

DEVELOPING HOST RESISTANCE TO THE HEMLOCK WOOLLY ADELGID

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The hemlock woolly adelgid (HWA; *Adelges tsugae*), an invasive exotic insect, has caused widespread decline and mortality in the two hemlock species native to the eastern US, eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*). Eastern hemlock, broadly distributed from northern Georgia northward into Canada, was ecologically important as a foundation species, and economically important in regions as a nursery crop, enjoying widespread use as a landscape and ornamental tree due to its shade-tolerance, ability to hedge, and availability of numerous cultivars. The Forest Restoration Alliance (FRA) seeks to produce hemlocks resistant to or tolerant of HWA that will be suitable for both species restoration and ornamental uses. FRA strategies include identification of resistant and tolerant genotypes through screening from our native hemlocks for inclusion in a resistance breeding program, and creation of interspecific hybrids between native and HWA-resistant or tolerant exotic hemlocks, including Chinese (*T. chinensis*), northern Japanese (*T. diversifolia*), and southern Japanese (*T. sieboldii*) hemlocks. We are currently testing 26 genotypes from native populations of eastern and Carolina hemlock with potential for resistance using artificial infestation with HWA, with infested and non-infested treatments. Stem cuttings from each of the genotypes were clonally propagated by rooting in 2015, and artificially infested using a rain-down technique (Jun 2017) and through direct attachment of infested branches (April 2019). We have not yet observed statistically significant differences among clones or between potentially resistant and putatively susceptible genotypes for adelgid density. The only significant differences observed for plant growth and health have been among clones, and not between infested and not-infested treatments, and are due to propagation differences, as some clones respond better to rooting than others. The lack of significant differences due to adelgid infestation is very likely due to our difficulty so far in attaining dense adelgid infestations that persist over time. We are continuing to search for native resistance using reports from natural resources professionals and citizen scientists, utilizing the TreeSnap app that was developed for Android and iPhone mobile devices. Working with the U.S. Forest Service Southern Institute of Forest Genetics, which has developed five species-specific chloroplast DNA SSR markers, we have verified 85 hybrid genotypes produced by our program between Carolina hemlock maternal parents and Chinese and southern Japanese paternal parents. To date, we have not been able to produce any verified hybrids between eastern hemlock and any of the three Asian hemlock species above.