



THE COMPOSTING PROCESS: Compost Maturity

Defining the Issue

Compost maturity was chosen as one of the parameters for determining the grade of compost in Canada because it is so important to product performance. Immature compost may stunt, damage, or even kill plants, rather than enhancing their growth. Maturity is not related to quality, but to what stage in the composting process the material has progressed.

Key Concepts

Mature compost is material in which biological activity has slowed. All of the easily degraded molecules have been broken down, leaving the complex organic material behind. It is difficult to identify the original feedstock materials. A fine texture, dark colour, and a rich earthy smell often characterize mature composts.

As organic material composts, large complex molecules are broken down in a series of steps. The final products are simple, stable molecules which make up the humus-like matrix of nutrients and organic matter that we call compost. While this finished product is very beneficial to plants, some of the intermediate stages may temporarily produce compounds, such as organic acids, that can be harmful to plant growth. This is why even compost made of high quality materials that is applied too soon to lawns or gardens may appear to “burn” leaves, stunt growth, or even kill sensitive plant species.

Immature composts continue to break down once they are incorporated into the soil. This can affect plant health by consuming or tying up two resources that growing roots need. The high level of microbial activity in unfinished compost requires a large intake of oxygen, and the microbes may pull this from the surrounding soil, essentially suffocating the roots. The high carbon to nitrogen ratio (C:N ratio) of immature compost also means that, as the carbon compounds continue to break down, microorganisms will

draw on soil nitrogen to assist in the process, leaving the root zone temporarily nitrogen-poor.

It is therefore crucial that responsible compost producers ensure that their compost has time to fully mature before selling it to most customers [see note on Bioactive Compost below], as compost that is still “hot” when it is applied can do serious damage to both customers’ plantings and your reputation.

A Note on Stability:

The term stability is often used interchangeably with maturity. They are not really equivalent, however, and you must be sure you are assessing maturity, rather than simply stability, when monitoring your own process.

Maturity: biological activity has slowed, as most remaining molecules are difficult to break down

any further.

Stability: biological activity has slowed, but this may be due to a variety of factors—the material

may be mature, or it may lack adequate nitrogen or water for the process to continue. In

this case, if the missing factors are added, biological activity will resume at active levels.

Establishing Maturity

The CCME guidelines [see *Guidelines* in Useful Tools] offer four ways of establishing compost maturity. These methods all attempt to confirm that the composting process has actually run its course rather than simply stalling due to lack of either nitrogen or moisture. The use of more than one test is recommended, since presently no single test exists that can reliably verify maturity.

TABLE 1: CCME Guidelines for Compost Maturity

Required Tests of Compost Maturity (must conform to <u>one</u> of the following four)	Significance
<p>1. Two of three of the following tests:</p> <ul style="list-style-type: none"> a) Carbon/nitrogen ratio (C:N) less than or equal to 25. b) Oxygen uptake less than 150 mg O₂/kg organic matter/hour c) Germination of cress or radish seeds in compost equal to more than 90% that of control sample, <i>and</i> plant growth rate in soil/compost mix not less than 50% that of control sample. 	<ul style="list-style-type: none"> a) As carbon is broken down through composting, the C:N ratio drops. (C:N ratio starts ideally at 30, but can be higher). b) Microbes require oxygen, so a drop in the O₂ required signals a slowing of microbial activity. c) Cress (<i>Lepidium sativum</i>) and radish (<i>Raphanus sativus</i>) are small seeds, quick to germinate and sensitive to phytotoxic (plant-damaging) substances like the organic acids temporarily present in immature composts.
<p>2. Compost must be cured* for a minimum of 21 days, and must not reheat upon standing to greater than 20⁰C above ambient temperature.</p>	<p>Microbial activity produces heat. When pile is no longer heating up, the level of microbial activity has dropped.</p>
<p>3. Compost must be cured* a minimum of 21 days and organic matter must be reduced by at least 60% by weight.</p>	<p>As composting progresses, water vapour and carbon dioxide are given off, resulting in a lighter, denser product.</p>
<p>4. Compost must be cured* for a six-month period.</p>	<p>In the absence of other tests, six months under proper conditions to promote effective composting is considered sufficient to achieve maturity.</p>

* The conditions of the curing pile “must be conducive to aerobic biological activity”—that is, there must be sufficient oxygen and moisture to allow microbial activity to continue.

A Note on Bioactive Compost: there are some applications where a less mature product is actually preferable. These include such projects as biofilter construction and landfill daily cover, where the high level of biological activity in the compost is desirable since it provides enhanced air filtering capability. And while sensitive plant species and seedlings require a high degree of maturity, other plants, such as many field and row

crops, orchards, pastures, and turf, are more tolerant of a compost's continuing biological activity. This can be an advantage to compost producers as it allows some compost to be sold more quickly, and alternatively may provide a value-added market opportunity for very mature compost which requires extra time to finish.

Useful Tools:

Guidelines: <http://www.compost.org/standard.html>

Additional Informational Links:

US Composting Council: <http://compostingcouncil.org/index.cfm>

Cornell Composting: http://www.cfe.cornell.edu/compost/Composting_homepage.html

US Environmental Protection Agency Composting: <http://www.epa.gov/compost/>

The Composting Association of the UK: http://www.compost.org.uk/dsp_home.cfm

Washington State University Compost Connection: <http://csanr.wsu.edu/compost/>

Compost Education and Resources for Western Agriculture:

<http://www2.aste.usu.edu/compost/>

Recycling and Composting Online: <http://www.recycle.cc/>

Feedback:

Are you an operator who has had experiences—faced particular challenges, solved specific problems—that would be of help to other operators? To share tips or solutions your facility has developed with regards to the subjects in this fact sheet, please click on the button below. Thanks for sharing your practical ingenuity!

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