

Biofumigation - A New Potential Option in Nursery Pest Management

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We recently became aware of several technical articles on a new technology that might have real applications in both container and bareroot nurseries. A naturally-occurring fungus species (*Muscodor albus*) was recently discovered on a cinnamon tree in a botanical garden in Honduras (Strobel 2006). Another member of the genus (*M. roseus*) has also been identified. Clinical trials demonstrate that cultures of these fungi generate a gaseous mixture of bioactive volatile organic compounds (VOCs). These VOCs have been shown to be lethal to a wide variety of plant and human pathogenic fungi (Table 1), as well as some bacteria, nematodes, and insects. Although the fungi tested may not be the same species that attack nursery crops, they are very closely related to common nursery pathogens (Figure 1A).

Biofumigation

The term "mycofumigation" is being used to describe the process of inoculating soil and growing media with the beneficial fungus for the purpose of eliminating potential pathogens prior to sowing. Of course, a promising application of this technology would be to replace methyl bromide fumigation as a means to control soil-borne plant diseases (Figure 1B).

Initial trials with agronomic crops have shown promise in both field and greenhouse applications. AgraQuest is a biotech company from Davis, California, is developing and commercializing *M. albus* for a variety of agricultural applications. AgraQuest received a conditional U.S. – EPA registration for *M. albus* products for use in greenhouse soils, agricultural soils and post-harvest de-

cay control in 2005. In recent experiments with sugar beet (*Beta vulgaris*) and eggplant (*Solanum melongena*) seedlings, soil inoculated with several pathogenic fungi was mycofumigated with *M. roseus* and *M. albus*. After several weeks, the transplanted seedlings were comparable to those growing in autoclaved soil (Stinson and others 2003).

Biofumigation with *M. albus* has some exciting advantages but also some challenges. It is an interesting fungus because it produces a white sterile mycelium with no asexual or sexual spores or other reproductive structures such as chlamydospores or sclerotia. This is ideal for a biocontrol agent because the fungus dies as soon as it uses up its food sources, and its VOCs dissipate quickly. On the other hand, one ongoing goal is to optimize delivery of the fungus to nursery seedbeds of container plants to maximize its effectiveness in the root zone.

Trials at Webster Nursery

The Washington State Webster Nursery tentatively plans to test *M. albus* as a pre-plant fumigant as part of an alternatives to methyl bromide trial scheduled for 2008. Measurements on 1+0 and 1+1 coastal Douglas-fir (*Pseudotsuga menziesii*) will include pre- and post-fumigation soil pathogen loads, seedling mortality, seedling shoot and root volumes, and shippable seedlings per bed foot.

Summary

Biofumigation with *M. albus* is certainly an exciting new development in nursery pest management. It will be interesting to follow the operational nursery trials and I'll keep my eyes open for any new published literature.

Table I—Effects of volatile organic compounds of the fungus (*Muscodor albus*) on common fungal pathogens (modified from Strobel 2006)

Fungus	Type of Disease	Viability After 3 Day Exposure	Mycelial Growth After 2 day Exposure (%)
<i>Pvthium ultimum</i>	Damping-off; root rot	Dead	0
<i>Phytophthora cinnamomi</i>	Root rot	Dead	0
<i>Rhizoctonia solani</i>	Damping-off; root rot	Dead	0
<i>Fusarium solani</i>	Damping-off; root rot	Alive	19.4
<i>Cercospora beticola</i>	Leaf spot	Alive	17.5

Sources

Stinson AM, Zidack NK, Strobel GA, Jacobsen BJ. 2003. Mycofumigation with *Muscodor albus* and *Muscodor roseus* for control of seedling diseases of sugar beet and Verticillium wilt of eggplant. Plant Disease 87:1349-1354.

Strobel GA. 2006. *Muscodor albus* and its biological promise. Journal of Industrial Microbiology and Biotechnology. 33:7 July, 2006: 514-522.

US Environmental Protection Agency. 2007. *Muscodor albus* QST 20799 (006503) Fact Sheet. URL: http://www.epa.gov/pesticides/biopesticides/ingredients/factsheets/factsheet_006503.htm (accessed 17 July 2007).



Figure 1 - Biofumigation has real potential as an environmentally friendly way to control common nursery diseases such as damping-off (A), and the ultimate application could be to replace the hazardous chemicals used for soil fumigation (B).

