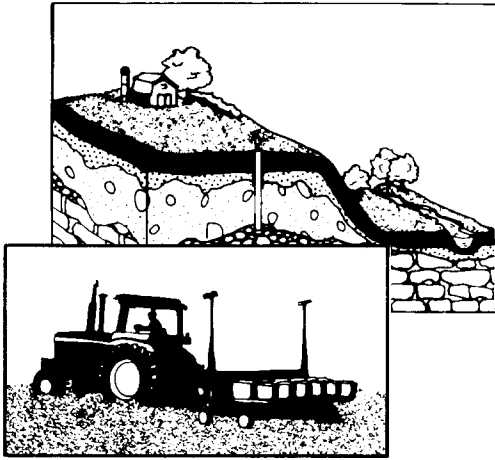


Soil Facts

Using Municipal Solid Waste Compost



Of the 160 million tons of municipal solid waste produced in the United States annually about 85 percent is landfilled. In 1989, North Carolina produced 6 million tons of municipal solid waste. Landfilling poses many problems, such as rising landfill maintenance and development costs, decreasing availability of landfill sites, and an increasing risk that substances leaching from landfills may contaminate groundwater and surface water.

From 25 to 40 percent of these solid wastes could be composted and used in land-based disposal systems. Using this organic material to amend the soil could not only improve soil quality but also serve as an environmentally safe and economically sound method of waste disposal.

From Trash to Compost

Composting is a natural biological process. Carried out under controlled conditions, it hastens the decomposition of organic waste and reduces its volume, creating a stable, soil-enriching humus. A basic understanding of the composting process will help you appreciate its beneficial effects on soil and crop growth.

The microorganisms that function in composting have basic requirements. To achieve an acceptable product, adequate amounts of air, water, and nutrients must be supplied. Proper control of surface area, temperature, and acidity is also necessary.

Microorganisms involved in organic waste degradation also need carbon as an energy source and nitrogen for protein synthesis. The carbon-to-nitrogen ratio required by these microorganisms is 30-to-1, whereas, municipal solid waste has a much larger ratio of 150-to-1 or higher. Thus, nitrogen added to reduce the carbon-to-nitrogen ratio will enhance the composting process.

Other elements needed by the microorganisms may not be available during their initial rapid build-up. These elements may be added as necessary. The addition of lime neutralizes some of the organic acids released during decomposition, maintains a desirable acidity

range, and reduces the loss of nitrogen gas. The added nutrients combined with the nutrients released during breakdown of the organic waste remain in the compost as a valuable resource for plant growth.

The biological activity and temperatures higher than 140°F destroy pathogens and most weed seed, resulting in a final product that is safe to use.

Properties of Compost

Because landfill waste is composed of a high percentage of noncompostible materials, composting must be followed by screening. In a recent study of Buncombe County landfill compost, screening removed the noncompostible and large wood particles, leaving a dark, friable product containing a high percentage of unidentifiable organic constituents. The composition of this material is shown in Figure 1. Table 1 gives an analysis of the elements found in the compost. The following additions were made to supply nutrients needed by the microorganisms and to achieve the necessary pH and carbon-to-nitrogen ratio: 3 pounds of nitrogen, 2 pounds of P_2O_5 (phosphate), 2 pounds of K_2O (potash), and 5 pounds of dolomitic limestone per cubic yard of raw material. The composting process reduced the volume by approximately 50 percent and concentrated the basic elements

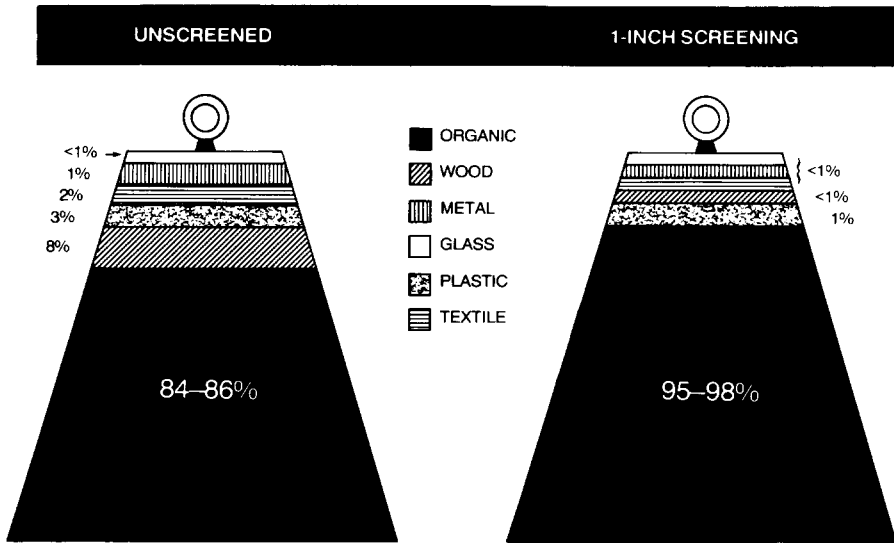


Figure 1. Weight composition of Buncombe County landfill compost (LC).

Table 1. Elemental Composition of Buncombe County Landfill

Element	Concentration	EPA Max. Levels
Nitrogen	6.0%	—
Phosphorous	4.2%	—
Potassium	5.1%	—
Calcium	2.6%	—
Magnesium	8.6%	—
Chromium	8.2 ppm	1,000
Cadmium	1.6 ppm	10
Copper	34.0 ppm	500
Lead	310.0 ppm	500
Nickel	7.5 ppm	100
Zinc	210.0 ppm	1,000
Barium	7.5 ppm	—
Cobalt	3.8 ppm	—
Silver	Trace <math><1</math> ppm	—
Gold	Trace <math><1</math> ppm	—

nitrogen, phosphorus, potassium, calcium, and magnesium as shown in Table 1. The finished compost had a pH of 7.3 and a cation exchange capacity* of 63 centi moles per kilogram. This high nutritive value and large cation exchange capacity suggest many uses for improving soil quality and crop

productivity. Also, heavy metal concentrations were well below Environmental Protection Agency limits and safe for crop production.

*Cation Exchange Capacity a measure of the soil's ability to hold basic cations such as potassium, calcium, and magnesium.

Effect of Compost on Soil Properties

When municipal solid waste compost was incubated with a sandy or clayey soil, the bulk density of each soil was reduced (Figure 2). Bulk density changed proportionally to the rate of compost addition. Consequently, the soils' structure, tilth, moisture retention capacity, and the water infiltration rate of the clay soil were improved. Compaction and crusting were reduced.

The two soils' cation exchange capacities were markedly increased by adding composted municipal solid waste (Figure 3). Adding 25 percent compost to a sandy or clayey soil increased the cation exchange capacity 500 to 600 percent. Further compost additions continued to increase the cation exchange capacity, but never as significantly as the first 25 percent. At an optimum level of saturation the increased cation exchange capacities would enhance the ability of the soils to hold potassium, calcium, and magnesium in an available form. Potassium would increase from 195 to 1,014 pounds per acre; calcium from 1,200 to 6,240 pounds per acre; and magnesium from 180 to 936 pounds per acre.

Plant Growth Response to Landfill Compost

The response of tomatoes grown in a variety of pine bark and landfill compost mixtures are shown in Figure 4. At all rates of nitrogen fertilization, plant response improved as the percentage of compost increased. In the first crop of tomatoes, the following gains in biomass were seen as the compost increased: 1,900 percent when no nitrogen was applied; 1,420 percent when 100 parts per million of nitrogen was applied; and 800 percent when 200 parts per million of nitrogen was applied (Figure 4A). Along with positive responses as the compost levels increased, the sec-

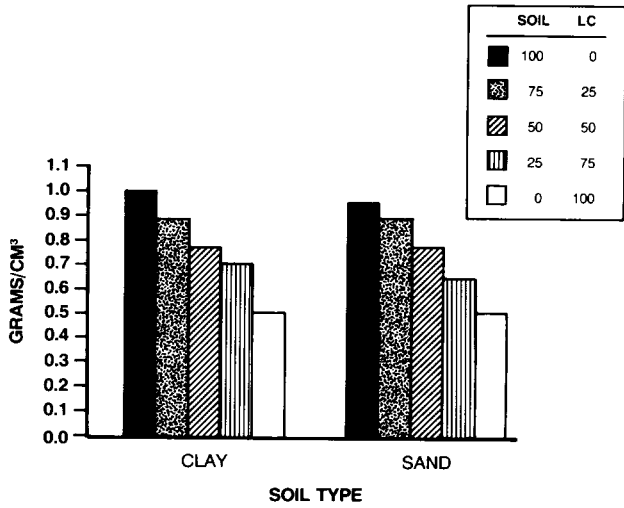


Figure 2. Effect of Buncombe County landfill compost on bulk density of a sandy and clayey soil.

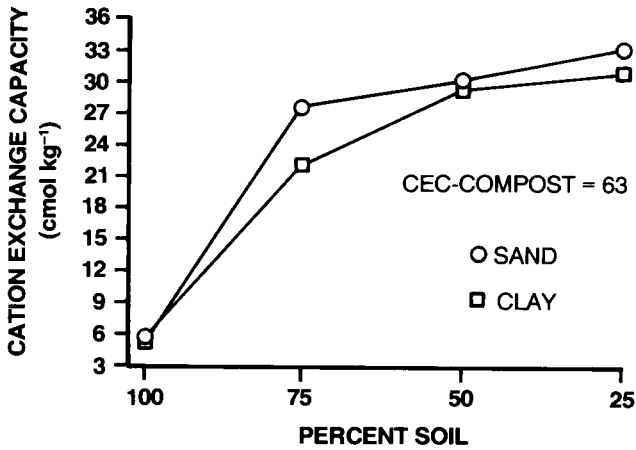


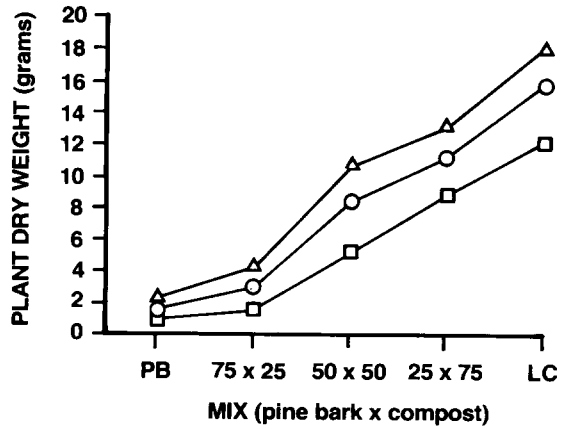
Figure 3. Effect of Buncombe County landfill compost on the cation exchange properties of a sandy and clayey soil.

ond crop of tomatoes grown in the same media showed a greater response to nitrogen. The removal of much of the available nitrogen contained in the compost by the first crop caused the increased effects of nitrogen in the second crop. The response to increasing compost levels, though not as great as in the first crop, was a direct response to the organic components of the compost (Figure 4B).

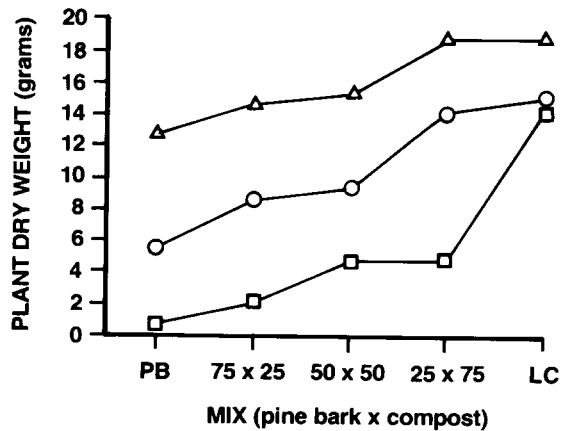
Fruit production was also enhanced by increasing the compost content of the growing medium

Key to Figure 4.	
Nitrogen Rate (ppm)	
200	△
100	○
0	□

A 1st CROP (BIOMASS)



B 2nd CROP (BIOMASS)



C 2nd CROP (FRUIT YIELD)

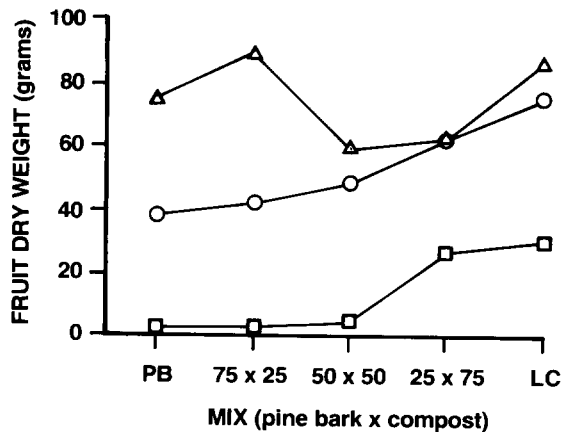


Figure 4. Effect of landfill compost on dry weight of tomato plants and fruit yield at three nitrogen levels.

(Figure 4C). At the highest level of nitrogen supply (200 parts per million of nitrogen), the fruit response varied with changes in the composition of the growing medium. These changes may have been caused by high nitrogen levels, which have been reported to reduce fruit set. Analysis of tomato fruit did not show any heavy metal accumulation. Thus the fruit would be safe for human consumption.

Impatiens responded much differently to compost. When no nitrogen was added, the best growth was attained in 100 percent compost. With nitrogen application rates of 100 or 200 parts per million, the maximum response to compost was at the 75 and 50 percent levels, respectively (Figure 5).

How to Use Landfill Compost

Landfill compost can be used effectively in many plant production systems. Field soils can be improved by incorporating compost into the soil during land preparation or by applying it as surface mulch. With field-grown nursery or sod crops, where significant volumes of soil are removed at harvest, compost could replenish soil losses, thus maintaining productivity.

Container-produced nursery crops are frequently grown in a

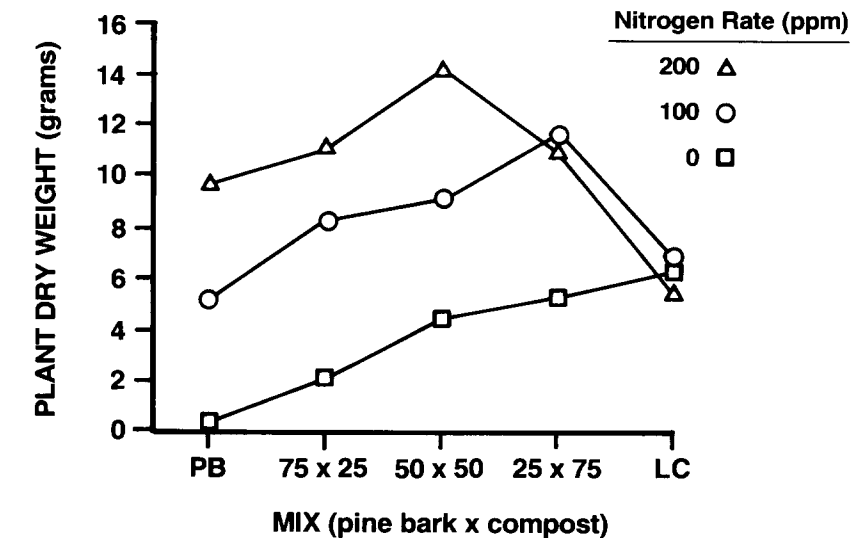


Figure 5. Effect of Buncombe County landfill compost on dry weight of impatiens at three nitrogen levels.

medium of pine bark and peat moss. Compost could be used as a substitute for the peat moss and, with some crops, as the growing medium for container production. Compost could be used in greenhouse operations as a medium or a medium amendment for production of floral crops and bedding plants.

Conclusion

Composted municipal solid waste has been used successfully to improve the physical and chemical

properties of soils and increase the growth of tomatoes, birch, maple, and bluegrass-fescue sod. However, it was not found to increase the growth of azaleas because the pH of the medium was too high for optimum growth. These studies indicate that composted landfill waste has many potential uses in producing various agricultural crops. Compost could be prepared to meet consumer demands with minimal processing.

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5,000 copies of this public document were printed at a cost of \$800.00, or \$0.16 per copy.

Published by
THE NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

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