm screen, or stick diameter > 5 mm) expressed as a percentage of the whole yard trimmings sample weight. Samples collected from four facilities over five dates. Boxes show median, 25th, and 75th percentile values; whiskers show 10th and 90th percentile; and points show outliers.

2. Methods

2.1. Sampling

Yard trimmings were collected from four composting facilities in the Puget Sound area of western Washington. Facilities B, C, and L receive curbside and self-hauled yard trimmings consisting mostly of grass clippings, woody trimmings, and woody debris. Facility S receives similar materials, primarily self-hauled by landscape maintenance companies.

Yard trimmings at Facility L were screened, ground, and piled in aerated windrows for three to five days before sampling. Yard trimmings from the other facilities were sampled within one to four days of delivery and processing. At Facility B yard trimmings were screened, ground and piled, while at Facility C yard trimmings were ground and piled without screening. At Facility S loads rich in grass clippings were segregated for this project, and placed directly in a pile without screening or grinding.

We sampled yard trimmings from each facility on five dates between April and September, 1999. Yard trimmings from Facilities B, C, and L were sampled from windrows 2.5 to 3.5 m high. A front-end loader opened the windrows, exposing fresh faces in a 40 m^3 volume of material. At Facility S, a smaller pile of 10 m^3 volume was split into two faces. We collected a minimum of 15 grab samples from different heights and locations along the faces, and combined them in a 50-L container. Three replicate samples were collected in the same fashion from each facility on each sampling date.

A 15-L subsample of each replicate was passed through a 16-mm screen to remove large woody material. The material that passed through the screen was sorted by hand to remove woody pieces greater than 5 mm in diameter. We assumed that the screened and sorted woody material would be nearly inert in the short run. The proportion of woody material from each source is shown in Fig. 1.

Some green material did not pass through the 16-mm screen. It consisted mostly of long grass mixed with large leaf fragments and whole leaves, and comprised less than 10% of the sample dry weight. It was not combined with the screened material, because the large particles would make it difficult to obtain representative samples.

2.2. Sample analyses

Analyses were run on whole (unscreened) and screened samples. Whole samples were dried (55 °C) and ground, and used for analysis of nutrients (except N) and trace elements. A portion of the screened sample was dried (55 °C), ground and used for N and C analyses, fiber fractionation, pH, and electrical conductivity. Another portion was retained fresh or frozen for ammonium analysis.

Total C and N were determined on dried, screened samples using a combustion analyzer equipped with an infrared detector (LECO Instruments Model CNS 2000, LECO Instruments, St. Joseph, MI; Sweeney, 1989). Ammonium-N concentrations in fresh and dried yard trimmings were measured after extraction with 2 M KCl. Ammonium-N was determined using an automated salicylate-nitroprusside method (Gavlak et al., 1994). Nitrate-N, determined by an automated cadmium reduction method (Gavlak et al., 1994), was insignificant (<50 mg/kg) in all yard trimmings samples. Total N concentrations (N_t) for the fresh yard trimmings samples were determined as:

$$N_t = \text{Total } N_{dried} - NH_4\text{-}N_{dried} + NH_4\text{-}N_{fresh}$$