From Forest Nursery Notes, Summer 2008

140. © Biological assay for compost quality. Emino, E. R. and Warman, P. R. Compost Science & Utilization 12(4):342-348. 2004.

Compost Science & Utilization, (2004), Vol. 12, No. 4, 342-348

Biological Assay for Compost Quality[1]

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A plant biological assay or bioassay for determining compost quality and/or maturity has received attention over the past two decades. However, no universal acceptance for compost quality is evident and cress, which was first reported to be used as a plant bioassay, is still the most commonly used. Furthermore, there is evidence indicating that cress is not sensitive enough to distinguish between mature and immature composts. Fourteen seed propagated species were surveyed to see if one or more would be useful as a bioassay for compost quality. The study confirmed that cress is a less sensitive indicator than several species, for example, lettuce, carrot or Chinese cabbage. *Amaranthus tricolor* was identified as a potential sensitive indicator species since it did not germinate in an immature compost extract. When the compost extract was diluted, the germination index was linear with extract concentration. While cress responded by differences in root growth, amaranthus responded by reduced germination and root growth which gave it a more definitive response. The study concluded that most of the species, including the commonly used cress, are not sensitive enough to detect differences between mature and immature composts. However, Chinese cabbage appears to be the best of the commonly used assay plants. Amaranthus' potential as a sensitive compost maturity indicator was discovered and more studies are needed to confirm this finding.

Introduction

Compost quality has many descriptors such as age, maturity, nutrient content, microbiological, biochemical, heavy metal and pesticide contamination, and chemical and physical properties. However, all these descriptors vary with the feedstock source, the composting technology used, and the maturity and length of curing of the compost. For compost to have utility, it should come into contact with a plant system as a soil amendment, mulch, top dressing or a potting mix component. Compost components such as organic decomposition products, NH_4^+-N, heavy metals, pesticide residues, etc. must be either metabolized or immobilized in the maturing and curing process of composting so that they are no longer phytotoxic. Each identified component can be determined by expensive and time consuming analytical processes and can give a predictive correlation to determine if the component is in excess or within an acceptable range. Further, there are no analytical procedures that measure the cumulative or synergistic effects of phytotoxins, which individually are not phytotoxic, and there is the possibility for unanticipated contaminants that are not subjected to analysis. Thus, there has been considerable interest in a bioassay to overcome these concerns, either as a seed germination or plant growth assay to determine the presence of phytotoxins. Such an assay should be rapid and broadly accepted.

In 1981, Zucconi *et al.* described a germination test or index using cress (*Lepidium sativum*, L.). Warman (1999) extensively reviewed the literature on germination tests and stated that the Zucconi *et al.* (1981) written procedure is difficult to duplicate. Since 1999, Garglio *et al.* (2002) used lettuce as an indicator, while Fauci *et al.* (2002) used pinto bean and tomato in a plant growth bioassay. Smith and Hughes (2001) recently compared cress germination and cellulolytic activity. The degradation of cellulose using filter paper as the cellulose substrate was negatively correlated with the fresh mass of cress roots. Not all biological tests involve plants or seeds, for example, *Folsomia candida* reproduction as a soil animal model has been used on urban composts (Crouau 2002).

Although cress is widely used, no universal seed species or growth test procedure is used worldwide, and there has been little work to determine whether there are certain seed species more sensitive than cress to toxicants in composts. Warman (1999) compared the germination of cress, radish, and cabbage in com-

[1]Florida Agricultural Experiment Station Journal (FAES) series No. R-09242. Work supported in part by FAES and the Nova Scotia Agricultural College; [2]Professor, on leave from the Department of Environmental Horticulture, University of Florida, Gainesville; [3]Professor