New England Botanical Society
Graduate Student Research Award
2024 AWARD WINNER

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Elucidating genomic mechanisms of hemlock woolly adelgid resistance through transcriptome profiling

The eastern hemlock is an important conifer tree found along the eastern coast of the United States. In the 1920s, an insect pest called the hemlock woolly adelgid (HWA) was accidentally introduced to North America. HWA has caused widespread destruction of eastern hemlock forests, often killing infested trees within 5-10 years. The eastern hemlock is one of nine hemlock species, and the Chinese hemlock is the most resistant to HWA damage. This is likely because the Chinese hemlock and HWA have co-existed together for a long period, allowing the tree to evolve resistance mechanisms.

The causes of HWA resistance in Chinese hemlocks may include physical traits like cuticle thickness, as well as production of natural pest-deterring terpenoids. In 2011, a population of eastern hemlocks was discovered that seemed tolerant to HWA - dubbed the "bulletproof" trees. Seeds from these tolerant trees were planted at 8 different sites and monitored until 2020, confirming their ability to withstand HWA infestations. We are now following up on this study of HWA-tolerant eastern hemlocks. We are assessing clonal and half-sibling tree populations derived from the original bulletproof trees. We are also comparing the production of natural defensive compounds called terpenoids in these trees to terpenoid levels in other hemlock species known to be resistant. This analysis will take place over the course of an entire year to account for seasonal variation. After the year-long terpenoid monitoring, we will select a subset of the trees to analyze the activity of genes involved in terpenoid production on a monthly basis. This will allow us to look for patterns of coordinated gene activity that may contribute to higher terpenoid levels and HWA resistance.

The New England Botanical Society offers awards of up to $3,000 to graduate students to support botanical research. The awards encourage and support botanical research on the New England flora (plants, algae, and fungi), including support for field, lab, and herbarium work, as well as travel to and within New England by those who would not otherwise be able to work in the region. The awards are made to the graduate student(s) submitting the best research proposal dealing with systematic botany, plant ecology, genetics, plant conservation biology, or related fields pertaining to the New England flora.