MULTIVARIATE STATISTICAL ANALYSIS OF HEMLOCK (*TSUGA*) VOLATILES BY SPME/GC/MS: INSIGHTS INTO THE PHYTOCHEMISTRY OF THE HEMLOCK WOOLLY ADELGID (*ADELGES TSUGAE* ANNAND)

Anthony Lagalante[1], Frank Calvosa[1], Michael Mirzabeigi[1], Vikram Iyengar[1], Michael Montgomery[2] and Kathleen Shields[2]

[1]Villanova University, 800 Lancaster Avenue, Villanova, PA 19085-1699

[2]USDA-USFS, Northeastern Center for Forest Health Research, 51 Mill Pond Rd., Hamden, CT 06514-1777

ABSTRACT

A previously developed single-needle, SPME/GC/MS technique was used to measure the terpenoid content of *T. canadensis* growing in a hemlock forest at Lake Scranton, PA (Lagalante and Montgomery 2003). The volatile terpenoid composition was measured over a 1-year period from June 2003 to May 2004 to follow the annual cycle of foliage development from bud-opening, bud-elongation, bud-maturation, and dormancy to bud-break at the start of the next growing season. In addition to the time dependence of the terpenoid composition, micro-dissections were made in order to analyze separately the terpenoid content of the leaf needle and the leaf cushion. The aim of these analyses was to relate any variation in terpenoid composition to the actual feeding location and period of feeding on the host by the hemlock woolly adelgid. The adelgid technically feeds in the stem wood and the xylem ray parenchyma tissue rather the leaf needle. The time-dependent terpenoid levels indicate that the relative percentage of only three of the 51 terpenoids present significantly vary temporally or spatially. Many of these same terpenoids which vary temporally and spatially on new growth were also identified as potential deterrents/attractants from the principal component analysis of the initial study and they may influence the ability of the adelgid to settle/survive on new growth. Analytical data will be presented that indicates a correlation between temporal and spatial terpenoid levels with the biannual reproductive lifecycle of the adelgid.

Additional, current work has examined the terpenoids present in cultivars of *T. canadensis* to examine if selective breeding of cultivars within the species might potentially possess enhanced natural resistance based on terpenoid profiles. *T. canadensis* cultivars were collected from local arboreta and analysed by the single-needle, SPME/GC/MS method. PCA indicates that the *T. canadensis* cultivars do not possess terpenoid profiles associated with the resistant species from our previous work. Future work will be directed toward assessing specific terpenoids for hemlock woolly adelgid fecundity through infusion techniques.

Literature Cited

Lagalante, A.F.; Montgomery, M.E. 2003 **Analysis of terpenoids from hemlock (*Tsuga*) species by solid-phase microextraction gas chromatography/ion-trap mass spectrometry**. J. Agric. Food Chem. 51(8): 2115-2120.