AMAZING RESULTS IN THREE YEARS

HIGHLY COMPACTED SOILS IMPROVED BY COMPOST USE

Original compacted clayey soil at the site (1) was amended with 50 percent compost by volume and added to a depth of 18 inches (2). Three years later, the landscape is thriving (3) and soil remains below root inhibiting levels.

Cornell University study shows how manure-based compost has lasting benefits for growth and health of plants.

Mary Schwarz, Nina Bassuk, Jean Bonhotal and Ellen Harrison

COMPACTED SOILS are the ubiquitous result of urbanization and the building process — with their high bulk densities and low macroporosities that restrict root growth. Creating viable landscapes on severely degraded sites due to construction damage is a tremendous challenge for professionals in horticulture. At the same time, livestock farms — especially New York State dairies — are under increasing pressure to improve their manure management. Composting is one important option that can help to reduce odors and pathogens, while enhancing biosecurity on farms.

A three-year long project was conducted by Cornell University's Waste Management Institute and Horticulture Department to examine use of manure-based compost for disturbed construction sites. The objective was to amend a compacted clayey soil with two types of compost in a landscape setting so that beneficial levels of soil density, aeration and drainage could be achieved.

Research conducted by A. Rivenshield and Nina Bassuk at Cornell's Urban Horticulture Institute in 2001, demonstrated that compacted soils can be made productive again if appropriate types and volumes of composted organic matter are incorporated. Soil bulk densities were reduced to below root restricting thresholds with the addition of 33 percent compost (by volume) in a sandy loam soil and 50 percent compost in a clay soil. With this in mind, a thorough characterization of the "before" conditions at the site was performed, including soil texture and density, spatial variability, drainage, water-holding capacity, nutrient and microbial status. Soil from the site was taken to the lab and amended with two types of composts (poultry and dairy) at increasing levels to predict how much would be necessary to create beneficial conditions for plant growth. The dairy compost was manure, bedding and food scraps bulked with wood chips. The compost was made on a dirt pad in windrows with a high turning frequency. The poultry compost was poultry manure and bedding bulked with wood chips. This was also made on a dirt pad in windrows with a high turning frequency.

Soil was taken from the site and roughly sieved through an 8 mm sieve. Zero, 25, 50 and 75 percent compost of both types was added by volume to the soil. The soil was mixed and recompacted using a standard Proctor hammer protocol and tested for density, macroporosity and drainage. Four replicates of each type of compost-soil mixture were analyzed. Table 1 shows the bulk density and macroporosity of the initial soil tests run in the laboratory. Fifty percent amendment reduced the bulk density of the soil to below root inhibiting levels (1.45g/cc) for silty clay soil after recompaction.

The original soil was taken from the site and amended with 50 percent compost (by volume). Half was amended with poultry compost and half with dairy manure compost and then returned to the site and added to a depth of 18 inches. The site was approximately 75 by 50 feet. It was divided into the "triangle" (site 1) and "Warren" (site 2). Both the poultry and the dairy manure compost amended soils were used in the triangle and Warren.

Because this was a "real world" project

Table 1. Average bulk density and macroporosity for different volumes of soil and compost. Values followed by different superscripts in each column are significantly different (p < 0.05).

Compost	% Volume	Bulk Density	Macro-porosity
None	0	1.81[a]	0.59[a]
Poultry	25	1.65[b]	0.54[a]
Poultry	50	1.51[c]	1.24[a]
Poultry	75	1.36[d]	1.43[a]
Poultry	100	1.22[e]	1.49[a]
Dairy	25	1.56[bc]	0.84[a]
Dairy	50	1.28[de]	1.08[a]
Dairy	75	0.91[f]	1.55[a]
Dairy	100	0.51[g]	4.99[b]

Table 2. Average bulk density of the soil at the different site/compost combination over three years.

Date	Poultry Site 1	Poultry Site 2	Dairy Site 1	Dairy Site 2
12/3/04	0.81[a]	1.13[a]	0.85[a]	1.01[a]
11/3/05	0.67[a]	1.12[a]	0.82[a]	0.98[a]
9/21/06	0.80[a]	1.15[a]	0.97[a]	0.94[a]

Values followed by different superscripts in each column are significantly different (p < 0.05).

Table 3. Average macroporosity of the soil at the different site/compost combination over three years.

Date	Poultry Site 1	Poultry Site 2	Dairy Site 1	Dairy Site 2
12/3/04	6.1[a]	3.3[a]	4.0[a]	3.2[a]
11/3/05	3.0[a]	3.3[a]	3.8[a]	3.9[a]
9/21/06	3.8[a]	3.0[a]	4.3[a]	4.1[a]

Values followed by different superscripts in each column are significantly different (p < 0.05).

seeking to improve a degraded landscape, there were no unamended control plots. Soil samples of the amended garden soils were taken in quadruplicate from the different site/compost combinations on 12/3/04, 11/3/05 and 9/21/06 and tested for density, macroporosity and drainage. The bulk density and the macroporosity remained constant over time indicating that the benefits of compost addition lasted over three growing seasons (Tables 2 and 3).

The landscape is thriving and the bulk density of the soil remains below root inhibiting levels. The use of manure-based compost in soil remediation of construction sites can have lasting benefits for the growth and health of plants. ■

The authors are with Cornell University's Waste Management Institute and Department of Horticulture based in Ithaca, New York.