Breaking it down

Growers can get the most value from their compost by having it analyzed first


OREGON STATE UNIVERSITY

By Dan M. Sullivan and Ryan Costello

The science and art of composting is becoming more important for a variety of horticultural enterprises.

As interest in compost grows, so does the need to better understand what compost is, and to learn about the limitations and advantages of particular composts. In this article, we provide suggestions for how to use compost testing as a tool to get greater value from compost use.

Selecting the right laboratory to analyze your compost is an important first step. It's best to use a laboratory that specializes in compost analysis. Tell the lab whether you plan to use the compost as potting media, soil amendment, or mulch. Compost testing laboratories typically offer several "routine" analyses that differ depending on intended compost use.

When choosing a lab, ask for a copy of their report form. By looking it over, you can see if the results are presented in a manner that you can

42 ▶

An ongoing series provided by
Oregon State University
in partnership with OAN

understand, and in units you can relate to. You will also want to find out how much your desired analysis will cost, how the lab wants the sample handled and delivered, and on what day the sample should be shipped.

A routine compost analysis usually includes analyses of three major components: general physical and chemical properties; organic matter (carbon) and nitrogen; and other nutrients. Following is a breakdown of each of these areas.

General properties

These physical and chemical attributes include the following.

Compost moisture or water content. This is expressed as a percentage of compost wet weight. A compost with 40 percent moisture contains 60 percent dry matter. Composts with high moisture (more than 60 percent) are usually clumpy and difficult to spread. Composts with low moisture (less than 40 percent) are dusty.

The higher the moisture content, the lower the amount of organic matter you get per cubic yard of compost.

Bulk density. This measurement is expressed in pounds per cubic yard. Laboratories can perform a bulk density test, or you can perform it in the field. An estimate of compost bulk density is needed to convert compost nutrient content from your lab report (expressed on a weight basis) to a volume basis (for compost application in the field).

Composts that are screened and contain 50 percent moisture have a bulk density of about 1000 pounds per cubic yard. In the field, bulk density can be estimated by packing a bucket of known size with compost, then measuring the compost weight.

Electrical conductivity (EC). This an indicator of soluble salt content. It is usually reported in units of mmhos/cm, mS/cm, or dS/m. All of these units are equal numerically and have the same interpretation.

High salt levels may injure plants. Most soluble salts are soluble nutrients, so a high salt compost may be a good fertilizer, when applied at a low rate. For potting media, an EC of 1 to 2 in the mixed media is the target for most plants. If compost EC is 4 mmhos/cm and you incorporate compost at 25 percent by volume in pots, then potting media EC is increased by 1 mmhos/cm by compost addition. Soluble salts can be leached out of potting media with irrigation, so they are not a long-term problem. Composts with high EC (>4) may injure transplants if used in planting holes.

Compost pH. Most composts are moderately acidic (pH 6) to moderately alkaline (pH 7.5). Raw manures have pH near 9, while finished manure based composts usually have pH of 7 to 8. The high pH of most manure-based composts is unsuitable for acid-loving plants such as rhododendron and blueberry. When used in moderation, composts with a pH of 6 to 7 are suitable for a wide range of plants.

Organic matter and nitrogen

Total Carbon (C) or organic matter (OM). This attribute is expressed as a percentage of the dry weight of a compost.

In a compost that contains 40 pecent organic matter, the remaining material is ash (inorganic). Typical values for compost are 40 to 60 percent organic matter.

Carbon comprises about half of the organic matter weight (total C multiplied by 2 equals organic matter). A compost with 50 percent organic matter, contains about 25 percent carbon.

Total nitrogen (N). This figure is comprised of organically bound nitrogen (not immediately plant-available) plus inorganic nitrogen (ammonium-N plus nitrate-N). Usually, more than 90 percent of total nitrogen in compost is in organic form. Compost organic nitrogen is estimated as total nitrogen minus inorganic nitrogen.

Carbon to nitrogen ratio (C:N). This is the ratio of total carbon to total nitrogen. Well-composted materials reach a stable ratio of 12 to 15, similar to the ratio found in soil organic matter. Woody composts typically have a higher carbon-to-nitrogen ratio of more than 20. These composts may increase the need for nitrogen fertilizer.

Composted manures may have a carbon-nitrogen ratio of less than 10, indicating that they will supply a significant amount of plant-available nitrogen in the short term.

Inorganic nitrogen. Sometimes called "plant-available nitrogen," this is composed of soluble ions (ammonium and nitrate), and is reported as ammonium-N and nitrate-N (nitrogen in the ammonium or nitrate form).

Ammonium-N and nitrate-N are released from decomposition of organic nitrogen. In most composts, inorganic nitrogen comprises less than 10 perecent of compost total nitrogen, with the remainder of total nitrogen in organic form. Finished composts usually contain more nitrate-N than ammonium-N.

Nitrogen fertilizer replacement value. This value for a particular compost can be estimated using its inorganic nitrogen content. The organic nitrogen in compost decomposes very slowly in soil after application, and can be ignored in estimating short term N fertilizer replacement value.

A compost that contains 0.1 percent inorganic nitrogen (1000 ppm N) on a dry weight basis contains 2 pounds inorganic nitrogen per dry ton, or about 0.5 pounds of inorganic nitrogen per cubic yard of compost.

So, if you apply 3 cubic yards of compost per 1,000 square feet (about an inch depth) of this compost, you apply the equivalent of 1.5 lb inorganic nitrogen per 1,000 square feet. This compost application would replace 3 pounds urea fertilizer (46-0-0) per 1,000 square feet.

Other nutrients

Composts supply other nutrients

44 ▶

DIGGER Marketplace

Researchers at OSU North Willamette Research & Extension Center mix compost feedstocks, then place them in "apple bins" for composting. Each week, for the first four to six weeks of composting, the bins are dumped and water is added to simulate the turning and watering a compost windrow.

that are important for plant nutrition, such as phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and micronutrients.

Lab methods for compost nutrient testing have been adapted from soil and plant tissue testing procedures. Ask your lab to use testing procedures for these nutrients that are appropriate for your intended compost use.

For potting media, most labs report the nutrient content of a saturated paste extract. For application of compost in the field, a simpler lab method (total nutrient analysis) can be used. For field applications, total phosphorous and total potassium are considered roughly equivalent to fertilizer phosphorous and potassium.

Optional tests

These compost tests are sometimes useful, depending upon how you plan to use the compost:

Particle size is determined by sieving. Composts for greenhouse potting mixes need to be of specific size to maintain correct porosity and water-holding capacity. Particle size is usually not important for field application of compost.

Stability is the resistance of compost to further biological decomposition. Stability is usually determined by measuring carbon dioxide loss during incubation of a compost sample.

Very unstable composts contain organic acids and/or ammonia that can kill or injure plants. Adequate compost stability is critical for composts used in greenhouse potting mixes and bagged composts, but less important for application to farmland, especially when several weeks elapse between application and planting, or when compost is applied as a mulch.

Stability is also an indicator of "shrinkage" (volume loss after potting) for container crops. A few labs that specialize in compost testing offer stability tests. A qualitative 4-hour on-site test for compost stability (Solvita™) is available from Woods End Laboratory.

Additional biological testing. Several labs offer analyses designed to evaluate compost biology (such as counts of fungi, bacteria, actinomycetes, and other microbial indicators). These tests may be of interest for specific applications. However, compost biology is extremely variable, and organisms present in compost may be short-lived in soil or potting media, these tests are of limited utility for most applications.

Looking at an example

Table 1 (next page) lists compost analyses derived from 2009 research at the North Willamette Research and Extension Center in Aurora, Ore. Composting was performed at a pilot scale research facility using locally available materials.

Let's look at some of the results.

Composts derived from dairy, poultry, horse or other animal manure had pH values greater than 7.5. Lower pH values (6 to 7.5) were found with composted woody materials and grass (yard debris compost).

Salt levels in manure-based composts varied depending upon the amount of bedding and how manure was collected. The addition of woody bedding to horse manure diluted its salt content. Compost derived from separated dairy solids had lower salt levels than found in other manure composts. Broiler litter added nitrogen to compost, but it also dramatically increased salts and pH. High pH values and salt (EC) concentrations in some manure-based composts would be a concern for potting media.

All of the composts listed in Table 1 were "stable" (resistant to decomposition) as determined by testing in our laboratory. Compost C:N ratios (less than 15) were typical of finished compost. At the start of our composting trials, raw materials were mixed together to give a starting carbon-nitrogen ratio of 30:1. During composting, carbon was lost as carbon dioxide, while nitro-

46 ▶

Table 1: Compost Analysis After Ten Weeks

Final Compost Analysis (6 months after start of composting)*							
Compost ID	Raw materials composted**	pH	Electrical Conductivity (EC) ***	Total Nitrogen (N)	Nitrate-N	Nitrate-N to Ammonium-N Ratio	C:N Ratio
	% by volume			%	%		
A	80% separated dairy solids ; 20% spent hop cones	7.8	1.3	1.1	0.03	18	14
B	60% separated dairy solids, 30% grass hay, 10% broiler litter	8.0	4.2	2.1	0.12	93	11
C	45% horse manure + bedding, 45% grass hay, 10% spent hop cones	7.7	3.4	1.3	0.07	66	11
D	50% grass clippings, 50% landscape shrub prunings	5.7	4.6	1.5	0.14	36	10

*Carbon and Nitrogen analyses on dry weight basis
** Starting compost feedstock mixes prepared with C:N ratio of 30:1
***Electrical conductivity (EC) in 1:5 dry compost:water slurry

gen was retained. The final compost carbon-nitrogen ratio of around 15, indicates that approximately half of the organic matter present in the raw organic materials was decomposed (lost as carbon dioxide) during the composting process.

All finished composts contained more nitrate-N than ammonium-N, another indicator of finished compost. As compost cools (after 4 to 6 weeks of hot composting), ammonium-N is converted to nitrate-N by microbes.

Dan M. Sullivan is an associate professor of crop and soil science at Oregon State University. He can be reached at Dan.Sullivan@oregonstate.edu. Ryan Costello is a graduate research assistant in the OSU Crop and Soil Science Department and can be reached at ryan.costello@oregonstate.edu.

ADVERTISERS INDEX