Extended Abstract on the Potential for *Phytophthora ramorum* to Infest Finished Compost[1]

Steven Swain[2] and Matteo Garbelotto[2]

Abstract

The survival rate of *Phytophthora ramorum* was assessed when introduced at high rates into composts of varying provenance and curing time, produced by both "turned windrow" and "forced air static pile" techniques. Survival in some compost media was high and statistically indistinguishable from positive controls ($P<0.01$), while other sources were statistically indistinguishable from negative controls ($P<0.01$). The difference between positive and negative controls was large and highly significant ($P<0.01$). We found no significant differences in survival rates between compost processing techniques or curing time. No compost material was so suppressive of *P. ramorum* that it could not be re-infested after the composting process was finished. This suggests that measures should be taken to insure that finished compost is not contaminated by infested greenwaste.

Key words: pathogen, eradication, green-waste, survival, quarantine

Introduction

Phytophthora ramorum is a (presumably) introduced plant pathogen that is currently under both state and federal quarantines. Because many cities within the infested region have curbside greenwaste collection, it becomes of public import to understand how this pathogen's survival and dispersal may be affected by the composting process (Garbelotto, 2003). Studies to determine *P. ramorum's* ability to survive the composting process are currently underway. However, even if this pathogen is killed by the composting process, it may be possible for it to survive in finished compost if it is introduced after the thermophilic "pathogen reduction" phase, and thereby may be inadvertently transported to new locations. This abstract

[1] A version of this paper was presented at the Sudden Oak Death Second Science Symposium: The State of Our Knowledge, January 18-21, 2005, Monterey, California

[2] Corresponding author: Matteo Garbelotto, Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720. Email: matteo@nature.berkeley.edu

outlines studies conducted to ascertain the degree to which *P. ramorum* can colonize finished compost. By "finished" we are here referring to compost which has completed its thermophilic phase, and has now cured for at least one month.

Materials and Methods

This experiment consisted of compost samples of varying ages and produced by varying techniques, which were exposed to *P. ramorum* in a water medium. After exposure, the samples were allowed to dry, and then were pear baited as outlined in Erwin and Ribeiro (1996), or in some cases was directly plated onto PARP media (Erwin and Ribeiro, 1996). Formal statistical analysis was done on a pair-wise basis using the non-parametric Fisher's Exact test.

The techniques used to produce the compost that the samples were taken from included turned windrow and forced air static pile composting. Two different compost ages were used in this assessment as well: (1) compost cured for more than one month; and (2) compost cured for less than one week. The inoculum sources that the compost samples were exposed to included *Umbellularia californica* leaves infected with two different strains of *P. ramorum*, or V-8 agar plugs containing those same two strains. The V-8 agar plugs were separated from the compost by a perforated physical barrier in water, while the *U. californica* leaves were in direct contact with the compost. Filter paper was substituted for compost for our negative controls. The entire experiment was replicated twice, and several portions three times.

Results

All composts tested evinced *P. ramorum* recovery rates that were statistically distinguishable from zero. Survival in some compost media was high and statistically indistinguishable from positive controls ($P<0.01$), while other sources were statistically indistinguishable from negative controls ($P<0.01$). The difference between positive and negative controls was large and highly significant ($P<0.01$). We found no significant differences in survival rates between compost processing techniques or curing time.

Discussion

The recovery rates of *P. ramorum* from most of our compost samples were statistically indistinguishable from filter paper, which suggests that these composts

are not any better substrates for this pathogen's survival than any other material. However, recovery rates obtained from one compost pile was both statistically indistinguishable from the positive controls and significantly higher than with filter paper or either of the other composts used. This suggests that some composts may actually facilitate the long term survival of *P. ramorum* better than other materials.

At present, we cannot explain the source variation found between our high and low recovery samples, as they came from different composting facilities, so a number of confounding factors may be involved. These factors may include the base materials going into the compost (Hoitink and Boehm, 1999), the moisture, carbon availability, and pathogen diversity of the pile (Soares and others 1995) and the frequency and efficiency of turning operations (Churchill and others 1995). The most apparent difference between the samples coming from these two windrow composting facilities is that the facility producing the low recovery samples has specially designed windrow turning equipment (Scarab compost turner), while the turned windrow facility producing the high recovery samples uses front end loaders to turn their materials.

Conclusion

No compost material was so suppressive of *P. ramorum* that it could not be re-infested after the composting process was finished. There is a significant amount of variation among composts as to how well *P. ramorum* can survive, and there is some evidence to support the idea that *P. ramorum* may be able to live as a saprophyte using certain finished composts as substrate. This suggests that measures should be taken to insure that finished compost is not contaminated by infected greenwaste.

Acknowledgements

The authors of this report wish to express their thanks to the California Integrated Waste Management Board for funding this project. The contributions of Jeff Creque, Will Bakx, Chip Sandborne, and Don Liepold have also been invaluable to the research.

References

Churchill, D.B.; Alderman, S.C.; Mueller-Warrant, G.W.; Elliott, L.F.; and Bilsland, D.M. (1995) **Survival of Weed Seed Pathogen Propagates in Composted Grass Seed Straw.** *Applied Engineering in Agriculture*, **12** (1) 57-63.

Erwin, D.C. and Ribeiro, O.K. 1996. **Phytophthora Diseases Worldwide,** St. Paul, MN: American Phytopathological Society, pp. 8-84**.**

Garbelotto, M. 2003. **Composting as a Control for Sudden Oak Death Disease**, *Biocycle*, 44 (2) 53-56.

Hoitink, H.A.J. and Boehm, M.J. 1999. **Biocontrol within the context of soil microbial communities: a substrate-dependent phenomenon.** *Annual Review of Phytopathology* **37**, 427-446.

Soares, H.M.; Cárdenas, B.; Weir, D.; and Switzenbaum, M.S. 1995. **Evaluating pathogen regrowth in biosolids compost.** *Biocycle*, 36 (6) 70-76.