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From Forest Nursery Notes, Winter 2011

172. © Maturity tests for composts -- verification of a test scheme for assessing maturity. Itavaara, M., Vikman, M., Liisa, M., and Vuorinen, A. Compost Science & Utilization 18(3):174-183. 2010.

Maturity Tests for Composts — Verification Of a Test Scheme for Assessing Maturity

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Increased recycling of organic wastes has raised concern about the quality of compost end products. In addition to the limit values for heavy metals and impurities including weeds and pathogens, the quality criteria for compost products should also include criteria for maturity. There is a tremendous number of maturity assays, developed earlier by several authors, and recommended to be used to evaluate maturity of composts. Because no such single test alone reliably demonstrates the complex properties occurring during maturation of compost, we developed a fast and easy-to-use two-phase test scheme for the assessment of maturity. In the first phase the degradation phase e.g. stability of compost samples is evaluated by using a carbon dioxide evolution test and/or determination of the $\text{NO}_3\text{-N}/\text{NH}_4\text{-N}$ ratio by simple test strips. In the second phase, the toxicity of the compost is evaluated by a plant growth test, germination tests and/or the Flash bioluminescence test. Eleven plants composting sewage sludge, source-separated biowaste, manure or a combination of these raw materials were sampled after 1-3 weeks of composting and when the compost was considered "ready for use". Chemical and physical analyses were considered useful as additional information when evaluating maturity especially when the results were not conclusively clear. This fast and easy-to-use test scheme was designed especially for the composting plant operators and official laboratories responsible for evaluating compost quality.

Introduction

The composting plants and official laboratories responsible for evaluating compost quality marketed for plant cultivation purposes require reliable tests for compost maturity assessment. Compost maturity has been evaluated using numerous physical, chemical and biological parameters (Jimenez and Garcia 1989, Inbar 1990, Barberis and Nappi 1996, Itävaara *et al.* 1998, Goyal *et al.* 2005, Baffi *et al.* 2007), but there is no one method available for measuring maturity. Mature compost is considered to be nontoxic and to release nutrients for plant growth (Itävaara *et al.* 2002). The quality criteria for composts include limit values for heavy metals and impurities including weeds and pathogens. In order to improve the evaluation of compost product quality, criteria for maturity assessment have also been included in the new legislation.

The processing conditions affect compost end product quality. Even though composting is considered to be an aerobic degradation process, there are also facultative and anaerobic degradation processes going on at the same time (Hamelers 1993). The aeration conditions are highly dependant on the physical structure and turning frequency of the compost pile. The effect of aer-

obicity and processing time on end product quality has been clearly demonstrated in our earlier studies, where three times more carbon dioxide was evolved from well aerated composts than from poorly aerated composts (Rajamäki *et al.* 2005). Poor aeration is known to increase the formation of odorous volatile anaerobic degradation products, and induce the formation of volatile fatty acids (VFAs) that result in compost phytotoxicity (Reinhardt 2002, Rajamäki *et al.* 2005, Himanen *et al.* 2006).

The stability level of compost is directly connected to the microbial activity and the availability of easily biodegradable carbon sources. Mature compost is also stable enough to no longer consume oxygen in microbial degradation processes (Wu *et al.* 2000, Rynk 2003). The stability degree can be measured by respiration-based tests, such as carbon dioxide evolution or oxygen consumption tests (Itävaara *et al.* 1998; Itävaara *et al.* 2002). The Rottegrad test (Anonym 1994), which is based on determining the temperature increase in an insulated container during a period of ten days, can also be considered to be a stability test, because the test generates information about the microbial activity and thus the degradation activity. This test is extremely sensitive to the insulation capacity of the container and the volume of compost.