DEVELOPMENT OF INSECT-KILLING FUNGI FOR MANAGEMENT OF HEMLOCK WOOLLY ADELGID

Scott D. Costa, Margaret Skinner, Svetlana Gouli, Michael Brownbridge, Vladimir Gouli, William Reid and Bruce L. Parker

Entomology Research Laboratory, University of Vermont, Burlington, VT

Abstract

The potential of insect-killing fungi for suppression of hemlock woolly adelgid (HWA), *Adelges tsugae* Annand, is highlighted by the observed impact of *Entomophaga maimaiga* Humber, Shimazu and Soper on gypsy moth populations in North America. Fungal isolates showing activity against HWA in laboratory trials were evaluated in a variety of forest trails during spring and fall of 2001-2003. Our goal was to select the most virulent fungal isolates and determine the best timing and concentration for fungal applications. Our fungi were also assayed against *Pseudoscymnus tsugae* Sasaji and McClure, a predator being developed for HWA management, to evaluate the compatibility these biological strategies.

Forest trials were conducted at Mt. Tom Reservation, Holyoke, MA. Fungi were applied to HWA infested branches using hand-held and ULV sprayers (5-6 branches/treatment) at concentrations from 5 x 10^7 to 2 X 10^8 spores/ml as either single or multiple applications. Horticultural oil (0.1%) was used as a positive control, in addition to both non-treated and formulation blank controls. Survival and density of HWA were examined 3-4 weeks post application. The non-target effects of fungi to *P. tsugae* were evaluated in the lab using a petri-dish assay and in the forest on caged hemlock branches infested with HWA.

We found that fall applications were optimal for targeting HWA and resulted in measurable reductions in HWA survival. For instance, in both 2002 and 2003, a single fall application of ARSEF 6010 [*Verticillium lecanii* (Zimmerman) Viegas] at 1 x 10^8 spores/ml significantly reduced HWA populations. A second isolate, CA 603 [*Beauveria bassiana* (Balsamo) Vuillemin], had activity only in 2002. In laboratory trials there was little or no effect of fungi on survival of *P. tsugae* and, when examined under forest conditions, fungi having activity against HWA did not reduce *P. tsugae* survival.

Targeting the sistens in late summer and fall offers a wide window during which HWA populations are relatively stable. In spring, HWA populations are rapidly expanding, which may allow HWA to overrun control effects, while also making evaluation of efficacy difficult. The reductions of HWA populations obtained with fungi and fungal compatibility with *P. tsugae* demonstrates the promise of fungi as a component in the integrated management of HWA. Future research is needed to develop novel formulations for delivery by ULV application, determine spore persistence and dispersal, and expand evaluation of nontarget effects.