

**EXTENSION**

BAE-1732

Compost quality

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Introduction

A question plaguing compost makers since ancient times is, “When is compost done?” The answer is — it all depends on the end use of the compost. Compost used as a winter mulch and tilled in the following spring should not heat up nor give off strong odors when wetted. Compost bagged and sold as a topsoil blend, on the other hand, must contain very stable organic matter and be free of foreign objects and large clumps.

This factsheet goes beyond, “Is it done yet?” and delves into Compost Quality — the measures by which compost is called “good” or “mature.” A comprehensive system for determining quality is the California Compost Quality Council’s Maturity Index. The maturity index uses four criteria — pH, C:N ratio, stability and toxicity to assign suitability of compost for all uses. This fact-sheet offers two additional measures of compost quality: salinity and texture.

Background on compost quality

Acidity and alkalinity

Some plants are sensitive to high pH (basic) soils, while others are sensitive to low pH (acidic) soils. Compost pH can be measured with a portable pH meter, or samples can be sent to a laboratory for a comprehensive compost test. It is best to keep compost relatively neutral (pH 7) and allow the end user to adjust soil pH as necessary (see OSU factsheets [PSS-2229, Soil pH and buffer index](#); [PSS-2290, Acidify lawn and garden soil in Oklahoma](#)). Achieving a neutral pH requires composting well beyond the hot composting phase into the curing phase, allowing sufficient time for organic acids and ammonia to reach more stable forms.

Nitrogen immobilization due to high C:N ratio

Perhaps the most harmful result of using immature compost is nitrogen immobilization, the temporary loss of plant-available nitrogen when immature compost is mixed with soil. If the ratio of carbon to nutrients (measured as nitrogen) of compost is higher than 20 ($C:N > 20$), microorganisms can steal available soil nitrogen away from plants. Microbes absorb nitrogen as they digest organic matter and grow. If there is not enough nitrogen available for both the microbes and the plants to use, the microbes, which grow faster than plants, lock the limited nitrogen away in their bodies. Nitrogen immobilization is not permanent. Eventually, soil microorganisms will consume all the readily available organic matter, die and release nitrogen back to the soil. The cycle will start over again the next time high C:N-ratio compost is added. Compost C:N ratio is measured by sending samples to a laboratory for comprehensive compost testing. Monitor C:N ratio and continue composting until C:N ratio consistently drops below 20.

Organic matter stability

Stability is a catch-all term for the level of microbial activity in compost. Microorganisms stabilize compost by partially decomposing organic matter, removing oxygen from the air and releasing heat and carbon dioxide to the environment. Some common ways to measure stability are temperature rise, respiration rate and putrescence.

Temperature rise

A sure sign that organic matter is still stabilizing is when a compost pile heats up after being turned and watered. This “auto-heating” is an outward sign of high microbial respiration. When aerobic microbes digest organic matter, they do so by using exothermic (heat-releasing) processes. If many microorganisms are eating at the same time and there is enough volume to retain heat in the pile, there will be a perceptible rise in temperature. The California Compost Council Maturity Index refers to “Dewar Jar Temperature Rise” as a measure of compost maturity (See Table 2). This may give the impression that there are standard containers and procedures for measuring auto-heating. This really isn't the case. A Dewar jar or bottle is a vacuum flask used to keep stored material hot or cold for long periods of time. It is so named because the vacuum bottle was invented by James Dewar in 1892. His name has become synonymous with a vacuum flask in the UK, much as we call it a thermos in the United States. “Dewar Jar Temperature Rise” can be approximated using an ice chest and a compost thermometer (See [BAE-1761 the icebox test: An easy method to determine auto-heating potential of compost and byproduct materials](#)).

Respiration rate

Aerobic organisms respire by taking in oxygen (O_2) and releasing carbon dioxide (CO_2). The collective breathing in and breathing out of all the organisms in a batch of compost is measured as its respiration rate. Respiration is measured by either calculating the amount of oxygen absorbed or the amount of carbon dioxide released per unit mass of compost in a sealed container. The Solvita test (Solvita.com) is a simple, commercially available test that approximates carbon dioxide release in a sealed jar. The color of a paddle changes as it is exposed to carbon dioxide.

Putrescence

Organic matter putrefies when it decays without adequate oxygen, giving off a putrid or “death” smell. Putrescence alerts flies and other undesirable visitors that organic matter is good to eat. Measuring putrescence is simple — the nose is a sensitive instrument.

These three measures of organic matter stability (temperature rise, respiration rate and putrescence) are related, and they have the same solution: Add sufficient carbonaceous or “brown” material at the start of composting, mix or aerate often and continue composting beyond the hot phase. Also, be sure not to overwater so the compost pile does not become anaerobic.

Toxicity

Compost may contain toxic substances such as ammonia, salt and herbicides that reduce seed germination, root development, and plant functions. Other poisonous toxins make compost hazardous to animals and humans. Gardeners often worry that compost too rich in nitrogen will “burn” their plants. Premature yellowing or wilting of leaves is most commonly a toxicity problem caused by salinity, free ammonia or pass-through herbicides in the compost.

Ammonia

Plants take up nitrogen primarily in the form of ammonium (NH_4^+) and nitrate (NO_3^-). If more nitrogen is present in the soil than the plant can use for growth, the plant will deposit the excess nitrogen in its cells. Deposition of nitrate is not a problem, but excess ammonia can damage cells. Ammonia toxicity is a greater problem in the winter than in the summer, because plants are actively growing in summer and microorganisms convert ammonium to nitrate in warmer soils. Ammonia nitrogen percentage is measured by sending samples to a laboratory for comprehensive compost testing. There is also a Solvita Ammonia paddle, separate from the CO_2 paddle, that measures the amount of ammonia gas (related to the free ammonia in the compost) released in the sealed jar. Methods to avoid excess ammonia are similar to those used to assure stable organic matter: Add plenty of carbonaceous material at the start of composting and continue composting for long periods of time, allowing microorganisms to convert ammonium to nitrate and organic nitrogen.

Pass through herbicides

Some herbicides can pass through the digestive systems of herbivores and a compost pile without losing their ability to kill broadleaf plants, i.e., tomatoes, beans, peas, lettuce, roses, etc. Picolinic acid-based herbicides used on hay crops, Aminopyralid (Milestone, Grazon, Invora), Picloram (Tordon) and Clopyralid (Curtail) are particularly bothersome. Damage appears as distorted and cupped leaves on new growth and shoots. If you suspect pass-through herbicide is damaging crops, contact your Extension County Educator, who can help direct you to resources for diagnosis and testing. The only way to control herbicide contamination is to track down the source of contamination (usually manure from animals fed with hay grown on fields treated with picolinic acid) and remove the source from your compost recipe.

Euthanasia drugs

Drugs used to euthanize animals, such as pentobarbital, are not degraded through composting and may harm or kill pets, wildlife and humans that ingest drug-contaminated compost. When handling animal mortality compost, be certain that only non-euthanized carcasses were used to make the compost.

Salinity

Most toxic materials are either volatilized or undergo further microbial conversion to less phytotoxic (toxic to plants) compounds as compost matures. An exception is salt. Even mature compost may be phytotoxic due to soluble salts or salinity. There are two methods of measuring salinity, both of which may appear in laboratory test results. The first method is conductance or electric conductivity (EC). Conductance is the measure of how easily an electric current will pass through compost; its units are $\mu\text{mho cm}^{-1}$ (micromhos per centimeter). The second method is total dissolved solids (TDS). Total dissolved solids are calculated by evaporating all the water out of a liquid and weighing the salt crystals that remain; units are mg L^{-1} (milligrams per Liter) or, less commonly, % (percent). Salinity analyses performed by the Oklahoma State University Soil, Water, Forage Analysis Lab (OSU SWFAL) report salinity as EC in $\mu\text{mho cm}^{-1}$. The toxic level of salinity varies greatly between different types of plants. For instance, the salt toleration of some vegetables based on the EC of a soil-water paste may be below $4,000 \mu\text{mho cm}^{-1}$; whereas, other plants, such as bermudagrass, can tolerate salinity as high as $10,000 \mu\text{mho cm}^{-1}$. Salinity is best controlled by either removing or limiting high salt components from the compost recipe. Some materials that increase the salinity of compost include urine-soaked animal bedding, poultry litter, salty food scraps and kelp and edible seaweed.

Texture and foreign objects

It goes without saying that the value of compost is diminished if it contains material that will not readily decompose in the soil. Common foreign objects are plastic, wood, bone, glass and metal. Eliminating plastics, glass or metal reduces soil contamination and protects equipment. The two ways to ensure foreign objects do not appear in compost are to remove them before composting or sift them out of finished compost.

Sifting is best done once compost is dry enough to crumble — overly wet compost clogs screens and reduces efficiency. Sifting provides benefits besides reducing contamination. Sifting improves product consistency and enhances product quality. Removing large, un-composted chunks produces a uniform particle size that spreads evenly and blends well in soil mixes. Clean and uniform compost commands a higher value and is more desirable to landscapers, gardeners and nurseries. The ideal screening size depends on the end use. A $\frac{1}{2}$ -inch (12 mm) screen is suitable for most field applications, while finer screens ($\frac{3}{8}$ -inch or smaller) are preferred for potting mixes and turf topdressing.

Standards for compost quality

There are a few regulations controlling compost quality, nutrient content, organic matter content and toxicity. In general, compost has no labeling requirement for N-P-K content unless it is sold as fertilizer.

The California Compost Quality Council (CCQC) proposed a compost maturity index to determine the suitability of compost for landscaping, nursery, turf, agriculture, and land reclamation. Table 1 lists general attributes of three levels of compost quality based on maturity and recommended use.

Determining compost maturity by the CCQC method is a three-step process. First, all organic amendments must have a C:N ratio less than 25 to be considered compost. Maturity is then determined by measuring the stability (Group A) and the toxicity (Group B) of the compost. Compost maturity must be tested using at least two analyses in each group listed in Table 2.

Compost analysis may be easier than you think. A compost test available through your county Extension office provides pH; C:N Ratio; nitrogen, phosphorus and potassium content, ammonia to nitrate ratio ($\text{NH}_4\text{-N}:\text{NO}_3\text{-N}$), base cations (Ca, Na, Mg, Mn), some micronutrients (S, Cu, Zn, Fe) and electric conductivity (EC).

Table 2 lists the criteria for Group A and B of the CCQC compost maturity index, as well as salinity and maximum particle size to be considered high, good, and marginal quality compost.

Summary

Compost quality is measured using four criteria. Is compost acidic or basic (pH)? Will soil microorganisms steal nutrients away from growing plants (C:N ratio)? Will the compost auto-heat, smell bad or attract pests (stability)? Will compost stunt the growth and germination of plants or harm animals (toxicity)? The California Compost Maturity Index takes these four criteria and ranks compost based on its suitability for various uses.

Table 1. Attributes and uses of compost based on maturity index (California Compost Quality Council, 2001).

	CCQC maturity index		
	Very Mature	Mature	Immature
Putrescence	No continued decomposition No odors on wetting	Odor production not likely	Odors likely
Toxicity	No potential toxicity	Limited toxicity potential	High toxicity potential
Soil N immobilization	No nitrogen immobilization	Minimal nitrogen immobilization	Significant nitrogen immobilization
Potential uses	Soil and peat based plant mixes Topsoil blends Turf top dressing	General field use Pasture and hay Row crops Orchards and vineyards	Land application on fallow fields Feedstock for further composting

Table 2. Criteria to determine compost quality (California Compost Quality Council, 2001. US Composting Council, 2001, Rynk et al, 1992).

	High quality, Very mature compost	Good quality, Mature compost	Marginal quality, Immature compost
pH	5.5 – 8.0	5.5 – 8.0	5.5 – 8.0
C:N ratio	<25	<25	<25
CCQC stability criteria (Group A)			
Oxygen uptake rate (mg O ₂ g TS ⁻¹ hr ⁻¹)	<0.4	0.4 – 1.3	>1.3
CO ₂ evolution (mg C g VS ⁻¹ day ⁻¹)	<2	2 – 8	>8
Dewar jar temperature rise (°C)	<10	10 – 20	>20
Solvita CO ₂ index	7 – 8	5 – 6	<5
CCQC toxicity criteria (Group B)			
Total nitrogen (ppm dry basis)	<100	100 – 500	>500
NH ₄ -N:NO ₃ -N	<0.5	0.5 – 3.0	>3
Solvita ammonia index	5	4	< 4
Volatile organic acids (ppm dry basis)	<200	200 – 1,000	>1,000
Seed germination rate (% of Control)	>90	80 – 90	<80
Salinity			
EC of soil-compost blend (µmho cm ⁻¹)	2,500 to 6,000 depending on use	<6,000	<6,000
Texture			
Largest particle size (inch)	<3/8	<1/2	>1/2

References

- Arnall, B., and B.K. Chimm. (2026). Acidifying Lawn and Garden Soils in Oklahoma. Stillwater, OK: Oklahoma Cooperative Extension Service.
- California Compost Quality Council. (2001). Compost Maturity Index. Nevada City, CA: California Compost Quality Council.
- Hamilton, D.W. (2017). BAE-1761, The Icebox Test: an Easy Method to Determine Autoheating Potential of Compost and Byproduct Materials. Stillwater, OK: Oklahoma Cooperative Extension Service.
- Rynk, R., M. van de Kamp, G.B Wilson, M.E. Singley, T.L. Richard, J.J Kolega, F.R. Gouin, L. Laliberty, D. Kay, D.W. Murphy, H.A.J. Hoitink, W.F. Binton. (1992). NRAES-54, On-Farm Composting Handbook. Ithaca, NY: Natural Resource, Agriculture, and Engineering Service (NRAES).
- US Composting Council. (2001). Field Guide to Compost Use. Raleigh, NC: US Composting Council.
- Zhang, H. (2017). L-297, Interpreting Soil Salinity Analyses. Stillwater, OK: Oklahoma Cooperative Extension Service.
- Zhang, H. (2017). PSS-2226, Reclaiming Slick-Spots and Salty Soils. Stillwater, OK: Oklahoma Cooperative Extension Service.
- Zhang, H. (2017). PSS-2229, Soil pH and Duffer Index. Stillwater, OK: Oklahoma Cooperative Extension Service.



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